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International Energy Outlook

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Preface

This report presents international energy projections through 2035, prepared by the U.S. Energy Information Administration, including outlooks for major energy fuels and associated carbon dioxide emissions.

The *International Energy Outlook 2010* (*IEO2010*) presents an assessment by the U.S. Energy Information Administration (EIA) of the outlook for international energy markets through 2035. U.S. projections appearing in *IEO2010* are consistent with those published in EIA's *Annual Energy Outlook 2010* (*AEO2010*) in April 2010.

The *IEO2010* projections are based to the extent possible on U.S. and foreign laws, regulations, and standards in effect at the start of 2010. 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. In addition, mechanisms whose implementation cannot be modeled given current capabilities or whose impacts on the energy sector are unclear are not included in *IEO2010*. For example, the European Union's Emissions Trading System, which includes non-carbon dioxide emissions and non-energy-related emissions, are not included in this analysis.

IEO2010 focuses exclusively on marketed energy. Non-marketed energy sources, which continue to play an important role in some developing countries, are not included in the estimates.

The *IEO2010* consumption projections are grouped according to Organization for Economic Cooperation and Development membership. (OECD includes all members of the organization as of March 1, 2010, throughout all time series included in this report. Chile became a member on May 7, 2010, but its membership is not reflected in *IEO2010*.) There are three basic groupings of OECD countries: North America (United States, Canada, and Mexico); OECD Europe; and OECD Asia (Japan, South Korea, and Australia/New Zealand). 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. In some instances, the *IEO2010* production models have different regional aggregations to reflect the important producer regions (for example, Middle East OPEC is a key region in the projections of liquid supplies). The complete regional definitions are listed in Appendix M.

The report begins with a review of world trends in energy demand and the major macroeconomic assumptions used in deriving the *IEO2010* projections, which—

Objectives of the *IEO2010* Projections

The projections in *IEO2010* are not statements of what will happen, but what might happen given the specific assumptions and methodologies used for any particular scenario. The Reference case projection is a business-as-usual trend estimate, given known technology and technological and demographic trends. EIA explores the impacts of alternative assumptions in other scenarios with different macroeconomic growth rates and world oil prices. The *IEO2010* cases generally assume that current laws and regulations are maintained throughout the projections. Thus, the projections provide policy-neutral baselines that can used to analyze international energy markets.

While energy markets are complex, energy models are simplified representations of energy production and consumption, regulations, and producer and consumer behavior. Projections are highly dependent on the data, methodologies, model structures, and assumptions used in their development. Behavioral characteristics are indicative of real-world tendencies, rather than representations of specific outcomes.

Energy market projections are subject to much uncertainty. Many of the events that shape energy markets cannot be fully anticipated. In addition, future developments in technologies, demographics, and resources cannot be foreseen with certainty. Key uncertainties in the *IEO2010* projections for economic growth and oil prices are addressed through alternative cases.

EIA has endeavored to make these projections as impartial, reliable, and relevant as possible. They should, however, serve as an adjunct to, not a substitute for, a complete and focused analysis of public policy initiatives.

for the first time—extend to 2035. In addition to Reference case projections, High Economic Growth and Low Economic Growth cases were developed to consider the effects of higher and lower growth paths for economic activity than are assumed in the Reference case. *IEO2010* also includes a High Oil Price case and, alternatively, a Low Oil 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."

Projections for energy consumption and production 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 capacity. Chapter 6 provides a discussion of industrial sector energy use. Chapter 7 includes a detailed look at the world's transportation energy use. Finally, Chapter 8 discusses the outlook for global energy-related carbon dioxide emissions.

Appendix A contains summary tables for the *IEO2010* Reference case projections of world energy consumption, gross domestic product, 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 Oil 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. Appendix I contains summary tables for projections of world natural gas production in all cases. Appendix J includes a set of tables for each of the four Kaya Identity components. In Appendix K, a set of comparisons of projections from the International Energy Agency's *World Energy Outlook 2009* with the *IEO2010* projections is presented. Comparisons of the *IEO2010* and *IEO2009* projections are also presented in Appendix K. Appendix L describes the models used to generate the *IEO2010* projections, and Appendix M defines the regional designations included in the report.

The *IEO2010* projections of world energy consumption were generated from EIA's World Energy Projections Plus (WEPS+) modeling system. WEPS+ is used to build the Reference case energy projections, as well as alternative energy projections based on different assumptions for GDP growth and fossil fuel prices. The *IEO2010* projections of global natural gas production and trade were generated from EIA's International Natural Gas Model (INGM), which estimates natural gas production, demand, and international trade by combining estimates of natural gas reserves, natural gas resources and resource extraction costs, energy demand, and transportation costs and capacity in order to estimate future production. The Generate World Oil Balance (GWOB) application is used to create a "bottom up" projection of world liquids supply—based on current production capacity, planned future additions to capacity, resource data, geopolitical factors, and oil prices—and to generate conventional crude oil production cases.

Highlights

World marketed energy consumption increases by 49 percent from 2007 to 2035 in the Reference case. Total energy demand in non-OECD countries increases by 84 percent, compared with an increase of 14 percent in OECD countries.

In the *IEO2010* Reference case, which does not include prospective legislation or policies, world marketed energy consumption grows by 49 percent from 2007 to 2035. Total world energy use rises from 495 quadrillion British thermal units (Btu) in 2007 to 590 quadrillion Btu in 2020 and 739 quadrillion Btu in 2035 (Figure 1).

The global economic recession that began in 2008 and continued into 2009 has had a profound impact on world energy demand in the near term. Total world marketed energy consumption contracted by 1.2 percent in 2008 and by an estimated 2.2 percent in 2009, as manufacturing and consumer demand for goods and services declined. Although the recession appears to have ended, the pace of recovery has been uneven so far, with China and India leading and Japan and the European Union member countries lagging. In the Reference case, as the economic situation improves, most nations return to the economic growth paths that were anticipated before the recession began.

The most rapid growth in energy demand from 2007 to 2035 occurs in nations outside the Organization for Economic Cooperation and Development[1] (non-OECD nations). Total non-OECD energy consumption increases by 84 percent in the Reference case, compared with a 14-percent increase in energy use among OECD countries. Strong long-term growth in gross domestic product (GDP) in the emerging economies of non-OECD countries drives their growing energy demand. In all non-OECD regions combined, economic activity—as measured by GDP in purchasing power parity terms—increases by 4.4 percent per year on average, compared with an average of 2.0 percent per year for OECD countries.

The *IEO2010* Reference case projects increased world consumption of marketed energy from all fuel sources over the 2007-2035 projection period (Figure 2). Fossil fuels are expected to continue supplying much of the energy used worldwide. Although liquid fuels remain the largest source of energy, the liquids share of world marketed energy consumption falls from 35 percent in 2007 to 30 percent in 2035, as projected high world oil prices lead many energy users to switch away from liquid fuels when feasible. In the Reference case, the use of liquids grows modestly or declines in all end-use sectors except transportation, where in the absence of significant technological advances liquids continue to provide much of the energy consumed.

Figure 1. World marketed energy consumption, 2007-2035 (quadrillion Btu)

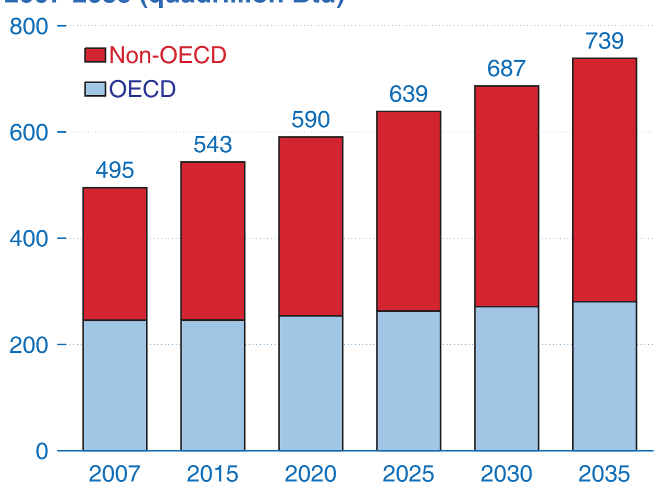
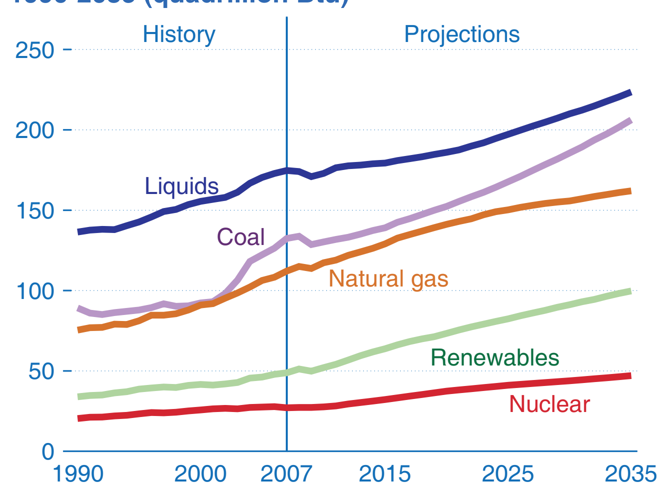


Figure 2. World marketed energy use by fuel type, 1990-2035 (quadrillion Btu)



[1]Current OECD member countries (as of March 10, 2010) are the United States, Canada, Mexico, Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, Turkey, the United Kingdom, Japan, South Korea, Australia, and New Zealand. Chile became a member on May 7, 2010, but its membership is not reflected in *IEO2010*.

Average oil prices[2] increased strongly from 2003 to mid-July 2008, when prices collapsed as a result of concerns about the deepening recession. In 2009, oil prices trended upward throughout the year, from about $42 per barrel in January to $74 per barrel in December. Oil prices have been especially sensitive to demand expectations, with producers, consumers, and traders continually looking for an indication of possible recovery in world economic growth and a likely corresponding increase in oil demand. On the supply side, OPEC's above-average compliance to agreed-upon production targets increased the group's spare capacity to roughly 5 million barrels per day in 2009. Further, many of the non-OPEC projects that were delayed during the price slump in the second half of 2008 have not yet been revived.

After 2 years of declining demand, world liquids consumption is expected to increase in 2010 and strengthen thereafter as the world economies recover fully from the effects of the recession. In the *IEO2010* Reference case, the price of light sweet crude oil in the United States (in real 2008 dollars) rises from $79 per barrel in 2010 to $108 per barrel in 2020 and $133 per barrel in 2035.

World energy markets by fuel type

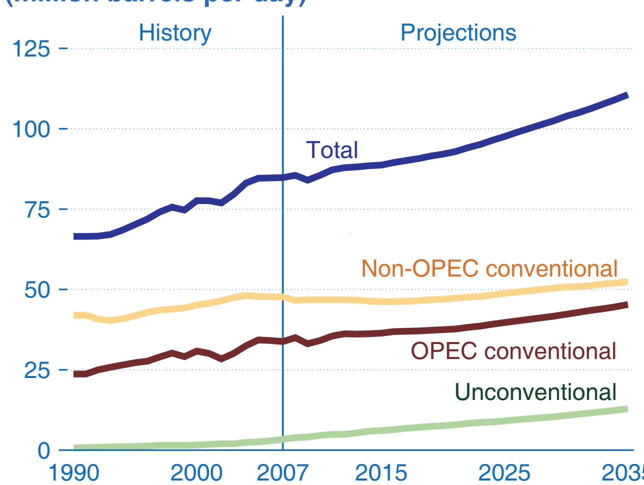
Liquid fuels

Liquids remain the world's largest energy source throughout the *IEO2010* Reference case projection, given their importance in the transportation and industrial end-use sectors. World use of liquids and other petroleum[3] grows from 86.1 million barrels per day in 2007 to 92.1 million barrels per day in 2020, 103.9 million barrels per day in 2030, and 110.6 million barrels per day in 2035. On a global basis, liquids consumption remains flat in the buildings sector, increases modestly in the industrial sector, but declines in the electric power sector as electricity generators react to rising world oil prices by switching to alternative fuels whenever possible. In the transportation sector, despite rising prices, use of liquid fuels increases by an average of 1.3 percent per year, or 45 percent overall from 2007 to 2035.

To meet the increase in world demand in the Reference case, liquids production (including both conventional and unconventional liquid supplies) increases by a total of 25.8 million barrels per day from 2007 to 2035. The Reference case assumes that OPEC countries will invest in incremental production capacity in order to maintain a share of approximately 40 percent of total world liquids production through 2035, consistent with their share over the past 15 years. Increasing volumes of conventional liquids (crude oil and lease condensate, natural gas plant liquids, and refinery gain) from OPEC producers contribute 11.5 million barrels per day to the total increase in world liquids production, and conventional supplies from non-OPEC countries add another 4.8 million barrels per day (Figure 3).

Unconventional resources (including oil sands, extra-heavy oil, biofuels, coal-to-liquids, gas-to-liquids, and shale oil) from both OPEC and non-OPEC sources grow on average by 4.9 percent per year over the projection period. Sustained high oil prices allow unconventional resources to become economically competitive, particularly when geopolitical or other "above ground" constraints[4] limit access to prospective conventional resources. World production of unconventional liquid fuels, which totaled only 3.4 million barrels per day in 2007, increases to 12.9 million barrels per day and accounts for 12 percent of total world liquids supply in 2035. Oil sands from Canada and biofuels, largely from Brazil and the United States, are the largest components of future unconventional production in the *IEO2010* Reference case, providing a combined 70 percent of the increment in total unconventional supply over the projection period.

Figure 3. World liquids production, 1990-2035 (million barrels per day)



[2]The oil price reported in *IEO2010* is for light sweet crude oil delivered to Cushing, Oklahoma. The price series is consistent with spot prices for light sweet crude oil reported on the New York Mercantile Exchange (NYMEX). All oil prices are in real 2008 dollars per barrel, unless otherwise noted.

[3]Liquid fuels and other petroleum include petroleum-derived fuels and non-petroleum-derived liquid 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.

[4]"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; environmental protection actions; and other short- and long-term geopolitical considerations.

Natural gas

Natural gas consumption worldwide increases by 44 percent in the Reference case, from 108 trillion cubic feet in 2007 to 156 trillion cubic feet in 2035. In 2009, world natural gas consumption declined by an estimated 1.1 percent, and natural gas use in the industrial sector fell even more sharply, by 6.0 percent, as demand for manufactured goods declined during the recession. The industrial sector currently consumes more natural gas than any other end-use sector, and in the projection it continues as the largest user through 2035, when 39 percent of the world's natural gas supply is consumed for industrial purposes. Electricity generation is another important use for natural gas throughout the projection, and its share of the world's total natural gas consumption increases from 33 percent in 2007 to 36 percent in 2035.

In the near term, as world economies begin to recover from the downturn, global demand for natural gas is expected to rebound, with natural gas supplies from a variety of sources keeping markets well supplied and prices relatively low. The largest projected increase in natural gas production is for the non-OECD region (Figure 4), with the major increments coming from the Middle East (an increase of 16 trillion cubic feet from 2007 to 2035), Africa (7 trillion cubic feet), and Russia and the other countries of non-OECD Europe and Eurasia (6 trillion cubic feet).

Although the extent of the world's tight gas, shale gas, and coalbed methane resource base has not yet been assessed fully, the *IEO2010* Reference case projects a substantial increase in those supplies—especially from the United States but also from Canada and China. In the United States, one of the keys to increasing natural gas production has been advances in horizontal drilling and hydraulic fracturing technologies, which have made it possible to exploit the country's vast shale gas resources. Rising estimates of shale gas resources have helped to increase total U.S. natural gas reserves by almost 50 percent over the past decade, and shale gas rises to 26 percent of U.S. natural gas production in 2035 in the *IEO2010* Reference case. Tight gas, shale gas, and coalbed methane resources are even more important for the future of domestic natural gas supplies in Canada and China, where they account for 63 percent and 56 percent of total domestic production, respectively, in 2035 in the Reference case.

World natural gas trade, both by pipeline and by shipment in the form of liquefied natural gas (LNG), is poised to increase in the future. Most of the projected increase in LNG supply comes from the Middle East and Australia, where a number of new liquefaction projects are expected to become operational within the next decade. In the *IEO2010* Reference case, world liquefaction capacity increases 2.4-fold, from about 8 trillion cubic feet in 2007 to 19 trillion cubic feet in 2035. In addition, new pipelines currently under construction or planned will increase natural gas exports from Africa to European markets and from Eurasia to China.

Coal

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 132 quadrillion Btu in 2007 to 206 quadrillion Btu in 2035, at an average annual rate of 1.6 percent. Much of the projected increase in coal use occurs in non-OECD Asia, which accounts for 95 percent of the total net increase in world coal use from 2007 to 2035 (Figure 5). Increasing demand for energy to fuel electricity generation and industrial production in the region is expected to be met in large part by coal. For example, installed coal-fired generating capacity in

Figure 4. Net change in world natural gas production by region, 2007-2035 (trillion cubic feet)

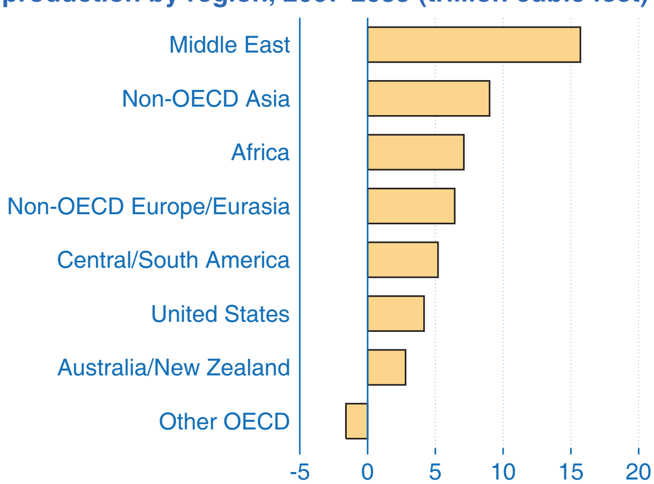
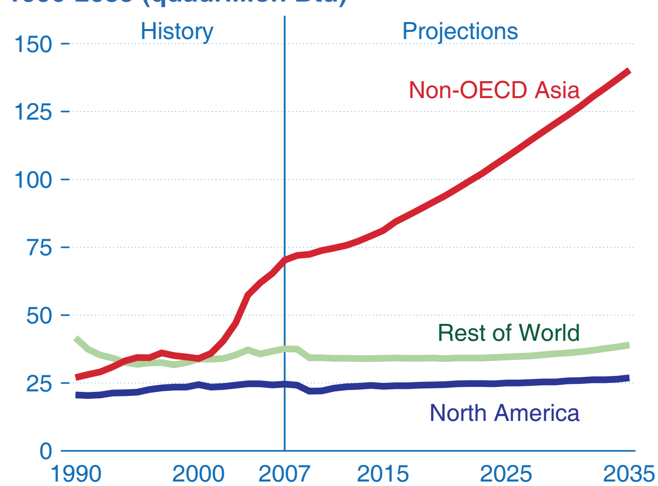


Figure 5. World coal consumption by region, 1990-2035 (quadrillion Btu)



China more than doubles in the Reference case from 2007 to 2035, and coal use in China's industrial sector grows by 55 percent. The development of China's electric power and industrial sectors will require not only large-scale infrastructure investments but also substantial investment in both coal mining and coal transportation infrastructure.

Electricity

World net electricity generation increases by 87 percent in the Reference case, from 18.8 trillion kilowatthours in 2007 to 25.0 trillion kilowatthours in 2020 and 35.2 trillion kilowatthours in 2035. Although the recession slowed the growth in electricity demand in 2008 and 2009, growth returns to pre-recession rates by 2015 in the Reference case. In general, in OECD countries, where electricity markets are well established and consumption patterns are mature, the growth of electricity demand is slower than in non-OECD countries, where a large amount of potential demand remains unmet. In the Reference case, total net generation in non-OECD countries increases by 3.3 percent per year on average, as compared with 1.1 percent per year in OECD nations.

The rapid increase in world energy prices from 2003 to 2008, combined with concerns about the environmental consequences of greenhouse gas emissions, has led to renewed interest in alternatives to fossil fuels—particularly, nuclear power and renewable resources. As a result, long-term prospects continue to improve for generation from both nuclear and renewable energy sources—supported by government incentives and by higher fossil fuel prices.

From 2007 to 2035, world renewable energy use for electricity generation grows by an average of 3.0 percent per year (Figure 6), and the renewable share of world electricity generation increases from 18 percent in 2007 to 23 percent in 2035. Coal-fired generation increases by an annual average of 2.3 percent in the Reference case, making coal the second fastest-growing source for electricity generation in the projection. The outlook for coal could be altered substantially, however, by any future legislation that would reduce or limit the growth of greenhouse gas emissions. Generation from natural gas and nuclear power—which produce relatively low levels of greenhouse gas emissions (natural gas) or none (nuclear)—increase by 2.1 and 2.0 percent per year, respectively, in the Reference case.

Much of the world increase in renewable electricity supply is fueled by hydropower and wind power. Of the 4.5 trillion kilowatthours of increased renewable generation over the projection period, 2.4 trillion kilowatthours (54 percent) is attributed to hydroelectric power and 1.2 trillion kilowatthours (26 percent) to wind. Except for those two sources, most renewable generation technologies are not economically competitive with fossil fuels over the projection period, outside a limited number of niche markets. Typically, government incentives or policies provide the primary support for construction of renewable generation facilities. Although they remain a small part of total renewable generation, renewables other than hydroelectricity and wind—including solar, geothermal, biomass, waste, and tidal/wave/oceanic energy—do increase at a rapid rate over the projection period (Figure 7).

Electricity generation from nuclear power increases from about 2.6 trillion kilowatthours in 2007 to a projected 3.6 trillion kilowatthours in 2020 and then to 4.5 trillion kilowatthours in 2035. Higher future prices for fossil fuels make nuclear power economically competitive with generation from coal, natural gas, and liquid fuels, despite the relatively high capital costs of nuclear power plants. Moreover, higher capacity utilization rates have been reported for many existing nuclear

Figure 6. World net electricity generation by fuel, 2007-2035 (trillion kilowatthours)

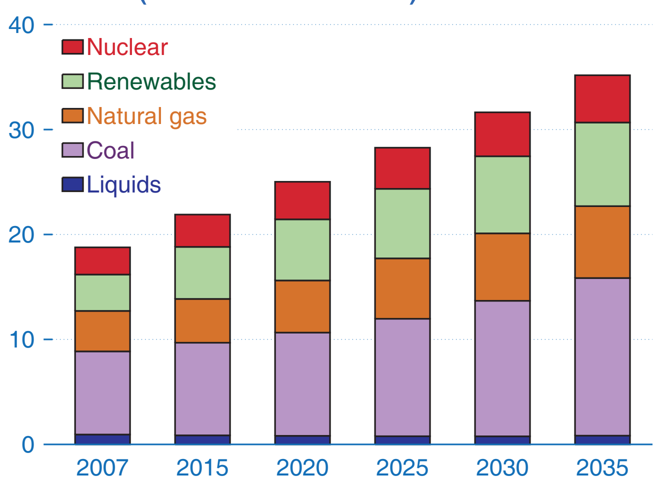
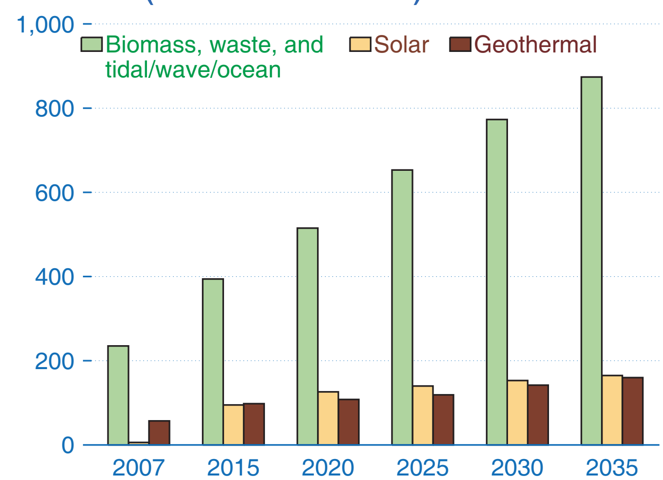


Figure 7. World renewable electricity generation by energy source, excluding wind and hydropower, 2007-2035 (billion kilowatthours)



facilities, and the projection anticipates that most of the older nuclear power plants in OECD countries and non-OECD Eurasia will be granted extensions to their operating lives.

Around the world, nuclear generation is attracting new interest as countries seek to increase the diversity of their energy supplies, improve energy security, and provide a low-carbon alternative to fossil fuels. Still, there is considerable uncertainty associated with nuclear power projections. Issues that could slow the expansion of nuclear power in the future include plant safety, radioactive waste disposal, rising construction costs and investment risk, and nuclear material proliferation concerns. Those issues continue to raise public concern in many countries and may hinder the development of new nuclear power reactors. Nevertheless, the *IEO2010* Reference case incorporates improved prospects for world nuclear power. The projection for nuclear electricity generation in 2030 is 9 percent higher than the projection published in last year's *IEO*.

On a regional basis, the Reference case projects the strongest growth in nuclear power for the countries of non-OECD Asia, where nuclear power generation is projected to grow at an average rate of 7.7 percent per year from 2007 to 2035, including projected increases averaging 8.4 percent per year in China and 9.5 percent per year in India. Outside Asia, the largest projected increase in installed nuclear capacity is in Central and South America, with increases in nuclear power generation averaging 4.3 percent per year. Prospects for nuclear generation in OECD Europe have undergone a significant revision from last year's outlook, because a number of countries in the region are reversing policies that require the retirement of nuclear power plants and moratoria on new construction. In the *IEO2010* Reference case, nuclear generation in OECD Europe increases on average by 0.8 percent per year, as compared with the small decline projected in *IEO2009*.

World delivered energy use by sector

This section discusses delivered energy use, which does not include losses associated with electricity generation and transmission.

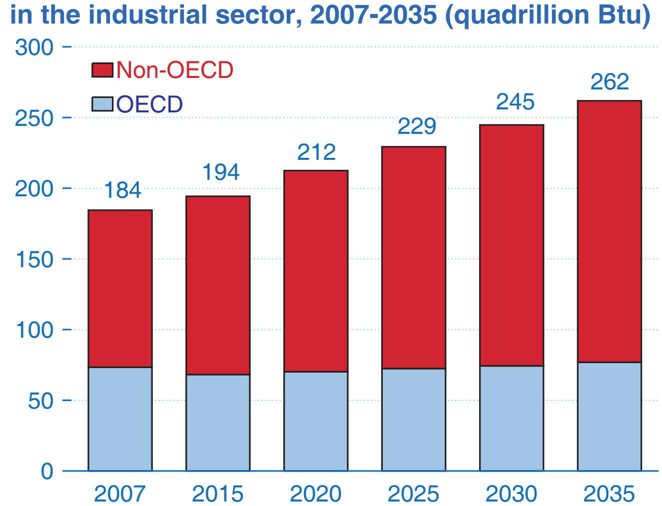
Industry

The industrial sector uses more energy globally than any other end-use sector, currently consuming about 50 percent of the world's total delivered energy. 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 processing and assembly, space conditioning, and lighting. Worldwide, projected industrial energy consumption grows from 184 quadrillion Btu in 2007 to 262 quadrillion Btu in 2035. The industrial sector accounted for most of the reduction in energy use during the recession, primarily as a result of substantial cutbacks in manufacturing that had more pronounced impacts on total fuel consumption than did the marginal reductions in energy use in other sectors. In the Reference case, national economic growth rates and energy consumption patterns return to historical trends.

Industrial energy demand varies across regions and countries of the world, based on levels and mixes of economic activity and technological development, among other factors. Non-OECD economies account for about 95 percent of the world increase in industrial sector energy consumption in the Reference case. Rapid economic growth is projected for non-OECD countries, accompanied by rapid growth in their combined total industrial energy consumption, averaging 1.8 percent per year from 2007 to 2035 (Figure 8). Because OECD nations have been undergoing a transition from manufacturing economies to service economies in recent decades, and have relatively slow projected growth in economic output, industrial energy use in the OECD region as a whole grows by an average of only 0.2 percent per year from 2007 to 2035 (as compared with an average increase of 0.9 percent per year in commercial sector energy use).

A new addition to the energy analysis in *IEO2010* is the incorporation of historical time series and projections for worldwide consumption of marketed industrial renewable energy.[5] Renewable energy use (excluding consumption of electricity generated from renewable

Figure 8. World delivered energy consumption in the industrial sector, 2007-2035 (quadrillion Btu)



[5]It is important to note that marketed (commercial) industrial renewable energy in the United States, including both historical data and projections from the *Annual Energy Outlook*, has always been reported in the *IEO*. The incorporation of data series on industrial sector renewable energy use outside the United States means that all data series are now presented in the *IEO* on a consistent basis worldwide.

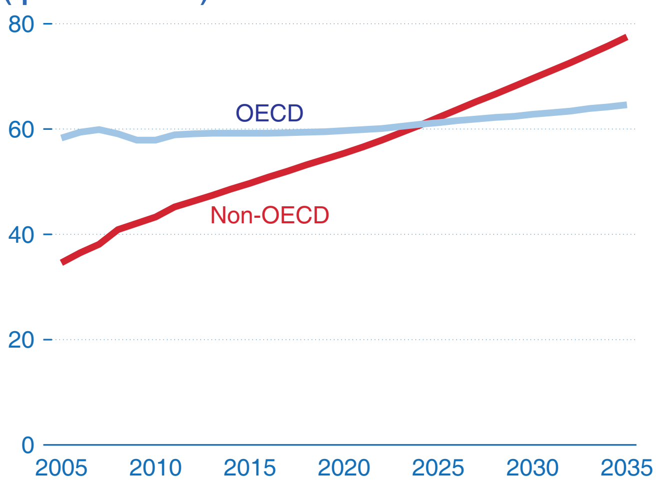
energy sources) constitutes a substantial portion of the world's industrial sector energy consumption. In 2007, the industrial sector consumed 13 quadrillion Btu of non-electricity renewables, or about 7 percent of the sector's total delivered energy use. From 2007 to 2035, renewable energy use in the industrial sector worldwide increases by an average of 1.8 percent per year, and the renewable share of total delivered energy use in the industrial sector increases to 8 percent in 2035. Biomass for heat and power production currently provides the vast majority of renewable energy consumed in the industrial sector (90 percent), and it is expected to remain the largest component of the industrial sector's renewable energy mix through the projection period.

Transportation

Energy use in the transportation sector includes the energy consumed in moving people and goods by road, rail, air, water, and pipeline. The transportation sector is second only to the industrial sector in terms of total end-use energy consumption. Almost 30 percent of the world's total delivered energy is used for transportation, most of it in the form of liquid fuels. The transportation share of world total liquids consumption increases from 53 percent in 2007 to 61 percent in 2035 in the *IEO2010* Reference case, accounting for 87 percent of the total increase in world liquids consumption. Thus, understanding the development of transportation energy use is the most important factor in assessing future trends in demand for liquid fuels.

World oil prices reached historically high levels in 2008, in part because of a strong increase in demand for transportation fuels, particularly in emerging non-OECD economies (Figure 9). Non-OECD energy use for transportation increased by 4.5 percent in 2007 and 7.3 percent in 2008, before the impact of the 2008-2009 global economic recession resulted in a slowdown in transportation sector activity. Even in 2009, non-OECD transportation energy use grew by an estimated 3.2 percent, in part because many non-OECD countries (in particular, but not limited to, the oil-rich nations) provide fuel subsidies to their citizens. With robust economic recovery expected to continue in China, India, and other non-OECD nations, growing demand for raw materials, manufactured goods, and business and personal travel is projected to support fast-paced growth in energy use for transportation both in the short term and over the long term. In the *IEO2010* Reference case, non-OECD transportation energy use grows by 2.6 percent per year from 2007 to 2035.

Figure 9. World delivered energy consumption in the transportation sector, 2005-2035 (quadrillion Btu)



In comparison with non-OECD economies, high oil prices and economic recession had more profound impacts on OECD economies. OECD energy use for transportation declined by an estimated 1.3 percent in 2008, followed by a further decrease estimated at 2.0 percent in 2009. Indications are that a return to growth in transportation energy use in OECD nations will not begin before late 2010, given the relatively slow recovery from the global recession anticipated for many of the key OECD nations. Moreover, the United States and some of the other OECD countries have instituted a number of new policy measures to increase the fuel efficiency of their vehicle fleets, as well as fuel taxation regimes to encourage fuel conservation. Thus, OECD transportation energy use, growing by only 0.3 percent per year over the entire projection period, does not return to its 2007 level until after 2020.

In the long term, for both non-OECD and OECD economies, steadily increasing demand for personal travel is a primary factor underlying projected increases in energy demand for transportation. Increases in urbanization and in personal incomes have contributed to increases in air travel and motorization (more vehicles per capita) in the growing economies. Increases 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.

Residential and commercial buildings

The buildings sector—comprising residential and commercial consumers—accounts for about one-fifth of the world's total delivered energy consumption. In the residential sector, energy use is defined as the energy consumed by households, excluding transportation uses. 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. Typical households in OECD nations use more energy than those in non-OECD nations, in part because higher income levels in OECD nations support purchases of larger homes and more energy-using equipment.

For residential buildings, the physical size of a structure is one key indicator of the amount of energy used by its occupants, although income level and a number of other factors, such as weather, also can affect the amount of energy consumed per household. Controlling for those factors, larger homes generally 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 usually 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.

In the *IEO2010* Reference case, world residential energy use increases by 1.1 percent per year over the projection period, from 50 quadrillion Btu in 2007 to 69 quadrillion Btu in 2035. Much of the growth in residential energy consumption occurs in non-OECD nations, where robust economic growth improves standards of living and fuels demand for residential energy. Non-OECD residential energy consumption rises by 1.9 percent per year, compared with the much slower rate of 0.4 percent per year for OECD countries, where patterns of residential energy use already are well established, and slower population growth and aging populations translate to smaller increases in energy demand.

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 service sector facilities include schools, stores, correctional institutions, restaurants, hotels, hospitals, museums, office buildings, banks, and sports arenas. 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 energy use. Economic trends and population growth drive activity in the commercial sector and the resulting energy use.

The need for services (health, education, financial, and government) increases as populations grow. 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 used 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.

OECD commercial energy use expands by 0.9 percent per year in the *IEO2010* Reference case. Slow expansion of GDP and low or declining population growth in many OECD nations contribute to slower anticipated rates of increase in commercial energy demand. In addition, continued efficiency improvements moderate the growth of energy demand over time, as energy-using equipment is replaced with newer, more efficient stock. Conversely, continued economic growth is expected to include growth in business activity, with its associated energy use, in areas such as retail and wholesale trade and business, financial services, and leisure services.

In non-OECD nations, economic activity and commerce increase rapidly over the 2007-2035 projection period, fueling additional demand for energy in the service sectors. Population growth also is expected to be more rapid than in OECD countries, portending increases in the need for education, health care, and social services and the energy required to provide them. In addition, as developing nations mature, they are expected to transition to more service-related enterprises, which will increase demand for energy in the commercial sector. The energy needed to fuel growth in commercial buildings will be substantial, with total delivered commercial energy use among non-OECD nations projected to grow by 2.7 percent per year from 2007 to 2035.

World carbon dioxide emissions

World energy-related carbon dioxide emissions rise from 29.7 billion metric tons in 2007 to 33.8 billion metric tons in 2020 and 42.4 billion metric tons in 2035—an increase of 43 percent over the projection period. With strong economic growth and continued heavy reliance on fossil fuels expected for most non-OECD economies under current policies, much of the projected increase in carbon dioxide emissions occurs among the developing non-OECD nations. In 2007, non-OECD emissions exceeded OECD emissions by 17 percent; in 2035, they are projected to be double OECD emissions (Figure 10).

A significant degree of uncertainty surrounds any long-term projection of energy-related carbon dioxide emissions. Major sources of uncertainty include estimates of energy consumption in total and by fuel source. The Kaya Identity provides an intuitive approach to the interpretation of historical trends and future projections of carbon dioxide emissions. It is a mathematical expression that is used to describe the relationship among the factors that influence trends in emissions: carbon intensity of energy (the amount of energy-related carbon dioxide emissions emitted per unit of energy produced), energy intensity of the economy (energy consumed per dollar of GDP), output per capita (GDP per person), and population.

Of the four Kaya components, policymakers are most actively concerned with the energy intensity of the economy and carbon intensity of energy, which are more readily affected by the policy levers available to them for reducing greenhouse gas emissions. In the *IEO-2010* Reference case, assuming no new climate policies, worldwide increases in output per capita and relatively moderate population growth overwhelm projected improvements in energy intensity and carbon intensity (Figure 11).

Figure 10. World energy-related carbon dioxide emissions, 2007-2035 (billion metric tons)

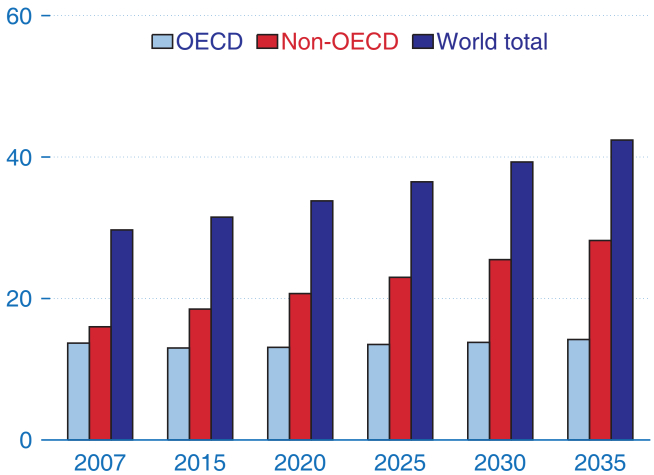
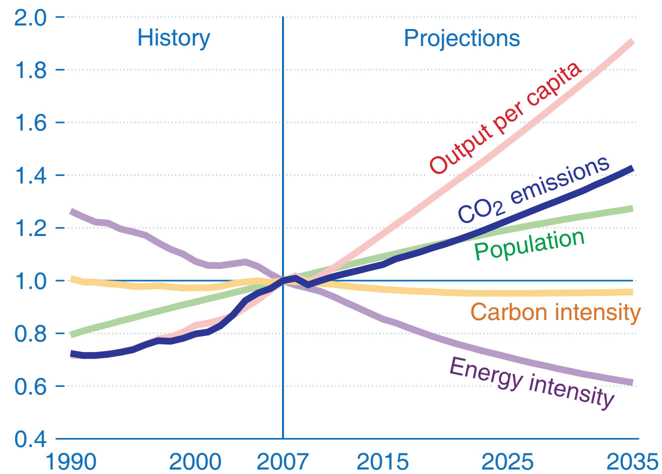


Figure 11. Impacts of four Kaya factors on world carbon dioxide emissions, 1990-2035 (index: 2007 = 1.0)



Chapter 1
World Energy Demand and Economic Outlook

In the IEO2010 projections, total world consumption of marketed energy increases by 49 percent from 2007 to 2035. The largest projected increase in energy demand is for non-OECD economies.

In the *IEO2010* Reference case, world energy consumption increases by 49 percent, or 1.4 percent per year, from 495 quadrillion Btu in 2007 to 739 quadrillion Btu in 2035 (Figure 12 and Table 1). The global economic recession that began in 2008 and continued into 2009 had a profound impact on world income (as measured by GDP) and energy use. After expanding at an average annual rate of 4.9 percent from 2003 to 2007, worldwide GDP growth slowed to 3.0 percent in 2008 and contracted by 1.0 percent in 2009. Similarly, growth in world energy use slowed to 1.2 percent in 2008 and then declined by an estimated 2.2 percent in 2009.

Global economic recovery from the recession has been uneven so far. Developing non-OECD Asian economies have led the global recovery, and many are already out of recession. While there are indications that the recession in the United States has ended, recovery in Europe and Japan has lagged. The *IEO2010* Reference case assumes that, by 2015, most nations of the world will have resumed their expected rates of long-term growth before the recession. World GDP rises by an average of 3.2 percent per year from 2007 to 2035 in the Reference case, with non-OECD economies averaging 4.4 percent per year and OECD economies 2.0 percent per year.

Historically, OECD member countries[6] have accounted for the largest share of current world energy consumption; however, in 2007—for the first time—energy use among non-OECD nations exceeded that among OECD nations (Figure 13). The discrepancy between OECD and non-OECD energy use grows in the future, given the more rapid growth in energy demand expected for the emerging non-OECD economies.

In 2007, energy use in non-OECD nations was 1.5 percent higher than that in OECD nations. In the *IEO2010*

Figure 12. World marketed energy consumption, 1990-2035 (quadrillion Btu)

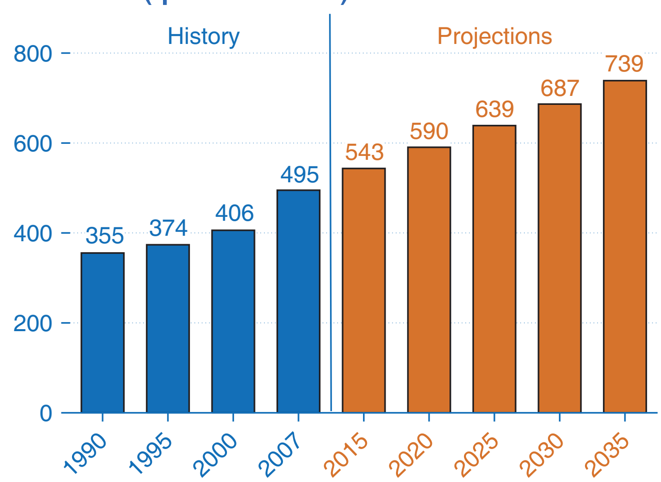


Table 1. World marketed energy consumption by country grouping, 2007-2035 (quadrillion Btu)

Region	2007	2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OECD	**245.7**	**246.0**	**254.2**	**263.2**	**271.4**	**280.7**	**0.5**
North America	123.7	124.3	129.4	134.9	140.2	146.3	0.6
Europe	82.3	82.0	83.0	85.0	86.5	88.2	0.2
Asia	39.7	39.7	41.8	43.3	44.8	46.3	0.5
Non-OECD	**249.5**	**297.5**	**336.3**	**375.5**	**415.2**	**458.0**	**2.2**
Europe and Eurasia	51.5	52.4	54.2	56.2	57.8	60.2	0.6
Asia	127.1	159.3	187.8	217.0	246.9	277.3	2.8
Middle East	25.1	32.9	36.5	39.1	41.8	45.7	2.2
Africa	17.8	20.8	22.5	24.6	26.5	29.0	1.8
Central and South America	28.0	32.1	35.5	38.7	42.2	45.7	1.8
Total World	**495.2**	**543.5**	**590.5**	**638.7**	**686.5**	**738.7**	**1.4**

[6]For consistency, OECD includes all members of the organization as of March 1, 2010, throughout all the time series included in this report. Chile became a member on May 7, 2010, but its membership is not reflected in *IEO2010*.

Reference case, non-OECD economies consume 32 percent more energy than OECD economies in 2020 and 63 percent more in 2035. OECD energy use grows slowly over the projection period, averaging 0.5 percent per year from 2007 to 2035, as compared with 2.2 percent per year for the emerging non-OECD economies.

Two nations that were among the least affected by the global recession were China and India, and they continue to lead the world's economic growth and energy demand growth in the Reference case. Since 1990, energy consumption as a share of total world energy use has increased significantly in both countries, and together they accounted for about 10 percent of the world's total energy consumption in 1990 and 20 percent in 2007. Strong economic growth in both countries continues over the projection period, with their combined energy use more than doubling and accounting for 30 percent of total world energy consumption in 2035 in the Reference case. In contrast, the U.S. share of world energy consumption falls from 21 percent in 2007 to about 16 percent in 2035 (Figure 14).

Energy use in non-OECD Asia (led by China and India) shows the most robust growth of all the non-OECD regions, rising by 118 percent from 2007 to 2035 (Figure 15). However, strong growth in energy use also is projected for much of the rest of the non-OECD regions. With fast-paced growth in population and access to rich resources, energy demand in the Middle East increases by 82 percent over the projection period. In Central and South America and Africa, energy consumption increases by 63 percent. The slowest projected growth among non-OECD regions is for non-OECD Europe and Eurasia, which includes Russia and the other former Soviet Republics. Growth in energy use for the region totals 17 percent from 2007 to 2035, as its population declines and substantial gains in energy efficiency are achieved through the replacement of inefficient Soviet-era capital equipment.

This chapter presents an overview of the *IEO2010* outlook for global marketed energy consumption by energy source. It also includes discussions of the major assumptions that form the basis for the *IEO2010* projections, including macroeconomic assumptions for the key OECD and non-OECD regions. As with any set of projections, there is significant uncertainty associated with the *IEO2010* energy projections. Two sets of sensitivity cases, which vary some of the assumptions behind the projections, are also examined in this chapter: the High Economic Growth and Low Economic Growth cases and the High Oil Price and Low Oil Price cases. The sensitivity cases are intended to illustrate alternative scenarios. They are not intended to identify any bounds on uncertainty, which can also be affected by policy and

Figure 13. World marketed energy consumption: OECD and Non-OECD, 1990-2035 (quadrillion Btu)

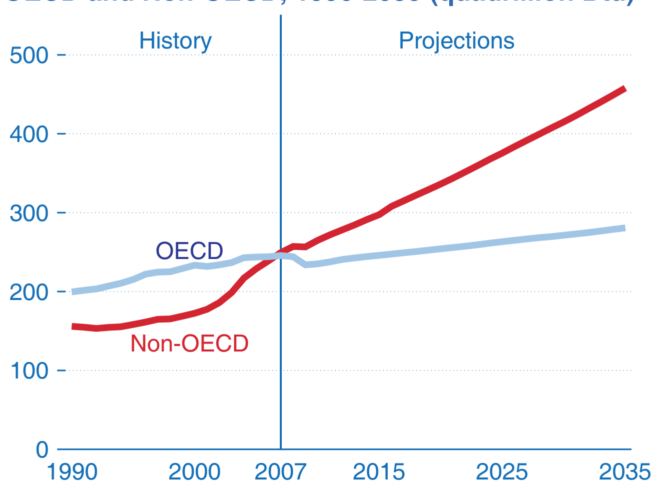


Figure 14. Shares of world energy consumption in the United States, China, and India, 1990-2035 (percent of world total)

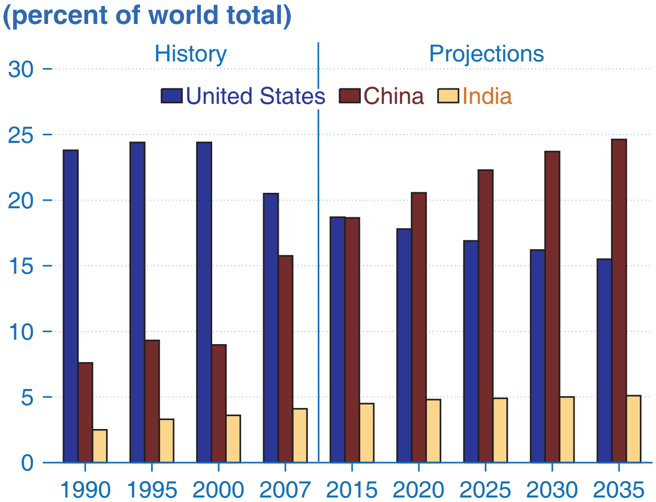
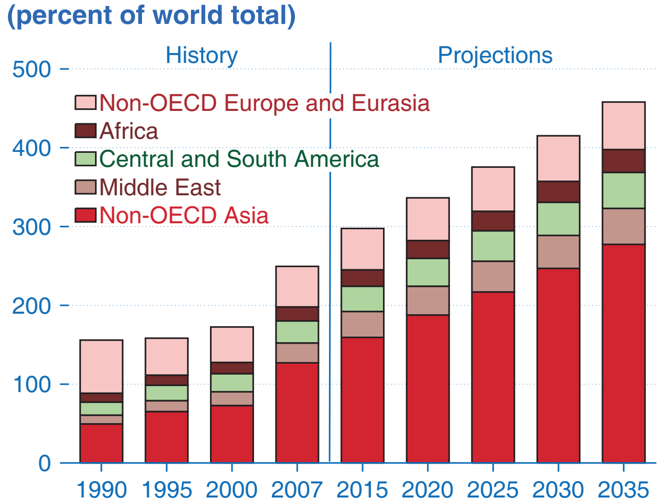


Figure 15. Marketed energy use in Non-OECD economies by region, 1990-2035 (percent of world total)



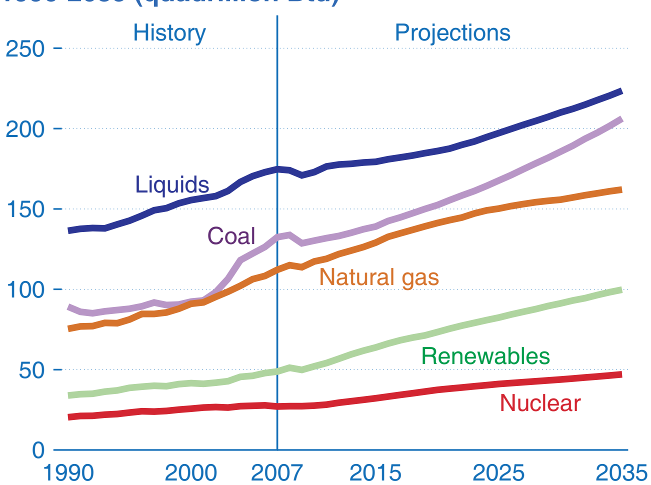
technology developments in addition to world oil price and economic growth paths.

Outlook for world energy consumption by source

The use of all energy sources increases over the time horizon of the *IEO2010* Reference case (Figure 16). Given expectations that world oil prices will remain relatively high through most of the projection period, liquid fuels and other petroleum[7] are the world's slowest-growing source of energy. Liquids consumption increases at an average annual rate of 0.9 percent from 2007 to 2035, whereas total energy demand increases by 1.4 percent per year. Renewables are the fastest-growing source of world energy, with consumption increasing by 2.6 percent per year. Projected oil prices, as well as concern about the environmental impacts of fossil fuel use and strong government incentives for increasing the use of renewable energy in many countries around the world, improve the prospects for renewable energy sources worldwide in the outlook.

Although liquid fuels are expected to remain the largest source of energy, the liquids share of world marketed energy consumption declines from 35 percent in 2007 to 30 percent in 2035. On a worldwide basis, the use of liquids remains flat in the building sector and increases modestly in the industrial sector. In the electric power sector, the use of liquids declines as electricity generators react to steadily rising world oil prices by switching to alternative fuels whenever possible. Liquids use in the transportation sector, in contrast, continues to increase despite the rising world oil prices in the Reference case. World liquids consumption for transportation grows by

Figure 16. World marketed energy use by fuel type, 1990-2035 (quadrillion Btu)



1.3 percent per year in the Reference case, and in the absence of significant technological advances, liquids continue to dominate the world's transportation markets through 2035.

Natural gas remains an important fuel for electricity generation worldwide. Electricity generation is less expensive with natural gas than with oil as the primary energy source, and natural-gas-fired generating plants are less capital-intensive than plants that use coal, nuclear, or most renewable energy sources. In the *IEO2010* Reference case, the world's total natural gas consumption increases by 1.3 percent per year on average, from 108 trillion cubic feet in 2007 to 156 trillion cubic feet in 2035, and its use in the electric power sector increases by 1.6 percent per year.

High world oil prices encourage consumers to turn to natural gas in the near term, but as supplies of natural gas become increasingly expensive to produce after 2020, the growth of natural gas use slows substantially. Between 2007 and 2020, worldwide natural gas demand increases by 1.8 percent per year, but between 2020 and 2035 the rate of growth is only 0.9 percent per year, as consumers turn to alternative sources of generation—notably, renewable energy sources, nuclear power, and, in the absence of policies that would limit its use, coal.

World coal consumption increases by 1.6 percent per year on average from 2007 to 2035, but most of the growth in demand occurs after 2020. Worldwide coal consumption increased by 35 percent between 2002 and 2007, largely because of the growth in China's coal use. Between 2007 and 2009, however, coal consumption declined by 3 percent. Coal use was strongly affected by the global recession, and consumption contracted strongly in 2009, in large part because coal is widely used in the production of heavy commodities (such as, steel and pig iron), which were particularly hard hit in the recession.

In the absence of policies or legislation that would limit the growth of coal use, China and, to a lesser extent, India and the other nations of non-OECD Asia consume coal in place of more expensive fuels. China alone accounts for 78 percent of the net increase in world coal consumption, whereas India and the rest of non-OECD Asia combined account for 17 percent of the world increase (Figure 17).

Electricity is the world's fastest-growing form of end-use energy consumption in the Reference case, as it has been for the past several decades. Net electricity generation worldwide rises by 2.3 percent per year on average from 2007 to 2035, while total world energy demand

[7] In *IEO2010*, "liquid fuels and other petroleum" 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) but do not include compressed natural gas (CNG), liquefied natural gas (LNG), or hydrogen.

grows by 1.4 percent per year. The strongest growth in electricity generation is for non-OECD countries. Non-OECD electricity generation increases by an average annual rate of 3.3 percent in the 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 OECD nations, where infrastructures are more mature and population growth is relatively slow, growth in generation is much slower, averaging 1.1 percent per year from 2007 to 2035.

Coal provides the largest share of world electricity generation in the Reference case. It accounted for 42 percent of total generation in 2007, and its share is largely unchanged through 2035 (Figure 18). In contrast, liquids, natural gas, and nuclear power all lose market share of world generation over the course of the projection period, displaced by the strong growth projected for renewable sources of generation. Renewable generation is the world's fastest-growing source of electric power in the *IEO2010* Reference case, rising at an average annual rate of 3.0 percent over the projection period, as compared with increases of 2.3 percent per year for coal, 2.1 percent per year for natural gas, and 2.0 percent per year for nuclear power. With government policies and incentives throughout the world supporting the rapid construction of renewable generation facilities, the renewable share of world generation increases from 18 percent in 2007 to 23 percent in 2035.

Worldwide, hydroelectricity and wind provide the largest shares of the projected increase in total renewable generation, accounting for 54 percent and 26 percent of the total increment, respectively. The relative mix of fuels in the OECD and non-OECD regions, however, differs dramatically. In OECD nations, the majority of economically exploitable hydroelectric resources already have been developed. With the exception of Canada and Turkey, there are few large-scale hydroelectric power projects planned for the future. Instead, most renewable energy growth in OECD countries is expected to come from nonhydroelectric sources, especially wind. Many OECD countries, particularly those in Europe, have government policies (including feed-in tariffs,[8] tax incentives, and market-share quotas) that encourage the construction of wind and other nonhydroelectric renewable electricity facilities.

In non-OECD nations, hydroelectric power is the predominant source of renewable energy growth. Strong increases in hydroelectric generation, primarily from mid- to large-scale power plants, are expected in Brazil and in non-OECD Asia (especially, China and India), which in combination account for 83 percent of the total increase in non-OECD hydroelectric generation over the projection period. Growth rates for wind-powered electricity generation also are high in non-OECD countries. The fastest-growing non-OECD regional market for wind power is attributed to China, where total generation from wind power plants increases from 6 billion kilowatthours in 2007 to 374 billion kilowatthours in 2035. Still, the total increase in China's wind-powered generation is less than half the increase in its hydroelectric generation (Figure 19).

Electricity generation from nuclear power worldwide increases from 2.6 trillion kilowatthours in 2007 to 4.5 trillion kilowatthours in 2035 in the *IEO2010* Reference case, as high fossil fuel prices and concerns about energy security and greenhouse gas emissions support the development of new nuclear generating capacity. World average capacity utilization rates have continued to rise over time, from about 65 percent in 1990 to about 80

Figure 17. Coal consumption in selected world regions, 1990-2035 (quadrillion Btu)

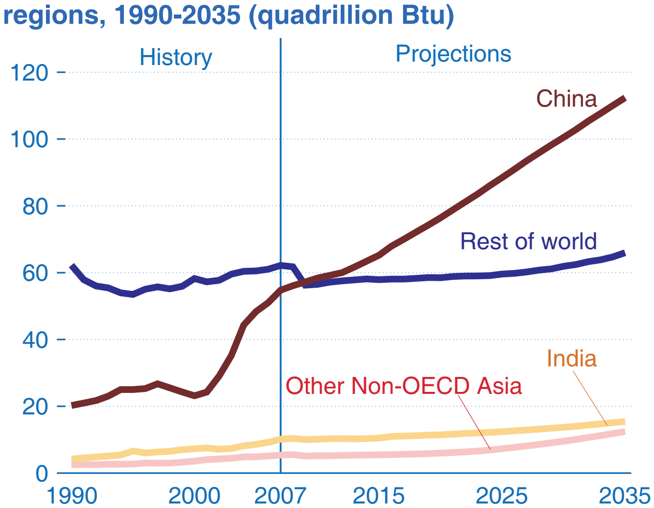
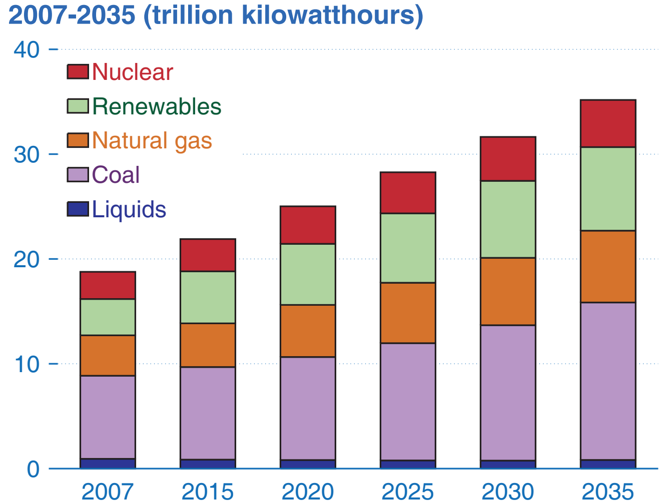


Figure 18. World electricity generation by fuel, 2007-2035 (trillion kilowatthours)



[8]A feed-in tariff is an incentive structure to encourage the adoption of renewable energy through government legislation. Under a feed-in tariff structure, regional or national electric utilities are obligated to purchase renewable electricity at a higher rate than retail, in order to allow renewable energy sources to overcome price disadvantages.

percent today, with some increases still anticipated in the future. In addition, most older plants now operating in OECD countries and in non-OECD Eurasia probably will be granted extensions to their operating licenses.

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 nuclear material proliferation concerns, 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.

Nearly 72 percent of the world expansion in installed nuclear power capacity is expected in non-OECD countries (Figure 20). China, India, and Russia account for the largest increment in world net installed nuclear power between 2007 and 2035. In the Reference case, China adds 66 gigawatts of nuclear capacity between 2007 and 2035, India 23 gigawatts, and Russia 25 gigawatts. Within the OECD, every region increases its installed nuclear capacity to some extent, except for Australia and New Zealand, where existing policies that discourage nuclear power are assumed to remain unchanged through the end of the projection period.

In a change from past *IEOs*, OECD Europe sees an increase in nuclear power capacity over the projection period, as a number of European countries have reassessed their nuclear stance in the past year. The governments of several countries have announced changes in their positions since 2009, including the Belgian government, which decided to delay its phaseout plans by 10 years; the German government, which has expressed willingness to reconsider its nuclear phaseout policies; and the Italian government, which has formally ended its anti-nuclear policies and announced plans for constructing a new reactor by 2020 [*1*]. There are also indications that several other European countries, including Poland and Turkey, plan to begin new nuclear generation programs. In this year's *IEO*, OECD Europe adds a net 10 gigawatts of installed nuclear capacity between 2006 and 2030, as compared with a net loss of 11 gigawatts of nuclear capacity projected in *IEO2009*.

In the United States, Title XVII of the Energy Policy Act of 2005 (EPACT2005, Public Law 109-58) authorizes the U.S. Department of Energy to issue loan guarantees for innovative technologies that "avoid, reduce, or sequester greenhouse gases." In addition, subsequent legislative provisions in the Consolidated Appropriation Act of 2008 (Public Law 110-161) allocated $18.5 billion in guarantees for nuclear power plants [*2*]. That legislation, along with high fossil fuel prices, results in increases of 8.4 gigawatts of capacity at newly built U.S. nuclear power plants between 2007 and 2035 and 4.0 gigawatts from expansion projects at existing plants. All existing U.S. nuclear units continue to operate through 2035 in the Reference case, which assumes that the owners will apply for and receive operating license renewals including, in some cases, a second extension after they reach 60 years of operation.

Delivered energy consumption by end-use sector

Understanding patterns in the consumption of energy delivered to end users[9] is important to the development of projections for global energy use. Outside the transportation sector, which at present is dominated by liquid fuels, the mix of energy use in the residential, commercial, and industrial sectors varies widely by region,

Figure 19. Renewable electricity generation in China by energy source, 2007-2035 (billion kilowatthours)

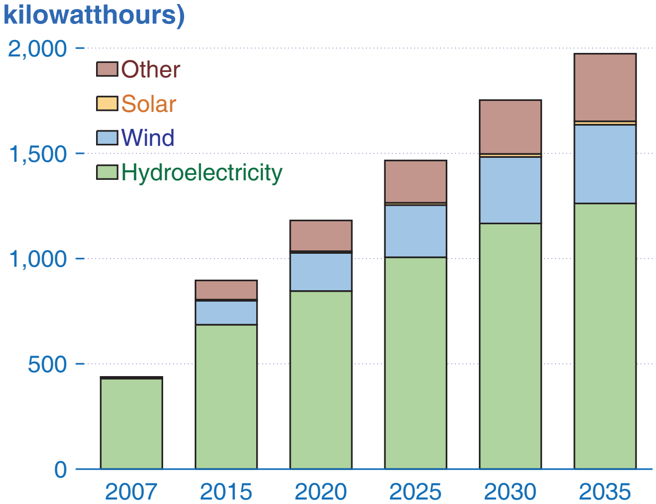
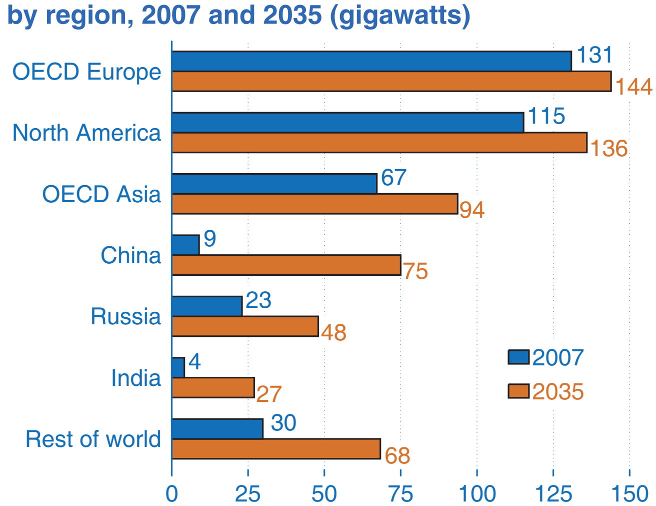


Figure 20. World nuclear generating capacity by region, 2007 and 2035 (gigawatts)



[9]Delivered energy consumption in the end-use sectors consists of primary energy consumption and electricity retail sales excluding electrical system energy losses.

depending on a combination of regional factors, such as the availability of energy resources, levels of economic development, and political, social, and demographic factors.

Residential sector

Energy use in the residential sector, which accounted for about 14 percent of world delivered energy consumption in 2007, is defined as the energy consumed by households, excluding transportation uses. Residential energy use grows at an average rate of 1.1 percent per year from 2007 to 2035. 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 OECD nations use more energy than those in non-OECD nations, in part because higher income levels allow OECD households to have larger homes and purchase more energy-using equipment. In the United States, for example, GDP per capita in 2007 was $43,076 (in real 2005 dollars per person), and residential energy use per capita was estimated at 37.2 million Btu. In contrast, China's per-capita income in 2007, at $5,162, was only about one-eighth the U.S. level, and its residential energy use per capita, at 4.0 million Btu, was about one-ninth the U.S. level.

For residential buildings, the physical size of a structure is one key indicator of the amount of energy used by its occupants, although income level and a number of other factors, such as weather, can also affect the amount of energy consumed per household. Controlling for those factors, larger homes generally 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 usually 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 [*3*].

Although the *IEO2010* 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 power grids, and the International Energy Agency estimates that more than 70 percent of the sub-Saharan African population does not have access to electricity [*4*]. About 37 percent of the world population—largely in India and Africa—still relies on animal dung, fuelwood, and agricultural residues for cooking fuel. Some areas of China and India also rely heavily on fuelwood, wood waste, and charcoal for cooking. As incomes rise in the developing world over the course of the projection, households replace the use of traditional fuels with marketed ones, such as propane and electricity, as they become more widely accessible.

Commercial sector

The commercial sector—often referred to as the service sector or the services and institutional sector—consists of businesses, institutions, and organizations that provide services. The sector, which accounted for 7 percent of total delivered energy consumption in 2007, encompasses many different types of buildings and a wide range of activities and energy-related services. Commercial sector energy use grows by an average of 1.5 percent per year from 2007 to 2035. Examples of commercial-sector facilities include schools, stores, correctional institutions, restaurants, hotels, hospitals, museums, office buildings, banks, and sports arenas. 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 energy use.

Economic trends and population growth drive commercial-sector activity and the resulting energy use. The need for services (health, education, financial, and 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 used 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, energy intensity—or energy use per dollar of income as measured by GDP—in non-OECD countries is much lower than in OECD countries. Non-OECD commercial energy intensity in 2007, at 281 Btu per dollar of GDP, was only about half the OECD level (522 Btu per dollar of GDP).

In the future, slower expansion of GDP and low or declining population growth in many OECD nations contribute to slower anticipated rates of increase in commercial energy demand. In addition, continued efficiency improvements moderate the growth of energy demand over time, as energy-using equipment is replaced with newer, more efficient stock. Conversely, continued economic growth is expected to include growth in business activity, with its associated energy use, in areas such as retail and wholesale trade and business, financial services, and leisure services. The United States is the largest consumer of commercial delivered energy in the OECD and remains in that position throughout the projection, accounting for about 45 percent of the OECD total in 2035.

In non-OECD nations, economic activity and commerce increase rapidly, fueling additional demand for energy in the service sectors. Population growth also is more rapid than in OECD countries, portending increases in the need for education, health care, and social services and the energy required to provide them. In addition, as developing nations mature, they transition to more service-related enterprises, increasing demand for energy in the commercial sector. The energy needed to fuel growth in commercial buildings will be substantial, with total delivered commercial energy use among non-OECD nations growing by 2.7 percent per year from 2007 to 2035.

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 processing and assembly, space conditioning, and lighting. The industrial sector comprised 51 percent of global delivered energy use in 2007 and grows by an average annual 1.3 percent over the projection. Industrial energy demand varies across regions and countries of the world, based on the level and mix of economic activity and technological development, among other factors. Industrial energy use also includes natural gas and petroleum products used as feedstocks to produce non-energy products, such as plastics and fertilizer. In aggregate, the industrial sector uses more energy than any other end-use sector, consuming about one-half of the world's total delivered energy.

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 the mix in non-OECD countries. As a result, the ratio of industrial energy consumption to total GDP tends to be higher in non-OECD economies than in OECD economies. On average, industrial energy intensity (the consumption of energy consumed in the industrial sector per dollar of economic output) in non-OECD countries is double that in OECD countries.

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 transportation sector accounted for 27 percent of total world delivered energy consumption in 2007, and transportation energy use increases by 1.3 percent per year from 2007 to 2035. 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 used for passenger travel. Growth rates for economic activity and population are the key factors for transportation energy demand. Economic growth spurs increases in industrial output, which requires the movement of raw materials to manufacturing sites, as well as the movement of manufactured goods to end users.

For both non-OECD and OECD economies, steadily increasing demand for personal travel is a primary factor underlying projected increases in energy demand for transportation. Increases in urbanization and in personal incomes have contributed to increases in air travel and motorization (more vehicles per capita) in the growing economies. Increases in the transport of goods result from continued economic growth in both OECD and non-OECD economies. For freight transportation, trucking leads the growth in demand for transportation fuels. In addition, as trade among countries increases, the volume of freight transported by air and marine vessels increases rapidly.

World economic outlook

Economic growth is among the most important factors to be considered in projecting changes in world energy consumption. In *IEO2010*, assumptions about regional economic growth—measured in terms of real GDP in 2005 U.S. dollars at purchasing power parity rates—underlie the projections of regional energy demand. Starting in 2008, the world experienced its worst recession of the past 60 years [*5*]. Although it appears that recovery has begun, its strength and timing are not entirely clear. The emerging economies of Asia (led by China and India) appear to be recovering quickly. The advanced economies, particularly the European countries and Japan, are improving much more slowly and have had concerns about a return to recession in the short term [*6*].

Substantial stimulus packages in the United States and China, as well as in a number of other countries around the world, are widely credited with averting another Great Depression [*7*]. China's $586 billion stimulus package has been used largely to fund infrastructure projects (including railways, roads, airports, urban power grids, and irrigation projects) and also for social programs, both domestically and abroad [*8*]. Many non-OECD Asian economies that are trading partners with China also have benefited from their ties with China. The emerging Asian economies—particularly those strongly dependent on exports for revenues—saw profound decreases in economic activity in 2008 and into

2009, as demand for goods among OECD economies declined sharply. The recovery in China has bolstered their recovery.

From 2007 to 2035, growth in world real GDP (on a purchasing power parity basis) averages 3.2 percent per year in the Reference case (Table 2). In the long term, the ability to produce goods and services (the supply side) determines the growth potential of each country's 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 also are important determinants of medium- to long-term growth potential.

Annual growth in world GDP over the 28-year projection period in *IEO2010* (3.23 percent per year) is about the same as the rate recorded over the past 30 years (3.25 percent per year). Growth in the more mature industrialized economies of the OECD is expected to be slower, and growth in the emerging non-OECD economies is projected to be higher, than in the past. The combined GDP of OECD countries, which increased by an annual average of 2.9 percent from 1977 to 2007, averages 2.0 percent per year from 2007 to 2035. In contrast, the combined GDP of non-OECD countries, which increased by an annual average of 3.7 percent from 1977 to 2007, averages 4.4 percent per year growth from 2007 to 2035, based in a large part on the strong growth projected for China and India. With non-OECD economies accounting for an increasing share of world GDP, their more rapid economic growth rates offset the slower growth rates for OECD economies in the Reference case (Figure 21).

OECD economies

In the *IEO2010* Reference case, overall OECD economic growth averages 2.0 percent per year and U.S. GDP growth averages 2.4 percent per year from 2007 to 2035. The U.S. recession, which began in December 2007, is the longest of the 10 recessions the United States has experienced since 1947, with four quarters of negative growth. It was also the country's deepest recession since 1957.[10] In 2009, U.S. GDP declined by 2.4 percent, and in 2010 it is expected to increase at a considerably slower rate than

Figure 21. OECD and Non-OECD total gross domestic product, 1990-2035 (trillion 2005 U.S. dollars)

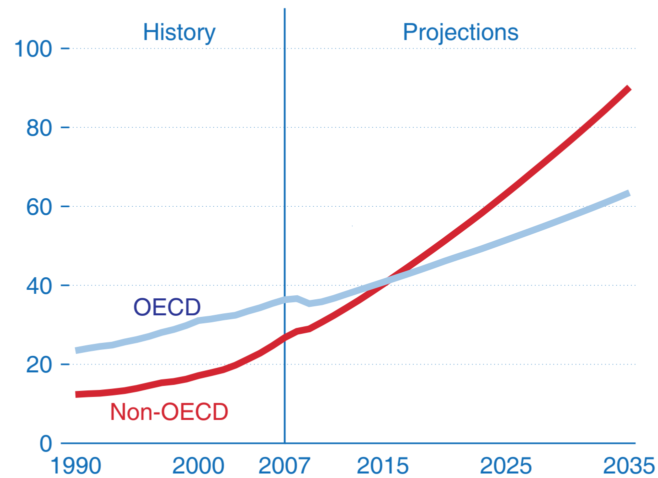


Table 2. World gross domestic product by country grouping, 2007-2035 (billion 2005 dollars, purchasing power parity)

Region	2007	2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OECD	**36,361**	**40,819**	**46,146**	**51,492**	**57,260**	**63,480**	**2.0**
North America	15,662	18,081	21,023	24,072	27,445	31,142	2.5
Europe	14,849	16,208	18,035	19,864	21,771	23,807	1.7
Asia	5,850	6,530	7,089	7,557	8,044	8,531	1.4
Non-OECD	**26,769**	**40,301**	**51,286**	**63,247**	**76,179**	**90,179**	**4.4**
Europe and Eurasia	3,481	4,193	4,940	5,731	6,557	7,440	2.7
Asia	14,323	24,055	31,832	40,307	49,366	59,023	5.2
Middle East	2,261	3,071	3,742	4,473	5,336	6,328	3.7
Africa	2,638	3,639	4,406	5,221	6,102	7,094	3.6
Central and South America	4,066	5,343	6,366	7,516	8,818	10,294	3.4
Total World	**63,130**	**81,120**	**97,433**	**114,740**	**133,439**	**153,658**	**3.2**

Source: IHS Global Insight and EIA.

[10] The National Bureau of Economic Research defines a recession as "a significant decline in economic activity spread across the economy, lasting more than a few months, normally visible in real GDP, real income, employment, industrial production, and wholesale-retail sales." However, the shorthand version of a recession is often given as two consecutive quarters of negative growth in GDP. In December 2008, the National Bureau of Economic Research declared that the United States had entered a recession in December 2007.

the annual average of 2.9 percent over the past two decades [*9*]. The U.S. economic recovery is expected to intensify in 2011, with employment recovering more slowly. As a result, real GDP returns to its 2007 pre-recessionary level by 2011, but employment rates do not return to 2007 levels until 2019.

Canada was also affected substantially by the world recession, with GDP contracting by 2.3 percent in 2009. The strong trade ties between Canada and the United States mean that weak U.S. economic growth, coupled with a relatively strong (by historical standards) Canadian dollar, helped lead Canada into economic recession [*10*]. Like many countries in the industrialized world, Canada instituted a substantial 2-year stimulus spending program in early 2009—about $30 billion or 1.9 percent of GDP—for infrastructure improvements, income tax reductions, and housing construction incentives, among other programs [*11*].

The Canadian economy showed signs of recovery at the end of 2009, with 5.0-percent GDP growth in the fourth quarter. In 2010, the government announced plans to phase out stimulus spending by March 2011 and, through budget austerity measures, to cut Canada's $54 billion deficit in half within 2 years [*12*]. In the long term, as U.S. consumer demand returns and export markets improve, economic growth in Canada returns to its potential. In the *IEO2010* Reference case, Canada's GDP grows by an average of 2.1 percent per year from 2007 to 2035.

Mexico was the Western Hemisphere's hardest-hit economy in the 2008-2009 recession [*13*]. Not only did it suffer when worldwide commodity exports collapsed, but the impact of the recession was compounded by the outbreak of H1N1 "swine flu" in 2009. Mexico's high reliance on the United States as a market for its manufacturing exports suggests that its economic recovery will be dependent on the U.S. recovery. About 80 percent of Mexico's exports are sent to the United States. Rising world oil prices and recovery of the U.S. economy are expected to support Mexico's return to trend growth, with GDP increasing by an average of 3.5 percent per year from 2007 to 2035.

In 2009, GDP in the economies of OECD Europe contracted by 3.9 percent—much more sharply than the 0.2-percent decline anticipated in last year's *IEO*. In 2010, economic growth in OECD Europe is expected to average only 1.0 percent. Several economies in the region, notably those of Greece, Spain, Portugal, and Ireland, are currently carrying very high debt levels [*14*]. In Greece, for instance, the high current account deficit, which surpassed 12 percent of total GDP and triggered a debt crisis, led the country nearly to default. However, a rescue package assembled jointly by the European Union, the International Monetary Fund, and the European Central Bank was implemented in May 2010 to prevent default and stop the crisis from spreading to other economies of the European Union [*15*]. Greece accounts for less than 3 percent of the European Union's total GDP, but signs of structural problems in the economies of Spain, Portugal, Ireland, and to a lesser extent Italy may weigh heavily on the economic recovery of OECD Europe as a whole [*16*]. In the *IEO2010* Reference case, total GDP in OECD Europe does not recover to its 2007 level until 2012. Economic growth in the region averages 1.7 percent per year from 2007 to 2035, below the increase of 2.0 percent per year for the OECD as a whole.

Japan was among the OECD economies hardest hit by the global economic downturn. Beginning in the second quarter of 2008, its GDP declined in four consecutive quarters. The International Monetary Fund estimates that, on an annualized basis, Japan's GDP contracted by more than 10 percent per year in the fourth quarter of 2008 and the first quarter of 2009 [*17*]. Although the Japanese banking sector was relatively insulated from the global financial crisis that began in 2007 and worsened in 2008, demand for Japanese goods declined precipitously as some of Japan's largest customers fell into recession [*18*]. In the past, Japan has relied on exports to generate about one-third of its GDP growth, and the decrease in exports strongly affected its economy.

Although improving exports and government incentive programs (which have stimulated domestic consumer demand) should allow Japan's GDP growth rate to improve in 2010, the pace of recovery is likely to be tied to those of its major customers in the United States and OECD Europe [*19*]. In the long term, Japan's aging labor force and declining population are likely to result in substantially slower economic growth over the projection period, averaging 1.4 percent per year from 2009 to 2020 and 0.3 percent per year from 2020 to 2035.

More robust economic growth occurs in the rest of OECD Asia. In South Korea, GDP growth averages 2.9 percent per year from 2007 to 2035. The global recession led to profound declines in Korea's exports and domestic demand in 2008 and into 2009 [*20*]. In response to the deepening economic crisis, the Bank of Korea cut its interest rate six times between October 2008 and February 2009, to 2.0 percent, where it remained into 2010 [*21*]. In addition, the South Korean government introduced stimulus packages worth about $44 billion (50 trillion won) into the economy to stimulate domestic demand. South Korea's economy began to recover in the second half of 2009, recording double-digit growth rates in the second and third quarters, as exports to China increased sharply and the effects of the stimulus funds were felt [*22*]. A return to world demand for Korean goods will support the South Korean economic recovery in the near term. In the long term, however, its growth tapers off as the growth of its labor force slows.

GDP growth in Australia/New Zealand averages 2.6 percent per year from 2007 to 2035 in the *IEO2010* Reference case. To address GDP growth that slowed markedly in Australia and declined in New Zealand as a result of the global recession, the Reserve Bank of Australia and the Reserve Bank of New Zealand eased monetary policies substantially in 2008-2009, helping to cushion the impact of the global economic downturn [*23*]. Australia's recovery is already well underway, with GDP growth expected to return to pre-crisis trend levels of about 3.0 percent per year in 2010. In fact, Australia was the first "Group of 20" nation to begin tightening monetary policy and increasing interest rates in October 2009. Interest rates have increased periodically since that time, reaching 4.0 percent in 2010. In comparison with Australia, New Zealand's economic recovery has been tepid, and interest rates remained at record low levels of 2.5 percent through the first quarter of 2010 with assurances that monetary policy would begin to be tightened by mid-year [*24*]. Long-term prospects in both countries are relatively 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

Overall non-OECD economic growth averages 4.4 percent per year in the *IEO2010* Reference case from 2007 to 2035. Economic growth in non-OECD Europe and Eurasia as a whole averages 2.7 percent per year. After several years of strong regional economic growth (the region's GDP grew by an average of 6.7 percent per year from 2000 to 2008), GDP in non-OECD Europe and Eurasia contracted by 7.3 percent in 2009. The region has a fairly diverse set of economies, and while some suffered deep recessions in 2008-2009, others saw economic growth slow but remain positive.

Those nations reliant on commodity exports tended to fare worse than their neighbors in the recent recession. For example, in Russia—the region's largest economy—GDP declined by 8.0 percent in 2009; Ukraine's GDP declined by 15.0 percent; and Kazakhstan's GDP declined by a more modest 1.1 percent. In contrast to the sharp economic declines among the energy-exporting nations of non-OECD Europe and Eurasia, other smaller regional economies with strong domestic demand were affected only slightly by the global economic downturn. For instance, both Albania and Uzbekistan recorded GDP growth of more than 4 percent in 2009.

Beginning in late 2007, it became more difficult for banks and other entities in non-OECD Europe and Eurasia—particularly, Russia, Kazakhstan, and Ukraine—to gain access to foreign loans [*25*]. The impact was softened somewhat by higher world market prices for commodity exports, but with the subsequent collapse of commodity prices and worsening global economic situation, the region's economic growth declined sharply. In the mid- to long term, a return to high world oil prices stimulates investment outlays, especially in the energy sector of the Caspian region. Given the volatility of energy market prices, however, it is unlikely that the economies of non-OECD Europe and Eurasia will be able to sustain their recent growth rates until they have achieved more broad-based diversification from energy production and exports.

Much of the growth in world economic activity between 2007 and 2035 occurs among the nations of non-OECD Asia, where regional GDP growth averages 5.2 percent per year. China, non-OECD Asia's largest economy, continues playing a major role in both the supply and demand sides of the global economy. *IEO2010* projects an average annual growth rate of approximately 5.8 percent for China's economy from 2007 to 2035—the highest among all the world's economies.

Non-OECD Asia is leading the recovery from the 2008-2009 global economic recession. The substantial Chinese stimulus, considerable loosening of lending terms, and tax breaks for new cars and appliances have translated to a 17-percent increase in retail sales (the largest increase in more than 20 years) and an 18-percent increase in industrial production [*26*]. It now appears that China posted a 9-percent increase in GDP in 2009, and that it is on its way to returning to double-digit growth in 2010. One caveat is that the government is attempting to remove stimulus spending and tighten lending terms in order to eliminate incentives for overinvestment and to control price inflation in the short term [*27*]. Many non-OECD Asian economies that are trade partners with China have also benefited from their ties with China. Although these emerging Asian economies—particularly those strongly dependent on exports for revenues—experienced profound decreases in economic activity in 2008 and into 2009 as demand for goods among OECD economies sharply declined, the recovery in China has bolstered their recovery.

Structural issues that have implications for economic growth in China in the mid- to long term include the pace of reform affecting inefficient state-owned companies and a banking system that is carrying a significant amount of nonperforming loans. Development of domestic capital markets continues in the *IEO2010* Reference case, providing macroeconomic stability and ensuring that China's large domestic savings are used more efficiently.

India's economy is not as dependent on export revenues as are the economies of China and some of the other non-OECD Asian countries. About 75 percent of India's population still depends on farming for income [*28*]. As a result, India was affected far less by the global economic downturn than were many other nations of the world. India's GDP grew by about 6.0 percent in 2008 and 2009 and is expected to grow by 7.5 percent in 2010. Its GDP growth is expected to return to pre-recession trends over the next year or so, with positive prospects for the economy in the mid-term, as it continues to privatize state enterprises and increasingly adopts free market policies. 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 India over the mid- to long term. In the *IEO2010* Reference case, GDP growth in India averages 5.0 percent per year from 2007 to 2035.

Outside China and India, recovery from the global recession in the countries of non-OECD Asia is likely to vary. Those economies that are export-dependent (including Hong Kong, Indonesia, Singapore, and Taiwan) weakened substantially in 2009, as demand in the United States, Europe, and Asia declined and industrial production contracted by about 25 percent [*29*]. For the export-dependent nations, China's strong economic rebound is likely to support recovery in the near term. For nations where domestic demand remains healthy (including Vietnam and the Philippines), the impact of the global recession was less severe, although their growth did slow in 2009 [*30*]. Overall, long-term economic activity in the nations of non-OECD Asia remains robust. From 2007 to 2035, national economic growth rates for the region—excluding China and India—average 4.3 percent per year, as labor force growth rates decline and economies mature.

From 2003 to 2008, rising oil production and prices helped boost economic growth in the oil-exporting countries of the Middle East, many of which also benefited from spillover effects on trade, tourism, and financial flows from the region's oil exports [*31*]. The sharp decline in world oil prices at the end of 2008 and into 2009, combined with OPEC-imposed production cuts, declining demand for other exports, and reduced capital inflows, slowed economic growth to its lowest rate since 1994. Stimulus funding from Saudi Arabia, the United Arab Emirates, and other countries in the region helped to keep GDP from falling lower. With strengthening oil prices and rebounding demand for the region's export commodities, prospects for economic growth remain favorable. The Middle East's reliance on oil and natural gas revenues continues for much of the projection period.

The impact of the global recession on the economies of Africa varied across the continent. In the countries of Southern Africa, GDP declined by 1.9 percent in 2009. South Africa—the region's largest economy—experienced its first recession since 1992, and the impact spread to neighboring countries [*32*]. Western Africa's economic growth slowed but remained positive, as Nigeria—the second largest economy in sub-Saharan Africa after South Africa—saw increases in agricultural output that offset declines in industrial output and oil production. Northern African nations benefited from strong domestic demand and high agricultural output from Algeria and Morocco. Eastern African nations experienced robust economic growth in 2009, largely because of strong economic performance in Ethiopia and the member countries of the East African Community (Kenya, Uganda, Rwanda, Burundi, and Tanzania).

In the *IEO2010* Reference case, Africa's combined economy grows at an average annual rate of 3.6 percent from 2007 to 2035, supported by the expansion of exports and robust domestic demand in many of the continent'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 the impact of disease—present formidable obstacles to growth in a number of African countries.

As in Africa, the impact of the global economic downturn on the nations of Central and South America varied across the region. Brazil—the region's largest economy—is already well along the path of recovery after experiencing a relatively short and mild recession in 2009. Its recovery is supported by domestic and foreign investment, along with strengthening domestic consumption [*33*]. Other countries—including Argentina, Bolivia, Ecuador, and Venezuela—are expected to recover much more slowly.

Investment in the countries of Central and South America is constrained by adverse economic circumstances, and revenues from commodities exports are not expected to provide the level of government revenue that they had from 2003 to 2008. The proximity of the region to the United States and the trade relationships of its national economies with the U.S. economy suggest that the region's recovery will be linked, in part, to the pace of the U.S. recovery. Even so, the long-term prospects for Central and South America remain positive. Most countries in the region have flexible exchange rates, positive trade balances, and relatively low fiscal deficits and public debts. Regional inflation is lower than it was in the mid-1990s, and a relatively young labor force supports the region's economic growth prospects over the next 30 years. Economic growth in Central and South America averages 3.4 percent per year from

2007 to 2035 in the Reference case, as the region benefits from the expected recovery in world economic growth after 2010, and foreign capital flows are revived.

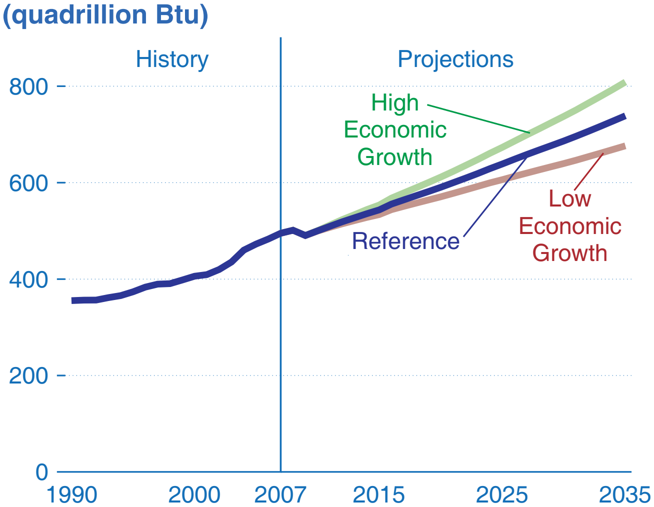
Sensitivity analyses in *IEO2010*

Alternative Economic Growth cases

Expectations for the future rates of economic growth are a major source of uncertainty in the *IEO2010* projections. To illustrate the uncertainties associated with economic growth trends, *IEO2010* includes a High Economic Growth case and a Low Economic 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 relationships between changes in GDP and changes in energy consumption that are used in the Reference case. The alternative growth cases maintain the oil price path of the *IEO2010* Reference case.

In the High Economic Growth case, 0.5 percentage point is added to the annual 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 annual growth rates. The *IEO2010* Reference case shows total world energy consumption reaching 739 quadrillion Btu in 2035—281 quadrillion Btu in OECD countries and 458 quadrillion Btu in non-OECD countries. In the High Growth case, world energy use in 2035 totals 810 quadrillion Btu—71 quadrillion Btu (about 35 million barrels oil equivalent per day) higher than in the Reference case. In the Low Growth case, total world energy use in 2035 is 60 quadrillion Btu (30 million barrels oil equivalent per day) lower than in the Reference case. Thus, the projections for 2035 in the High and Low Economic Growth cases span a range of uncertainty equal to 134 quadrillion Btu (Figure 22).

Figure 22. World marketed energy consumption in three Economic Growth cases, 1990-2035 (quadrillion Btu)



Alternative Oil Price cases

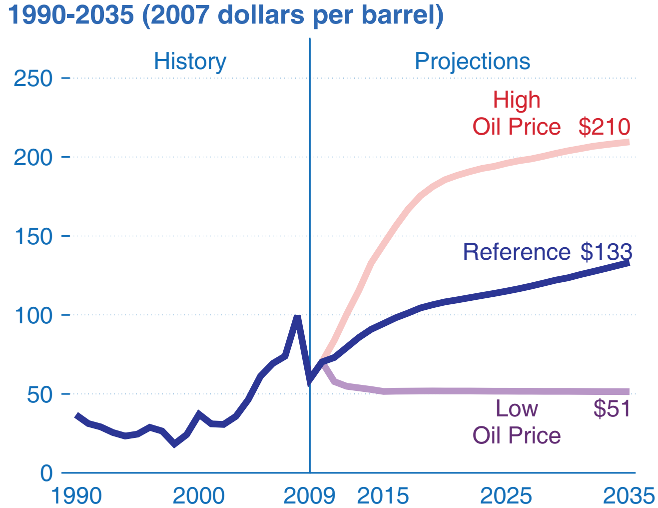
Assumptions about world oil prices are another important factor that underscores the considerable uncertainty in long-term energy market projections. The effects of different assumptions about future oil prices are illustrated in *IEO2010* by two alternative oil price cases. In the High Oil Price case, world oil prices (in real 2008 dollars) climb from $59 per barrel in 2009 to $210 per barrel in 2035; in the Low Oil Price case, they decline to $52 per barrel in 2015 and remain approximately at that real level through 2035. In comparison, world oil prices rise to $133 per barrel in 2035 in the Reference case (Figure 23). These three oil price cases are the same as those used in EIA's *Annual Energy Outlook 2010*.

Although the difference in world oil prices between the High and Low Oil Price cases is considerable, the projections for total world energy consumption in 2035 do not vary substantially among the cases. The projections for total world energy use in 2035 in the High and Low Oil Price cases are separated by 33 quadrillion Btu (Figure 24), as compared with the difference of 134 quadrillion Btu between the High and Low Economic Growth cases.

The most substantial impacts of the high and low oil price assumptions are on the mix of energy fuels consumed in each region—particularly, fossil fuels (Figure 25). In the High Oil Price case, total world liquids consumption in 2030 is about 31 quadrillion Btu lower (about 15 million barrels per day oil equivalent), coal consumption in 2035 is 7 quadrillion Btu higher, natural gas consumption is 5 quadrillion Btu higher, and renewable energy use is 2 quadrillion Btu higher than projected in the Reference case. The difference in nuclear power consumption between the two cases is small.

In the *IEO2010* Reference case, world oil prices begin to rise after 2009 and reach $133 per barrel by 2035. As a result, liquids consumption is curtailed in countries that

Figure 23. World oil prices in three Oil Price cases, 1990-2035 (2007 dollars per barrel)



have other fuel options available—especially in the electric power sector, where coal and other fuels can be substituted. Worldwide use of liquids for electricity generation, which falls by 1.5 quadrillion Btu from 2007 to 2035 in the Reference case, increases by 1.7 quadrillion Btu in the Low Oil Price case, as non-OECD countries retain their oil-fired generating capacity in the lower price environment.

In the Low Oil Price case, consumers increase their use of liquids for transportation, and there is less incentive for movement away from liquids to other energy sources in sectors where fuel substitution is fairly easy to achieve (for example, electricity). Total liquids consumption in 2035 is 25 quadrillion Btu (12 million barrels per day) higher in the Low Oil Price case than in the Reference case, reflecting increased demand in all the end-use sectors. In the Low Oil Price case, the industrial sector shows the largest increase in liquids consumption (14 quadrillion Btu or 7 million barrels per day) in 2035 relative to the Reference case (Figure 26), followed by the transportation sector (7 quadrillion Btu or 3 million barrels per day) and the electric power sector (3 quadrillion Btu or 2 million barrels per day).

Figure 24. World marketed energy consumption in three Oil Price cases, 2007-2035 (quadrillion Btu)

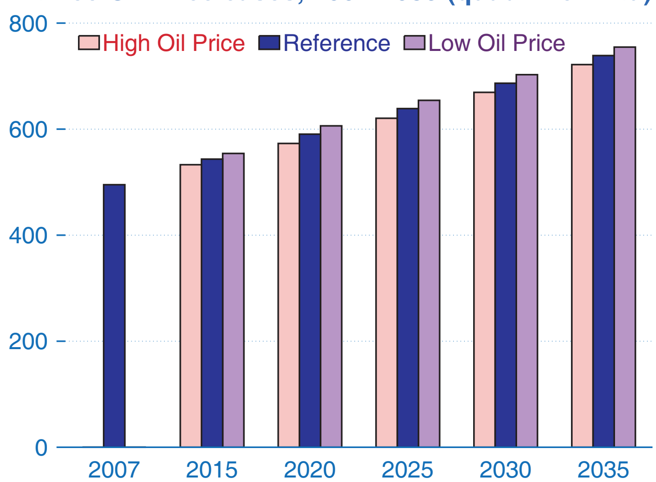


Figure 25. World marketed energy consumption by fuel in three Oil Price cases, 2035 (quadrillion Btu)

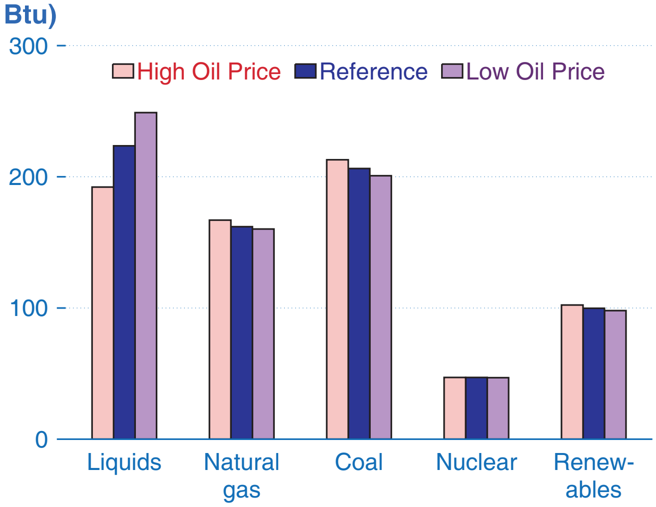
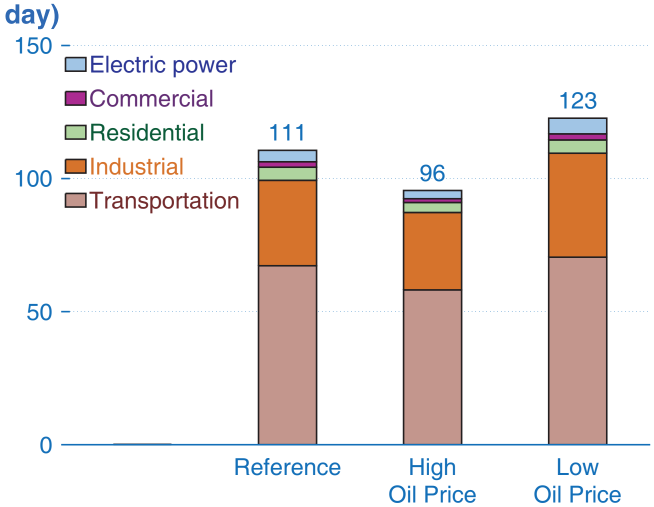


Figure 26. World liquids consumption by sector in three Oil Price cases, 2035 (million barrels per day)



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Chapter 2
Liquid Fuels

World liquids consumption in the IEO2010 Reference case increases from 86.1 million barrels per day in 2007 to 110.6 million barrels per day in 2035. Unconventional liquids, at 12.9 million barrels per day, make up 12 percent of total liquids production in 2035.

Overview

Consumption of liquid fuels and other petroleum[11] increases from 86.1 million barrels per day in 2007 to 110.6 million barrels per day in 2035 in the *IEO2010* Reference case. Although world liquids consumption actually declined in 2008 (to 85.8 million barrels per day) and again in 2009 (to an estimated 84.1 million barrels per day) as the global economic recession deepened, it is expected to recover in 2010 and beyond as economic growth resumes. In the long term, world liquids consumption increases despite world oil prices that remain above $90 per barrel (in real 2008 dollars) after 2014 and rise to more than $130 per barrel by 2035. More than 80 percent of the increase in total liquids consumption is projected for the nations of non-OECD Asia and the Middle East, where EIA expects strong economic growth (Figure 27). The transportation sector accounts for the largest increment in total liquids demand, making up nearly 80 percent of the world increase.

To satisfy the increase in world liquids demand in the Reference case, liquids production increases by 26 million barrels per day from 2007 to 2035, including the production of both conventional liquid supplies (crude oil and lease condensate, natural gas plant liquids, and refinery gain) and unconventional supplies (biofuels, oil sands, extra-heavy oil, coal-to-liquids, gas-to-liquids, and shale oil) (Figure 28 and Table 3). In the Reference case, sustained high world oil prices allow for the economical development of unconventional resources and the use of enhanced oil recovery technologies to increase production of conventional resources. High world oil prices also incentivize the development of additional conventional resources through technically difficult, high-risk, and very expensive projects, including wells in ultra-deep water and the Arctic.

The most significant non-OPEC contributors to production growth are Russia, the United States, Brazil, and Canada. Total non-OPEC liquids production in 2035 is nearly 13 million barrels per day higher than in 2007, representing 51 percent of the total world increase (Figure 29). OPEC producers[12] are assumed to restrict investment in incremental production capacity in the Reference case, below the levels justified by high prices.

Figure 27. World liquids consumption by region and country group, 2007 and 2035 (million barrels per day)

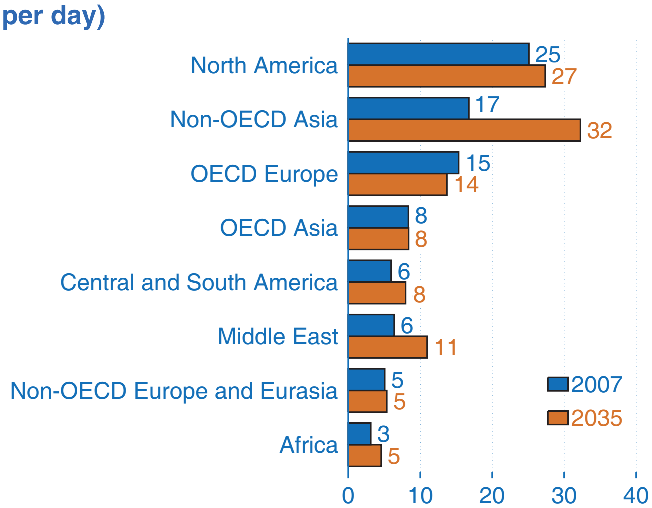
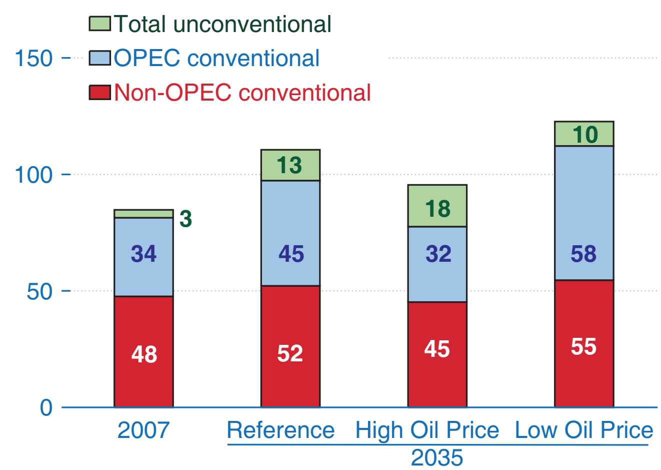


Figure 28. World liquid fuels production in three cases, 2007 and 2035 (million barrels per day)



[11] Liquid fuels and other petroleum include petroleum-derived fuels and non-petroleum-derived liquid 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.

[12] Indonesia officially suspended its membership in OPEC on January 1, 2009. In this chapter, all references to OPEC exclude Indonesia. In addition, all time series have been updated to reflect country groupings as of January 1, 2009, so that Indonesia's liquids production is excluded from the OPEC totals for 1980 through 2035.

Table 3. World liquid fuels production in the Reference case, 2007-2035 (million barrels per day)

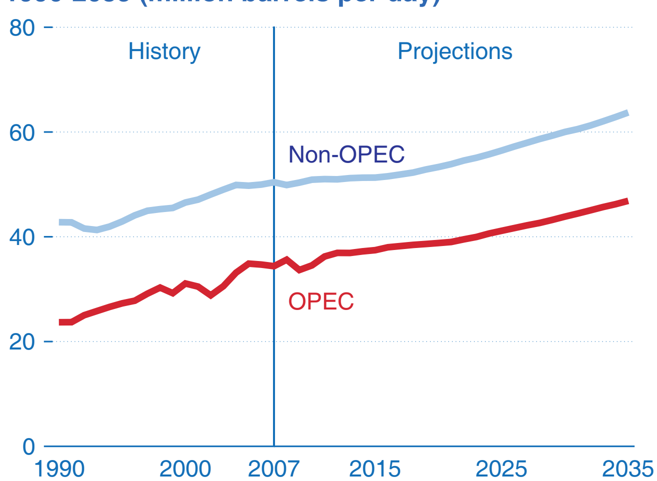
Source	2007	2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OPEC							
Conventional liquids[a]	33.8	36.4	37.5	39.7	42.3	45.3	1.0
Extra-heavy oil	0.6	0.8	1.1	1.2	1.3	1.4	3.1
Bitumen	0.0	0.0	0.0	0.0	0.0	0.0	—
Coal-to-liquids	0.0	0.0	0.0	0.0	0.0	0.0	—
Gas-to-liquids	0.0	0.2	0.2	0.3	0.3	0.3	15.4
Shale oil	0.0	0.0	0.0	0.0	0.0	0.0	—
Biofuels	0.0	0.0	0.0	0.0	0.0	0.0	—
OPEC total	**34.4**	**37.4**	**38.8**	**41.2**	**43.9**	**47.0**	**1.1**
Non-OPEC							
Conventional liquids[a]	47.7	46.2	47.0	48.8	50.8	52.5	0.3
Extra-heavy oil	0.0	0.0	0.0	0.1	0.1	0.1	—
Bitumen	1.4	2.4	2.9	3.5	4.2	5.2	4.8
Coal-to-liquids	0.2	0.3	0.5	0.8	1.1	1.4	7.9
Gas-to-liquids	0.0	0.1	0.1	0.1	0.1	0.1	—
Shale oil	0.0	0.0	0.0	0.1	0.2	0.4	15.6
Biofuels	1.2	2.4	2.8	3.2	3.5	4.1	4.6
Non-OPEC total[b]	**50.4**	**51.3**	**53.3**	**56.5**	**60.0**	**63.6**	**0.8**
World							
Conventional liquids[a]	81.4	82.6	84.5	88.5	93.1	97.7	0.7
Extra-heavy oil	0.6	0.8	1.1	1.2	1.4	1.5	3.3
Bitumen	1.4	2.4	2.9	3.5	4.2	5.2	4.8
Coal-to-liquids	0.2	0.3	0.5	0.8	1.1	1.4	7.9
Gas-to-liquids	0.1	0.3	0.3	0.3	0.4	0.4	7.3
Shale oil	0.0	0.0	0.0	0.1	0.2	0.4	15.6
Biofuels	1.2	2.4	2.8	3.2	3.5	4.1	4.6
World total	**84.8**	**88.7**	**92.1**	**97.6**	**103.9**	**110.6**	**1.0**

[a]Includes conventional crude oil and lease condensate, natural gas plant liquids (NGPL), and refinery gain.
[b]Includes some U.S. petroleum product stock withdrawals, domestic sources of blending components, other hydrocarbons, and ethers.

As a result, OPEC provides roughly 40 percent of the world's total liquids supply over the 2007-2035 period.

Unconventional resources from both OPEC and non-OPEC sources become increasingly competitive in the *IEO2010* Reference case. Production of unconventional petroleum liquids, such as Canada's oil sands and Venezuela's extra-heavy oil, is limited somewhat by environmental concerns and investment restrictions. Production of nonpetroleum unconventional liquids, such as biofuels, coal-to-liquids, and gas-to-liquids (GTL), is spurred by sustained high prices in the Reference and High Oil Price cases (Figure 30); however, their development also depends on country-specific programs or mandates. World production of unconventional liquids, which in 2007 totaled only 3.4 million barrels per day, increases in the Reference case to 12.9 million barrels per day in 2035, when it accounts for 12 percent of total world liquids production.

Figure 29. World total liquids production, 1990-2035 (million barrels per day)



World liquids consumption

World liquids consumption in the *IEO2010* Reference case increases from 86.1 million barrels per day (174 quadrillion Btu) in 2007 to 110.6 million barrels per day (223 quadrillion Btu) in 2035. World GDP is a key driver, growing by 3.4 percent per year from 2007 to 2020 and 3.1 percent per year from 2020 to 2035. Developing non-OECD nations, particularly in Asia, the Middle East, and Central and South America, are expected to have strong economic growth accompanied by increasing demand for liquids in the transportation and industrial sectors.

Rising prices for liquids increase the cost-competitiveness of non-liquid fuels, leading many users of liquids outside the transportation sector to switch to substitute sources of energy. As a result, the transportation share of total liquid fuels consumption increases, accounting for 77 percent of the overall increase in liquids consumed over the projection period across all sectors (Figure 31). In 2035, the transportation sector consumes 61 percent of total liquids supplied.

Strong expansion of liquids use is projected for non-OECD countries, fueled by a return to robust economic growth, burgeoning industrial activity, and rapidly expanding transportation use. The largest increase in regional non-OECD consumption between 2007 and 2035 is projected for non-OECD Asia, at 15.5 million barrels per day. Within non-OECD Asia, the largest increases in demand come from China (9.4 million barrels per day) and India (1.8 million barrels per day), with the increase from China being the largest for any single country worldwide. Large consumption increases are also expected in the Middle East (4.6 million barrels per day), and Central and South America (2.0 million barrels per day) (see Figure 27).

Liquids consumption in OECD regions generally grows more slowly over the next 25 years, reflecting slowly growing or declining populations and relatively slow economic growth as compared with non-OECD nations. In addition, growth in demand for liquids in many OECD countries is slowed by government policies and legislation aimed at improving the efficiency of personal motor vehicles. This includes increased automobile efficiency standards and government incentives introduced in many nations during the recession, such as the U.S. "cash for clunkers" program, designed to encourage consumers to trade in older, less efficient cars for newer ones that are more fuel-efficient. In Japan and OECD Europe, liquids consumption declines by average annual rates of 0.7 percent (0.9 million barrels per day) and 0.4 percent (1.6 million barrels per day), respectively, from 2007 to 2035.

The different growth trends for the non-OECD and OECD regions mean that, by 2025, non-OECD regions consume more liquids than OECD regions. Despite significant country-level consumption growth, China still consumes less liquid fuel than the United States in 2035.

World oil prices

The impacts of world oil prices on energy demand are a considerable source of uncertainty in the *IEO2010* projections. In addition to the Reference case, High Oil Price and Low Oil Price cases illustrate the range of that uncertainty, although they do not span the complete range of possible price paths. In the Reference case, the world oil price[13] increases from $59 per barrel in 2009 to $70 per barrel in 2010 and then rises to $95 per barrel in

Figure 30. World production of unconventional liquid fuels in three cases, 2007 and 2035 (million barrels per day)

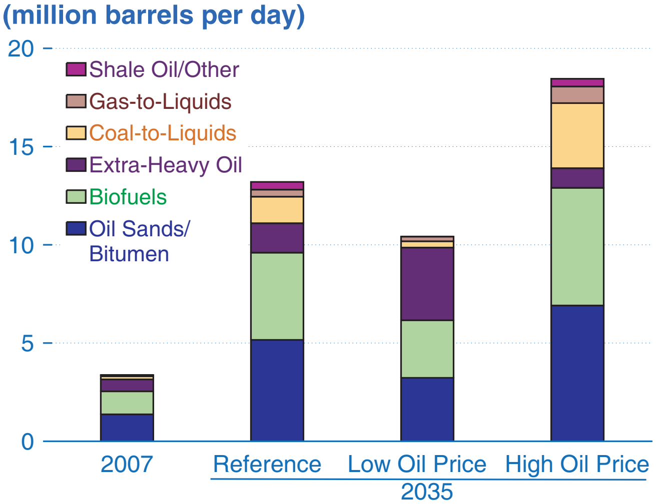
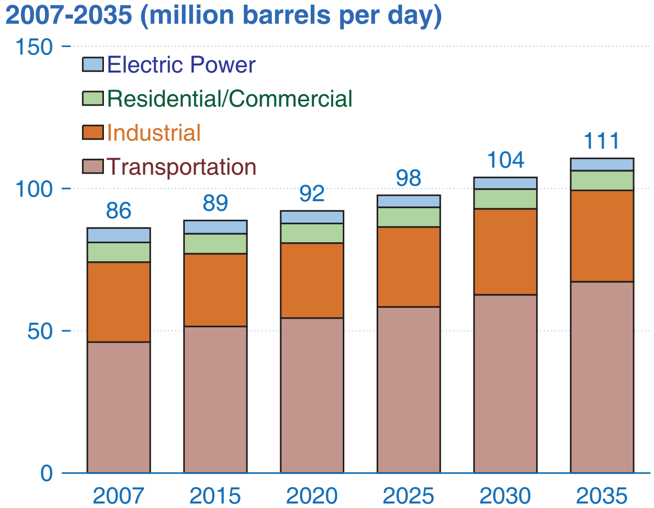


Figure 31. World liquids consumption by sector, 2007-2035 (million barrels per day)



[13] The oil price reported in *IEO2010* is for light sweet crude oil delivered to Cushing, Oklahoma. The price series is consistent with spot prices for light sweet crude oil reported on the New York Mercantile Exchange (NYMEX). All oil prices are in real 2008 dollars per barrel, unless otherwise noted.

2015 and $133 per barrel in 2035 ($224 per barrel in nominal terms) (Figure 32 and Table 4). In the High Oil Price case, the world oil price increases to $210 per barrel in 2035 ($289 per barrel in nominal terms). In the Low Oil Price case, the world oil price falls to $51 per barrel in 2035 ($72 per barrel in nominal terms). The three world oil price paths in *IEO2010* are consistent with those in EIA's *Annual Energy Outlook 2010* [**1**].

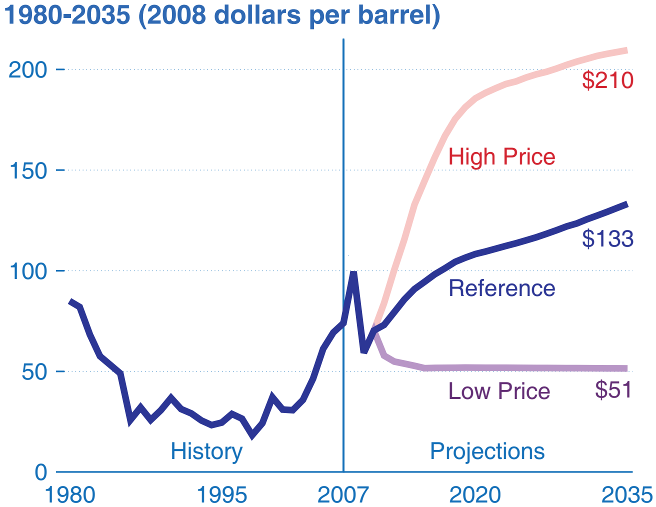
The *IEO2010* projections for total world liquids consumption in 2035 range from 90 million barrels per day in the High Oil Price case to 120 million barrels per day in the Low Oil Price case. This range indicates the substantial uncertainty in the oil market projections.

The three price cases are distinct scenarios, each reflecting alternative assumptions about the sources and costs of world oil supplies. The Reference case reflects an assumed decision by OPEC members to maintain the organization's aggregate production at approximately 40 percent of world liquids supply. To retain that share of world liquids supply, OPEC would have to increase production by 12.6 million barrels per day from 2007 to 2035, or about one-half of the projected total increase in world liquids supply. Non-OPEC conventional supplies—including production from high-cost projects and from countries with unattractive fiscal or political regimes—account for an increase of 4.8 million barrels per day over the projection, and non-OPEC production of unconventional liquid fuels supplies the remaining 8.4 million barrels per day of the increase.

The High Oil Price case assumes that several non-OPEC producers further restrict access to, or increase taxes on, production from prospective areas, and that the OPEC members reduce their production substantially below current levels. Oil prices rise above the Reference case levels, dampening demand for liquid fuels and enabling increased production from those high-cost conventional and unconventional non-OPEC oil resources that still are accessible and attractive for exploration and development.

The Low Oil Price case assumes greater access to, and more attractive fiscal regimes in, several prospective non-OPEC areas—including Russia and the Caspian region—as well as increased production from OPEC members. Under those conditions, oil prices fall below the Reference case levels, leading to increased demand for liquid fuels and dampening production of conventional and unconventional resources from non-OPEC producers that currently have attractive fiscal regimes but relatively mature or depleted resource bases.

Figure 32. World oil prices in three cases, 1980-2035 (2008 dollars per barrel)



Recent market trends

In 2009, world oil prices responded primarily to demand expectations, with producers, consumers, and traders continuing to look for any indication as to when the world's economy would recover, what shape the recovery would take, and how strong the corresponding increase in oil demand would be. Despite record levels of floating storage, gradual reductions in OPEC compliance to pledged production cuts, and even moderate reductions in factor input costs, oil prices rose throughout the year as each month brought hope that there would be some clear signal of an economic turnaround.

In addition, 2009 was an eventful year for the supply factors that drive long-term pricing. Over the course of the year, OPEC demonstrated greater dedication to supporting prices than it has historically, maintaining an average 70-percent compliance rate from February through June before falling to 60 percent later in the year [**2**]. Above-average compliance increased the group's spare capacity to 5.0 million barrels per day in December 2009. It also helped prices rise to a range of $70 to $80 per barrel, which several members of OPEC, including Saudi Arabia, Venezuela, and Algeria, have identified publicly as a desirable price level [**3**].

Table 4. World oil prices in four cases, 2008-2035 (2008 dollars per barrel)

	IEO2010			*IEO2009*
Year	Reference	Low Oil Price	High Oil Price	Reference case
2008	100	100	100	101
2015	95	52	145	113
2020	108	52	186	118
2025	115	52	196	125
2030	124	52	204	134
2035	133	51	210	—

Since June 2009, Iraq—the only OPEC member not currently assigned a quota—has held two bid rounds. The sum of the targeted production increase from the awarded fields is about 9.5 million barrels per day, or almost four times the country's current production. Although most industry analysts do not expect Iraq to achieve the production targets in full, especially not in the near to mid-term, the likely increase still could cause changes in OPEC's quota allocation and long-term production decisions.

The year also held significant challenges and surprises for non-OPEC supply, some with potentially long-lasting implications. Although prices rose throughout 2009, many of the supply projects delayed during the price slump that started in 2008 have not been revived. Given the time needed for project development, there is a lag between the time of investment decision and the eventual arrival of the projects in the market. Consequently, mid-term supply growth may be constrained if delayed projects are not restarted in the short term.

A related trend that began in 2008 and continued in 2009 was the decline in costs for materials, labor, and equipment ("factor inputs") necessary to develop supply projects. The decline may have encouraged delays in some projects as investors waited to secure contracts at the lowest possible cost; however, the trend appears to have bottomed out at the end of 2009 after only a slight overall reduction in costs [*4*]. Before the recent reduction in production costs, an industry research group estimated that costs had approximately doubled since 2000 [*5*]. Higher costs serve to raise the breakeven oil price at which a project would be considered economical, thus affecting decisions as to which supply projects are likely to move forward in the future.

Also starting in 2008 and continuing into 2009 was a crisis in the global credit market, which made it difficult to finance some exploration and production projects. It will take several years to realize the full effect of limits on credit availability for oil supply projects, because the projects stalled by the lack of financing, particularly exploration projects, would not have brought supply to the market for years. In addition, the recent credit crisis may also have lead to an overall and possibly lasting change in risk appetite on the part of both lenders and investors. Ironically, while credit terms were being tightened and financial risk was being trimmed, ongoing exploration efforts in Africa resulted in a wave of discoveries and new hope for unexplored and under-explored non-OPEC frontiers (see box on page 28). It remains unknown whether those exploration efforts will continue to bear fruit, and whether future efforts will be hampered by credit conditions. At present these are important uncertainties to be considered in the projections of future oil supply and demand balance.

World liquids production

In the *IEO2010* Reference case, world liquids production in 2035 exceeds the 2007 level by 26 million barrels per day. Increases in production are expected for both OPEC and non-OPEC producers. Overall, 51 percent of the total increase is expected to come from non-OPEC areas, including 33 percent from non-OPEC unconventional liquids production alone. OPEC produces 47 million barrels per day in 2035 in the Reference case, and non-OPEC producers provide 64 million barrels per day.

The Reference case assumes that OPEC producers will choose to maintain their market share of world liquids supply and will invest in incremental production capacity so that their liquids 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 [NGPL], and refinery gain) from OPEC members contribute 10.3 million barrels per day to the total increase in world liquids production from 2007 to 2035, and conventional liquids supplied from non-OPEC nations contribute 4.8 million barrels per day.

Unconventional liquids production increases by about 5 percent annually on average over the projection period, because sustained high oil prices make unconventional liquids more competitive, and above-ground factors limit the production of economically competitive conventional liquids. Unconventional fuels account for 37 percent (9.5 million barrels per day) of the increase in total liquids production in the Reference case, and 8.4 million barrels per day of the increase in unconventional supply comes from non-OPEC sources. High oil prices, improvements in exploration and extraction technologies, emphasis on recovery efficiency, and the emergence and continued growth of unconventional resource production are the primary factors supporting the growth of non-OPEC liquids production in the *IEO2010* Reference case.

Liquids production modeling approach

The *IEO2010* 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

Is offshore West Africa the world's next frontier for oil?

The development of non-OPEC oil supply centers has grown and diversified widely over time. North America dominated non-OPEC supply in the early 1970s, the North Sea and Mexico evolved as major sources in the 1980s, and much of the new production in the 1990s and into the 2000s came from developing countries in Central and South America, the non-OPEC Middle East, and China. Now industry has shifted its attention to offshore resources along Africa's western coast, suggesting that Africa may become an important non-OPEC oil-producing region within a decade.

Between 2007 and 2009, oil discoveries off the West African coast resulted in a flurry of exploration and production activity, with a number of companies showing active interest in obtaining exploration blocks. In June 2007, the Jubilee field was discovered by the United Kingdom's Tullow Oil in the deep coastal waters of Ghana.[a] Initial estimates suggest that the Jubilee field contains approximately 490 million barrels of proven reserves and may have as much as 1.8 billion barrels of potential reserves.[b] Work on the Jubilee field began in 2009. Initial production is expected to begin at the end of 2010, increasing to 120,000 barrels per day in 2011.

The discovery of Jubilee spurred interest in oil exploration along the coast of several other West African nations, notably, Côte d'Ivoire, Liberia, and Sierra Leone. In September 2009, Anadarko Petroleum discovered oil off the coast of Sierra Leone at the Venus-B1 exploratory well—the first deepwater discovery in the Sierra Leone-Liberian Basin. Although its commercial viability has not yet been confirmed, the discovery serves to frame a "new oil frontier" area of the West African coast, extending from Ghana to Sierra Leone, with significant resource potential.[c]

A 2010 assessment by the U.S. Geological Survey (USGS) of two West African provinces, the Senegal Province and the Gulf of Guinea Province, estimated mean undiscovered resources of 2.4 billion barrels and 4.1 billion barrels, respectively.[d] This represents a significant increase in the undiscovered potential of the two provinces since the 2000 USGS *World Petroleum Assessment*. In 2000, the Senegal Province was estimated to hold a mere 157 million barrels of oil. The Gulf of Guinea Province estimate has grown from 1.0 billion barrels of oil resource in 2000 to 4.1 billion barrels in 2010.

While the potential resource base offshore West Africa appears to be ample, there are other important considerations that may deter the region's oil development. Investment climates vary among countries, and there are risks that must be evaluated before foreign companies commit to investing in oil production. Foreign investors attempt to limit their risks, including but not limited to political, economic, operational, and geopolitical risks.

Many West African nations have only recently recovered from civil war or other periods of political instability, and they may still be dealing with inexperienced governments, potentially suffering from corruption and mismanagement. Companies can be dissuaded from investing if they believe that business operations might be hampered by government interference. For example, the recent dispute between Kosmos Energy and the government of Ghana concerning the proposed sale of Kosmos's stake in the Jubilee field to ExxonMobil signaled potential problems for companies operating in offshore Ghana.[e] Although the dispute was resolved—at least temporarily—when Kosmos agreed to remain a partner until the field begins first production, the issue over transfer of assets could have negative impacts on future international investment.

Because this is the first time that oil production has been a consideration for many West African countries, they may have little or no legislation concerning hydrocarbon resources. Côte d'Ivoire introduced a new Oil and Gas Development Code in 1996 in an attempt to increase foreign direct investment, and the Ghanaian government is scheduled to draft legislation establishing an independent regulator to manage oil revenues before production begins at the Jubilee field

(continued on page 29)

[a]"Ghana: 'World-class' Jubilee Oilfield Larger Than Expected," *Petroleum Economist* (January 27, 2009), web site www.petroleum-economist.com (subscription site).

[b]"Africa: Jubilee Field: Ghana's Oil Industry Takes Off," iStockAnalyst.com (April 5, 2010), web site www.istockanalyst.com/article/viewiStockNews/articleid/4006121; and "Exxon's Ghana Move Raises Hopes, Tensions," *Petroleum Intelligence Weekly*, Vol. 48, No. 42 (October 19, 2009), pp. 2-3, web site www.energyintel.com/publicationhomepage.asp (subscription site).

[c]J. Collin, "Andarko: West Africa Find Opens New Frontier," *Oil Daily* (September 17, 2009), web site www.energyintel.com (subscription site).

[d]U.S. Geological Survey, World Petroleum Resources Project, "Assessment of Undiscovered Oil and Gas Resources of Four West Africa Geologic Provinces," Fact Sheet 2010–3006 (February 2010), web site http://pubs.usgs.gov/fs/2010/3006/pdf/FS10-3006.pdf.

[e]E. Gismatullin and T. Patel, "Tullow Says Kosmos to Stay in Ghana Until Production Starts" (April 22, 2010), web site www.bloomberg.com/apps/news?sid=aigcwbvWOSCE&pid=20601087.

Is offshore West Africa the world's next frontier for oil? (continued)

later this year.[f] The legislation aims to create an independent regulatory body and revenue management procedures to avoid the mismanagement and corruption that have arisen elsewhere on the continent. It remains to be seen how Sierra Leone and Liberia, both still recovering from recent civil wars, will manage this task.

The coast of West Africa represents a new frontier for the petroleum industry, but how and when the resources will be brought to market remains uncertain. Although there has been healthy exploratory activity, production from the region is still in its infancy.

[f]C. Hunter, IHS Global Insight, "Ghana: Oil & Gas: Government Policy," *Energy Country Profiles* (April 5, 2010), web site www.ihsglobalinsight.com (subscription site).

and development plans of companies and countries, make it possible to take a detailed approach to modeling mid-term supply.

Although some projects are publicized more than 7 to 10 years before their first production, others can come on line within 3 years. For that reason, project-by-project analyses are unlikely to provide a complete representation of company or country production plans and achievable production volumes beyond 3 years into the future. Instead, production decisions made after the mid-term, or 2015, are assumed to be based predominantly on resource availability and the resulting economic viability of production.

In view of the residual effects of previous government policies and the unavoidable lag time between changes in policy and any potential production changes, however, most country-level changes in production trends are noticeable only in 2020 and beyond. Geopolitical and other "above-ground" constraints[14] 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 affecting world supplies long after 2015. Even if above-ground constraints were relaxed, the expansion of production capacity could be delayed, depending on the technical difficulty and typical development schedule of the projects likely to be developed in a particular country.

For some resource-rich countries it is assumed that current political barriers to production increases will not continue after 2015. For instance, both Mexico and Venezuela currently have laws that restrict foreign ownership of hydrocarbon resources. Their resource policies have 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 ease restrictions at some point after 2015, allowing some additional foreign involvement in their oil sectors that facilitates increases in liquids production, including from deepwater prospects in Mexico and extra-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 2002 to 2003 production declined from 2.0 million barrels per day to 1.3 million barrels per day, and since then it has achieved only inconsistent and slow growth. Although Iraq's production levels are not expected to increase substantially in the near term, it is assumed that political and legal uncertainty subsides, and that renewed investment and development activity ensue, resulting in significant growth in production from 2015 to 2035.

Non-OPEC production

The return to sustained high oil prices projected in the *IEO2010* Reference case encourages 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 50 million barrels per day in 2007 to 64 million barrels per day in 2035, as high prices attract investment in areas previously considered uneconomical, and fears of supply restrictions encourage some net consuming nations to expand unconventional liquids production from domestic resources, such as coal and crops.

Despite the maturity of most non-OPEC producing basins, conventional liquids production in the Reference case increases from 48 million barrels per day in 2007 to 52 million barrels per day in 2035. The overall increase results primarily from production increases in four

[14]"Above-ground" constraints refer to those nongeological factors that could affect supply, including but not limited to government policies that limit access to resources; conflict; terrorist activity; lack of technological advances or access to technology; price constraints on the economic development of resources; labor shortages; materials shortages; weather; environmental protection actions; and short- and long-term geopolitical considerations.

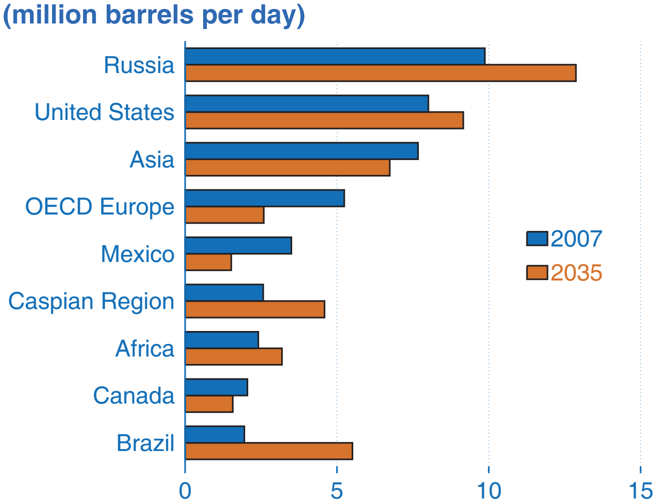
countries: Brazil, Russia, Kazakhstan, and the United States (Figure 33). Among non-OPEC producers, the near absence of prospects for new, large conventional petroleum liquids projects, along with declines in production from existing conventional fields, results in heavy investment in the development 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 most established non-OPEC producers to maintain or slow production declines but not to raise production volumes.

In the Reference case, unconventional liquids production from non-OPEC suppliers rises to 6 million barrels per day in 2020 and 11 million barrels per day in 2035. In the High Oil Price case, non-OPEC unconventional liquids production rises to 17 million barrels per day in 2035, as significantly higher prices encourage the development of alternative fuel sources to the limits imposed by expected environmental protection measures and industry expansion in general. In contrast, in the Low Oil Price case, fewer unconventional resources become economically competitive, and non-OPEC production of unconventional liquids rises to only 7 million barrels per day in 2035.

Major areas of decline in non-OPEC liquids production

In the *IEO2010* Reference case, Mexico and the North Sea are the only non-OPEC production areas that lose more than 1 million barrels of liquids production per day from 2007 to 2035. The most significant decline in non-OPEC liquids production is for OECD Europe, with a decrease from 5.4 million barrels per day in 2007 to 2.9 million barrels per day in 2035. Most of that decline is in North Sea production, which includes offshore operations by Norway, the United Kingdom, the Netherlands, and Germany. Over time, fewer and fewer prospects capable of compensating for declines in existing fields have been discovered. The drop in North Sea liquids production does not vary significantly in the High and Low Oil Price cases, both because it is based on depletion of resources and because all the countries currently producing liquids from North Sea operations are expected to continue encouraging investment and providing open access to development.

Figure 33. Non-OPEC conventional liquids production by region, 2007 and 2035 (million barrels per day)



In Mexico, liquids production sinks to approximately 1.4 million barrels per day in 2025 before slowly rebounding to 1.6 million barrels per day in 2035, still 1.9 million barrels per day below 2007 volumes. The rebound after 2025 depends entirely on the development of potential resources in the deepwater Gulf of Mexico, which must begin some years in advance of any increase in production levels. The outlook for Mexico's liquids production is markedly different from the *IEO* projection just 3 years ago, in which production did not fall below 2.9 million barrels per day and a long-term recovery began in 2013. The difference between the projections is a result of declines at Cantarell that were more severe than expected, along with diminished expectations for Chicontepec production and more pessimistic assumptions about the level of future investment, both foreign and domestic, in Mexico's deepwater production.

Although the shortage of investment in Mexico is expected to lead to a mid-term decline, Mexico has potential resources to support a long-term recovery in total production, primarily in the Gulf of Mexico. The extent and timing of a recovery will depend in part on the level of economic access granted to foreign investors and operators. Mexico's national oil company, PEMEX, currently does not have the technical capability or financial means to develop potential deepwater projects in the Gulf of Mexico.

Major areas of growth in non-OPEC liquids production

The largest increase in non-OPEC total liquids production is expected for Brazil, with projected growth of 4.9 million barrels per day by 2035 from its 2007 level of 2.3 million barrels per day. Of that increase, 3.6 million barrels per day is attributed to conventional liquids production. The strong growth in Brazil's conventional production results in part from short- and mid-term increases at producing fields for which expansions are either planned or in progress. It also results in part from recent and expected discoveries in the Campos and Santos basins, including the massive Tupi and related Guara and Iara discoveries, which both add to production in the mid- and long term and suggest the presence of other large fields in the same formation [*6*]. The vast size of the sub-salt potential in Brazil, as well as national economic strategy and industrialization goals, have led Brazil to pursue new petroleum legislation [7]. The legislative change most pertinent to production potential is the requirement that the state oil company, Petrobras, be the sole operator and a minimum 30-percent equity holder for all sub-salt fields.

Although Petrobras has repeatedly proven itself a leader in deepwater development and is known to have the technical capabilities to develop sub-salt prospects, it is not expected to have the resources (financial, labor, etc.) to develop its domestic plays completely on its own. The different *IEO2010* price cases assume different investment terms offered by Brazil to foreign investors and hence different rates of sub-salt development. The High Oil Price case assumes tighter terms of access to conventional resources, resulting in average annual growth of 2.2 percent and conventional production that reaches 3.5 million barrels per day in 2035. In comparison, the Low Oil Price case assumes open terms of access to conventional resources, resulting in average annual growth of 4.6 percent and conventional production of 6.6 million barrels per day in 2035.

In addition to the growth in conventional liquids production, Brazil's ethanol production also increases, from 0.3 million barrels per day in 2007 to 1.6 million barrels per day in 2035 in the Reference case. This growth is a result of steady increases in yields and the expansion of crop production. Brazil's major ethanol production is derived from sugar cane, currently the highest-yielding and cheapest feedstock for ethanol. Brazil also has a large amount of land available for sugar cane production in the form of previously cleared, underutilized pasture land. The country's domestic consumption is not expected to rise as fast as its expansion of ethanol production, making Brazil a net ethanol exporter over the course of the projection. Thus, its production depends largely on other countries' policies and demand for ethanol.

In the High Oil Price case, Brazil's ethanol production totals 2.0 million barrels per day in 2035, reflecting higher demand for ethanol both at home and abroad. In the Low Oil Price case, which assumes reduced domestic and international demand for ethanol, Brazil's ethanol production totals 1.2 million barrels per day in 2035. Even in the Low Oil Price case, however, there is only a small drop in Brazil's domestic ethanol consumption, because of the country's mandatory minimum E25 blend and the fact that ethanol makes up a nearly 50-percent share of the country's domestic gasoline market [8].

The second-largest contributor to future increases in non-OPEC total liquids production is the United States. U.S. conventional liquids production grows from 8.0 million barrels per day in 2007 to 9.2 million barrels per day in 2035 in the Reference case, as rising world oil prices spur both onshore and offshore drilling. In the short term, the vast majority of the increase in crude oil production comes from deepwater offshore fields. Fields that started producing in 2009, or that are expected to start producing in the next few years, include Great White, Norman, Tahiti, Gomez, Cascade, and Chinook. All are in water depths greater than 2,600 feet, and most are in the U.S. Central Gulf of Mexico. Production from those fields, combined with increased production from fields that started producing in 2007 and 2008, contributes to the near-term growth in U.S. offshore production. Production from other recently discovered and yet-to-be discovered fields offsets production declines in older fields, resulting in a net increase in liquids production through 2035.

U.S. lower 48 onshore production of crude oil continues to grow through 2035, primarily as a result of increased application of EOR techniques. In 2035, EOR accounts for 37 percent of total onshore production. The rate of growth in domestic crude oil production depends largely on assumptions about world oil prices and improvements in technology, because remaining onshore resources typically require more costly secondary or tertiary recovery techniques. In a future world where carbon dioxide emissions may be captured for sequestration, increased carbon dioxide supply could spur additional EOR activities.

U.S. unconventional liquids production becomes more significant as world oil prices rise, with domestic production of biofuels increasing from 0.46 million barrels per day in 2007 to 1.6 million barrels per day in 2035 in the Reference case. Although advances in coal liquefaction technology have made it commercially available in other countries, including South Africa, China, and Germany, the technical and financial risks of building what would be essentially a first-of-a-kind facility in the United States have discouraged significant investment thus far. In addition, the possibility of new legislation aimed at reducing U.S. greenhouse gas emissions creates further uncertainty for future investment in CTL. With ongoing improvement in oil shale technology, commercial production starts in 2023 and increases rapidly to 1.7 percent of total U.S. liquids supply in 2035. However, oil shale development suffers from environmental, technical, and financial uncertainties similar to those for CTL.

Canada's production of conventional liquids declines slowly in the Reference case, by a total of just under 0.5 million barrels per day from 2007 to 2035. However, increased production of unconventional petroleum liquids from oil sands more than offsets the decline in conventional production. As a result, Canada's total liquids production doubles in the projection, from 3.4 million barrels per day in 2007 to 6.8 million barrels per day in 2035.

Russia and Kazakhstan are the other key players in non-OPEC production growth. However, non-OECD Europe and Eurasia is a region prone to territorial disputes, transportation blockages, contractual changes, and political intervention. For example, Russia's production is expected to decline in the mid-term, with recent trends indicating that tax policies which previously caused companies to operate at a net financial loss may soon be reinstated, creating a large disincentive for potential private investment in resource development [***9***].

After declining to 9.4 million barrels per day in 2016, Russia's liquids production begins a slow increase to 9.8 million barrels per day in 2020 in the Reference case, as uncertainty about tax regimes lessens. In addition, the annual increases in the world oil price assumed in the *IEO2010* Reference case spur liquids development and allow Russia's production to reach 12.8 million barrels per day in 2035. Although exploration in eastern Siberia is expected during the projection period, Arctic exploration is not. In the High and Low Oil Price cases, which assume different levels of economic access granted to investors in the long term, Russia's total liquids production in 2035 ranges from 8.6 to 15.7 million barrels per day, respectively.

Mid-term growth in Kazakhstan's production depends predominantly on the resources of the Kashagan and Tengiz oil fields, as well as the ability of investors to transport production from those projects to the world market. Although known and potential resources are sufficient to support the growth of liquids production in Kazakhstan, they could be undermined by a lack of easy export routes. Currently, exports are limited to six routes: the CPC pipeline, Atyrau-Samara pipeline, and railway shipments can transport a total of 0.8 million barrels per day to Russia; another pipeline can move 0.2 million barrels per day to China, and two barge routes allow shipments of about 0.1 million barrels per day to Azerbaijan and Iran.

Kazakhstan's export potential is strongly affected by its geographical position. Attaining the production levels projected in the Reference case depends not only on resource availability and production but also on the construction of export routes—a task requiring regional cooperation that has not been easy to achieve in the past. A number of possible projects to expand Kazakhstan's capacity for liquids exports have been proposed over the past several years. The most likely expansions in the near term are capacity increases in the pipelines to Russia and China [***10***].

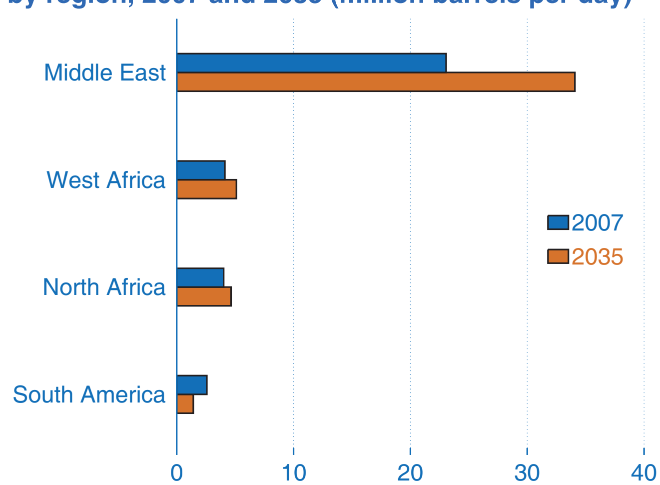
In addition to the problem of transportation capacity, Kazakhstan has previously reopened legal contracts with private foreign investors, forcing renegotiation of investment returns and making companies reluctant to increase their investment in the country's energy sector. Because of the varying degrees of resource access and investment terms, Kazakhstan's total liquids production in 2035 ranges from 2.2 million barrels per day in the High Oil Price case to 3.7 million barrels per day in the Low Oil Price case.

OPEC production

Total liquids production from OPEC nations increases from the 2007 level of 34.4 million barrels per day at an average annual rate of 1.0 percent, resulting in the production of 47.0 million barrels of liquids per day in 2035, of which 34.3 million barrels per day originates in the Middle East (Figure 34). OPEC decisions on investment in additional production capacity are the primary difference between the three price cases in *IEO2010*. The Low Oil Price case assumes that OPEC members will increase investment either through their own national oil companies or by allowing greater economic access to foreign investors, depending on the country. It also assumes that OPEC members will expand production capacity in an attempt to maximize government revenue through increased production. OPEC production in the Low Oil Price case increases by 27.1 million barrels per day from 2007 to 2035, to 61.5 million barrels per day or approximately 50 percent of total world liquids production in 2035.

In the High Oil Price case, OPEC member countries maintain record high prices by restricting production targets to a smaller share of world total liquids production each year. As a result, OPEC production accounts for less than 35 percent of the world total in 2035. Volumetric reductions are concentrated in the mid-term,

Figure 34. OPEC conventional liquids production by region, 2007 and 2035 (million barrels per day)



with liquids production falling by 2.4 million barrels per day from 2007 to 2015 and gaining 1.0 million barrels per day from 2015 to 2035.

Throughout the projection period, Saudi Arabia remains the largest liquids producer in OPEC, with total production increasing from 10.3 million barrels per day in 2007 to 15.1 million barrels per day in 2035, as prices stabilize at historically high levels and world consumption continues to grow. Thirty percent of the increase (1.4 million barrels per day) is expected to be NGPL production related to expansion of natural gas production. The total production increase equates to an average annual growth rate of 1.4 percent, based on the assumption that Saudi Arabia will continue with its current plan to maintain spare production capacity at levels between 1.5 and 2.0 million barrels per day.

Iraq increases its liquids production by 3.9 percent per year in the *IEO2010* Reference case, the largest annual average growth in total liquids production among all OPEC members. The projection assumes that political, legislative, logistical, investment, and security uncertainties in Iraq will be resolved in the long term, and that OPEC constraints and resource availability will be the factors with the strongest influence on Iraq's willingness and ability to increase production (see box on page 34).

In addition to political and legislative uncertainty, import and export infrastructure are also expected to limit production growth in Iraq to 0.5 million barrels per day from 2007 to 2015. If the country is able to achieve long-term political and economic stability and expand the capacity of import and export routes as projected in the Reference case, investment in production capacity could rise by an average of 5.2 percent annually from 2015 and 2030 before slowing to a more modest 3.8 percent per year from 2030 to 2035. The fact that Iraq has the resources necessary to support such growth in the long run, yet produced only 2.1 million barrels per day in 2007, illustrates the significant impacts that the political environment and other above-ground constraints can have on production projections.

Qatar has the second-highest average annual growth rate in total liquids production among OPEC nations from 2007 to 2035 in the Reference case, at 3.3 percent, with total volumes increasing from 1.2 million barrels per day in 2007 to 2.5 million barrels per day in 2035. About one-half of the increase consists of crude oil and lease condensate production; production of NGPLs contributes another 0.4 million barrels per day; and GTL projects add just over 0.2 million barrels per day. Despite the current negative outlook for many previously announced GTL projects around the world, the return and persistence of historically high oil prices in the Reference case supports the operation of Qatar's Pearl facility (0.1 million barrels per day capacity) and expansion of its Oryx facility (adding another 0.1 million barrels per day).

Total liquids production in Iran is expected to be restricted by political rather than resource-related factors. The political factors include the effectiveness of the national oil company's operations, the ability of the government and foreign investors to agree on contractual terms, and continuing financial sanctions. In the *IEO-2010* Reference case, Iran's oil production declines from 2007 through 2035 because of both financial and political constraints on the development of new oil and natural gas prospects. In addition, the projections anticipate that natural gas demand for domestic electric power and heat production will limit the amount of natural gas available for improving oil recovery through natural gas reinjection. Political factors and investment constraints affect Iran's liquids production so severely that production in 2035 varies by 2.7 million barrels per day across the *IEO2010* projections, from 2.6 million barrels per day in the High Oil Price case to 5.3 million barrels per day in the Low Oil Price case.

In the OPEC nations of Western Africa, total liquids production increases from 4.1 million barrels per day in 2007 to 5.1 million barrels per day in 2035 in the Reference case. Angola expands production to 2.5 million barrels per day in 2020—almost entirely by increasing crude oil and condensate production from offshore projects—before entering a slow but steady resource-driven decline in the long term. Nigeria's liquids production is likely to be hampered in the short term by conflict and infrastructure difficulties; in the long term, however, a higher level of known resources enables Nigeria's liquids production to grow at an average annual rate of 0.9 percent, from 2.4 million barrels per day in 2007 to a total of 3.0 million barrels per day in 2035.

Recent history suggests that Venezuela's national government reacts to high oil prices by tightening investment terms for foreign direct investment and limiting access to its reserves. As a result, in the Reference case, with prices rising in real terms through 2035, further mandated changes in contractual terms, along with threats of actions to recapture upside returns from potential investors, are likely to hinder Venezuela's production potential in the short term and discourage investment in and development of additional projects in the long term. The trend will be particularly evident in the mature conventional oil basins, with conventional production declining by 1.1 million barrels per day over the period from 2007 levels of 2.1 million barrels per day. However, development of several extra-heavy oil projects in the Orinoco belt offsets some of the decline in conventional liquids production.

Ecuador rejoined OPEC in October 2007, after having suspended its membership in 1999. Ecuador is a

New Iraqi oil production: How much; how fast?

Iraq holds a considerable portion of the world's conventional oil reserves, but has been unable to increase oil production substantially in recent years due to conflict and geopolitical constraints. As violence in Iraq has lessened, there has been a concerted effort to increase the country's oil production, both to bolster government revenues and to support wider economic development. Recently, Iraq offered prequalified foreign oil companies two opportunities to bid on designated fields under specific terms of investment. The success of the bidding rounds and the level of interest from foreign companies have raised hopes that oil production could increase substantially over a short period of time, with some Iraqi government officials stating that the country could increase its production to 12 million barrels per day by 2017.[a] Although Iraq has the reserves to support such growth, it will need to overcome numerous challenges in order to raise production to even a fraction of that goal.

Iraq has an estimated 115 billion barrels of proven conventional oil reserves, the third largest in the world after Saudi Arabia (260 billion barrels) and Iran (138 billion barrels).[b] However, Iraqi oil production was significantly affected not only by the U.S.-led invasion in 2003 and subsequent armed conflict, but also by neglect of the oil industry infrastructure and restrictions on investment resulting from United Nations sanctions imposed during the Saddam Hussein regime before the invasion. Oil production capacity has not increased substantially since the recent abatement of hostilities, and Iraq's current total production is about 2.5 million barrels per day—still below the peak annual average of 2.9 million barrels per day in 1989.

Between June 2009 and January 2010, Iraq awarded development service contracts for 10 oil projects to foreign companies, the majority of which were consortia formed to share the responsibility, risk, and, ultimately, returns on each of the projects. Originally, the Iraqi Ministry of Oil had expected the development of the fields up for bidding to raise Iraq's production capacity to 6 million barrels per day, in line with the Ministry's strategic goal.[c] However, heavy competition and high expectations for the fields led bidding companies to propose production levels that were significantly higher than expected. As a result, rather than raising the country's total production to 6 million barrels per day, the proposed production from all awarded fields suggests that Iraq's total production could increase to 12 million barrels per day in 2017 (see table below).

(continued on page 35)

Results of Iraq bidding rounds, 2010

Field	Consortium operator	Plateau production target (million barrels per day)	Remuneration fee (dollars per barrel)	Plateau production target duration (years)	Current production (million barrels per day)	Planned production increase (million barrels per day)
First bid round						
Rumaila	BP	2.85	2.00	7	1.00	1.85
West Qurna (Phase 1)	ExxonMobil	2.33	1.90	7	0.27	2.06
Zubair	Eni	1.20	2.00	7	0.21	1.00
Second bid round						
Majnoon	Royal Dutch Shell	1.80	1.39	10	0.06	1.75
Halfaya	CNPC (PetroChina)	0.54	1.40	13	0.00	0.53
Qaiyarah	Sonangol	0.12	5.00	9	0.00	0.12
West Qurna (Phase 2)	Lukoil	1.80	1.15	13	—	1.80
Garraf	Petronas	0.23	1.49	13	—	0.23
Badra	Gazprom	0.17	5.50	7	—	0.17
Najmah	Sonangol	0.11	6.00	9	—	0.11
Total					**1.54**	**9.61**

Source: IHS Global Insight, Energy Country Profiles, "Iraq: Oil & Gas Upstream" (last updated March 31, 2010), web site www.ihsglobalinsight.com (subscription site).

[a]IHS Global Insight, "Country Summary—Iraq" (updated April 30, 2010), web site www.ihsglobalinsight.com (subscription site).
[b]"Worldwide Look at Reserves and Production," *Oil & Gas Journal*, Vol. 107, No. 47 (December 21, 2009), pp. 20-21, web site www.ogj.com (subscription site).
[c]IHS Global Insight, "Country Summary Upstream—Iraq" (updated March 31, 2010), web site http://myinsight.ihsglobalinsight.com (subscription site).

New Iraqi oil production: How much; how fast? (continued)

EIA analysis suggests that, even in a stable political and security climate, it would be extremely difficult to raise production by nearly 10 million barrels per day over such a short period. The two recent historical examples of massive production capacity expansion are those of Russia, where production increased by 3.8 million barrels per day over a 10-year period, and Saudi Arabia, where production increased by 2.0 million barrels per day over a 5-year period. The proposed pace and scale of Iraq's planned production expansion defy historical precedents and ignore a long list of logistical and political impediments.

The *IEO2010* Reference case expects significant delays in current production plans because of limitations on Iraq's service sector; import difficulties; likely constraints on the number of operating rigs and skilled personnel available; and limitations on the export infrastructure, with current pipelines able to only support marginal increases in flows. There are also security threats from current and past conflicts, with pipelines still at risk of being attacked, field surfaces populated with unexploded ordinances, and land mines that must be cleared. Finally, there is legislative uncertainty, particularly related to the Kurdistan region. The prospects for long-term growth, however, are bright.

The uncertainty associated with the evolution of Iraq's upstream oil sector is reflected in the range of projections for liquids production in 2035. In the Reference case, the political and security situation in Iraq stabilizes, and a few of the operating companies overcome, in some measure, the obstacles they face. In this case, Iraq's total liquids production rises to 2.8 million barrels per day in 2017 and 6.1 million barrels per day in 2035. In the *IEO2010* Low Oil Price case, Iraq's total liquids production reaches 8.3 million barrels per day by 2035, reflecting greater success in addressing the considerable difficulties facing oil industry expansion. In the High Oil Price case, liquids production reaches only 4.2 million barrels per day in 2035, because companies to a great extent are unable to reduce the difficulties they face in their attempts to increase production.

relatively small oil producer in comparison with other OPEC members, producing 0.5 million barrels per day of oil in 2007. Liquids production in Ecuador declines through 2015 in the Reference case, as uncertainties associated with the country's Hydrocarbons Law make foreign companies reluctant to investment in Ecuador's oil sector [***11***]. After 2015, although investment in the country's oil sector continues to be hindered by high investment risk, development of its ITT heavy oil field in the Amazon helps to stabilize its production. Consequently, liquids production in Ecuador rebounds to just under 0.5 million barrels per day in 2025 and remains fairly flat through 2035.

Unconventional liquids production

Unconventional liquids play an increasingly important role in meeting demand for liquid fuels over the course of the *IEO2010* projections. In the Reference case, 11.6 percent of world liquids supply in 2035 comes from unconventional sources, including 1.7 million barrels per day from OPEC and 11.2 million from non-OPEC sources. Although the volume and composition of unconventional production vary between the *IEO2010* Low and High Oil Price cases (from 17.9 million barrels per day in the High Price case to 10.5 million barrels per day in the Low Price case), the geographic origin of each unconventional liquid type is relatively constant across the cases, usually being limited to countries where projects are underway or advertised.

OPEC unconventional production

OPEC's unconventional production consists predominantly of extra-heavy oil production in Venezuela (from the Orinoco belt) and GTL production in Qatar. In the Reference case, Venezuela's extra-heavy oil production rises from 0.6 million barrels per day in 2007 to 1.4 million barrels per day in 2035, and Qatar's GTL production increases from a negligible amount in 2007 to 0.2 million barrels per day in 2035. Although the resources to support production at those levels abound in the two countries, large investments will be required to bring them to market, and the timing of such investment is uncertain.

There are four major projects currently operating in Venezuela's Orinoco belt, but they have been suffering from poor maintenance and lack of investment. Venezuela's ability to increase its extra-heavy oil production will depend on the level of foreign investment and expertise it is able to attract for extraction and upgrading projects. In the Reference case, only two Orinoco belt projects are developed over the course of the projection period: the Junín 4 (operated by a consortium of Chinese companies) and Junín 6 (operated by a consortium Russian companies). The two projects add 0.4 million barrels per day of production capacity each.

In the Low Oil Price case, Venezuela improves contract terms and stabilizes its investment climate to attract more foreign investment in the development of Orinoco resources, including Junín 2 and the Carabobo area, which contribute 0.2 and 1.2 million barrels per day, respectively. In addition, several other development projects are undertaken in the long term. In contrast, in the High Oil Price case, Venezuela restricts access to its resources and thus discourages the development of even the Junín 4 and 6 projects. The collapse of bilateral development agreements means that investment in the extra-heavy oils of the Orinoco belt is limited to Venezuela's state oil company, Petróleos de Venezuela S.A. (PDVSA), resulting in a gradual decline in production to 0.4 million barrels per day in 2035, only one-third the amount projected in the Reference case.

Non-OPEC unconventional production

Outside OPEC, unconventional liquids production comes from a much more diverse group of countries and resource types. As a whole, non-OPEC unconventional liquids production increases by 8.4 million barrels per day from 2.8 million barrels per day in 2007 to 11.2 million barrels per day in 2035, with 69 percent coming from OECD countries. By volume, the countries making the largest contribution to the increase in non-OPEC unconventional liquids are Canada (an increase of 3.8 million barrels per day**),** the United States (1.8 million barrels per day), Brazil (1.3 million barrels per day), and China (0.8 million barrels per day).

In each of the three cases, Canada's bitumen (oil sands) production makes up more than 30 percent of total non-OPEC unconventional production, ranging from 3.2 million barrels per day in the Low Oil Price case to 6.9 million barrels per day in the High Oil Price case. Bitumen production in the High Oil Price case ramps up quickly in the short to mid-term then begins to slow in the long term, following closely the assumed world oil price path in High Price case. In the Low Oil Price case, production growth stagnates because the price is too low for new projects to be economical. Over time, reductions in the cost of technology lead to an overall increase in production.

Biofuels production in the Reference case increases from 1.2 million barrels per day in 2007 to 4.0 million barrels per day in 2035, or an average annual growth rate of 4.6 percent. The largest increase in biofuels production over the projection period comes from Brazil, where production grows by 1.3 million barrels per day from 2007 to 2035. Strong growth in biofuels consumption is projected for the United States, where production of biofuels increases by 1.1 million barrels per day, from 0.5 million barrels per day in 2007 to 1.6 million barrels per day in 2035. The growth in U.S. biofuels production is supported by the Energy Independence and Security Act of 2007, which mandates increased use of biofuels.

Government policies are the main drivers of biofuels production. Biofuels are used as a means to reduce greenhouse gas emissions, promote energy security, and support local economic development. To achieve those goals, many countries set mandates for the amount of biofuels to be used and give tax credits to biofuel producers. The United States, for example, mandates 36 billion gallons of biofuels by 2022 under the Energy Independence and Security Act of 2007. The European Union mandates that biofuels must make up 10 percent of the liquid fuels market by 2020, according to the European Union Biofuels Directive [***12***]. Canadian producers receive payments or operating grants based on output, and the Chinese government has a flexible subsidy scheme with payments based on plant profitability [***13***]. The Canadian and Chinese tax credits are designed to expire over time as the cost of production falls and oil prices rise.

Despite the wide range of biofuels incentive programs, some recent studies suggest that biofuels may not be as effective in reducing greenhouse gas emissions as previously thought. As a result, many countries have relaxed or postponed renewal of their mandates. For example, Germany reduced its biofuels quota for 2009 from 6.25 percent to 5.25 percent [***14***]. The global economic recession has also dampened investment in biofuels development. In light of those developments, world biofuels production in 2030 is 40 percent lower in the *IEO2010* Reference case than was projected in the *IEO2009* Reference case.

As in the Reference case, biofuels become more competitive with conventional oil products in both the High and Low Oil Price cases; however, the level of competitiveness depends on the oil price assumption. In the Low Price case, only the cheapest and most cost-effective feedstocks and production technologies are competitive with gasoline and diesel fuels. In the High Price case more feedstocks and production processes are competitive. Total biofuel production in 2035 is 2.9 million barrels in the Low Oil Price case and 6.0 million barrels in the High Oil Price case. The growth of biofuel production slows in all cases from 2007 to 2015, as the current generation of crops reach their economic potential, then accelerates after 2016 with the advent of new technologies that use cellulosic feedstocks.

China is the primary coal-to-liquids producer in all the *IEO2010* cases, with 2035 production levels ranging from 0.2 million barrels per day (or 56 percent of the world total) in the Low Oil Price case to 2.0 million barrels per day (60 percent of the world total) in the High Oil Price case. Other major producers are the United States and South Africa, which produce about 0.2 and 0.3 million barrels per day, respectively, in the Reference case, 0.9 and 0.3 million barrels per day in the High Oil Price case, and less than 0.1 million barrels per day each in the Low Oil Price case.

The unconventional liquid product that consistently contributes the least to total unconventional production in each of the *IEO2010* cases is GTL. In the Reference and Low Oil Price cases, GTL production is limited primarily to Qatar, although South Africa and Nigeria also produce small volumes. In the High Oil Price case, the United States rapidly becomes the world's largest GTL producer, accounting for 0.5 million barrels per day of the world's total of 0.8 million barrels per day in 2035. (For a discussion of GTL prospects in the United States, see EIA's *Annual Energy Outlook 2010*, pages 39-40.)

World oil reserves

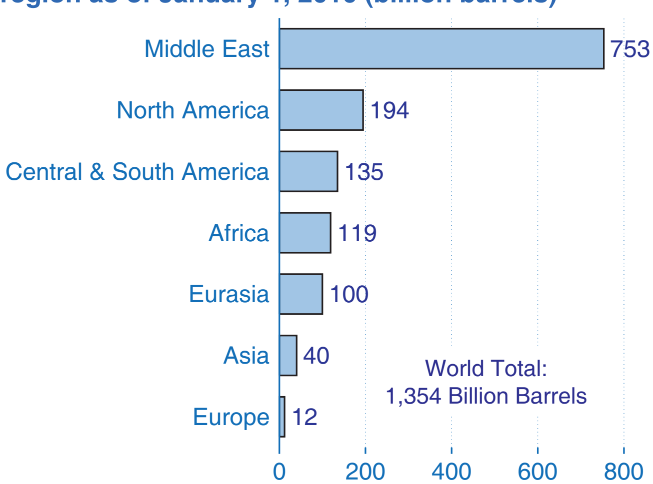
As of January 1, 2010, proved world oil reserves, as reported by the *Oil & Gas Journal*, were estimated at 1,354 billion barrels—12 billion barrels (about 1 percent) higher than the estimate for 2009 [*15*]. According to the *Oil & Gas Journal*, 56 percent of the world's proved oil reserves are located in the Middle East (Figure 35). Just under 80 percent of the world's proved reserves are concentrated in eight countries, of which only Canada (with oil sands included) and Russia are not OPEC members (Table 5).

Proved reserves of crude oil are the estimated quantities that geological and engineering data indicate 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. In December 2008, the SEC released revisions to its reserves reporting requirements in an attempt to provide investors with a more complete picture of the reserves held by reporting companies by recognizing the technologies and reserve quantification methods that have evolved over time. Country-level estimates of proved reserves from the *Oil and Gas Journal* are developed from the data reported to the SEC, from foreign government reports, and from international geologic assessments. The 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 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 become recoverable in the future as technologies advance.

Readers may notice that, in some cases in the *IEO2010* projections, country-level volumes for cumulative production through 2035 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 considers resource availability in all long-term country-level projections, the aggregation of

Figure 35. World proved oil reserves by geographic region as of January 1, 2010 (billion barrels)



Source: *Oil & Gas Journal*.

Table 5. World oil reserves by country as of January 1, 2010 (billion barrels)

Country	Oil reserves	Percent of world total
Saudi Arabia	259.9	19.20
Canada	175.2	12.94
Iran	137.6	10.16
Iraq	115.0	8.50
Kuwait	101.5	7.50
Venezuela	99.4	7.34
United Arab Emirates	97.8	7.22
Russia	60.0	4.43
Libya	44.3	3.27
Nigeria	37.2	2.75
Kazakhstan	30.0	2.22
Qatar	25.4	1.88
China	20.4	1.51
United States	19.2	1.42
Brazil	12.8	0.95
Algeria	12.2	0.90
Mexico	10.4	0.77
Angola	9.5	0.70
Azerbaijan	7.0	0.52
Norway	6.7	0.49
Rest of World	72.2	5.33
World Total	**1,353.7**	**100.00**

Source: *Oil & Gas Journal*.

which gives the total world production projection. However, proved reserves are not an appropriate measure for judging total resource availability in the long run. For example, despite continued production, global reserves have not declined historically due to exploration, discovery, and reserve replacement.

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 22.5 billion barrels of proved reserves in 1998, proved reserves of 19.1 billion barrels were reported in 2009—a decrease of only 3.4 billion barrels despite the cumulative 24.2 billion barrels of liquids supplied from U.S. reserves between 1998 and 2009.

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, 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, initially-in-place volumes, and technologically limited recovery factors. By basing long-term production assessments on resources rather than reserves, EIA is able to present projections that are physically achievable and can be supported beyond the 2035 projection horizon in *IEO-2010*. The realization of such production levels depends 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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Chapter 3
Natural Gas

In the IEO2010 Reference case, natural gas consumption in non-OECD countries grows about three times as fast as in OECD countries. Non-OECD production increases account for 89 percent of the growth in world production from 2007 to 2035.

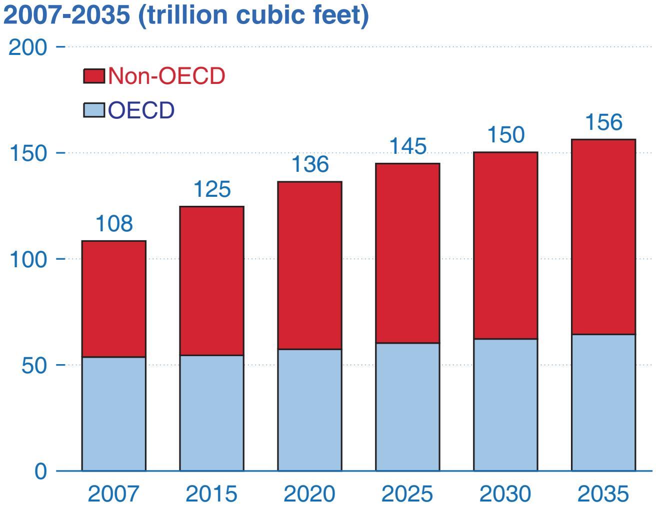
Overview

Total natural gas consumption worldwide increases 44 percent in the *IEO2010* Reference case, from 108 trillion cubic feet in 2007 to 156 trillion cubic feet in 2035 (Figure 36). Demand for natural gas slowed in 2008 as the global economic recession began to affect world energy markets, and in 2009 world consumption of natural gas contracted by an estimated 1.1 percent. The impact of the recession on natural gas use was especially evident in the industrial sector—the end-use sector with the highest level of natural gas consumption—where demand for natural gas declined by an estimated 6 percent from 2008 to 2009.

As world economies begin to recover from the economic downturn, global demand for natural gas rebounds. Nonetheless, natural gas supplies from a variety of sources help keep markets well supplied and prices relatively low. In the Reference case, natural gas consumption expands by an average of 1.8 percent per year from 2007 to 2020. From 2020 to 2035, the growth in consumption of natural gas slows to an average of 0.9 percent per year, as prices rise and increasingly expensive natural gas resources are brought to market.

Natural gas remains a key energy source for industrial uses and for electricity generation throughout the projection. The industrial sector accounted for approximately 40 percent of total world natural gas use in 2007,

Figure 36. World natural gas consumption, 2007-2035 (trillion cubic feet)



and it maintains that share through 2035. Because natural gas produces less carbon dioxide when it is burned than does either coal or petroleum, governments implementing national or regional policies to reduce greenhouse gas emissions may encourage its use to displace other fossil fuels. In the electric power sector, for example, natural gas is often an attractive choice for new generating plants because of its relative fuel efficiency, low emissions, quick construction timelines, and low capital costs. Electricity generation in the Reference case becomes an increasingly important part of the world's natural gas consumption, accounting for 36 percent of the world total in 2035, up from 33 percent in 2007.

Natural gas consumption in non-OECD countries grows approximately three times as fast as consumption in OECD countries in the Reference case, with increases averaging 1.9 percent per year for non-OECD countries and 0.6 percent per year for OECD countries from 2007 to 2035. As a result, non-OECD countries account for 78 percent of the total world increment in natural gas consumption over the projection period, and the non-OECD share of total world natural gas consumption increases from 50 percent in 2007 to 59 percent in 2035.

The major projected increase in natural gas production is expected to occur in non-OECD regions, with the largest increments coming from the Middle East (an increase of 16 trillion cubic feet between 2007 and 2035), Africa (7 trillion cubic feet), and Russia and the other countries of non-OECD Europe and Eurasia (6 trillion cubic feet) (Figure 37). Over the projection period, Iran and Qatar alone increase their natural gas production by a combined 12 trillion cubic feet, nearly one-fourth of the total increment in world gas production. A significant share of the increase is expected to come from a single offshore field, which is called North Field on the Qatari side and South Pars on the Iranian side.

Although the extent of the world's tight gas, shale gas, and coalbed methane resource base has not yet been assessed fully, the *IEO2010* Reference case projects a substantial increase in those supplies—especially in the United States, but also in Canada and China. In the United States, one of the keys to increasing natural gas production has been advances in horizontal drilling and hydraulic fracturing technologies, which have made it possible to develop the country's vast shale gas resources, and have helped to increase total U.S. natural gas resources by almost 50 percent over the past decade. Shale gas accounts for 26 percent of U.S. natural gas production in 2035. Tight gas, shale gas, and coalbed methane resources are even more important for the future of domestic natural gas supplies in Canada and China, where they account for 63 percent and 56 percent of total domestic production, respectively, in 2035 in the Reference case.

Liquefied natural gas (LNG) accounts for a growing share of world natural gas trade in the Reference case. World natural gas liquefaction capacity increases 2.4-fold, from about 8 trillion cubic feet in 2007 to 19 trillion cubic feet in 2035. Most of the increase in liquefaction capacity is in the Middle East and Australia, where a multitude of new liquefaction projects are expected to be developed, many of which will become operational within the next decade. Utilization of liquefaction capacity is expected to remain high during the entire projection period. Given the capital-intensive nature of liquefaction projects, long-term contracts requiring the purchase of high volumes (or high "takes") are often used to ensure high utilization rates and acceptable returns on investments.

Despite the growing importance of LNG, long-distance pipelines remain an important component of world gas trade. As indigenous natural gas production in OECD Europe declines, its import demand increases, driving much of the global growth in pipeline traded gas. The other major factor in the growth of piped gas is rising natural gas demand in Asia, particularly China.

World natural gas consumption

OECD natural gas consumption

Natural gas consumption in North America increases by 0.7 percent per year in the *IEO2010* Reference case, from 28.3 trillion cubic feet in 2007 to 34.6 trillion cubic feet in 2035, accounting for 59 percent of the total increase for OECD countries and 13 percent of the total increase for the world over the projection period. U.S. consumption increases by 0.3 percent per year on average (Figure 38), considerably less than the annual increases in Canada (1.4 percent) and Mexico (3.0 percent). Mexico accounts for almost 50 percent of the growth in North America's natural gas consumption, the United States about 30 percent, and Canada about 20 percent.

In the United States, natural gas use declines initially (from 2007 through 2015) as a result of slow growth in electricity demand, completion of coal-fired plants currently under construction, and additions of new renewable capacity. U.S. natural gas consumption falls to 21.7 trillion cubic feet in 2015 before the decline reverses, then returns to 2007 levels shortly before 2025. Most of the growth is provided by demand increases of 0.6 trillion cubic feet for electricity generation and 0.7 trillion cubic feet for use in commercial buildings.

In Mexico, the strong growth in natural gas consumption is concentrated almost exclusively in the electricity generation and industrial sectors, where consumption grows by 2.0 and 1.1 trillion cubic feet, respectively, from 2007 to 2035. In Canada, 59 percent of the growth in natural gas demand is for industrial uses (including significant amounts of natural gas used for the mining of Canada's vast oil sands deposits) and 24 percent is for electricity generation.

Natural gas consumption in OECD Europe grows by 0.5 percent per year on average, from 19.2 trillion cubic feet in 2007 to 21.9 trillion cubic feet in 2035 (Figure 39), primarily as a result of increasing demand in the electric power sector. Natural gas accounts for about one-fourth of the region's total energy consumption over the projection period, with the coal and liquids shares declining

Figure 37. Change in world natural gas production by region, 2007-2035 (trillion cubic feet)

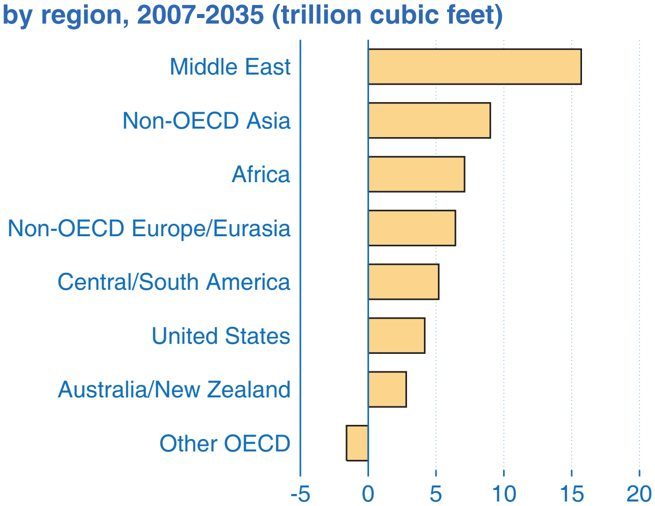
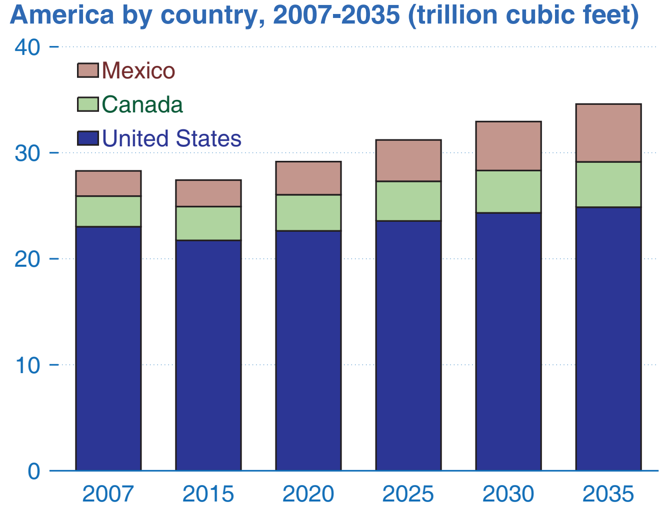


Figure 38. Natural gas consumption in North America by country, 2007-2035 (trillion cubic feet)



from their earlier levels. Many governments in OECD Europe have made commitments to reduce greenhouse gas emissions and promote development of "clean energy." Because natural gas is less carbon-intensive than either coal or petroleum, it is a more environmentally attractive option and thus is likely to remain an important fuel for Europe's electric power sector development in the long term.

Natural gas consumption in OECD Asia grows on average by 0.8 percent per year from 2007 to 2035, with Japan, South Korea, and Australia/New Zealand each adding less than 1 trillion cubic feet of natural gas consumption over the period (Figure 40). Total natural gas consumption for the region as a whole increases from 6.3 trillion cubic feet in 2007 to 8.0 trillion cubic feet in 2035.

Japan's natural gas consumption grows modestly, by an average of 0.2 percent per year, from 3.7 trillion cubic feet in 2007 to 4.0 trillion cubic feet by 2035. A declining population and aging labor force limit the country's natural gas demand in the long term. Moreover, new nuclear generation capacity projected for Japan limits the need for additional natural-gas-fired generation after 2015.

South Korea's demand for natural gas grows by 1.4 percent per year from 2007 to 2035, led by strong growth in the electric power sector. The share of the country's natural gas consumption used for electricity generation increases from 39 percent in 2007 to 48 percent in 2035. As deregulation in the electric power sector moves forward, South Korea's electricity producers will be able to contract directly with global LNG suppliers, stimulating further growth in natural gas demand for the electric power sector. In the buildings sector, where natural gas consumption has grown robustly over the past two decades with the development of South Korea's national natural gas transmission grid, consumption growth slows somewhat. Still, natural gas use in the buildings sector increases by approximately 126 billion cubic feet from 2007 to 2035, making up about one-fifth of the country's total increase in natural gas use of 596 billion cubic feet in the *IEO2010* Reference case.

In Australia/New Zealand, the industrial sector is the predominant consumer of natural gas, accounting for about 60 percent of the region's total natural gas consumption in 2007. This remains the case throughout the projection. Natural gas use in the electric power sector grows modestly, from 0.3 trillion cubic feet in 2007 to 0.6 trillion cubic feet in 2035, as Australia—in its efforts to reduce carbon dioxide emissions—gradually increases the share of natural gas in its power generation mix to diversify away from its more carbon-intensive coal-fired generation.

Non-OECD natural gas consumption

The countries of non-OECD Europe and Eurasia rely on natural gas for more than 50 percent of their primary energy needs—a larger share than for any other country grouping in the *IEO2010* Reference case. Russia is the world's second-largest consumer of natural gas after the United States, with demand totaling 16.7 trillion cubic feet in 2007 and representing 55 percent of Russia's total energy consumption. In the Reference case, Russia's natural gas consumption grow at a modest average rate of 0.2 percent per year from 2007 to 2035. As the country makes progress in liberalizing domestic natural gas prices to approach parity with international market values, increasing fuel costs for natural-gas-fired plants are likely to make them less competitive with other baseload generation. Furthermore, expected efficiency improvements and other demand-side management measures

Figure 39. Natural gas consumption in OECD Europe by end-use sector, 2007-2035 (trillion cubic feet)

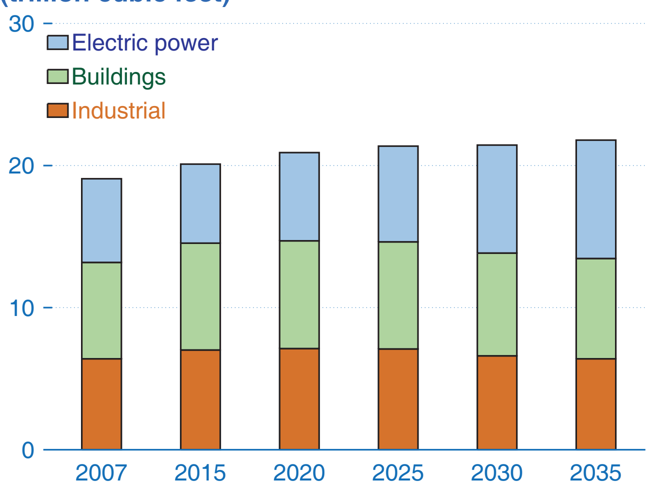
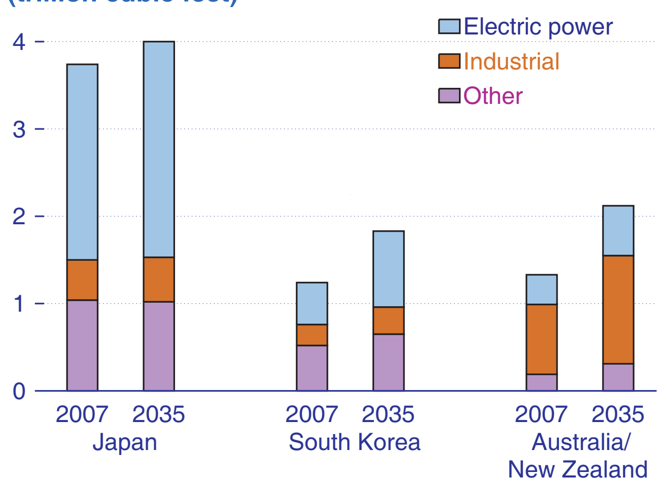


Figure 40. Natural gas consumption in OECD Asia by country and end-use sector, 2007 and 2035 (trillion cubic feet)



will limit growth in natural gas demand over the long term.

In the countries of non-OECD Europe and Eurasia other than Russia, natural gas consumption grows by 0.6 percent annually over the projection period, from 9.1 trillion cubic feet in 2007 to 10.9 trillion cubic feet in 2035 (Figure 41). Natural gas is the largest component of the countries' primary energy consumption, representing more than 45 percent of the total throughout the projection period. The industrial sector remains the region's largest consumer of natural gas, with a share of approximately 40 percent of total gas consumption throughout the projection period. In the long term, rising prices for both domestically produced and imported natural gas are likely to moderate the region's growth in natural gas demand.

Among all regions of the world, the fastest growth in natural gas consumption is projected for non-OECD Asia, which accounts for 35 percent of the total increment in natural gas use in the Reference case and nearly doubles its share of total world natural gas consumption from about 10 percent in 2007 to 18 percent in 2035. Natural gas use in non-OECD Asia increases by an average of 3.5 percent annually over the projection period, from 10.5 trillion cubic feet in 2007 to 27.5 trillion cubic feet in 2035 (Figure 42).

India and China lead the growth in natural gas demand in non-OECD Asia. In both India and China, natural gas currently is a minor part of the overall energy mix, accounting for only 7 percent and 3 percent, respectively, of total energy consumption in 2007. Those shares nearly double in the projection, however, to 12 percent in India and 6 percent in China, adding a combined 10.2 trillion cubic feet of natural gas consumption between 2007 and 2035. In the rest of the countries of non-OECD Asia, natural gas consumption increases by a total of 6.7 trillion cubic feet from 2007 to 2035.

China's central government is promoting natural gas as a preferred energy source. It has set an ambitious target of increasing the share of natural gas in its overall energy mix to 10 percent by 2020 [*1*]. In the *IEO2010* Reference case, China's natural gas consumption grows at an average rate of 5.0 percent annually over the forecast period—the highest growth rate worldwide—to a total of 9.7 trillion cubic feet in 2035. Nevertheless, China does not achieve its targeted natural gas share, as coal continues to fulfill the country's largest share of energy demand. Natural gas provides 5 percent of China's energy supply in 2020 in the Reference case.

In the other countries of non-OECD Asia, natural gas already is a large component of the energy mix, representing 23 percent of their combined total energy consumption in 2007. In the Reference case, their natural gas consumption doubles from 6.6 trillion cubic feet in 2007 to 13.3 trillion cubic feet in 2035. Several countries in the region are building LNG receiving terminals and will join the league of LNG importers in the next few years. Indonesia, in response to strong growth in domestic demand, has established policies to prioritize domestic consumption of natural gas over exports [**2**].

In the Middle East and Africa, natural gas consumption has grown substantially in recent years, stimulated by increased economic activity, large investments in new infrastructure, and domestic price subsidies. Despite significant growth in natural gas production over the past decade, several countries in the Middle East have experienced domestic supply shortfalls resulting from rapidly growing demand in the electric power and industrial sectors. As a result, some of those countries have established policies assigning priority to domestic natural gas use over exportation. Also in development are various approaches to phasing out price subsidies in order to align domestic natural gas prices with export prices.

Figure 41. Natural gas consumption in Non-OECD Europe and Eurasia, 2007-2035 (trillion cubic feet)

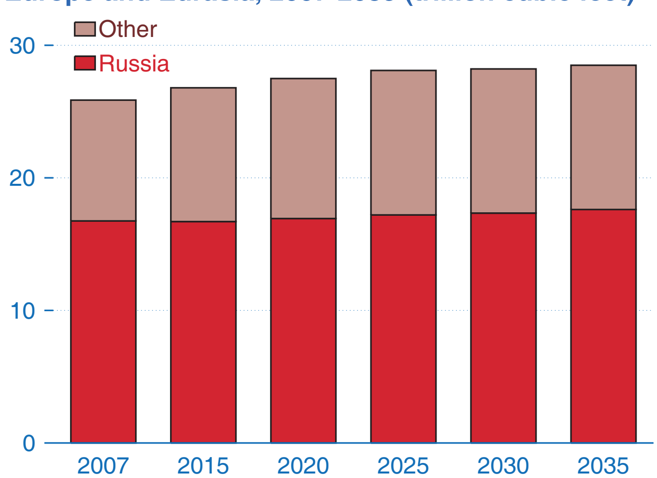
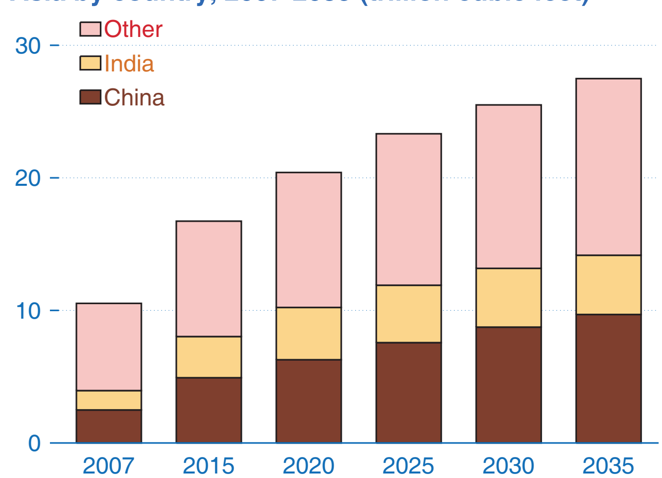


Figure 42. Natural gas consumption in Non-OECD Asia by country, 2007-2035 (trillion cubic feet)



In the Middle East, natural gas consumption nearly doubles between 2007 and 2035, growing at an average annual rate of 2.4 percent over the forecast period. The region's industrial and electric power sectors remain the most important natural gas consumers, with shares of approximately 50 percent and 40 percent of total use, respectively, in 2035. Growth in industrial consumption is driven by the petrochemical industry, primarily in Saudi Arabia, Iran, Qatar, and UAE. Natural gas use in the region's electric power sector nearly doubles from 2007 to 2035 with an overall increase of 3.9 trillion cubic feet. Several countries in the region have opted to import natural gas in the form of LNG. Kuwait started importing LNG in 2009, and Dubai plans to begin in 2010.

In Africa, the electric power sector drives the increase in natural gas demand over the projection period, as Africa's total natural gas consumption increases from 3.1 trillion cubic feet in 2007 to 6.8 trillion cubic feet in 2035. In West Africa, Nigeria is taking measures to end natural gas flaring and to prioritize domestic natural gas use over exportation in order to support growing consumption in the electric power sector. Similarly, in Egypt, the government announced a moratorium on new export contracts until 2010. In order to continue development of its natural gas reserves, however, Egypt will need to maintain investment from international oil and gas companies developing those reserves. Toward that end, domestic natural gas prices will have to be competitive with international prices.

In Central and South America, natural gas use increases at a rate that is second only to the rate of increase in nuclear energy use. However, nuclear electricity generation is growing from a very small base and remains a minor part of the region's total energy consumption. Natural gas demand increases on average by 2.3 percent per year, from 4.6 trillion cubic feet in 2007 to 8.6 trillion cubic feet in 2035.

Although parts of Central and South America have well-developed natural gas pipeline infrastructure, supply disruptions and political disagreements in recent years have raised concerns about security of supply and have prompted several countries to look to imported LNG as a long-term supply solution. Brazil is developing its own domestic resources and also imports large quantities of natural gas from Bolivia via pipeline. It has not been able to meet its burgeoning demand, however, and in 2008 it inaugurated an LNG import terminal [*3*]. Argentina also commenced LNG imports in 2008 [*4*]. Chile, faced with disruptions of natural gas supply from Argentina as a result of Argentina's own natural gas supply shortages, commissioned its first LNG receiving terminal in July 2009 and has another terminal under construction [*5*]. Also, a proposed new regasification terminal in Uruguay could be operational as early as 2012 [*6*].

World natural gas production

In order to meet the demand growth projected in the *IEO2010* Reference case, the world's natural gas producers will need to increase supplies by almost 50 trillion cubic feet between 2007 and 2035. Much of the increase in supply is expected to come from non-OECD countries, which in the Reference case account for 89 percent of the total increase in world natural gas production from 2007 to 2035. Non-OECD natural gas production grows by an average of 1.8 percent per year in the Reference case, from 67 trillion cubic feet in 2007 to 111 trillion cubic feet in 2035 (Table 6), while OECD production grows by only 0.4 percent per year, from 40 trillion cubic feet to 45 trillion cubic feet.

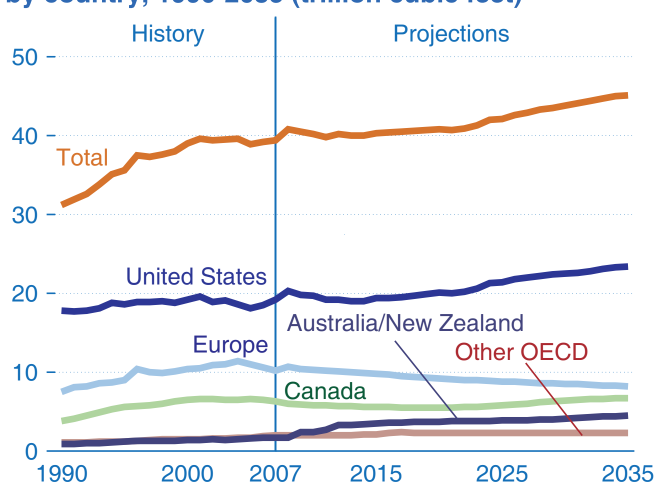
OECD natural gas production

Natural gas production in OECD nations increases by 5.3 trillion cubic feet from 2007 to 2035 in the Reference case (Figure 43). The largest increases are in the United States (4.2 trillion cubic feet) and Australia/ New Zealand (2.8 trillion cubic feet). The production increases projected for the two regions are offset in part by production declines in OECD Europe, where smaller increases in tight gas, shale gas, and coalbed methane production are insufficient to offset declines in conventional natural gas production.

North America's natural gas production grows by 18 percent over the projection period. The United States, which is by far the largest producer in North America, accounts for more than 85 percent of the total production growth, with an increase from 19.2 trillion cubic feet in 2007 to 23.4 trillion cubic feet in 2035.

One of the keys to U.S. production growth is advancement in production technologies, such as horizontal drilling and hydraulic fracturing. Advances made to date have allowed for the exploitation of vast shale gas

Figure 43. OECD natural gas production by country, 1990-2035 (trillion cubic feet)



resources, which are found in most U.S. production regions but concentrated mainly in the eastern and Gulf Coast States. Rising estimates of shale gas resources have been the primary factor in increasing U.S. technically recoverable natural gas resources by almost 50 percent over the past decade.

U.S. production from shale gas formations is expected to increase more than fivefold between 2007 and 2035, more than offsetting a decline in conventional natural gas production. Increases in Alaskan production and offshore production in the lower 48 States also contribute to the growth. Favorable economic conditions are expected to support the completion of an Alaska pipeline, which in the Reference case begins transporting natural gas to the lower 48 States in 2023. In 2035, shale gas accounts for 26 percent of total U.S. natural gas production, lower 48 offshore production accounts for 19 percent, and Alaska and coalbed methane resources account for 8 percent each. The remaining 39 percent comes from other associated and nonassociated lower 48 onshore resources.

Canada's natural gas production declines from 6.3 trillion cubic feet in 2007 to 5.5 trillion cubic feet in 2020 in the Reference case, followed by production increases as the exploitation of shale gas, tight gas, and coalbed methane resources reverses the decline in overall production. Canada's natural gas production totals 6.7 trillion cubic feet in 2035. Mexico's natural gas production remains fairly flat, growing only from 1.8 trillion cubic feet in 2007 to 2.1 trillion cubic feet in 2035. The country faces substantial difficulties in attracting the investment and technology improvements needed to increase production.

In OECD Europe, production from tight gas, shale gas, and coalbed methane resources is not expected to arrest the ongoing decline in total production as it has in the United States in recent years (Figure 44). Those resources are estimated to be smaller in Europe than in North America, and their development faces substantial hurdles in terms of cost, infrastructure, regulation, and public acceptance. In the Reference case, natural gas production in OECD Europe declines at an average annual rate of 0.9 percent over the projection period, from 10.2 trillion cubic feet in 2007 to 8.0 trillion cubic feet in 2035.

Both Japan and South Korea have limited natural gas resources and, consequently, very limited current and

Table 6. World natural gas production by region and country in the Reference case, 2007-2035 (trillion cubic feet)

Region/country	History 2007	History 2008	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD North America								
United States[a]	19.2	20.3	19.4	20.1	21.4	22.5	23.4	0.7
Canada	6.3	6.0	5.6	5.5	5.8	6.4	6.7	0.2
Europe	10.2	10.7	9.6	9.0	8.6	8.3	8.0	-0.9
Australia/New Zealand	1.7	1.7	3.5	3.7	3.9	4.1	4.5	3.5
Other OECD	2.0	2.0	2.1	2.3	2.2	2.2	2.2	0.3
Total OECD	**39.5**	**40.8**	**40.2**	**40.5**	**41.9**	**43.5**	**44.8**	**0.4**
Non-OECD								
Russia	23.1	23.4	23.0	24.3	25.3	26.5	27.3	0.6
Europe and Central Asia	7.3	7.8	9.2	9.5	9.6	9.5	9.5	0.9
Iran	4.0	4.1	6.4	8.0	8.7	9.0	8.7	2.9
Qatar	2.2	2.7	6.4	7.4	8.2	9.2	9.5	5.3
Other Middle East	6.4	6.7	8.1	9.2	9.7	9.6	10.2	1.7
North Africa	5.3	5.4	8.2	9.0	9.7	9.9	9.8	2.2
Other Africa	1.6	1.7	3.1	3.7	4.0	4.2	4.2	3.6
China	2.4	2.7	2.9	3.0	3.4	4.5	5.6	3.0
Other Asia	9.6	9.9	12.9	14.2	14.9	15.3	15.4	1.7
Central and South America	5.2	5.3	6.6	8.7	9.4	10.0	10.5	2.5
Total Non-OECD	**67.0**	**69.7**	**86.8**	**97.0**	**103.0**	**107.7**	**110.6**	**1.8**
Total World	**106.6**	**110.5**	**126.9**	**137.5**	**144.8**	**151.1**	**155.4**	**1.4**
Discrepancy[b]	1.9	0.7	-2.3	-1.1	0.1	-0.9	0.9	

[a]Includes supplemental production, less any forecast discrepancy.

[b]Balancing item. Differences between global production and consumption totals result from independent rounding and differences in conversion factors derived from heat contents of natural gas that is produced and consumed regionally.

future production. Both countries receive the vast majority of their natural gas supplies in the form of imported LNG. In 2007, natural gas production in Japan and South Korea accounted for only 5 percent and 1 percent of their natural gas consumption, respectively. Although the presence of substantial deposits of methane hydrates in both Japan and South Korea has been confirmed, and both countries are investigating how those resources could be safely and economically developed, the *IEO2010* Reference case does not include methane hydrate resources in its estimates of natural gas resources, and the development of hydrates on a commercial scale is not anticipated during the projection period.

Natural gas production in the Australia/New Zealand region grows from 1.7 trillion cubic feet in 2007 to 4.5 trillion cubic feet in 2035 in the Reference case, at an average rate of 3.5 percent per year—the strongest growth in natural gas production among OECD regions. In 2007, the Northwest Shelf area of Australia's Carnarvon Basin accounted for around 56 percent of total production in the Australia/New Zealand region [*7*], with much of the production used as feedstock at the Northwest Shelf LNG liquefaction facility. Other areas and basins in Australia provided another 35 percent of the region's total production in 2007. New Zealand's natural gas production accounted for around 9 percent of the 2007 regional total.

Coalbed methane, from the Bowen-Surat Basin in eastern Australia, accounted for between 5 percent and 7 percent of total production in Australia in 2007 [*8*], and its share is certain to grow in the future. The Cooper Basin has also been a source of natural gas supply since 1969, but its production is in decline. Coalbed methane production from the Bowen-Surat Basin is expected to offset declines from the Cooper Basin in the future, providing natural gas supplies to satisfy the area's demand growth and to feed proposed LNG export projects.

Non-OECD natural gas production

Middle East production

Four major natural gas producers in the Middle East—Qatar, Iran, Saudi Arabia, and the United Arab Emirates—together accounted for 84 percent of the natural gas produced in the Middle East in 2007. With more than 40 percent of the world's proved natural gas reserves, the Middle East accounts for the largest increase in regional natural gas production from 2007 to 2035 (Figure 45) and for nearly one-third of the total increment in world natural gas production in the Reference case.

In the *IEO2010* Reference case, the strongest growth among Middle East producers from 2007 to 2035 comes from Qatar, where natural gas production increases by 7.2 trillion cubic feet, followed by Iran (4.8 trillion cubic feet of new production) and Saudi Arabia (2.2 trillion cubic feet). Although Iraq is the region's fastest-growing supplier of natural gas, at 11.6 percent per year over the projection, it is a relatively minor contributor to regional gas supplies. In 2035, Iraq's natural gas production totals only 1.1 trillion cubic feet, or about 4 percent of the Middle East total.

Iran has the world's second-largest reserves of natural gas, after Russia, and currently is the Middle East's largest natural gas producer. Iran is also the Middle East's largest user of reinjected natural gas for enhanced oil recovery operations. In 2007, Iran reinjected more than 1 trillion cubic feet of natural gas, or 16 percent of its gross production. In 2009, Iran began enhanced oil recovery operations at the Agha-Jari oil field, where it plans to raise oil production by 60,000 barrels per day by injecting 1.3 trillion cubic feet of natural gas annually, more than doubling the 2007 reinjected volumes [*9*]. In 2020, Iran is estimated to need between 3.7 trillion and 7.3 trillion cubic feet of natural gas per year for

Figure 44. OECD Europe natural gas production, 1990-2035 (trillion cubic feet)

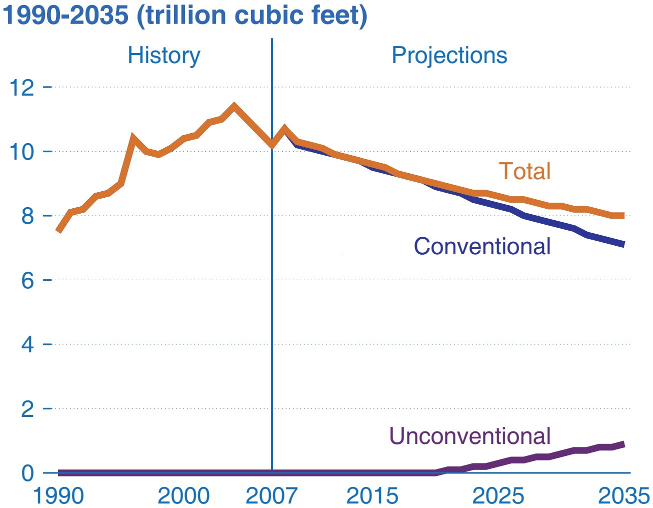
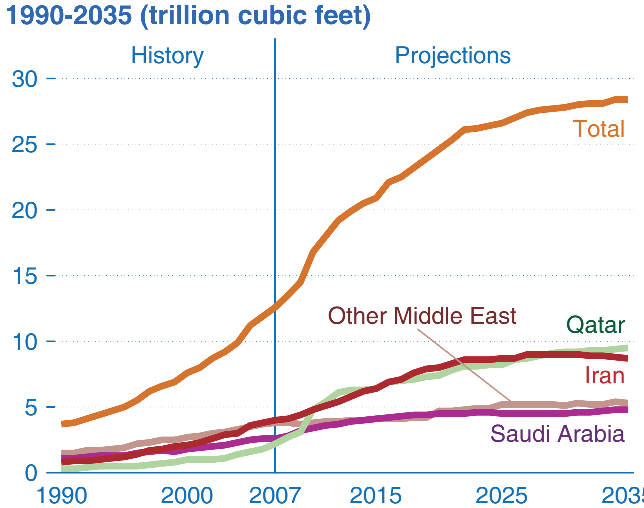


Figure 45. Middle East natural gas production, 1990-2035 (trillion cubic feet)



reinjection [*10*]. The higher estimate is close to the projected total for Iran's marketed natural gas production in 2020. The actual figure for reinjection use, whatever it turns out to be, will have a significant impact on Iran's future marketed natural gas production.

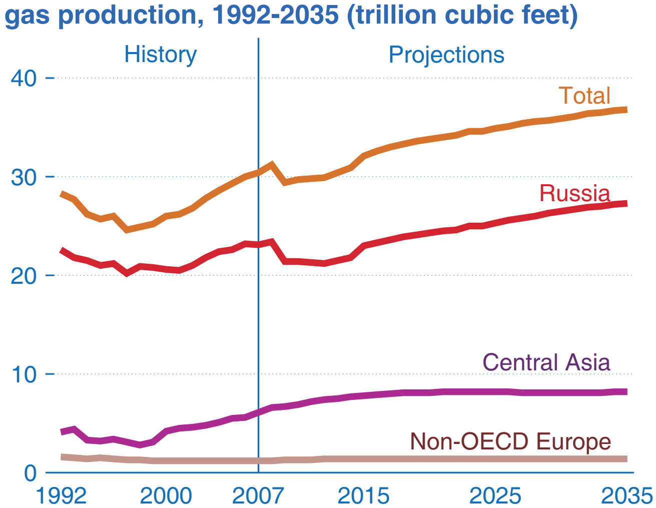
Natural gas production in Saudi Arabia grows at an average annual rate of 2.2 percent, from 2.6 trillion cubic feet in 2007 to 4.8 trillion cubic feet in 2035. The Saudi national oil company, Saudi Aramco, has made several natural gas finds in the Persian Gulf that are not associated with oil fields. Three fields, the Karan, Arabiyah and Hasbah, are expected to begin producing in the next 5 years, adding at least 1.3 trillion cubic feet of production when fully operational. Both Arabiyah and Hasbah are offshore, and both are also sour natural gas fields, making them relatively expensive to produce, with an estimated cost of $3.50 to $5.50 per million Btu [*11*]. The *IEO2010* Reference case assumes that Saudi Arabia's policy of reserving natural gas production for domestic use persists throughout the projection period, and that no natural gas is exported. Thus, in the long term, production is more dependent on domestic demand growth and domestic prices than on resource availability.

Non-OECD Europe and Eurasia production

After the Middle East, the world's second-largest regional increase in natural gas production is expected in non-OECD Europe and Eurasia, which includes Russia, Central Asia, and non-OECD Europe. In the Reference case, natural gas production in the region as a whole increases from 30.4 trillion cubic feet in 2007 to 36.8 trillion cubic feet in 2035 (Figure 46). Russia remains the dominant natural gas producer, accounting for more than 70 percent of the region's production throughout the projection.

In 2007, Russia produced 23.1 trillion cubic feet of natural gas. Preliminary EIA data for 2008 show a 1.4-percent increase in natural gas production over 2007, to 23.4 trillion cubic feet. Early estimates for 2009, however, indicate a decline of 12.4 percent (2 to 3 trillion cubic feet) in Russia's natural gas production from the 2008 total [*12*]. The production decline was due not to a lack of resources or production capacity, but rather to the global economic downturn and the resultant decline in natural gas demand in Russia and in its gas export markets, especially those in Europe. Russia's exports to Europe were down by 24.5 percent in 2009, and its total natural gas exports were down by almost 9 percent, offset in part by new LNG exports from Sakhalin II to Asian markets [*13*]. In the *IEO2010* Reference case, Russia's natural gas production largely recovers by 2015. Nevertheless, the long-term outlook remains less optimistic than it was in *IEO2009*, mainly as a result of lower projections for natural gas demand in Russia and Europe in *IEO2010*.

Figure 46. Non-OECD Europe and Eurasia natural gas production, 1992-2035 (trillion cubic feet)



The recent natural gas supply-demand balances in Europe and North America, and their implications for the future, are affecting investment and future production plans in Russia. Official development plans for the giant Shtokman field in Russia's Arctic offshore had called for first pipeline natural gas and LNG to begin to flow in 2014. In early 2010, however, those plans were revised, pushing the official target date for first pipeline flows back to 2016 and for first LNG flows back to 2017 [*14*]. It had been widely believed that the pipeline flows from the Shtokman field would be used to fill the second pipe of the Nord Stream export pipeline to Germany and beyond. With Russian pipeline exports to Europe down so severely in 2009, however, many doubt the need for the additional export capacity that the second pipeline would provide. Furthermore, North America had been the intended market for LNG exports from the Shtokman field, but recent declines in expectations of future U.S. demand for natural gas imports have led many to conclude that North America will be relatively self-sufficient in natural gas production for some time to come and will not need large volumes of imported LNG.

Despite the uncertain future of natural gas import demand in Europe and North America, Russia must still invest in new fields if it is to realize its goal of increasing exports to Asia. Moreover, it will require such investments simply to maintain total natural gas production levels, because production at its three largest fields (Yamburg, Urengoy, and Medvezh'ye) is in decline [*15*]. Accordingly, investment is proceeding at the Bovanenkovo field on Russia's northern Yamal Peninsula and at the Chayandinskoye field in eastern Siberia, among other projects. The Bovanenkovo field is currently scheduled to start production in the third quarter of 2012, ramping up production from an initial 0.3 trillion cubic feet per year to an eventual level of almost 5 trillion cubic feet per year [*16*]. Output from the Bovanenkovo field is aimed mainly at Western markets, while production from the smaller and more easterly

Chayandinskoye field is aimed at Asian markets. Production from Chayandinskoye could eventually reach a peak of slightly more than 1 trillion cubic feet per year. Initial production is currently planned for 2016, but the actual start date is dependent on the agreements and infrastructure that must be in place before the natural gas can be exported to Asia [*17*].

Natural gas production in Central Asia (which includes the former Soviet Republics) grows by 1.0 percent per year on average, from 6.1 trillion cubic feet in 2007 to 8.2 trillion cubic feet in 2035. Much of the growth is expected to come from Turkmenistan, which already is a major producer accounting for 40 percent of the region's total production in 2007. Turkmenistan is just beginning to develop its recently assessed giant Yolotan field. It will be developed in several phases, with each of the initial four phases adding around 0.4 trillion cubic feet of annual natural gas production and the first production expected in 2010 or 2011 [*18*]. Initial natural gas production from the Yolotan field will probably be exported by pipeline to China, with further expansion of Turkmen and Central Asian production dependent on securing markets and transit routes to reach those markets. Also contributing to Central Asia's projected production growth is Azerbaijan, which has been planning to bring on line the second phase of natural gas production at its Shah Deniz field. Upon reaching peak production, Shah Deniz will add around 0.7 trillion cubic feet to the country's annual production.

Africa production

Substantial growth in natural gas production is also projected for Africa, where production increases from 6.8 trillion cubic feet in 2007 to 12.7 trillion cubic feet in 2020 and 14.0 trillion cubic feet in 2035 (Figure 47). In 2007, 77 percent of Africa's natural gas was produced in North Africa, mainly in Algeria, Egypt, and Libya. West Africa accounted for another 20 percent of the 2007 total, and the rest of Africa accounted for 3 percent. Remaining resources are more promising in West Africa than in North Africa, which has been producing large volumes of natural gas over a much longer period. Indeed, faster production growth is projected for West Africa, with an average annual rate of 4.0 percent, versus 2.2 percent for North Africa.

Nigeria is the predominant natural gas producer in West Africa, although recent production increases in the region have also come from Equatorial Guinea, which brought an LNG liquefaction facility on line in 2007. Angola also is expected to add to West Africa's production in the near term, with its first LNG liquefaction facility, currently under construction, expected to come on line in 2012 [*19*]. Still, because security concerns and uncertainty over terms of access in Nigeria limit production growth in West Africa, North Africa remains the continent's leading region for natural gas production over the course of the projection.

Non-OECD Asia production

Non-OECD Asia's natural gas production increases by 8.9 trillion cubic feet from 2007 to 2035 in the Reference case, with China accounting for 35 percent of the growth and India 24 percent (Figure 48). Another 30 percent of the growth is attributed to the Asian LNG-exporting countries, including traditional exporters Indonesia, Malaysia, and Brunei, as well as Papua New Guinea, which appears poised to become a significant LNG exporter within the next 5 to 10 years.

From 2007 to 2035, China has the largest projected increase in natural gas production in non-OECD Asia, from 2.4 trillion cubic feet in 2007 to 5.6 trillion cubic feet in 2035, for an average annual increase of 3.0 percent (Figure 49). Increases in natural gas supplies that are easily accessible account for most of the total production growth between 2007 and 2020. After 2020, continued

Figure 47. Africa natural gas production, 1990-2035 (trillion cubic feet)

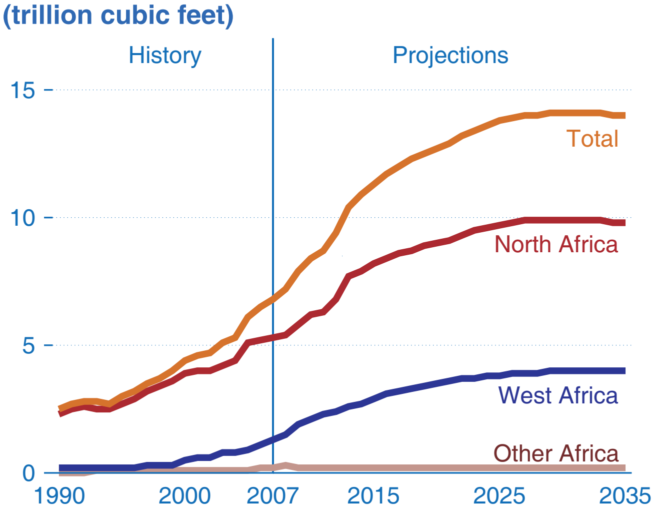
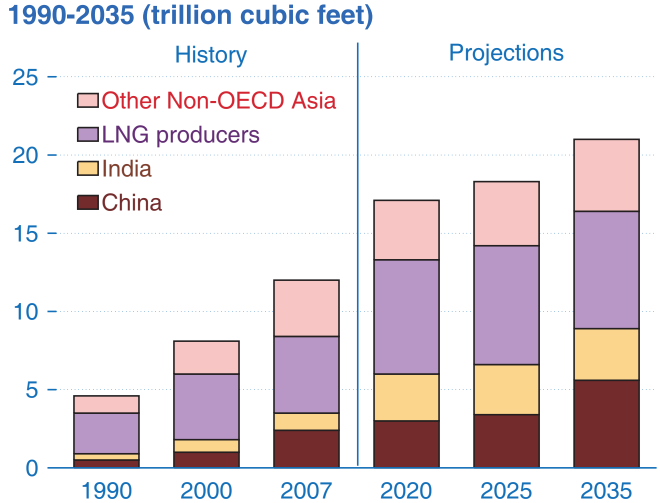


Figure 48. Non-OECD Asia natural gas production, 1990-2035 (trillion cubic feet)



growth in natural gas production in China comes from more expensive tight gas, shale gas, and coalbed methane resources, which in 2035 provide more than three times as much production as the same three resource types in OECD Europe.

The outlook for unconventional natural gas production is more positive in China than in OECD Europe first and foremost because China's geology suggests a greater unconventional resource potential than in Europe. Further, although natural gas production from conventional resources in China, as in Europe, cannot keep up with domestic demand, China's government strongly supports unconventional gas development, and public resistance is likely to be less of an impediment in China than in OECD Europe. The outlook for unconventional natural gas production is also more positive in China than in the rest of the non-OECD countries, because China is unique among non-OECD nations in having both significant unconventional gas potential and insufficient conventional natural gas resources to satisfy growing demand through 2035.

Natural gas production in India grows at an average annual rate of 4.0 percent over the projection period, the fastest growth in non-OECD Asia. Most of the growth in India's natural gas production is expected in the near term, averaging 11.7 percent per year as total production grows from 1.1 trillion cubic feet in 2007 to 2.7 trillion cubic feet in 2015. The increase is due mainly to a single development. Production from the Dhirubhai-6 block in the Krishna Godavari Basin (KG-D6 block) began in April 2009 and reached an annual production rate of around 0.8 trillion cubic feet by mid-January 2010 [*20*]. Natural gas production from the KG-D6 block is ready to flow at its plateau rate of just over 1 trillion cubic feet per year as soon as the government-designated customers are ready to receive it. From 2015 to 2035, India's natural gas production grows much more slowly, by an average of 1.0 percent per year, as production from older fields declines.

Natural gas production in the LNG-exporting countries of non-OECD Asia grows at an average annual rate of only 1.6 percent. Indonesia, Malaysia, and Brunei currently export LNG, and Papua New Guinea is on the verge of becoming another regional LNG exporter in the near term. In 2007, Malaysia and Indonesia together accounted for more than 90 percent of total production from the four countries. In the future, however, significant production growth is expected for Papua New Guinea, where several proposed LNG export projects, if built according to plan, will require more than 0.7 trillion cubic feet per year of new natural gas production [*21*]. Both Malaysia and Indonesia, on the other hand, face declining production from many older fields and must make substantial investments to maintain current production levels. In the short term, Indonesia's natural gas production rises somewhat as the new Tangguh LNG export project, which came on line in the second half of 2009, ramps up to full production in 2010 [*22*].

Central and South America production

Natural gas production in Central and South America doubles between 2007 and 2035 (Figure 50). The fastest growth is projected for Brazil, averaging 7.4 percent per year. The majority of Brazil's current natural gas production comes from fields located offshore of the Rio de Janeiro and Espírito Santo states in the Campos and Espírito Santo basins, respectively. In addition, numerous recent discoveries of oil and natural gas in the subsalt Santos basin to the southwest of the Campos basin are expected to increase the country's natural gas production potential. The Merluza and Lagosta fields, a pair of smaller natural gas and condensate fields in the Santos basin, currently are producing and sending natural gas and liquids to shore via a pipeline that is more than 100 miles long [*23*]. By 2015, another pipeline,

Figure 49. China natural gas production, 1990-2035 (trillion cubic feet)

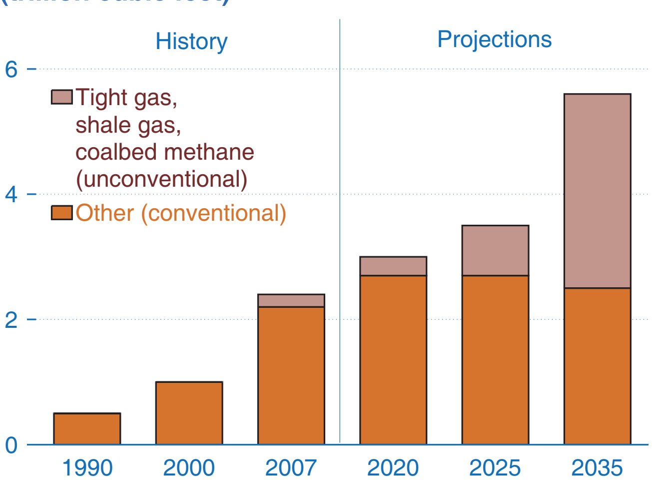
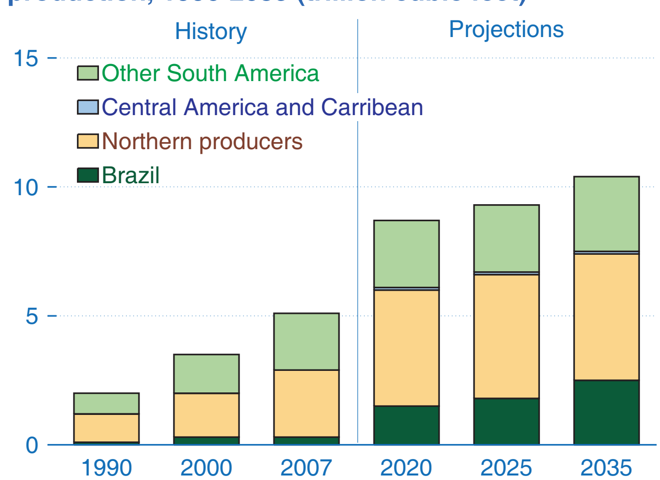


Figure 50. Central and South America natural gas production, 1990-2035 (trillion cubic feet)



stretching almost 100 miles, is planned to connect the Mexilhão field, a large non-associated natural gas field, to shore.

Other large Brazilian fields in the Santos Basin lie even farther from shore, and because of a lack of current infrastructure to bridge the distances, much of the initial natural gas production associated with oil extraction at the fields is likely to be reinjected. The Tambaú gas field and the Uruguá and Tupi oil fields have significant natural gas resources, and in the longer term there are plans to connect the three fields to shore with two separate pipelines, each stretching more than 100 miles and connecting to shore via the Mexilhão pipeline [***24***].

Another proposed option is to produce and liquefy Brazil's natural gas at sea, on floating platforms, from which the LNG could then be loaded onto ships for transport to existing LNG regasification terminals on the country's coast. Although several international oil companies currently are pursuing floating LNG liquefaction facilities, no such facilities have yet been developed or deployed. Petrobras, the owner and operator of most of Brazil's fields, has experience in the operation of floating production, storage, and offloading facilities for oil, which could help it in deploying a floating LNG plant. However, Petrobras does not possess LNG liquefaction technology of its own and would have to partner with another company for the project.

World natural gas trade

World natural gas trade grows in the *IEO2010* Reference case as OECD demand for non-OECD supplies continues to increase. Net natural gas imports by OECD countries increase at an average annual rate of 1.2 percent from 2007 to 2035. Most of the growth in OECD imports occurs in Europe, where net import demand increases from 9.0 trillion cubic feet in 2007 to 14.1 trillion cubic feet in 2035, to make up for falling domestic production. In North America, net import demand increases from 0.9 trillion cubic feet in 2007 to 2.6 trillion cubic feet in 2035, mostly because of Mexico's increasing need for imports to meet growing domestic demand.

Demand and import growth in Japan and South Korea, on the other hand, is relatively flat. Paired with strong growth in natural gas exports from Australia, this implies that as a region, OECD Asia's net demand for imports declines over the projection period, from 4.4 trillion cubic feet in 2007 to 3.4 trillion cubic feet in 2035. The declines in net import demand in OECD Asia, however, are overshadowed by increases in demand in the other OECD regions.

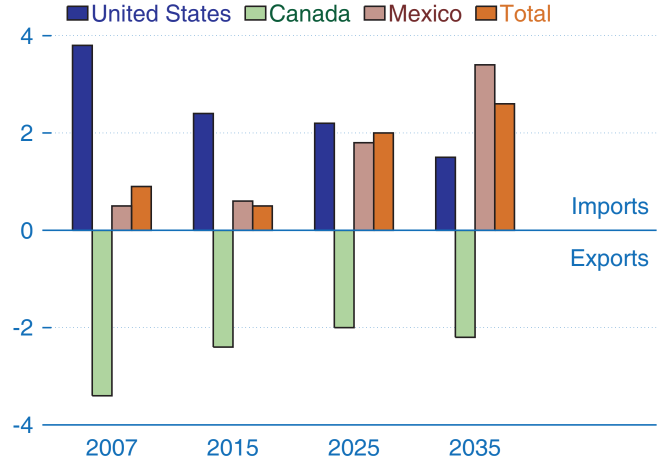
Net exports of natural gas from non-OECD countries grow from 12.3 trillion cubic feet in 2007 to 18.9 trillion cubic feet in 2035. Most of the growth occurs in the near term, as new LNG export projects in the Middle East and Africa and new natural gas pipelines from Africa to Europe come on line. Non-OECD Asia, with regional net exports of 1.5 trillion cubic feet of natural gas in 2007, becomes a net importer of natural gas by 2015, as China's imports grow rapidly with the completion of multiple LNG and pipeline import facilities.

OECD natural gas trade

North America's net imports of natural gas increase significantly in the Reference case, growing at an average annual rate of 3.9 percent from 2007 to 2035. The growth is attributable primarily to Mexico's growing dependence on imports, as its domestic production fails to keep pace with consumption growth. With Mexico's net imports growing from 0.5 trillion cubic feet in 2007 to 3.4 trillion cubic feet in 2035 (Figure 51), more than two-thirds of the increase is met by LNG, and the remainder is met by pipeline imports from the United States. There are two LNG facilities currently operational in Mexico, at Altamira on the east coast and in Baja California on the west coast. Another west coast terminal is under construction at Manzanillo, and several additional terminals are at various stages of the planning process and are expected to come on line by the end of the decade.

The rapid growth of shale gas production expected in the United States lessens the need for U.S. imports, and the *IEO2010* Reference case projects that net natural gas imports will decrease from 16 percent of total supply in 2007 to 6 percent in 2035. Several new LNG import facilities coming on line provide a significant increase in U.S. LNG import capacity. Competition for supplies in the world market, however, limits the amount of LNG that reaches U.S. markets, and U.S. LNG imports in 2035 are expected to be within 100 billion cubic feet of those received in 2007. Although U.S. LNG imports increase in the early years of the projections as additional

Figure 51. OECD North America net natural gas trade, 2007-2035 (trillion cubic feet)



liquefaction capacity comes on line, they peak at 1.5 trillion cubic feet in 2020, then decline through 2035 as the world market absorbs the additional supplies.

The continuing decline in Canada's pipeline exports is tempered by increases in production of tight gas, shale gas, and coalbed methane, along with LNG imports that allow Canada to continue exporting pipeline gas to the United States. Currently, Canada has one LNG import facility in operation at St. Johns, New Brunswick, and at least five others that are either approved or in the planning stages. LNG could play a significant role in Canada's natural gas markets by the end of the projection period, depending on the rate at which natural gas supplies can increase. The expected growth in LNG imports, particularly for Mexico and Canada, means that North America as a whole moves from a relatively self-contained natural gas market to one that is a growing participant in, and increasingly influenced by, the global natural gas market.

Natural gas trade involving OECD Europe has recently experienced some major shifts. In 2009, natural gas demand was down approximately 8 percent from 2008. At the same time, imports of LNG were up 27 percent [*25*], and imports of Russian pipeline gas were down almost 25 percent [*26*]. Continental Europe's long-term natural gas contracts have some flexibility in terms of volumes, but the prices generally are linked to lagged prices for oil products. Thus, despite the drop in demand following the global economic recession, most natural gas prices remained high, with the extremely high oil prices from 2008 continuing to figure into contract natural gas prices until the second half of 2009.

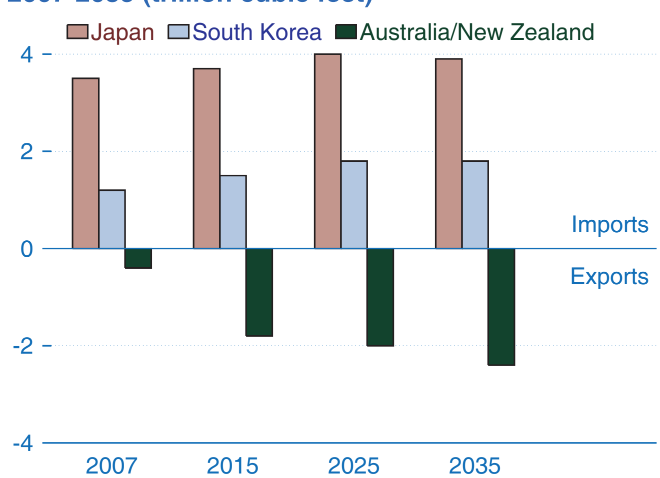
The recession and long-expected increases in global supplies of LNG combined to push European spot prices for natural gas well below those of long-term oil-linked prices, spurring those consumers who could access LNG on the spot market to increase their LNG purchases. In Europe in 2009, oil-linked prices were, at times, twice as high as LNG spot prices [*27*]. Volume flexibility in long-term contracts was inadequate to deal with the drop in demand and the increased LNG supplies. As a result, European consumers accepted less natural gas than contractual minimums and may have failed to take as much as $2.8 billion worth of natural gas under take-or-pay contracts [*28*].

Contributing to abundant European supplies in 2009 were additional LNG imports from Qatar, which brought three new liquefaction trains online, and new regasification facilities in the United Kingdom and Italy. Continued growth is expected for natural gas imports, as global LNG supplies continue to expand rapidly over the next few years and as the Medgaz pipeline from Algeria begins exporting gas to Spain in 2010 [*29*]. Furthermore, the Nord Stream pipeline from Russia and the Galsi pipeline from Algeria could push additional natural gas supplies into OECD Europe as soon as 2012 and 2014, respectively, according to planned start dates. In the *IEO2010* Reference case, net natural gas imports to OECD Europe grow on average by 1.6 percent per year from 2007 to 2035.

In OECD Asia, Japan and South Korea continue to be almost entirely dependent on LNG imports for natural gas supplies (Figure 52). The two countries continue to be major players in LNG markets (with Japan representing 41 percent of global LNG imports in 2007 and South Korea 14 percent) despite consuming relatively small amounts of natural gas on a global scale (representing 3 and 1 percent, respectively, of world consumption in 2007).

Japanese and South Korean companies are also influential in LNG markets as foundation customers[15] for greenfield Pacific liquefaction projects. For example, Japanese and South Korean companies have signed firm contracts for significant shares of the output from Russia's Sakhalin liquefaction project, which came on line in 2009, as well as from Australia's Pluto project, which is near completion, and Australia's Gorgon LNG project, which is just starting construction in 2010 [*30*]. In addition, Japanese and South Korean companies have signed either firm contracts or preliminary agreements with several projects that have not yet made final investment decisions, including the Wheatstone and Fisherman's Landing projects in Australia; an ExxonMobil-led project in Papua New Guinea; and the Kitimat project in Canada. Japanese and South Korean companies have

Figure 52. OECD Asia net natural gas trade, 2007-2035 (trillion cubic feet)



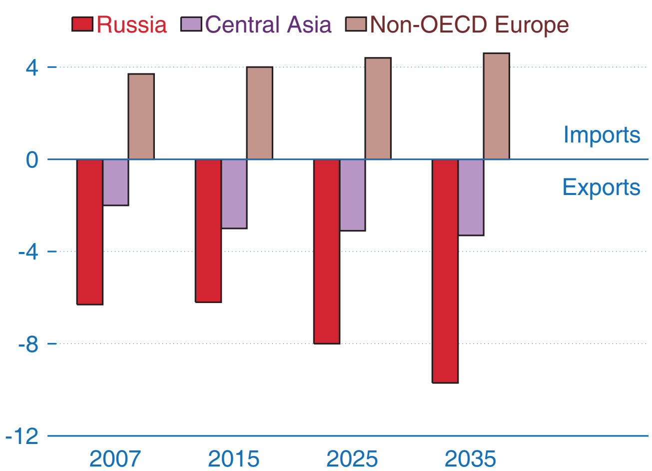
[15] A "foundation customer" is a company with a good credit rating that has signed an agreement to buy a certain amount of natural gas from a new LNG project at a certain price. By signing contracts with foundation customers, a company trying to develop a new LNG project is able to show that the project is financially viable and thus is able to obtain financing more readily and move forward with the project.

also taken small equity stakes in several of the projects, and Japan's Inpex is leading the Ichthys project in Australia, with a final investment decision expected in early 2011 [*31*].

In 2007, Australia exported 0.7 trillion cubic feet of natural gas from its two operating LNG liquefaction facilities—North West Shelf LNG, which draws gas from the Carnarvon Basin off Australia's northwest coast, and Darwin LNG, which draws gas from the Bonaparte Basin north of the Carnarvon Basin. Australia is one of the most active areas for future LNG development. Its exports of natural gas more than double by 2015, to 1.8 trillion cubic feet, in the Reference case and continue to grow throughout the projection period. Australia has two new liquefaction projects under construction in 2010, Pluto and Gorgon, both drawing gas from fields in the Carnarvon Basin. There are also at least four separate liquefaction projects in eastern Australia that aim to reach final investment decisions in 2010. All are planning to use coalbed methane from the Bowen-Surat Basin as supply, and most are planning to produce first gas around 2014 or 2015 [*32*].

Two additional liquefaction projects based off Australia's northwest coast aim for final investment decisions in 2010 or 2011. The Wheatstone project would be the fourth independent liquefaction project to draw gas from the Carnarvon Basin, and Ichthys LNG would be the first project to draw gas from the Browse Basin, which lies between the Carnarvon and Bonaparte Basins [*33*]. Several of the Australian LNG projects have plans to expand, and at least seven other separate liquefaction projects have been proposed and plan to make final investment decisions at some point after 2011. Not all of the proposed projects and expansions are assumed to go forward in the *IEO2010* Reference case, because some of them appear to be competing for the same reserves to supply their facilities.

Figure 53. Non-OECD Europe and Eurasia net natural gas trade, 2007-2035 (trillion cubic feet)



Non-OECD natural gas trade

Russia's net exports of natural gas grow from 6.3 trillion cubic feet in 2007 to 9.7 trillion cubic feet in 2035 in the reference case (Figure 53). Despite the recent dramatic declines in demand for Russian natural gas in Europe, construction of the first pipe of the new Nord Stream pipeline is moving forward. Construction on the Russian onshore sections began in 2009, and construction on the offshore portions of the first line is set to begin in April 2010, with first natural gas exports planned for the end of 2011. When complete, the first line will carry 1.0 trillion cubic feet of natural gas per year from Russia, across the Baltic Sea to Germany, bypassing eastern European transit states with which Russia has had pricing and payment disputes in the past. Russia has several other proposed export pipeline projects, including plans for a second parallel pipe on the Nord Stream pipeline by the end of 2012 and for the South Stream pipeline, which would carry natural gas across the Black Sea, bypassing Ukraine on its way to European markets [*34*].

A pipeline explosion in April 2009 forced Turkmenistan to discontinue all natural gas exports to Russia [*35*]. With demand in Russia and Europe down, Russia did not need the contracted volumes, and flows were not resumed at any point in 2009 while Russia tried to negotiate better contract prices and lower contract volumes. As a result, natural gas exports from Turkmenistan to Russia totaled only about 0.4 trillion cubic feet in 2009, just one-quarter of the approximately 1.6 trillion cubic feet traded in 2008 [*36*]. Historically, Russia has accounted for more than 85 percent of Turkmenistan's total natural gas exports. Turkmenistan was estimated to have been losing $1 billion per month during the halt in Russian imports [*37*]. The remaining 12 to 13 percent of Turkmen natural gas exports in 2007 and 2008 was delivered to Iran [*38*].

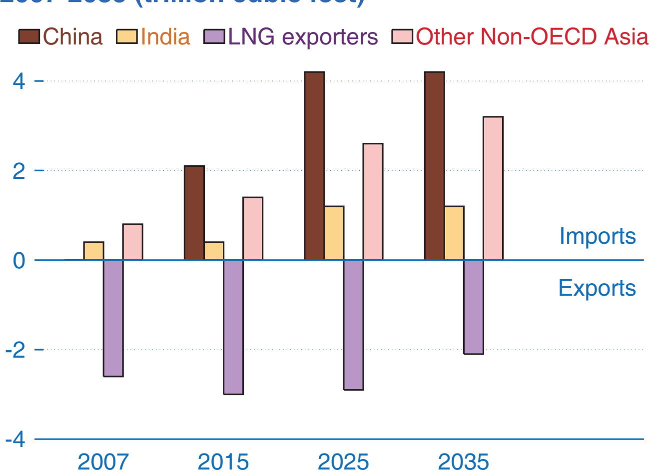
Turkmenistan has been pursuing alternative export markets and routes, with developments moving quickly since the cut-off of Russian imports in April 2009. In July 2009, Turkmenistan and Iran agreed to increase Iranian contractual natural gas volumes from 0.3 trillion cubic feet to 0.5 trillion cubic feet and to build a new cross-border pipeline. It may take some time to reach full contractual volumes, however, as actual flows have never reached the previous contractual levels since exports began in 1997 [*39*]. An existing pipeline runs from the Korpedzhe field in Turkmenistan to the town of Kurt Kui in northeastern Iran. The first phase of the new pipeline, completed in December 2009, can carry 0.2 trillion cubic feet per year from Turkmenistan's sizable Dauletabad field to a natural gas processing plant just inside Iran's northern border. In the second phase, with construction scheduled to begin in 2010 and completion expected 1 to 2 years later, the pipeline will be extended to reach more of the Iranian market.

In late 2009, Turkmenistan completed the first line of a two-line pipeline to China, which runs from the Bagtyyarlyk, Saman-Depe, and Altyn Asyr natural gas fields in Turkmenistan through Uzbekistan and Kazakhstan, before connecting with China's second West-East pipeline in Xinjiang province [*40*]. The first line has a capacity of 0.7 trillion cubic feet per year, but initial flows are likely to be much lower, because the West-East pipeline that will link it to more of China's demand centers will not be complete until 2012. By that time, the second line of the Central Asia-China pipeline should be complete, bringing total cross-border capacity to 1.4 trillion cubic feet per year [*41*]. Additional export volumes are expected to come from Turkmenistan's giant South Yolotan-Osman field and could also come from fields in Kazakhstan.

In 2005, China had no imports of natural gas and none of the infrastructure necessary to accommodate imports (Figure 54). In 2007, China's net imports amounted to just 1.8 percent of its total natural gas consumption, with 85 percent of those imports coming from a single country, Australia. At the time, China had just one operating import facility, China National Offshore Oil Corporation's LNG regasification terminal in Guangdong province, and just one long-term import contract with Australia. In the *IEO2010* Reference case, China meets 43 percent of its consumption in 2035 with imported natural gas. To meet its future import demands, China is actively pursuing multiple potential sources for natural gas imports.

At the end of 2009, China had three LNG import terminals in operation, two under construction, and several more proposed or in various stages of development. At that time, China was importing natural gas under long-term contract from four different countries—Australia, Indonesia, Malaysia, and Qatar—with no single country signed up to provide more than 37 percent of the total contracted volume. Chinese companies have signed contracts to increase imports from Australia, Qatar, and Malaysia, but Australia is likely to remain China's main LNG supplier because of its geographic proximity and its large and growing list of upcoming LNG export projects. Chinese companies have also signed agreements to bring in LNG from Iran and Papua New Guinea. Although there has been little progress on Iran's LNG projects, those in Papua New Guinea are progressing quickly and could be delivering natural gas by 2015.

Figure 54. Non-OECD Asia net natural gas trade, 2007-2035 (trillion cubic feet)



At the same time that China is pursuing multiple sources for LNG imports, it is pursuing multiple sources for pipeline natural gas imports. As noted above, the first line of China's first natural gas import pipeline, completed in late 2009, will transport supplies from Turkmenistan and Kazakhstan. Another new pipeline from Myanmar, scheduled for completion in 2013, will carry 0.4 trillion cubic feet of natural gas per year from Myanmar's offshore fields in the Bay of Bengal to Kunming in China's Yunnan province [*42*].

China and Russia continue to discuss future natural gas pipeline connections between the two countries. They signed an agreement in 2006 stating that natural gas deliveries should begin by 2011, and then in 2009 they signed another agreement stating that deliveries should begin by 2014 or 2015. Both agreements envision two separate pipelines: an eastern line and a western line. No agreement has been reached with regard to prices and volumes, and the lack of agreement on prices has been the main impediment to the project's progress. The 2006 agreement suggested volumes of 1.1 to 1.4 trillion cubic feet per year of natural gas. In the 2009 agreement, however, the volumes under discussion grew to 2.5 to 2.8 trillion cubic feet per year [*43*].

In 2007, India imported 0.4 trillion cubic feet of natural gas through its two operating LNG regasification terminals, accounting for about 24 percent of the natural gas consumed in India that year. In the *IEO2010* Reference case, India's imports as a share of its total natural gas consumption fall to 14 percent in 2015, as new production from the Krishna Godavari Basin comes on line. In the long term, however, demand growth outpaces production growth: consumption grows by 1.8 percent per year from 2015 to 2035, while domestic production grows by 1.0 percent per year. Accordingly, India is expected to continue expanding its LNG import infrastructure.

Although India has discussed pipeline projects with Iran, Central Asia, and Myanmar in the past, there are significant barriers to those plans, including politics, geography, and costs. Two LNG regasification terminals were operating in India in 2007, at Dahej and Hazira. In addition, a third terminal at Dabhol is to be brought partially on line in 2010, and a fourth, under construction at Kochi, is expected to come on line in 2012. Numerous other facilities have been proposed, but progress has been hindered, first by difficulties in finding long-term supplies at acceptable prices and more recently by a wait-and-see attitude in the Indian natural gas industry as participants wait to see how quickly production from the Krishna Godavari field will be absorbed.

In 2007, three countries in non-OECD Asia—Indonesia, Malaysia, and Brunei—had LNG export facilities. In addition, Papua New Guinea is preparing to become an LNG exporter. There are several LNG liquefaction projects proposed for Papua New Guinea. At the end of 2009, a project led by ExxonMobil became the first to reach a final investment decision [*44*]. Construction is set to begin in 2010, and first gas is expected in 2014. Two liquefaction trains are planned, with total annual exports of 0.3 trillion cubic feet of natural gas. In the mid-term, growth in exports from Papua New Guinea and Indonesia's Tangguh LNG, which came on line in 2009, increases net exports from these Asian producers as a region. Production from the Arun and Bontang LNG facilities currently in operation in Indonesia, however, is expected to continue declining [*45*]. Indonesia has plans to build at least one LNG regasification facility on its own shores, which would further decrease net exports from the region. In the Reference case net exports from these four countries, as a region, decline from 2.6 trillion cubic feet in 2007 to 2.1 trillion cubic feet in 2035.

Qatar is the world's largest LNG exporter. Its total LNG exports grew by 17.5 percent per year on average from 2000 to 2007 and by another 30.6 percent from 2007 to 2008. In the *IEO2010* Reference case, Qatar's LNG exports grow throughout the projection period. Most of the growth is projected for the 2007-2015 period, as Qatar brings on line six mega-sized liquefaction trains. Each train has the capacity to produce the equivalent of 0.36 trillion cubic feet of natural gas per year for export. The first of the six liquefaction trains came on line in 2009, and the last is scheduled for completion in 2011.

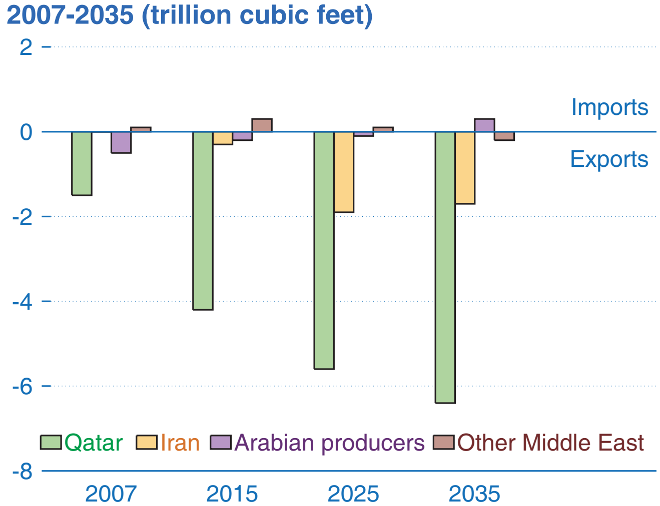
Qatar's natural gas exports grow by an estimated average of 13.5 percent per year from 2007 to 2015 in the Reference case (Figure 55), then slow to an average increase of just 2.1 percent per year after 2015, when projects currently under construction will have been completed. Because of a current moratorium on further development from the North Field, no new projects are being initiated. The moratorium was put in place in 2005 in order to give Qatar a chance to assess the effect of the ongoing ramp-up in production on the North Field before it commits to further production increases. Originally set to expire in 2008, the moratorium has recently been extended to 2014 [*46*].

If Qatar decides to lift the moratorium on North Field development in 2014, its stated development priority is to ensure that it can meet long-term domestic natural gas needs for power generation, water desalination, and local industry. Only after those needs are met will it consider further increases in exports, and any increases are expected to come primarily from optimization of current facilities [*47*]. The six mega-trains currently being brought on line are the largest liquefaction trains in the world, and they employ several new technologies. Although the new technologies have contributed to the sometimes problematic commissioning process, they also are likely to provide opportunities for increasing operating capacity through process optimization and "de-bottlenecking" operations [*48*].

Iran, which shares the North Field/South Pars Field with Qatar, has the world's second-largest natural gas reserves (behind Russia but ahead of Qatar). Despite its abundant reserves, Iran was a net importer of natural gas in 2007, importing slightly more from Turkmenistan than it exported to Turkey. Although its first LNG export plant is under construction, Iran is without international partners and without any obvious source for obtaining the actual liquefaction technology, which it currently does not possess domestically [*49*]. Other export projects continue to be discussed, but as a result of international and internal politics there has been little progress on most projects. In the Reference case, Iran becomes a net exporter of natural gas with a combination of LNG and pipelines through Turkey to Europe, but it does not become a major exporter, because domestic demand and demand for reinjected gas limit its exports despite its massive resources.

Yemen began production at its first LNG export plant in 2009. At full capacity, the plant is expected to export the equivalent of 0.3 trillion cubic feet of natural gas per year. Two additional countries in the Middle East—Oman and the United Arab Emirates (UAE)—also export LNG. Both countries also import natural gas via pipeline from Qatar, and while the UAE maintained a slim margin as a net exporter in 2007, preliminary data for 2008 indicate that it became a net importer. The

Figure 55. Middle East net natural gas trade, 2007-2035 (trillion cubic feet)



IEO2010 Reference case projects a similar trend for the Arabian Peninsula producers, which include Kuwait, Oman, UAE, and Yemen. As a group, they exported a total of 0.5 trillion cubic feet of natural gas in 2007; but by 2030 the region becomes a net importer of natural gas, and in 2035 its net imports total 0.3 trillion cubic feet.

In addition to pipeline natural gas from neighboring countries, countries in the Arabian Peninsula are beginning to import small volumes of LNG. In 2010, the emirate of Dubai in the UAE will begin importing LNG to meet peak summer natural gas demand via a floating LNG regasification terminal. A similar facility allowed Kuwait to begin importing natural gas in the summer of 2009, also to meet seasonal peak demand [***50***].

In 2007, North Africa exported almost 3 trillion cubic feet of natural gas (Figure 56), or 56 percent of its production, with about one-half of the exports coming from Algeria, Egypt, and Libya via pipelines to Spain, Italy, and parts of the Middle East. The remainder was exported as LNG from liquefaction facilities in Algeria, Egypt, and Libya.

Algeria is in the process of expanding its natural gas export capacity both by pipeline and from LNG terminals. The Medgaz pipeline from Algeria to Spain is expected to come on line in mid-2010, with sufficient capacity to carry 0.3 trillion cubic feet of natural gas per year. Two liquefaction projects are also progressing in Algeria: the Gassi Touil project and a new liquefaction train at the existing Skikda export facility [***51***]. Together they are expected to increase Algeria's LNG export capacity by 0.4 trillion cubic feet per year by 2013. In addition, the Galsi pipeline from Algeria to Italy is planning to make a final investment decision before the end of 2010 and to initiate gas flow on a 0.4 trillion cubic foot per year pipeline by 2014 [***52***].

Any additional major expansions of export capacity from North Africa are projected to be dependent on the Trans-Sahara natural gas pipeline. The pipeline, if built, would stretch 2,800 miles to bring natural gas from Nigeria, across Niger, and connecting in Algeria to export pipelines to Europe. The Trans-Sahara pipeline was given the official go-ahead in 2009, having been declared economically and technically feasible, and 2015 was set as the official targeted start date. However, the project still faces significant security issues and has not yet secured financing.

As recently as 2007, South America was an almost entirely self-contained market for natural gas, with no means of importing gas to the continent (Figure 57) and only one avenue for exporting it: the LNG liquefaction facilities on the island of Trinidad and Tobago. Since then, natural gas in South America has become increasingly globalized. In late 2008, Brazil opened its first floating LNG storage and regasification facility, the Pecem terminal in the country's northeast. A second floating LNG regasification unit followed in 2009 at the Guanabara Bay terminal in the southeast [***53***]. Brazil also has proposals to employ floating LNG liquefaction at its offshore subsalt natural gas fields. The primary goal of the offshore liquefaction project is to bring gas to Brazil's own regasification terminals, exporting it only when there is excess supply.

In the *IEO2010* Reference case, Central and South America's northern natural gas producers (Colombia, Ecuador, Trinidad and Tobago, and Venezuela) account for most of the region's net exports, which increase from 0.7 trillion cubic feet in 2007 to 1.8 trillion cubic feet in 2035. The rest of South America—mainly, Bolivia, Argentina, Chile, and Peru—was a net natural gas exporting region in 2007, with 0.4 trillion cubic feet of natural gas exported from Bolivia to Brazil. However, in the Reference case, increases in Brazil's domestic production diminish the need for Bolivian supplies. In addition, LNG imports to Argentina, Chile, and possibly Uruguay more than offset exports from Peru, where an LNG

Figure 56. Africa net natural gas trade, 2007-2035 (trillion cubic feet)

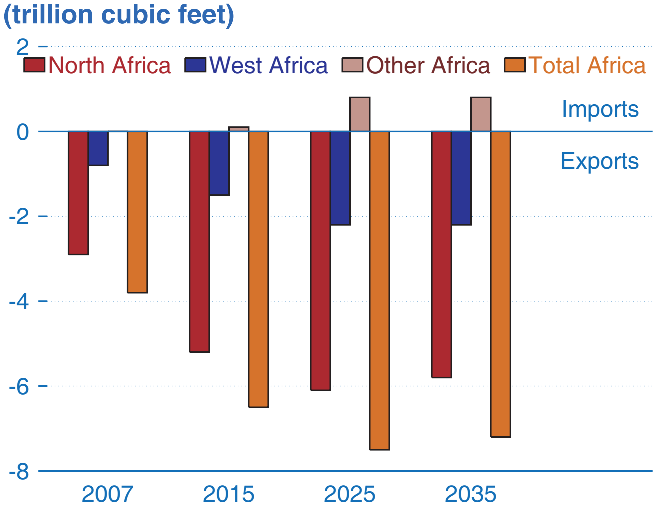
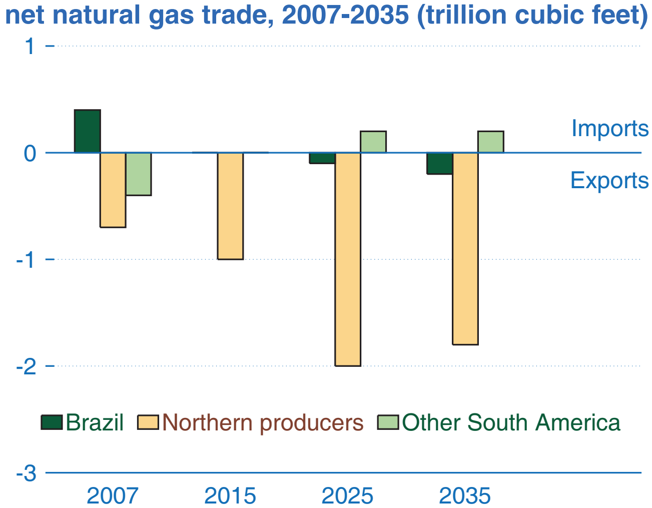


Figure 57. Non-OECD Central and South America net natural gas trade, 2007-2035 (trillion cubic feet)



project is likely to come on line in 2011 with an export capacity of 0.2 trillion cubic feet per year.

As of January 2010, there were two LNG import facilities operating in South America outside Brazil. The first, in Argentina, came on line in 2008 with a nominal capacity of 0.1 trillion cubic feet per year. The second, at Quintero, Chile, opened in 2009 and brought the region's total import capacity to 0.3 trillion cubic feet [*54*]. Chile's second regasification facility is currently under construction at Mejillones, and additional import capacity has been proposed for Uruguay and Argentina. There is no additional export capacity proposed for the region.

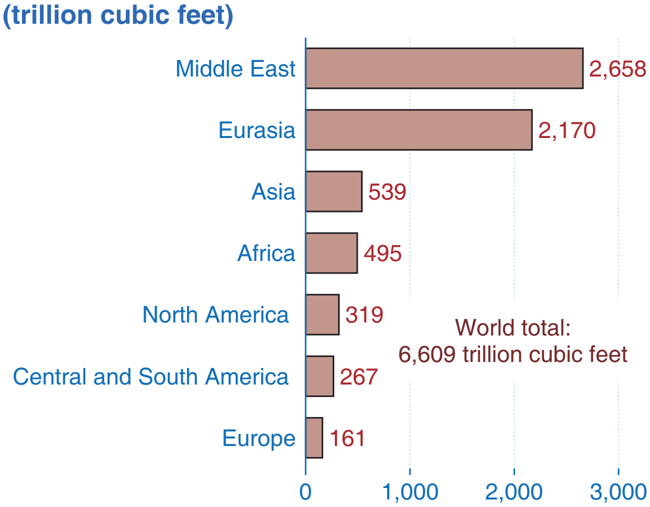
World natural gas reserves

Almost three-quarters of the world's natural gas reserves are located in the Middle East and Eurasia (Figure 58). Russia, Iran, and Qatar together accounted for about 55 percent of the world's natural gas reserves as of January 1, 2010 (Table 7).

Historically, world natural gas reserves have generally trended upward (Figure 59). As of January 1, 2010, the world's total proved natural gas reserves, as reported by *Oil & Gas Journal*,[16] were estimated at 6,609 trillion cubic feet—355 trillion cubic feet (6 percent) higher than the estimate of 6,254 trillion cubic feet for 2009 [*55*].

The largest increases in reported natural gas reserves in 2010 were for Turkmenistan and Australia. In Turkmenistan, natural gas reserves are now estimated at

Figure 58. World natural gas reserves by geographic region as of January 1, 2010 (trillion cubic feet)



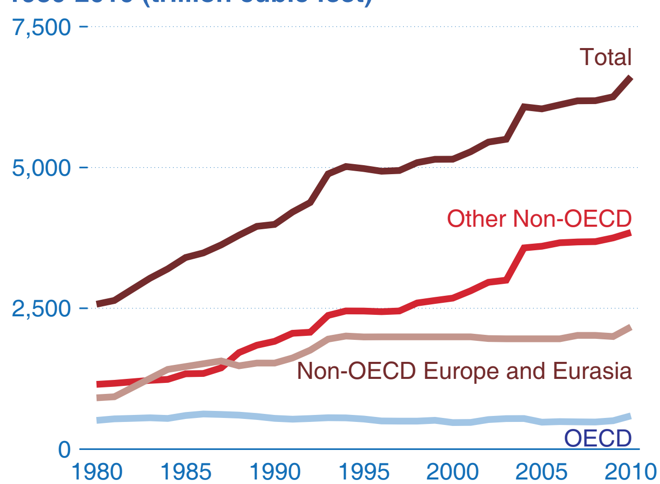
Source: *Oil & Gas Journal*.

Table 7. World natural gas reserves by country as of January 1, 2010

Country	Reserves (trillion cubic feet)	Percent of world total
World	**6,609**	**100.0**
Top 20 Countries	**6,003**	**90.8**
Russia	1,680	25.4
Iran	1,046	15.8
Qatar	899	13.6
Turkmenistan	265	4.0
Saudi Arabia	263	4.0
United States	245	3.7
United Arab Emirates	210	3.2
Nigeria	185	2.8
Venezuela	176	2.7
Algeria	159	2.4
Iraq	112	1.7
Australia	110	1.7
China	107	1.6
Indonesia	106	1.6
Kazakhstan	85	1.3
Malaysia	83	1.3
Norway	82	1.2
Uzbekistan	65	1.0
Kuwait	63	1.0
Canada	62	0.9
Rest of World	**606**	**9.2**

Source: *Oil & Gas Journal*.

Figure 59. World natural gas reserves by region, 1980-2010 (trillion cubic feet)



Sources: *International Petroleum Encyclopedia* and *Oil & Gas Journal*.

[16]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 U.S. Energy Information Administration and are defined as the estimated quantities of natural gas reserves as of December 31, 2009, which analysis of geological and engineering data demonstrates with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions. Significant natural gas discoveries made in 2009 are not likely to be reflected in the reported reserves.

265 trillion cubic feet, an increase of 171 trillion cubic feet (182 percent) over its 2009 proved reserves, following reappraisals of the giant South Yolotan-Osman gas field [*56*]. The reserves in the South Yolotan-Osman field are now estimated at between 141 and 494 trillion cubic feet, making it the fifth-largest natural gas field in the world [*57*].

In Australia, reserve estimates were revised upward by 80 trillion cubic feet, from 30 trillion cubic feet to 110 trillion cubic feet. The increase is attributed to the reporting of reserves under the Australian government's McKelvey reporting system rather than the traditional petroleum industry classification.[17] Smaller but still substantial increases were reported for Iran and China. Iran added an estimated 54 trillion cubic feet, a 5-percent increase over 2009 reserves, and China added 27 trillion cubic feet, a 34-percent increase. In the Middle East, Qatar and Saudi Arabia added 7 trillion cubic feet and 5 trillion cubic feet, respectively. In North America, the United States and Canada added a combined 11 trillion cubic feet. In South America, Venezuela added 5 trillion cubic feet. Declines in natural gas reserves were reported for Trinidad and Tobago (a decrease of 3 trillion cubic feet, or 18 percent) and the United Kingdom (a decrease of almost 2 trillion cubic feet, or 15 percent).

Despite high rates of increase in natural gas consumption, particularly over the past decade, the above increases in reserves imply that reserves-to-production ratios for most regions have remained substantial. Worldwide, the reserves-to-production ratio is estimated at 60 years [*58*]. By region, the highest ratios are about 46 years for Central and South America, 72 years for Russia, 68 years for Africa, and more than 100 years for the Middle East.

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[17] Geosciences Australia reports petroleum resources under two classification systems: the traditional industry classification and the McKelvey classification. For further information, see web site www.ga.gov.au/oceans/pub_reports.jsp. Use of different reporting systems underscores the inherent uncertainty associated with the reported world reserves estimates. Definitions may vary among country reports, with potentially substantial impacts on the reported levels of reserves.

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Chapter 4
Coal

In the IEO2010 Reference case, world coal consumption increases by 56 percent from 2007 to 2035, and coal's share of world energy consumption grows from 27 percent in 2007 to 28 percent in 2035.

Overview

In the *IEO2010* Reference case, which does not include prospective greenhouse gas reduction policies, world coal consumption increases by 56 percent, from 132 quadrillion Btu in 2007 to 206 quadrillion Btu in 2035 (Figure 60). The growth rate for coal consumption is uneven, averaging 1.1 percent per year from 2007 to 2020 and 2.0 percent per year from 2020 to 2035. The slower growth rate for the earlier period results largely from a decline in coal consumption—primarily in OECD countries—in 2009 during the global economic recession. After 2009, with continuous yearly increases through 2035, world coal consumption rebounds, returning to its 2008 level by 2013. Coal consumption in OECD countries, however, does not return to its 2008 level until 2035. As a result, increased use of coal in non-OECD countries accounts for nearly all of the growth in world coal consumption over the entire period.

In 2007, coal accounted for 27 percent of world energy consumption (Figure 61). Of the coal produced worldwide in 2007, 64 percent was shipped to electricity producers and 33 percent to industrial consumers, with most of the remainder going to consumers in the residential and commercial sectors. Coal's share of total world energy consumption increases to 28 percent in 2035 in the *IEO2010* Reference case. In the electric power sector, its share declines from 44 percent in 2007 to 40 percent in 2020, then increases to 43 percent in 2035.

International coal trade grows by 47 percent in the Reference case, from 21.2 quadrillion Btu in 2008 to 31.2 quadrillion Btu in 2035. The share of total world coal consumption accounted for by internationally traded coal peaks at 18 percent in 2015 and declines to 15 percent after 2025, slightly below the 2008 level of 16 percent. The decline in the share of coal traded primarily reflects the ability of the world's largest coal consumers, China and India, to meet their future coal demand with domestic production.

World coal consumption

OECD coal consumption

In the Reference case, OECD coal consumption declines from 47.9 quadrillion Btu in 2007 to 43.1 quadrillion Btu in 2010 and remains virtually flat until after 2025. After 2025, OECD coal consumption increases to 48.3 quadrillion Btu in 2035, largely because of an increase in natural gas prices that allows coal—in the absence of policies or regulations to limit its use—to compete economically. Almost all of the OECD increase after 2025 is attributable to North America (Figure 62). Over the projection period, slight increases in coal consumption in North America and OECD Asia are, to a large extent, offset by declines in OECD Europe.

Figure 60. World coal consumption by country grouping, 1980-2035 (quadrillion Btu)

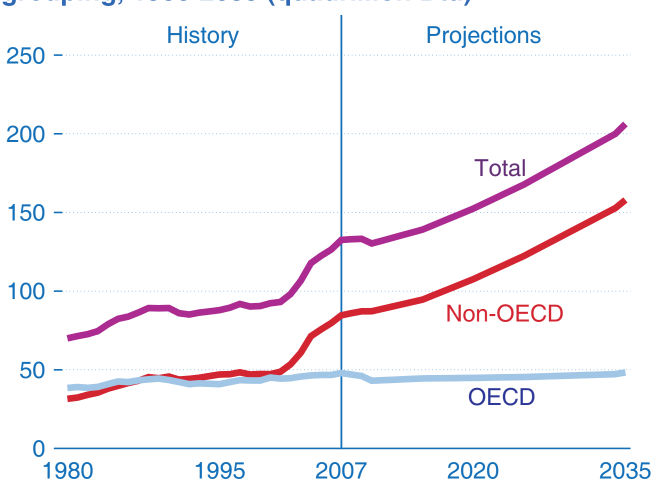
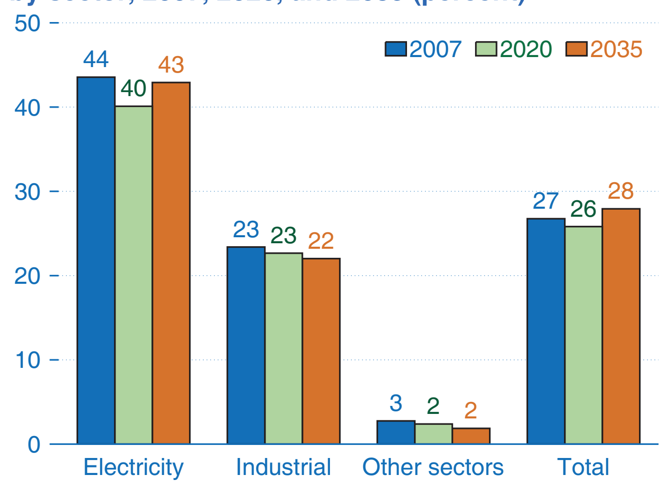


Figure 61. Coal share of world energy consumption by sector, 2007, 2020, and 2035 (percent)



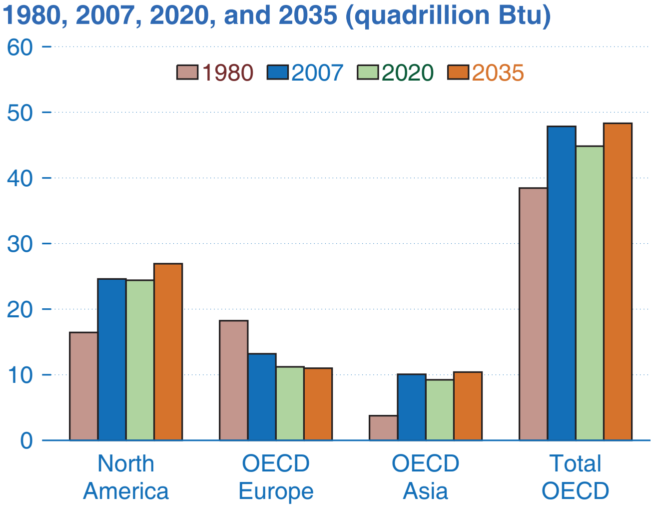
North America

Coal use in the United States totaled 22.7 quadrillion Btu in 2007—92 percent of total coal use in North America and 47 percent of the OECD total. U.S. coal demand rises to 25.1 quadrillion Btu in 2035 in the Reference case. 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 48 percent in 2007 to 44 percent in 2035.

Increasing use of coal for electricity generation at new and existing plants, combined with the startup of several coal-to-liquids (CTL) plants toward the end of the projection, leads to modest growth in U.S. coal consumption, averaging 0.4 percent per year from 2007 to 2035. Although an assumed increase in the cost of capital for greenhouse-gas-intensive technologies dampens investment in new coal-fired power plants in the United States, the increase in coal-fired electricity generation still is substantial, exceeded only by growth in generation from renewables. Increased generation from coal-fired power plants accounts for 26 percent of the growth in total U.S. electricity generation from 2007 to 2035, while increased generation from renewables (including conventional hydroelectric resources) accounts for 49 percent of the growth. U.S. production of coal-based synthetic liquids increases to 243,000 barrels per day in 2035.

In Canada and Mexico, there are only minor changes in coal consumption over the projection period: a decrease of 0.3 quadrillion Btu in Canada from 2007 to 2035, and an increase of 0.2 quadrillion Btu in Mexico. The decline in Canada's coal consumption is attributable primarily to the Ontario government's plans to phase out the Province's remaining 6.1 gigawatts of coal-fired generating capacity by the end of 2014 [*1*]. In a recent announcement, Ontario Power Generation indicated that approximately 2 gigawatts of coal-fired generating capacity at its Nanticoke and Lambton plants will be retired in late 2010. In Mexico, an additional 0.7 gigawatts of coal-fired generating capacity is scheduled to be completed in 2010 at the existing 2.1-gigawatt Petacalco plant on the Pacific coast [*2*].

Figure 62. OECD coal consumption by region, 1980, 2007, 2020, and 2035 (quadrillion Btu)



OECD Europe

Total coal consumption in the countries of OECD Europe declines in the *IEO2010* Reference case from 13.2 quadrillion Btu in 2007 (28 percent of the OECD total) to 11.0 quadrillion Btu in 2035 (23 percent). In 2007, the electricity and industrial sectors accounted for 95 percent of the coal consumed in OECD Europe, with electricity producers using 9.0 quadrillion Btu of coal and industrial plants using 3.6 quadrillion Btu. Over the projection period, the use of coal declines in both sectors, falling at an average rate of 1.6 percent per year in the industrial sector and 0.3 percent per year in the electricity sector. In 2035, OECD Europe's electric power sector accounts for 75 percent of the region's total coal use, up from 68 percent in 2007.

Although total installed coal-fired electricity generating capacity in OECD Europe declines from 200 gigawatts in 2007 to 177 gigawatts in 2035, coal remains an important component of Europe's power generation, providing nearly one-fifth or the region's total generation in 2035. Plans to retire aging and inefficient generating capacity will, to some extent, be offset by new coal-fired capacity. Currently, between 15 and 20 gigawatts of new coal-fired generating capacity is under construction in OECD Europe, with projects in Germany representing more than one-half of the new construction [*3*]. In addition, there are plans to refurbish some existing coal-fired capacity to make it more efficient.

OECD Asia

The slight increase in coal consumption for the OECD Asia region in the Reference case is the net result of two divergent trends, consisting of a decline in coal use of 1.1 quadrillion Btu for Japan and an increase of 1.3 quadrillion Btu projected for South Korea from 2007 to 2035. Japan is the region's largest coal-consuming nation, but declining population and increasing reliance on nuclear power for electricity generation lowers the demand for coal in the future.

Unlike Japan, Australia and New Zealand increase their coal consumption slightly, by an average of 0.2 percent per year, from 2.9 quadrillion Btu in 2007 to 3.0 quadrillion Btu in 2035. Of the two countries, Australia is by far the larger coal consumer, with 97 percent of the regional total in 2007. 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. Compared with coal, generation from both renewables and natural gas increases at a more rapid pace, so that those fuels capture an increasing share of Australia/New Zealand's total generation. Coal-fired power plants supplied 70 percent of the region's total electricity generation in 2007, as compared with a 58-percent share in 2035.

South Korea is OECD Asia's fastest-growing consumer of coal. Its coal use increases by an average of 1.6 percent per year, from 2.3 quadrillion Btu in 2007 to 3.6 quadrillion Btu in 2035. The 56-percent overall increase from 2007 to 2035 results primarily from growing demand for coal in the electric power sector. According to South Korea's most recent long-term power plan, published in late 2008, the country's generating companies plan to add as much as 15 gigawatts of new coal-fired generating capacity during the years 2008 through 2022 [*4*].

Non-OECD coal consumption

In contrast to coal consumption in OECD economies, fast-paced growth is projected for non-OECD nations, particularly among the Asian economies. Led by strong economic growth and rising energy demand in non-OECD Asia, total coal consumption in non-OECD countries increases to 157.9 quadrillion Btu in 2035, growing by 87 percent from the 2007 total of 84.6 quadrillion Btu (Figure 63). The substantial increase in non-OECD coal consumption illustrates the importance of coal in meeting the region's energy needs. Over the entire period from 2007 to 2035, coal accounts for about one-third of total non-OECD energy consumption.

Non-OECD Asia

The countries of non-OECD Asia account for 95 percent of the projected increase in world coal consumption from 2007 to 2035. Strong economic growth is expected for non-OECD Asia, averaging 5.2 percent per year from 2007 to 2035, with China's economy averaging 5.8 percent per year and India's 5.0 percent per year. In *IEO2010*, much of the increase in demand for energy in non-OECD Asia, particularly in the electric power and industrial sectors, is met with coal.

Coal use in China's electricity sector increases from 27.7 quadrillion Btu in 2007 to 72.2 quadrillion Btu in 2035, at an average rate of 3.5 percent per year (Figure 64). In comparison, coal consumption in the U.S. electric power sector grows by 0.4 percent annually, from 20.8 quadrillion Btu in 2007 to 23.1 quadrillion Btu in 2035. At the end of 2007, China had an estimated 496 gigawatts of coal-fired capacity in operation. To meet the demand for electricity that accompanies its rapid economic growth, an additional 736 gigawatts of coal-fired capacity (net of retirements) is expected to be brought on line in China by 2035, requiring large financial investments in new coal-fired power plants and associated electricity transmission and distribution systems. In the near term, the *IEO2010* projections show a substantial amount of new coal plant builds, with 138 gigawatts of capacity additions between 2007 and 2010. Notwithstanding the substantial growth in coal-fired generating capacity and generation projected for China in the *IEO2010* Reference case, coal's share of the country's total generation declines from 80 percent in 2007 to 74 percent in 2035, as generation from nuclear and renewables grows at an even more rapid pace than generation from coal.

Nearly one-half (49 percent) of China's coal use in 2007 was in the non-electricity sectors, primarily in the industrial sector and notably for the production of steel and pig iron. In the *IEO2010* Reference case, coal consumption in those sectors increases by 13.1 quadrillion Btu (48 percent) from 2007 to 2035. Within the industrial sector, the single largest use of coal is for the production of coke, which in turn is used primarily to produce pig iron. In 2007, Chinese coke plants consumed 459 million tons[18] of coal, representing, on a tonnage basis, about 17 percent of the total amount of coal consumed in all sectors in

Figure 63. Non-OECD coal consumption by region, 1980, 2007, 2020, and 2035 (quadrillion Btu)

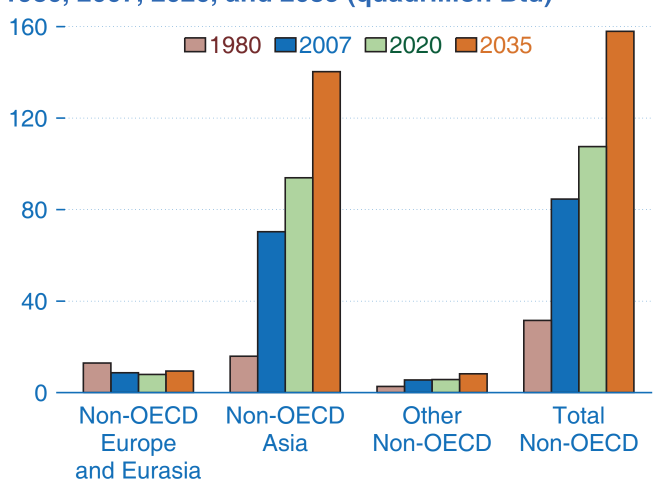
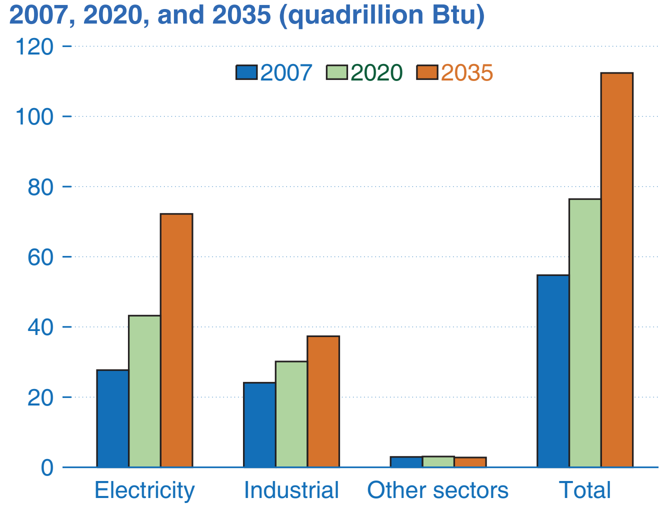


Figure 64. Coal consumption in China by sector, 2007, 2020, and 2035 (quadrillion Btu)



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

China during 2007 [*5*]. China was the world's leading producer of both steel and pig iron in 2007, accounting for 36 percent of global raw steel output and 50 percent of world pig iron production [*6*].

Coal remains the leading source of energy for China's industrial sector in the Reference case, although its share of industrial energy consumption declines over the projection period, with electricity and other energy sources making up an increasing share of the total. Electricity's share of total industrial energy use rises from 19 percent in 2007 to 32 percent in 2035, while coal's share drops from 60 percent to 47 percent. However, with coal-fired power plants satisfying approximately three-fourths of China's total power generation requirements throughout the period from 2007 to 2035, the increase in electricity demand in the industrial sector can be viewed indirectly as an increase in the demand for coal.

In India, 56 percent of the growth in coal consumption is expected to be in the electric power sector and most of the remainder in the industrial sector. In 2007, India's coal-fired power plants consumed 6.6 quadrillion Btu of coal, representing 65 percent of the country's total coal demand. Coal use for electricity generation in India grows by 1.3 percent per year on average, to 9.5 quadrillion Btu in 2035, requiring an additional 51 gigawatts of coal-fired capacity (net of retirements). As a result, India's coal-fired generating capacity increases from 84 gigawatts in 2007 to 135 gigawatts in 2035. Despite a 45-percent increase in the use of coal for electricity generation over the projection period, growth in generation from natural gas, nuclear power, and renewable energy sources is even more rapid, and coal's share of India's total generation declines from 71 percent in 2007 to 51 percent in 2035.

In the nations of non-OECD Asia outside China and India, coal consumption grows by an average of 3.0 percent per year, from 5.4 quadrillion Btu in 2007 to 12.4 quadrillion Btu in 2035. Growing demand for energy in the region's electric power and industrial sectors drives the increase in coal use. In the electric power sector, significant growth in coal consumption is expected in Indonesia and Vietnam, where considerable amounts of new coal-fired generating capacity are expected to be built.

Non-OECD Europe and Eurasia

Coal consumption in non-OECD Europe and Eurasia increases in the *IEO2010* Reference case by an average of 0.3 percent per year, from 8.7 quadrillion Btu in 2007 to 9.4 quadrillion Btu in 2035. Russia is the region's largest coal consumer, at 4.3 quadrillion Btu in 2007, or 49 percent of the total for non-OECD Europe and Eurasia. Coal met 14 percent of Russia's total energy requirements in 2007, and coal-fired power plants provided 23 percent of its electricity. In the Reference case, coal consumption in Russia in 2035 totals 5.2 quadrillion Btu, its share of total energy consumption increases slightly to 15 percent, and its share of electricity generation increases to 24 percent. Although natural gas is the leading source of electricity generation in Russia, and continues to hold that position throughout the projection, increased generation from nuclear and coal-fired power plants, taken together, accounts for 68 percent of the country's generation growth. The natural gas share of Russia's total electricity generation declines from 40 percent in 2007 to 32 percent in 2035 in the Reference case, and the nuclear share rises from 15 percent to 25 percent.

Coal consumption in the other countries of non-OECD Europe and Eurasia declines slightly, from 4.4 quadrillion Btu in 2007 to 4.1 quadrillion Btu in 2035. The use of coal declines in every end-use sector of the region except for the electric power sector, where it increases by an average of 0.7 percent per year. From 2007 to 2035, coal, natural gas, and nuclear power satisfy much of the additional electricity requirement for non-OECD Europe and Eurasia, with increased output from coal-fired plants meeting 18 percent of the growth, natural-gas-fired plants 41 percent, and nuclear plants 29 percent. Coal's share of total electricity generation declines from 29 percent in 2007 to 25 percent in 2035. Currently, a number of new coal-fired power projects are in the planning stages in the region [*7*]. Locally mined lignite is the proposed fuel for most of the proposed plants, although imported coal is the likely fuel source for several plants that may be constructed in coastal areas.

Africa

Africa's coal consumption increases by 1.9 quadrillion Btu from 2007 to 2035 in the Reference case. South Africa currently accounts for 91 percent of the coal consumed on the continent and is expected to continue to account for much of Africa's total coal consumption over the projection period.

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 [*8*]. The individual units at those plants, with a combined generating capacity of 3.8 gigawatts, are scheduled to return to service by 2011. In addition, Eskom is proceeding with the construction of two new coal-fired power plants, Medupi and Kusile, with a combined generating capacity of 9.6 gigawatts. The 12 individual units at the Medupi and Kusile plants are scheduled to be fully operational by the end of 2016. In April 2010, the World Bank approved a $3.8 billion loan for Eskom to help with the financing of several energy-related projects, including $3.1 billion allocated for completion of the Medupi plant [*9*].

Recent power shortages and a general lack of spare generating capacity in southern Africa also have led to increased interest in new coal-fired power projects in countries other than South Africa. Of particular significance are major investments being made by several international energy companies to develop coal reserves in Mozambique and Botswana for the purpose of supplying both domestic coal-fired generating plants and international markets[***10***].

In the industrial sector, increasing coal use results from 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 large-scale CTL plants in South Africa (Sasol II and Sasol III) can supply up to 150,000 barrels of synthetic liquids per day and account for about 20 percent of the country's total liquid fuel supply [***11***]. About 25 percent of South Africa's total coal consumption is used for synthetic liquids production [***12***].

Central and South America

Central and South America consumed 0.9 quadrillion Btu of coal in 2007. Brazil, with the world's ninth-largest steel production in 2007, accounted for 51 percent of the region's coal demand, and Chile, Colombia, Puerto Rico, Argentina, and Peru accounted for most of the remainder [***13***]. In the Reference case, coal consumption in Central and South America increases by 0.8 quadrillion Btu from 2007 to 2035, with most 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 mid-term to meet increasing domestic and international demand for steel [***14***].

Middle East

Countries in the Middle East consumed 0.4 quadrillion Btu of coal in 2007. Israel accounted for 85 percent of the total and Iran most of the remainder. The region's coal use remains near the current level through 2035.

World coal production

In the *IEO2010* Reference case, 75 percent of the increase in world coal production occurs in China, where output rises by 54.7 quadrillion Btu from 2007 to 2035 (Table 8). This outlook is based on the assumption that much of the demand for coal in China will continue to be met by domestic production. Other substantial increases in regional coal production from 2007 to 2035 include 7.1 quadrillion Btu in Australia/New Zealand (representing 10 percent of the increase in world coal production), 4.0 quadrillion Btu in non-OECD Asia (excluding China), 3.0 quadrillion Btu in Africa, 2.8 quadrillion Btu in the United States, and 2.4 quadrillion Btu in Central and South America.

Most of the growth in coal production in Australia/New Zealand and other Central and South America is based on continuing increases in coal exports, whereas production growth in Africa and non-OECD Asia (excluding China) is attributable to both rising levels of coal consumption and increasing exports. For the United States, growth in coal production is a result primarily of increases in domestic coal consumption. The projected increases in coal production for these six regions dominate the overall trends for the OECD and non-OECD regions as a whole, accounting for more than 100 percent of the increase in net production for OECD countries and 97 percent of the net increase for non-OECD countries.

World coal trade

With the global recession, international trade in coal in 2009, moving via ship or barge, is estimated to have fallen slightly from the 2008 level (even though China's coal imports doubled in 2009 compared with 2008). Still, the rapid decommissioning of small coal mines in China's historically most productive coal province (Shanxi), a cold winter in China, delays in some infrastructure projects in exporting nations, and continued transportation bottlenecks kept international coal supply tight in 2009. The volume of seaborne coal trade continues its long-term trend, rising through 2035 mainly in response to large increases in non-OECD coal demand—predominantly from China and India.

Although both steam coal and coking coal are traded internationally, most of the trade is in steam coal, which represents 72 percent of world coal trade in 2035 (slightly higher than the current level of 70 percent). In 2008, 58 percent of the world's exported steam coal was imported by Asian countries, and their share of the total increases to 72 percent in 2035.

The share of coking coal imports destined for Asian countries increases from 62 percent in 2008 to an estimated 70 percent in 2009 and never falls below 67 percent in the Reference case. China, India, and Iran were the only significant steel-producing countries in which steel production increased from 2008 to 2009.[19] China increased its production by 73 million tons, India by 2 million tons, and Iran by 1 million tons [***15***]. Most of the other countries producing crude steel reduced their steel production by double-digit percentages from 2008 to 2009, and there were similar declines in blast furnace iron production, part of the steelmaking process that requires coking coal. Although some coke plants have been closed down since 2008, most appear to be

[19] Ecuador, Morocco, and Saudi Arabia increased raw steel production from 64,000 to 291,00 tons, from 527,000 tons to 528,000 tons, and from 5,145,000 tons to 5,170,000 tons, respectively, from 2008 to 2009.

operating still (although at lower utilization rates since the recession began) and are expected to see increased utilization as the global economy improves.

International coal trade, which accounted for about 16 percent of total world coal consumption in 2008, grows at an average annual rate of 1.4 percent in the Reference case, from about 21 quadrillion Btu in 2008 to 31 quadrillion Btu in 2035. Because the largest increases are projected for non-OECD Asia—particularly China, which meets most of the increase in its coal demand with domestic supply rather than seaborne imports—the share of coal trade as a percentage of global coal consumption falls to 15 percent in 2035. Australia and Indonesia are well situated geographically to continue as the leading suppliers of internationally traded coal, especially to Asia, over the period. In addition, South America is poised to expand its role as an international supplier of coal, primarily as a result of increasing coal production in Colombia.

Coal imports

Asia

In the *IEO2010* Reference case, Asia remains the world's largest importer of coal. The region already accounts for 59 percent of total world imports (12.6 quadrillion Btu), and its share increases to 70 percent (21.8 quadrillion Btu) in 2035 (Table 9 and Figure 65). Japan is currently Asia's largest coal importer (Figure 66), and although 2001 marked the final year of significant Japanese coal production [*16*], the country has continued to rely on coal to meet its energy requirements. Australia provides about 62 percent of Japan's coal supply (both steam and metallurgical coal), and China supplies about 20 percent of its steam coal imports. Because Japan lacks significant resources of its own, it is likely to continue seeking diverse sources of coal supply for the long term. Japanese companies also have pursued investments in coal production in other countries, including Russia and

Table 8. World coal production by region, 2007-2035 (quadrillion Btu)

Region	2007	2010	2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OECD North America	**25.3**	**23.4**	**25.3**	**26.0**	**26.6**	**27.4**	**28.8**	**0.5**
United States	23.5	21.3	23.3	24.1	24.6	25.4	26.3	0.4
Canada	1.6	1.8	1.8	1.8	1.8	2.0	2.2	1.1
Mexico	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.1
OECD Europe	**7.2**	**6.8**	**5.4**	**5.5**	**5.2**	**5.2**	**5.4**	**-1.0**
OECD Asia	**9.1**	**10.9**	**11.6**	**11.4**	**12.3**	**13.7**	**15.1**	**1.9**
Japan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
South Korea	0.1	0.0	0.0	0.0	0.0	0.0	0.0	-3.4
Australia/New Zealand	9.0	10.8	11.6	11.4	12.3	13.7	15.1	1.9
Total OECD	**41.6**	**41.0**	**42.3**	**42.9**	**44.1**	**46.4**	**49.3**	**0.6**
Non-OECD Europe and Eurasia	**10.2**	**9.8**	**10.0**	**10.0**	**10.1**	**10.7**	**11.9**	**0.5**
Russia	5.9	6.0	6.3	6.3	6.4	6.9	7.9	1.1
Other	4.3	3.8	3.7	3.7	3.7	3.8	4.0	-0.3
Non-OECD Asia	**72.8**	**71.8**	**78.0**	**89.5**	**103.0**	**117.2**	**132.0**	**2.2**
China	55.3	56.3	63.1	74.5	86.5	98.3	110.0	2.5
India	8.7	8.3	7.8	7.8	8.3	8.7	9.5	0.3
Other	8.8	7.2	7.0	7.2	8.2	10.1	12.5	1.3
Middle East	**0.0**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**2.1**
Africa	**5.9**	**5.5**	**6.2**	**6.5**	**6.9**	**7.6**	**9.0**	**1.5**
Central and South America	**2.2**	**2.3**	**2.8**	**3.8**	**4.0**	**4.2**	**4.6**	**2.6**
Brazil	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0
Other	2.1	2.2	2.7	3.7	3.9	4.2	4.5	2.7
Total Non-OECD	**91.1**	**89.4**	**97.1**	**109.9**	**124.0**	**139.8**	**157.5**	**2.0**
Total World	**132.7**	**130.4**	**139.4**	**152.8**	**168.2**	**186.2**	**206.9**	**1.6**

Note: With the exception of North America, non-seaborne coal trade is not represented in the projections. As a result, the projected levels of production assume that net non-seaborne coal trade will balance out across the *IEO2010* 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.

Table 9. World coal flows by importing and exporting regions, Reference case, 2008, 2020, and 2035 (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]
2008												
Australia	0.12	2.98	0.04	**3.17**	0.76	2.67	0.20	**3.62**	0.88	5.64	0.23	**6.79**
United States	0.36	0.02	0.45	**0.83**	0.76	0.11	0.30	**1.17**	1.11	0.13	0.75	**1.99**
Southern Africa[d]	1.17	0.26	0.05	**1.55**	0.00	0.00	0.00	**0.01**	1.17	0.26	0.05	**1.56**
Eurasia	1.16	0.38	0.00	**1.55**	0.08	0.08	0.00	**0.16**	1.24	0.47	0.00	**1.71**
Poland	0.11	0.00	0.00	**0.11**	0.00	0.00	0.00	**0.00**	0.11	0.00	0.00	**0.11**
Canada	0.01	0.11	0.03	**0.14**	0.19	0.43	0.11	**0.74**	0.20	0.55	0.14	**0.88**
China	0.04	1.02	0.00	**1.07**	0.00	0.09	0.00	**0.09**	0.04	1.11	0.00	**1.16**
South America[e]	0.96	0.00	0.99	**1.95**	0.00	0.00	0.00	**0.00**	0.96	0.00	0.99	**1.95**
Vietnam	0.01	0.45	0.00	**0.46**	0.00	0.00	0.00	**0.00**	0.01	0.45	0.00	**0.46**
Indonesia[f]	0.49	3.45	0.10	**4.07**	0.00	0.53	0.00	**0.54**	0.49	3.99	0.10	**4.60**
Total	**4.42**	**8.67**	**1.66**	**14.89**	**1.80**	**3.92**	**0.60**	**6.33**	**6.21**	**12.59**	**2.26**	**21.23**
2020												
Australia	0.00	4.19	0.00	**4.19**	0.32	3.97	0.04	**4.33**	0.32	8.15	0.04	**8.52**
United States	0.16	0.04	0.06	**0.26**	0.74	0.17	0.40	**1.31**	0.90	0.20	0.47	**1.57**
Southern Africa[d]	1.01	0.76	0.20	**1.96**	0.05	0.34	0.02	**0.40**	1.05	1.09	0.21	**2.36**
Eurasia	1.43	0.51	0.00	**1.94**	0.07	0.21	0.00	**0.28**	1.50	0.72	0.00	**2.22**
Poland	0.10	0.00	0.01	**0.11**	0.03	0.00	0.00	**0.03**	0.13	0.00	0.01	**0.14**
Canada	0.11	0.00	0.00	**0.11**	0.32	0.25	0.30	**0.87**	0.43	0.25	0.30	**0.98**
China	0.00	0.97	0.00	**0.97**	0.00	0.02	0.00	**0.02**	0.00	0.99	0.00	**0.99**
South America[e]	2.13	0.37	1.25	**3.75**	0.00	0.00	0.00	**0.00**	2.13	0.37	1.25	**3.75**
Vietnam	0.00	0.24	0.00	**0.24**	0.00	0.00	0.00	**0.00**	0.00	0.24	0.00	**0.24**
Indonesia[f]	0.00	4.13	0.09	**4.21**	0.01	0.49	0.00	**0.50**	0.01	4.62	0.09	**4.72**
Total	**4.93**	**11.20**	**1.61**	**17.74**	**1.54**	**5.44**	**0.77**	**7.75**	**6.47**	**16.64**	**2.38**	**25.49**
2035												
Australia	0.06	6.77	0.00	**6.83**	0.38	4.67	0.22	**5.27**	0.44	11.44	0.22	**12.10**
United States	0.23	0.09	0.05	**0.37**	0.49	0.04	0.65	**1.19**	0.72	0.14	0.71	**1.56**
Southern Africa[d]	0.70	1.67	0.18	**2.55**	0.05	0.32	0.03	**0.40**	0.75	1.99	0.21	**2.95**
Eurasia	1.37	0.64	0.13	**2.13**	0.22	0.27	0.00	**0.49**	1.58	0.91	0.13	**2.62**
Poland	0.07	0.00	0.02	**0.09**	0.01	0.00	0.00	**0.01**	0.09	0.00	0.02	**0.10**
Canada	0.21	0.00	0.00	**0.21**	0.40	0.22	0.37	**0.99**	0.61	0.22	0.37	**1.20**
China	0.00	0.97	0.00	**0.97**	0.00	0.02	0.00	**0.02**	0.00	0.99	0.00	**0.99**
South America[e]	2.09	1.06	1.38	**4.53**	0.00	0.00	0.00	**0.00**	2.09	1.06	1.38	**4.53**
Vietnam	0.00	0.24	0.00	**0.24**	0.00	0.00	0.00	**0.00**	0.00	0.24	0.00	**0.24**
Indonesia[f]	0.00	4.29	0.12	**4.41**	0.01	0.49	0.00	**0.50**	0.01	4.78	0.12	**4.91**
Total	**4.73**	**15.73**	**1.87**	**22.32**	**1.56**	**6.04**	**1.29**	**8.88**	**6.28**	**21.77**	**3.16**	**31.21**

[a]Includes coal shipments to the Middle East and Africa.

[b]In 2008, total world coal flows include a balancing item used to reconcile discrepancies between reported exports and imports. The 2008 balancing items by coal type were 0.14 quadrillion Btu (steam coal), 0.01 quadrillion Btu (coking coal), and 0.16 quadrillion Btu (total).

[c]Includes 0.8 quadrillion Btu of coal for pulverized coal injection at blast furnaces shipped to Japanese steelmakers in 2008.

[d]Southern Africa includes South Africa, Mozambique, and Botswana.

[e]Coal exports from South America originate from mines in Colombia and Venezuela.

[f]Includes shipments from other countries not modeled for the projection period. The 2008 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: SSY Consultancy and Research, Ltd., and EIA.

Canada [*17*]. Japan is a leader in steel production, ranking second only to China [*18*], and continues to import coking coal for use in its steelmaking plants through 2035.

Like Japan, South Korea continues importing most of the coal it consumes through 2035. With planned increases in coal-fired generating capacity, South Korea (in OECD Asia) and Taiwan (in non-OECD Asia) maintain a combined 17 -percent share of world imports in 2035, despite sizable increases in coal imports by other countries.

In 2035, China's coal imports total 3.7 quadrillion Btu in the Reference case. China remains a net importer through 2035, but even with a substantial increase in imports, a preponderant share of the coal consumed in China will continue to be supplied by its own coal mines. Extremely cold weather has played a key role in China's strong coal demand in the winter of 2009-2010. In addition, the unpredictability of China's coal markets raises the level of uncertainty surrounding the world trade projections.

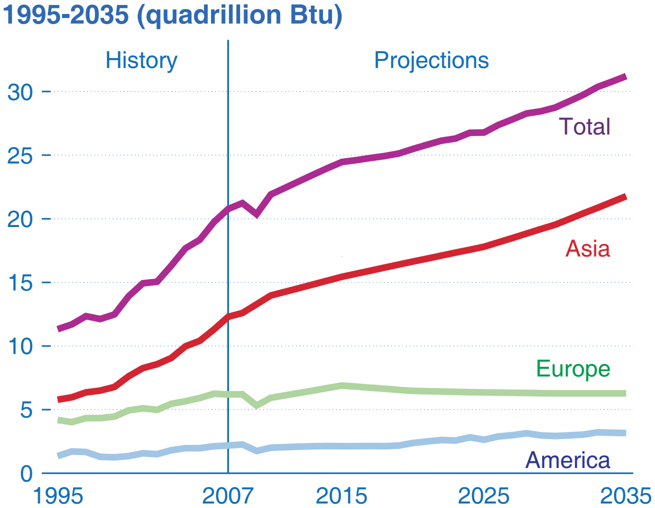
China began to increase its coal imports at the end of 2008, while accelerating the closure of the country's small, inefficient, and comparatively less safe mines in Shanxi Province. Shanxi has typically been China's top coal-producing region, and although it appears to have produced more coal in 2009 than in 2008, production was not sufficient to keep up with demand, creating coal shortages within the region that contributed to the need for imports. However, past consolidations in other Chinese provinces suggest that the country could quickly reopen small mines should international supplies tighten and international coal prices rise substantially.

The removal of coal import tariffs is a possible indication of China's intention to import large quantities of coal, at least in the short term, while Shanxi's coal industry is being restructured. An expected influx of dry bulk carriers beginning in 2010 may provide another short-term boost for Chinese coal imports by lowering the cost of bulk freight. The country may also manage any coal supply deficit in the future by importing more coal overland (trade that is not captured in Table 9) from new production sources in Mongolia and Russia. In addition, China plans to build strategic coal stocks in various provinces as a hedge against future volatility in coal import levels and prices.

China's steel production increased by an estimated 13 percent from 2008 to 2009. To feed the steelmaking process and compensate for production losses in Shanxi, China's coking coal imports rose from approximately 0.1 quadrillion Btu to 0.9 quadrillion Btu, and they are assumed to remain at roughly the same level through 2035. The Chinese government is planning to address issues of overcapacity in the steel industry in part through consolidation of various steel- and coke-making companies, which has potential to affect coking coal imports by moderating demand for coking coal. On the other hand, with new facilities strategically located in coastal areas (one possible outcome of consolidation), China's steel plants could have greater flexibility to use either domestic or foreign coal.

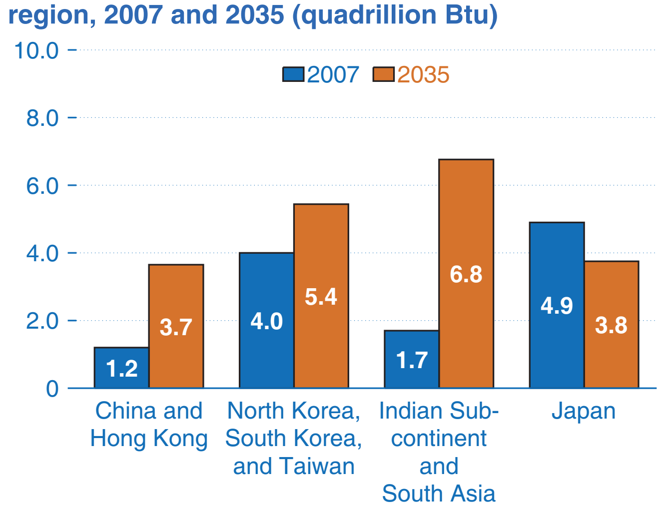
India also has been increasing its imports of coal while facing ongoing coal transportation challenges. Its improvements in infrastructure include the expanded use of smaller ports to satisfy increasing demand for coal imports. Like China, India increased its coal imports in both 2008 and 2009 (although preliminary data suggest that the growth in 2009 was much less than that in China). In 2035, India's coal imports in the Reference case are four times the 2008 level, spurred by rising imports of both coking and steam coal.

Figure 65. Coal imports by major importing region, 1995-2035 (quadrillion Btu)



Sources: SSY Consultancy and Reseach, Ltd., and EIA.

Figure 66. Coal imports to Asia by major importing region, 2007 and 2035 (quadrillion Btu)



Sources: SSY Consultancy and Reseach, Ltd., and EIA.

The large coal-fired electricity plants planned for India's coastal areas will be fueled by imported steam coal. The country is faced with domestic coal supply and quality issues and, while it is building new plants, its demand for coal imports continues to grow. Unfortunately, delays in meeting established construction schedules are commonplace in India, and transportation infrastructure issues abound. For instance, in 2009 India had difficulty handling coal imports at its river port of Haldia because of an unexpected loss of water depth. In order for tonnage to be handled at the port, larger ships have been diverted to deeper ports, where their coal cargos are transferred to smaller ships for delivery to Haldia [*19*].

India's planned infrastructure improvements include coastal port expansions at Goa and Paradip [*20*]. Freight capacity at Paradip is expected to increase from about 55 million tons in 2009 to 77 million tons in 2012, but recent bottlenecks at the port must be overcome in order for that goal to be achieved [*21*]. In addition, coal-handling capability at the port of Mormugao will be expanded from 6 million tons to 17 million tons by 2014 [*22*]. India completed the new port of Gangavaram in 2009, only one of two (the second being the Mundra port) capable of handling capesize vessels. Gangavaram already handled about 17 million tons of freight (not all of it coal) in 2009. In the long term, Gangavaram's owners would like to expand its freight handling capability to 221 million tons per year. The new port of Dharma, also capable of handling capesize ships, should begin operation by the end of 2010.

India has domestic resources of coking coal, but its quality is poor in comparison with foreign-sourced coking coal. India's long-term plans include expansion of its steel industry to between 165 and 198 million tons of raw steel output by 2020, up from about 62 million tons in 2008 [*23*], with increased imports of coking coal supporting the expansion. Some plans for new steelmaking capacity, such as ArcelorMittal's new coastal steel plant in Orissa, appear to have been delayed by land acquisition difficulties and environmental issues and thus are unlikely to add to India's demand for coking coal imports until after 2014. Largely because of its imports of coking coal, India surpass Japan as the world's largest importer of coal by 2025 in the *IEO2010* Reference case.

Europe, Middle East, and Africa

In the *IEO2010* Reference case, total coal imports to Europe (including the Middle East and Africa) in 2035 are about the same as in 2008 (Figure 66). With most European countries placing greater emphasis on natural gas in their power sectors, coal becomes a less significant component of the fuel mix for electricity generation. Europe's demand for lower sulfur coal (from South America and Eurasia, for example) will be tempered over time by the gradual addition of flue gas desulfurization equipment at existing coal-fired power plants.

Some European countries will import more coal to compensate for their own dwindling coal production, which will offset some of the decline expected for coal imports to other European nations. For example, Germany's planned closure of its remaining hard coal mines by 2018 results in increasing imports of coal for electricity generation [*24*]. In Turkey, electricity demand and steel industry growth also are projected to offset some of the decline in Europe's coal use. Over time, however, Turkey is expected to rely more heavily on electric arc furnace steelmaking technology, which does not require coking coal. Italy's conversion of power plants from oil to coal also offsets some of the decline in Europe's coal demand.

The Americas

In the mid- to long term, port expansions are expected to facilitate U.S. coal imports. In 2008, Kinder Morgan Energy Partners LP completed an expansion of annual capacity at its import terminal in Newport News, Virginia, by 6 million tons; and in late 2009, it received an air permit enabling it to expand its coal terminal in Jacksonville, Florida [*25*]. Keystone Coal Co. is planning a coal import terminal in Jacksonville, Florida, as well. With declining productivity and mining difficulties in Central Appalachia and rising domestic demand for coal, imports are expected to remain competitive for coastal States in the East and South. South America (Colombia, in particular) is expected to be an important source of U.S. coal imports.

Canada has been the largest importer of U.S. coal in recent years, but exports of U.S. steam coal to Canada in 2035 are projected to fall below their 2008 level. A portion of Ontario's coal-fired generating capacity is assumed to be shut down by 2035 for environmental reasons, as legislated by the Provincial government. (By 2014, if the plan proceeds, there could be a decline of 0.4 quadrillion Btu in U.S. exports of thermal coal to Canada.)

Brazil's steelmaking capacity increase in the Reference case, taking advantage of its domestic resources of iron ore but requiring increased use of coking-grade coal that the country does not produce domestically [*26*]. The United States, Canada, Australia, and southern Africa all provide a portion of the coal needed to meet Brazil's import requirements. Overall, South America's imports of coking coal—driven primarily by demand in Brazil—grow from about 0.4 quadrillion Btu in 2008 to 1.1 quadrillion Btu in 2035. Brazil and Chile account for most of the increase in thermal coal imports to South America through 2035.

Coal exports

Most of the world's coal trade is in the form of steam coal, at nearly 15 quadrillion Btu (about 70 percent of total coal exports) in 2008. The top five exporters of steam coal in 2008 were Indonesia, Australia, South America (primarily Colombia), Russia, and southern Africa (primarily South Africa). Although Indonesia currently is the world's largest exporter of steam coal, exports from Australia exceed those from Indonesia on a Btu basis in most years of the projection. In terms of coking coal, Australia, the United States, and Canada rank as the three top exporters and are expected to remain the top three through 2035. Poland, Vietnam, and China are expected to lower their coking coal exports in the long term—for Poland, largely because of geological difficulties, and for Vietnam and China, because increasing domestic demand for coal constrains exports.

Already the world's leading exporter of coal (steam and coking coal combined), Australia dominates future international coal trade in the Reference case as it continues to improve and expand its inland transportation and port infrastructure to expedite coal shipments to international markets. For instance, a new coal terminal at Kooragang Island in New South Wales will add about 66 million tons of capacity, about half of which is expected to be operational by 2011 [*27*]. Expansion of Queensland's Dalrymple Bay port in 2009 is expected to increase its annual export capacity from about 75 million tons to 94 million tons [*28*]. Australia remains the primary exporter of metallurgical coal to Asian markets, supplying about 77 percent of Asia's import demand for coking coal in 2035, compared with about 71 percent in 2008. Numerous mine expansions could add close to 100 million tons of coal capacity by 2015, equivalent to nearly one-quarter of Australia's coal production in 2008. As of 2009, Australia's primary supply choke point appears to be in rail movement from mine to port. Although some improvements in this area have already taken place, more needs to be done to accommodate the expected growth in coal exports.

Indonesia, with its relatively low-cost surface mines, has also demonstrated its potential for significant growth in coal exports. Despite this potential, Indonesia's government has been warning for years that it plans to restrict coal exports in favor of domestic coal use. The rate of export growth slowed in 2009, probably due to the slowdown in global economic activity rather than concerns about meeting domestic coal demand.

The Indonesian company Bumi Akit plans to add 37 million tons of export capacity over the next 5 to 6 years and is simultaneously involved in a rail project from its South Sumatran reserves to the port of Lampung. The rail link, with a planned capacity of 20 million tons, should begin operation by 2013. Another Indonesian company, PT Adaro Energy Tbk, also plans to expand coal production by about 44 million tons between 2009 and 2014 [*29*].

Over the long term, areas of uncertainty for Indonesian exports include the rate of growth in its domestic coal consumption; whether domestic coal demand is, in fact, given preference over coal exports; the adequacy of its internal transportation infrastructure; the continued development of new mines; and environmental concerns. In the Reference case Indonesia continues to be an important source of coal supply for other nations through 2035, but its exports increase only slightly, at an average annual rate of 0.4 percent.

South America remains the world's third-largest coal-exporting region in 2035, primarily as a result of continued increases in exports from Colombia. The government of Colombia expects the nation's coal production to reach 160 million tons by 2019, up from about 87 million tons in 2008 [*30*]. The expansion will require sizable investments in mine capacity, rail infrastructure, and port capacity. Drummond Coal is now producing from its El Descanso mine, and it expects ultimately to attain export production of 40 million tons per year through 2032 [*31*]. The El Hatillo mine is planning to increase production from 1.8 million tons to 4.5 million tons by 2011 [*32*].

Increasing coal transportation infrastructure is also a concern for Colombia. There is a proposal to build a tunnel that would expedite coal transportation via truck to Colombia's Pacific Ocean port of Buenaventura when it is completed in 2013. Another planned infrastructure project, the Carare railway, now appears to be at risk because the government has decided not to provide financial support for the project [*33*], which was intended to facilitate coal transport from central Colombia to the Caribbean coast. Other expansion projects on Colombia's Caribbean coast appear to be on track, including a coal terminal at the port of Cienaga, Puerto Nuevo, ultimately handling 66 million tons per year, roughly one-half of which would be available by 2013 [*34*]. Brazil's MPX is planning a coal export terminal along the Colombia's Atlantic seaboard with a capacity of 20 million tons per year [*35*]. An expanded river-to-port terminal at Barranquilla, Colombia, with an annual capacity of about 39 million tons, is also planned [*36*].

Many of Colombia's port expansions lie on the Caribbean near the eastward opening of the Panama Canal. Begun in 2008 and slated for completion by 2015, the Panama Canal expansion should enhance opportunities for coal exports from both the United States and South America traveling westward to Asian markets. The so-called "post-panamax" vessels, which are capable of holding about 20 percent more than current panamax vessels, will be able to transit the Canal. Because many ports may not be able to accommodate the larger vessels without dredging, however, some opportunities could be limited.

South Africa's coal exports have remained flat over the past few years, primarily as a result of domestic infrastructure constraints; however, coal mining is expected to continue playing an important role in South Africa's economy. Delays in the scheduled expansion of the Richards Bay Coal Terminal to an annual productive capacity of 100 million tons have kept South Africa from increasing coal exports in recent years, but the project is scheduled for completion by the end of 2010[***37***]. Even with completion of the expansion, export levels still may fall short of expectations because rail capacity into the port is limited. An additional Richards Bay terminal with a capacity of 10 million tons has also been proposed [***38***].

Rail bottlenecks from coal basins to port facilities also appear to be Russia's primary limitation in its efforts to expand exports. Nevertheless, Russia has managed to triple its seaborne coal exports from 2000 levels to a total of 76 million tons in 2008. The Russian mining and steel production company, Mechel, is on track to begin operations at Russia's Elga coking coal deposit in 2010 and ultimately plans to produce 27 to 30 million tons per year [***39***]. Russia's coal exports to Asia will be facilitated by capacity expansion at the new Pacific port of Muchka, where SUEK (Siberia's coal energy company) has built about 13 million tons of an annual export capacity, and Mechel has plans for about 28 million tons of export capacity at the new Muchka Bay Terminal 2 [***40***]. As in 2008, Eurasia (primarily Russia) supplies 8 percent of the coal traded internationally in 2035.

The African countries of Mozambique and Botswana are expected to play an emerging role in world coal trade, as importing countries seek to secure additional and diversified sources of supply. For example, India's Tata Steel, Brazil's Companhia Vale do Rio Doce (CVRD), and Australia's Riversdale Mining all have financial stakes in mine operations in the Moatize basin of Mozambique [***41***]. The Moatize project, expected to be completed by 2011, will produce between 9 to 14 million tons of marketable coking coal and 3 to 5 million tons of thermal coal [***42***]. An expansion of the port of Beira in Mozambique to handle an annual capacity of about 20 million tons is also planned, and the rail link between Moatize coal basin and Beira (Sena Railway) is being updated [***43***]. Landlocked Botswana is also interested in expanding coal mining and in constructing a railroad to connect inland coal mines to an Atlantic port on the Namibian coast.

U.S. coal exports decline in the *IEO2010* Reference case from their high 2008 levels but remain steady, contributing an average of about 1.6 quadrillion Btu per year to international coal supply through 2035. The geographic distance of the United States from Asian markets—where much of the growth in coal demand is centered—places it at a distinct disadvantage relative to other countries with large coal reserves (see box on page 72). The comparatively high transportation costs associated with shipping coal from the United States to Asian markets mean that U.S. coal exports cannot typically compete economically in that region. Thus, the United States remains a marginal supplier of world coal trade throughout the projection period.

There have been recent shipments of coal to Japan from Alaska, but the volumes have been small; likewise, eastern U.S. miners have shipped small volumes to Asian markets. There is also some possibility that smaller coal shipments to Asia might be accommodated at other bulk terminals in Washington State in lieu of a dedicated western coal terminal. Some coal has also shipped to Asian markets through Canada's Westshore Terminal.

World coal reserves

Total recoverable reserves of coal around the world are estimated at 909 billion tons—reflecting a current reserves-to-production ratio of 129 years (Table 10).[20] Historically, estimates of world recoverable coal reserves, although relatively stable, have declined gradually from 1,145 billion tons in 1991 to 1,083 billion tons in 2000 and 909 billion tons in 2008 [***44***]. Although the decline in estimated reserves is sizable, the large reserves-to-production ratio for world coal indicates that sufficient coal will be available to meet demand well into the future. Further, because recoverable reserves are a subset of total coal resources, recoverable reserve estimates for a number of regions with large coal resource bases—notably, 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 most recent assessment of world coal reserves includes a substantial downward adjustment for Africa, from 55 billion tons reported in the 2007 edition of the World Energy Council's *Survey of Energy Resources* to 35 billion tons in the 2009 interim update [***45***]. The update is based on a new estimate for recoverable reserves in South Africa, which was derived on the basis of factors that include: a reduction in estimated reserves resulting from the subtraction of cumulative production by coalfield for the years 1982 through 2007 from previously completed estimates of reserves; and some additions to the reserve base resulting from several new assessments of coal resources in the Waterberg, Springbok Flats, Limpopo, and Free State coalfields.

[20] 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. The reserves-to-production ratio is based on the reserves estimates and data on world coal production for 2007 shown in Table 9.

Future role of the United States in world coal trade

U.S. coal exports increased each year from 2002 to 2008 at an average annual rate of 12.8 percent, to 82 million tons in 2008. Some analysts have viewed the sharp increase in U.S. exports as an indication of the growing importance of the United States as a world coal supplier. There has also been speculation that China's growing demand for coal will support this trend in the future. However, U.S. coal is a relatively high-cost supply source when shipped to Asian markets, and in the long term U.S. coal will be competing in the Chinese market with lower cost suppliers, notably Australia and Indonesia among others. U.S. exports compete most strongly in European markets and then only when less expensive options are unavailable. In *IEO-2010*, the United States remains a marginal coal supplier over the long term, responding to short-term disruptions or spikes in demand rather than significantly expanding its market share of world coal trade.

International coal trade patterns can be parsed into two distinct regions, the Atlantic region and the Pacific region. The Americas and Europe are the primary demand centers for international coal trade in the Atlantic region. Asia, dominated by Japan, South Korea, India, and China, is the demand stakeholder in the Pacific region. Historically, geography has been a critical component in determining which suppliers serve which markets, with most suppliers primarily serving only one region. The United States is considered a marginal or "swing" supplier to both markets but rarely participates in the Pacific market, meaning that the United States produces coal at a higher delivered cost than other international suppliers and "swings in" to satisfy demand only when a supply shortage occurs.

Competition is an important factor in assessing the ability of the United States to take a larger share of world coal trade in the future. The cost of production, primarily the expense of mining, is just one of the costs involved in international trade. In terms of the cost of production, the United States tends to be among the more expensive worldwide, primarily because most coal exports come from the Appalachian region, which has been mined more extensively than other U.S. coal basins and generally has higher production costs. Beyond the costs of production, transportation costs associated with moving export coal to port can also be substantial, adding as much as an additional 30 to 50 percent to the total cost for Appalachian coal. Ocean freight rates to transport coal from the United States to Asian markets tend to be volatile and are as much as 40 percent higher than the freight costs for transporting coal from Australia to Asia. As a result, the United States represents a less attractive option for satisfying Asian coal demand in the long run.

U.S. coal exports to Asian markets might be more competitive if large volumes of western coal could be exported from the U.S. West Coast. However, the lack of a dedicated large coal terminal on the West Coast makes it less likely that such an expansion will occur. Previous unsuccessful efforts to operate a western coal terminal also make new western coal ports less likely. In the late 1990s, substantial investments were made at the Los Angeles Export Terminal to support coal exports, but the terminal closed in 2003 when the anticipated surge in U.S. coal exports to Asian markets did not materialize. While Asia's coal import demand grew during that period, its demand for U.S. coal did not.

The Atlantic markets of Europe and Canada currently account for the largest portion of U.S. coal exports (approximately three-fourths of total exports in recent years). In 2008, the largest increases in U.S. coal exports were destined for Europe rather than China. On a worldwide basis, international coal trade in 2008 was affected by significant supply disruptions in several key coal-exporting countries. Floods in Indonesia and Australia affected mine operations, electricity shortages closed mines in South Africa, and there were shortages of rail cars in Russia and long queues at Australian ports. Some of the problems were unexpected, one-time events. For supply bottlenecks that are ongoing, infrastructure improvements are already being undertaken.

In any case, temporary supply problems did raise the perception of ongoing limited global supplies, and as a result the price of coal rose steeply. In 2008, the limited amount of coal that typically flowed from suppliers in the Pacific region to Europe was redirected to importers in the Pacific region, causing a ripple effect into the Atlantic region, where the United States was able to help fill the void by increasing its exports to consumers in the Atlantic region. The circumstances contributing to increased U.S. exports in 2008 are anomalies, however, and not expected to be sustained in the long term. In fact, recently published data indicate that U.S. coal exports contracted by 27 percent in 2009—with European imports from the United States declining by approximately 25 percent.[a]

(continued on page 73)

[a]U.S. Energy Information Administration, *Quarterly Coal Report*, DOE/EIA-0121(2009/4Q), Table 7. U.S. Coal Exports, web site www.eia.gov/cneaf/coal/quarterly/html/t7p01p1.html.

Future role of the United States in world coal trade (continued)

In the past decade, several new coal suppliers have emerged to compete with the United States in supplying coal to the global marketplace. Colombia is the key U.S. rival in the Atlantic market and is typically a lower cost producer than the United States. Colombia's domestic coal consumption is low, and so its investments in the coal industry are dedicated to increasing coal exports. Russia also has increased its market share of coal supplied to European countries, the primary market for U.S. coal exports. Russia has substantial reserves of metallurgical coal, used in the steelmaking process, which is a market where the United States has been more competitive internationally. Moreover, in the long term Europe as a region is expected to rely less on coal to meet its energy needs, so that the United States will face increasing competition from lower cost Colombian and Russian supplies to satisfy a declining European market for coal.

In the Asian markets, Australia has been systematically expanding its export capability. In the next few years alone, Australian mining companies are planning to expand their mining capacity by approximately 100 million tons. Even in 2008, a year of high U.S. coal exports, Australia's coal export volume was more than 2.5 times the U.S. volume. Russia is also investing in infrastructure, including ports to serve the Asian market. Its proximity to Asian importers could allow Russia to become a key Asian supplier. Mongolia may also be an important overland source of coal imports for China, and Mozambique will soon be entering the coal trade arena with its planned exports of both metallurgical and thermal coal.

The United States is not a major supplier of coal to China, but China has an indirect impact on the Atlantic market, and there could be years through 2035 in which events trigger temporary increases in U.S. coal exports to China. China's demand for foreign coal is driven by its growing coal consumption and how its domestic coal production costs compare with international coal prices. Given the limits on its own domestic coal production, any unexpected capacity problem could induce short-run bursts in China's import demand and, less directly, increases in global coal prices.

The higher the global prices, the more likely it is that the United States, as a high-cost supplier, will increase its coal exports. China also has the option, if it decides that international coal prices are too high, of allowing its less efficient domestic coal mines to operate. Because the United States is a relatively high-cost supply source when its coal is shipped to Asian markets, other suppliers—and not the United States—are expected to meet most of China's demand for coal imports from 2007 to 2035.

Table 10. World recoverable coal reserves as of January 1, 2008 (billion short tons)

Region/Country	Recoverable reserves by coal rank				2007 production	Reserves-to-production ratio (years)
	Bituminous and anthracite	Subbituminous	Lignite	Total		
World Total	**452.9**	**291.4**	**165.1**	**909.4**	**7.0**	**129**
United States[a]	119.6	108.7	33.3	261.6	1.1	228
Russia	54.1	107.4	11.5	173.1	0.3	543
China	68.6	37.1	20.5	126.2	2.7	46
Other Non-OECD Europe and Eurasia	49.1	19.0	27.3	95.3	0.3	290
Australia and New Zealand	40.6	2.5	41.5	84.6	0.4	195
India	59.5	0.0	5.1	64.6	0.5	122
Africa	35.1	0.2	0.0	35.3	0.3	127
OECD Europe	9.3	3.4	19.0	31.7	0.7	48
Other Central and South America	7.7	1.1	0.0	8.8	0.1	102
Other Non-OECD Asia	2.5	2.8	4.5	9.8	0.4	24
Brazil	0.0	7.8	0.0	7.8	0.0	1,182
Canada	3.8	1.0	2.5	7.3	0.1	96
Other[b]	3.0	0.3	0.1	3.4	0.0	181

[a]Data for the United States represent recoverable coal estimates as of January 1, 2009.
[b]Includes Mexico, Middle East, Japan, and South Korea.
Sources: World Energy Council and EIA.

Although coal deposits are widely distributed, 82 percent of the world's recoverable reserves are located in five regions: the United States (29 percent), Russia (19 percent), China (14 percent), other non-OECD Europe and Eurasia (10 percent), and Australia/New Zealand (9 percent). In 2007 those five regions, taken together, produced 4.9 billion tons (95.8 quadrillion Btu) of coal, representing 71 percent (74 percent on a Btu basis) of total world coal production [***46***]. By rank, anthracite and bituminous coal account for 50 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 0.8 percent by weight [***47***]. 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 2007 indicate that the average heat content of lignite in major producing countries varies from a low of 5.9 million Btu per ton in Greece to a high of 13.1 million Btu per ton in Canada [***48***].

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Chapter 5

Electricity

World electricity generation increases by 87 percent from 2007 to 2035 in the IEO2010 Reference case. Non-OECD countries account for 61 percent of world electricity use in 2035.

Overview

World net electricity generation increases by an average of 2.3 percent per year from 2007 to 2035 in the *IEO2010* Reference case. Electricity supplies an increasing share of the world's total energy demand and grows faster than liquid fuels, natural gas, and coal in all end-use sectors except transportation. From 1990 to 2007, growth in net electricity generation outpaced the growth in total energy consumption (1.9 percent per year and 1.3 percent per year, respectively), and the growth in demand for electricity continues to outpace growth in total energy use throughout the projection period (Figure 67).

World net electricity generation increases by 87 percent in the Reference case, from 18.8 trillion kilowatthours in 2007 to 25.0 trillion kilowatthours in 2020 and 35.2 trillion kilowatthours in 2035 (Table 11). Although the recent economic downturn slowed the rate of growth in electricity use in 2008 and resulted in no change in electricity use in 2009, the Reference case projection expects growth in electricity use to return to pre-recession trend rates by 2015.

The impact of the recession on electricity consumption has been felt most keenly in the industrial sector. Demand in the building sector (the residential and commercial sectors) is less sensitive to changing economic conditions than it is in the industrial sector, because people generally continue to consume electricity for space heating and cooling, cooking, refrigeration, lighting, and water heating, even in a recession.

In general, projected growth in OECD countries, where electricity markets are well established and consumption patterns are mature, is slower than in non-OECD countries, where a large amount of demand goes unmet at present. The electrification of historically off-grid areas plays a strong role in projected growth trends. The International Energy Agency estimates that 22 percent of the world's population did not have access to electricity in 2008—a total of about 1.5 billion people [***1***]. Regionally, sub-Saharan Africa is worst off: more than 71 percent of the population currently remains without access to power. With strong economic growth and targeted government programs, however, electrification can occur quickly. In Vietnam, for example, the government's rural electrification program increased access to power from 51 percent of rural households in 1996 to 95 percent by the end of 2008 [**2**].

Non-OECD nations consumed 46 percent of the world's total electricity supply in 2007, and their share of world consumption is poised to increase over the projection period. In 2035, non-OECD nations account for 61 percent of world electricity use, while the OECD share declines to 39 percent (Figure 68). Total net electricity

Figure 67. Growth in world electric power generation and total energy consumption, 1990-2035 (index, 1990 = 1)

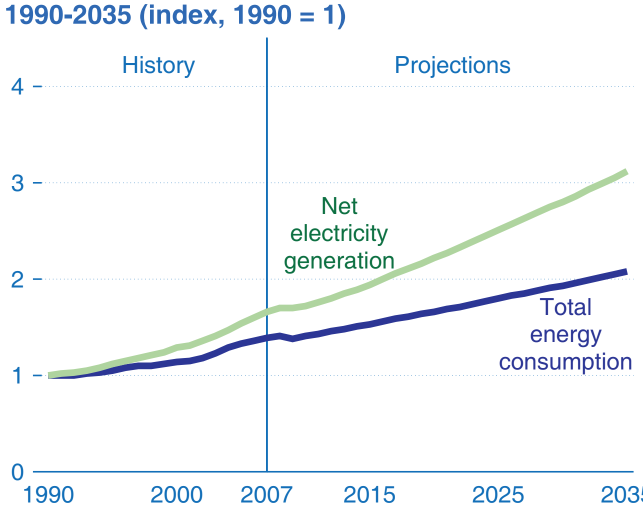
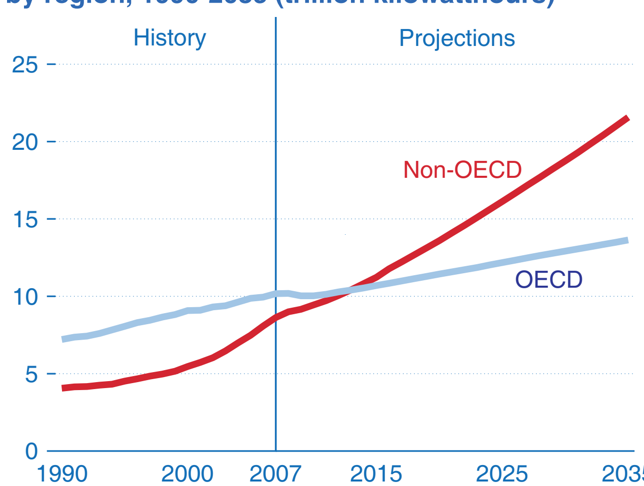
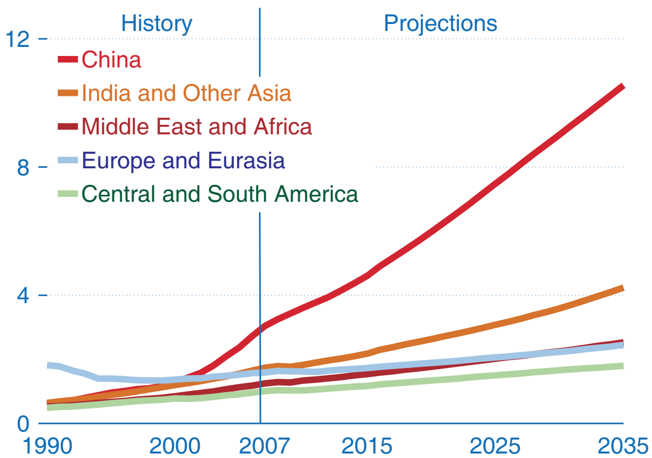


Figure 68. World net electricity generation by region, 1990-2035 (trillion kilowatthours)



generation in non-OECD countries increases by an average of 3.3 percent per year in the Reference case, led by non-OECD Asia (including China and India), with annual increases averaging 4.1 percent from 2007 to 2035 (Figure 69). In contrast, net generation among OECD nations grows by an average of only 1.1 percent per year from 2007 to 2035.

Figure 69. Non-OECD net electricity generation by region, 1990-2035 (trillion kilowatthours)



The Reference case does not include any carbon emissions caps or prices. However, the *IEO2010* Reference case does incorporate national energy policies that are currently active, such as the European Union's "20-20-20" plan and its member states' nuclear policies; China's wind capacity targets; and India's National Solar Mission.

The projection for total electricity generation in 2030 is 0.3 percent lower in the *IEO2010* Reference case than it was in last year's outlook, largely because the impact of the recession in the near term was more severe than anticipated in last year's projection. Compared with *IEO2009*, the generation mix in 2030 in *IEO2010* also changes. For example, liquids-fired generation is 11 percent lower than in *IEO2009*, both natural gas and coal-fired generation are about 5 percent higher, nuclear power generation is 9 percent higher, and generation from renewable sources is 10 percent higher.

Electricity supply by energy source

The mix of primary fuels used to generate electricity has changed a great deal over the past four decades on a worldwide basis. Coal continues to be the fuel most widely used for electricity generation, although

Table 11. OECD and Non-OECD net electricity generation by energy source, 2007-2035 (trillion kilowatthours)

Region	2007	2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OECD							
Liquids	0.3	0.3	0.3	0.3	0.3	0.2	-1.0
Natural gas	2.2	1.9	2.2	2.5	2.9	3.1	1.4
Coal	3.9	3.8	3.8	3.8	4.0	4.2	0.3
Nuclear	2.2	2.4	2.5	2.6	2.7	2.8	1.0
Renewables	1.6	2.3	2.6	2.9	3.1	3.2	2.5
Total OECD	**10.1**	**10.7**	**11.4**	**12.2**	**12.9**	**13.6**	**1.1**
Non-OECD							
Liquids	0.6	0.6	0.5	0.5	0.5	0.6	-0.2
Natural gas	1.7	2.2	2.8	3.2	3.6	3.7	2.8
Coal	4.1	5.1	6.0	7.3	9.0	10.8	3.6
Nuclear	0.4	0.7	1.0	1.3	1.5	1.7	5.0
Renewables	1.8	2.7	3.2	3.7	4.3	4.8	3.5
Total Non-OECD	**8.6**	**11.2**	**13.6**	**16.1**	**18.8**	**21.6**	**3.3**
World							
Liquids	0.9	0.9	0.8	0.8	0.8	0.8	-0.4
Natural gas	3.9	4.2	5.0	5.8	6.4	6.8	2.1
Coal	7.9	8.8	9.8	11.2	12.9	15.0	2.3
Nuclear	2.6	3.1	3.6	3.9	4.2	4.5	2.0
Renewables	3.5	5.0	5.8	6.6	7.3	8.0	3.0
Total World	**18.8**	**21.9**	**25.0**	**28.3**	**31.6**	**35.2**	**2.3**

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

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 oil prices rose sharply.

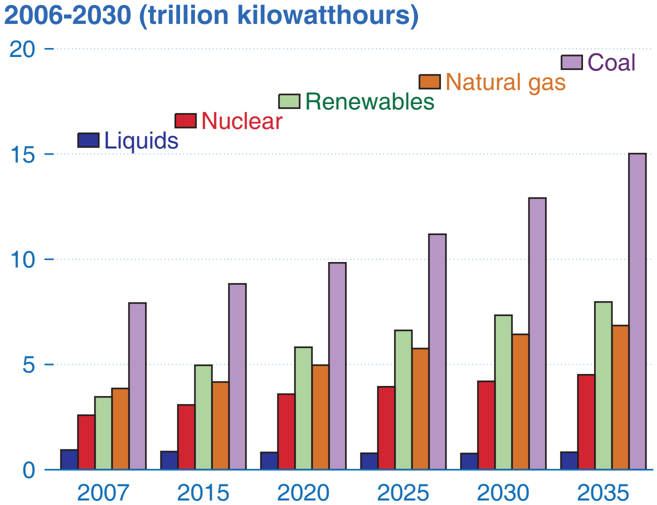
High fossil fuel prices recorded between 2003 and 2008, combined with concerns about the environmental consequences of greenhouse gas emissions, have renewed interest in the development of alternatives to fossil fuels—specifically, nuclear power and renewable energy sources. In the *IEO2010* Reference case, long-term prospects continue to improve for generation from both nuclear and renewable energy sources—supported by government incentives and by high fossil fuel prices. Coal and natural gas are the second and third fastest-growing sources of energy for electricity generation in the projection (Table 11), but the outlook for coal, in particular, could be altered substantially by any future national policies or international agreements that aim to reduce or limit the growth of greenhouse gas emissions.

Coal

In the *IEO2010* Reference case, coal continues to fuel the largest share of worldwide electric power production by a wide margin (Figure 70). In 2007, coal-fired generation accounted for 42 percent of world electricity supply; in 2035, its share increases slightly to 43 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, including China and India. World net coal-fired generation nearly doubles over the projection period, from 7.9 trillion kilowatthours in 2007 to 15.0 trillion kilowatthours in 2035.

The outlook for coal-fired generation could be altered substantially by national policies or international agreements to reduce greenhouse gas emissions. The electric

Figure 70. World net electricity generation by fuel, 2006-2030 (trillion kilowatthours)



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 energy for power generation and also the most carbon-intensive energy source. If a cost, either implicit or explicit, were applied to carbon dioxide emissions, 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.

Natural gas

Over the 2007 to 2035 projection period, natural-gas-fired electricity generation increases by 2.1 percent per year. Generation from natural gas worldwide increases from 3.9 trillion kilowatthours in 2007 to 6.8 trillion kilowatthours in 2035, but the total amount of electricity generated from natural gas continues to be less than one-half the total for coal, even in 2035. Natural-gas-fired combined-cycle technology is an attractive choice for new power plants because of its fuel efficiency, operating flexibility (it can be brought online in minutes rather than the hours it takes for coal-fired and some other generating capacity), relatively short planning and construction times, relatively low emissions, and relatively low capital costs.

Liquid fuels and other petroleum

With world oil prices projected to return to relatively high levels, reaching $133 per barrel (in real 2008 dollars) in 2035, liquid fuels are the only energy source for power generation that does not grow on a worldwide basis. Most nations are expected to respond to higher oil prices by reducing or eliminating their use of oil for generation—opting instead for more economical sources of electricity, including coal and nuclear. Generation from liquid fuels decreases by 0.4 percent per year, from 0.9 trillion kilowatthours in 2007 to 0.8 trillion kilowatthours in 2035. Modest growth in liquid fuels generation in the later years of the projection, particularly in the Middle East, is more than offset by decline in all other regions.

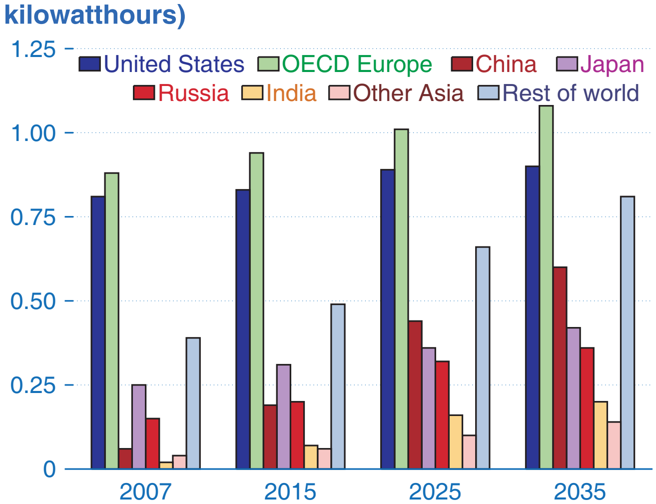
Nuclear power

Electricity generation from nuclear power increases from about 2.6 trillion kilowatthours in 2007 to 4.5 trillion kilowatthours in 2035, 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 liquid fuels despite the relatively high capital 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.

Around the world, nuclear generation is attracting new interest as countries look to increase the diversity of their energy supplies and provide a low-carbon alternative to fossil fuels. Still, there is considerable uncertainty associated with nuclear power projections. Issues that could slow the expansion of nuclear power in the future include plant safety, radioactive waste disposal, rising construction costs and investment risk, 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 concern in many countries and may hinder the development of new nuclear power reactors. Nevertheless, the *IEO2010* Reference case incorporates improved prospects for world nuclear power. The projection for nuclear electricity generation in 2030 is 9 percent higher than the projection published in last year's outlook.

On a regional basis, the *IEO2010* Reference case projects the strongest growth in nuclear power for the countries of non-OECD Asia (Figure 71). Non-OECD Asia's nuclear power generation grows at an average annual rate of 7.7 percent from 2007 to 2035, including increases of 8.4 percent per year in China and 9.5 percent per year in India. China leads the field with nearly 43 percent of worldwide active construction projects in 2009 and is expected to install the most nuclear capacity over the period, building 66 gigawatts of net generation capacity by 2035 [*3*]. Outside Asia, nuclear generation grows the fastest in Central and South America, where it increases

Figure 71. World net electricity generation from nuclear power by region, 2007-2030 (trillion kilowatthours)



by an average of 4.3 percent per year. The nuclear generation forecast in OECD Europe has undergone a significant revision from *IEO2009*, because multiple countries in the region are reversing their anti-nuclear policies. In the *IEO2010* Reference case, nuclear generation worldwide increases by 2.0 percent per year.

To address the uncertainty inherent in projections of nuclear power growth in the long term, a two-step approach is used to formulate the outlook for nuclear power. In the short term (through 2020), 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 on which nuclear projects are likely to become operational in the short-term. After 2020, 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, environmental policies, and uranium availability.

Hydroelectric, wind, geothermal, and other renewable generation

Renewable energy is the fastest-growing source of electricity generation in the *IEO2010* Reference case. Total generation from renewable resources increases by 3.0 percent annually, and the renewable share of world electricity generation grows from 18 percent in 2007 to 23 percent in 2035. Almost 80 percent of the increase is in hydroelectric power and wind power. The contribution of wind energy, in particular, has grown swiftly over the past decade, from 18 gigawatts of net installed capacity at the end of 2000 to 159 gigawatts at the end of 2009—a trend that continues into the future [*4*]. Of the 4.5 trillion kilowatthours of new renewable generation added over the projection period, 2.4 trillion kilowatthours (54 percent) is attributed to hydroelectric power and 1.2 trillion kilowatthours (26 percent) to wind (Table 12).

Although renewable energy sources have positive environmental and energy security attributes, most renewable technologies other than hydroelectricity are not able to compete economically with fossil fuels during the projection period outside of a few regions. Solar power, for instance, is currently a "niche" source of renewable energy but can be economical where electricity prices are especially high, where peak load pricing occurs, or where government incentives are available. Government policies or incentives often provide the primary economic motivation for construction of renewable generation facilities.

Wind and solar are intermittent technologies that can be used only when resources are available. Once built, the cost of operating wind or solar technologies when the resource is available is generally much less than the cost of operating conventional renewable generation. However, high construction costs can make the total cost to build and operate renewable generators higher than those for conventional power plants. The intermittence of wind and solar can further hinder the economic competitiveness of those resources, as they are not operator-controlled and are not necessarily available when they would be of greatest value to the system. The use of energy storage (such as hydroelectric pumped storage, compressed air storage, and batteries) and a wide geographic dispersal of wind and solar generating facilities could mitigate many of the problems associated with intermittence in the future.

Changes in the mix of renewable fuels used for electricity generation differ between the OECD and non-OECD regions in the *IEO2010* Reference case. In OECD nations, the majority of economically exploitable hydroelectric resources already have been captured; with the exceptions of Canada and Turkey, there are few large-scale hydroelectric projects planned for the future. As a result, most renewable energy growth in OECD countries comes from nonhydroelectric sources, especially wind and biomass. Many OECD countries, particularly those in Europe, have government policies, including feed-in tariffs,[21] tax incentives, and market share quotas, that encourage the construction of renewable electricity facilities.

In non-OECD countries, hydroelectric power is expected to be the predominant source of renewable electricity growth. Strong growth in hydroelectric generation, primarily from mid- to large-scale power plants, is expected in China, India, Brazil, and a number of nations in Southeast Asia, including Malaysia and Vietnam. Growth rates for wind-powered generation are also high in non-OECD countries. The most substantial additions of electricity supply generated from wind power are centered in China.

The *IEO2010* projections for renewable energy sources include only marketed renewables. Non-marketed (noncommercial) biomass from plant and animal resources, while an important source of energy, particularly in the developing non-OECD economies, is not included in the

Table 12. OECD and Non-OECD net renewable electricity generation by energy source, 2007-2035 (billion kilowatthours)

Region	2007	2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OECD							
Hydropower	1,246	1,384	1,460	1,530	1,585	1,624	0.9
Wind	144	525	671	803	846	898	6.8
Geothermal	37	57	61	66	73	80	2.8
Solar	6	85	104	107	114	122	11.6
Other	195	253	318	398	456	485	3.3
Total OECD	**1,628**	**2,303**	**2,614**	**2,904**	**3,074**	**3,208**	**2.5**
Non-OECD							
Hydropower	1,753	2,305	2,706	3,061	3,449	3,795	2.8
Wind	21	157	231	312	388	457	11.7
Geothermal	21	41	47	52	68	80	5.0
Solar	0	10	23	33	39	44	21.7
Other	40	141	196	255	317	389	8.4
Total Non-OECD	**1,834**	**2,654**	**3,203**	**3,714**	**4,263**	**4,764**	**3.5**
World							
Hydropower	2,999	3,689	4,166	4,591	5,034	5,418	2.1
Wind	165	682	902	1,115	1,234	1,355	7.8
Geothermal	57	98	108	119	142	160	3.7
Solar	6	95	126	140	153	165	12.7
Other	235	394	515	653	773	874	4.8
Total World	**3,462**	**4,958**	**5,817**	**6,618**	**7,336**	**7,972**	**3.0**

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

[21] A feed-in tariff is a financial incentive that encourages the adoption of renewable electricity. Under a feed-in tariff, government legislation requires electric utilities to purchase renewable electricity at a higher price than the wholesale price. This allows the renewable generator to achieve a positive return on its investment despite the higher costs associated with these resources.

projections because comprehensive data on its use are not available. Off-grid distributed renewables (renewable energy consumed at the site of production, such as off-grid photovoltaic panels) are not included in the projections for the same reason.

Regional electricity outlooks

In the *IEO2010* Reference case, the highest growth rates for electricity generation are in non-OECD nations, where strong economic growth and rising personal incomes drive the growth in demand for electric power. In OECD countries—where electric power infrastructures are relatively mature, national populations generally are expected to grow slowly or decline, and GDP growth is slower than in the developing nations—demand for electricity grows much more slowly. In the Reference case, electricity generation in non-OECD nations increases by 3.3 percent per year, as compared with 1.1 percent per year in OECD nations.

OECD electricity

North America

North America currently accounts for the largest regional share of world electricity generation, with 27 percent of the total in 2007. That share declines as non-OECD nations experience fast-paced growth in demand for electric power. In 2035, North America accounts for only 19 percent of the world's net electric power generation.

The United States is by far the largest consumer of electricity in North America (Figure 72). U.S. electricity generation—including both generation by electric power producers and on-site generation—increases slowly, at an average annual rate of 0.8 percent from 2007 to 2035. Canada, like the United States, has a mature electricity market, and its generation increases by 1.2 percent per year over the same period. Mexico's electricity generation grows at a faster rate—averaging 3.2 percent per year through 2035—reflecting the present less-developed state of the country's electric power infrastructure (and thus the greater potential for expansion) relative to Canada and the United States.

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 73). In the United States, coal is the leading source of energy for power generation, accounting for 49 percent of the 2007 total. In Canada, hydroelectricity provided 59 percent of the nation's electricity generation in 2007. Most of Mexico's electricity generation is currently fueled by petroleum-based liquid fuels and natural gas, which together accounted for 63 percent of its total electricity generation in 2007. In the Reference case, U.S. reliance on coal decreases to 44 percent in 2035; Canada's hydropower continues to be the predominant energy source for electricity generation, although its share of the total falls to 54 percent in 2035; and the natural gas share of Mexico's total electricity generation increases from 37 percent in 2007 to 63 percent in 2035.

Generation from renewable energy sources in the United States increases in response to requirements in more than half of the 50 States for minimum renewable generation or capacity shares. Renewable generation in the *IEO2010* Reference case is substantially higher than in recent *IEO* projections, as the share of generation coming from renewable energy sources grows from 8.5 percent in 2007 to 17.0 percent in 2035. Net installed capacity of wind power increased by 39 percent, equal to nearly 10 gigawatts, in 2009 alone [*5*]. The American Recovery and Reinvestment Act of 2009 directed $16.8 billion into energy efficiency and renewable energy and another $4.0 billion into loan guarantees for renewable energy [*6*]. U.S. federal subsidies for renewable generation are assumed to expire as enacted. If those subsidies

Figure 72. Net electricity generation in North America, 1990-2035 (trillion kilowatthours)

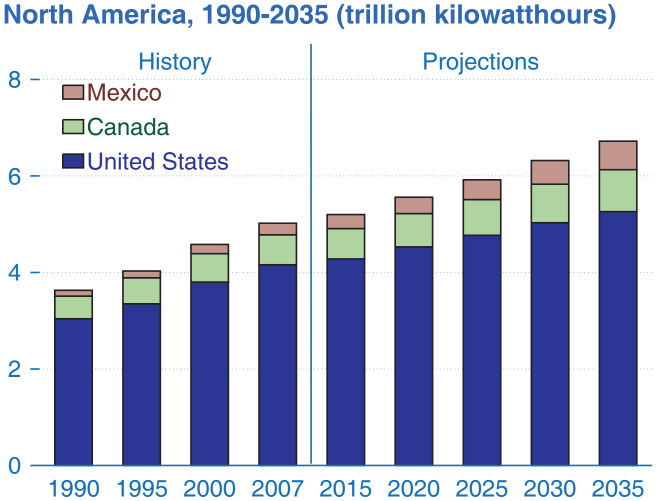
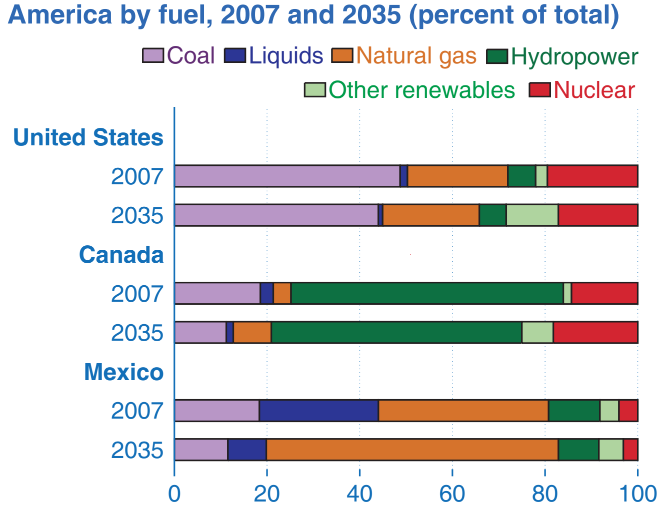


Figure 73. Net electricity generation in North America by fuel, 2007 and 2035 (percent of total)



were extended, however, a larger increase in renewable generation would be expected.

Electricity generation from nuclear power plants accounts for 17.1 percent of total U.S. generation in 2035 in the *IEO2010* Reference case. From 2007 to 2035, the United States adds 8.4 gigawatts of new capacity and 4.0 gigawatts from expansions at existing plants. No U.S. nuclear plants are retired in the Reference case. Despite the increasing estimated costs of new nuclear plants, growth in nuclear power is expected to be spurred by the rising costs of natural-gas-fired generation, concerns about greenhouse gas emissions (which limit additions of coal-fired plants in the projection), and favorable U.S. policies.

In Canada, generation from natural gas increases by 4.0 percent per year from 2007 to 2035, nuclear by 2.1 percent per year, hydroelectricity by 0.9 percent per year, and wind by 10.7 percent per year. Oil-fired generation and coal-fired generation, on the other hand, decline by 1.0 percent per year and 0.6 percent per year, respectively.

In Ontario—Canada's largest provincial electricity consumer—the government plans to close its four coal-fired plants (Atikokan, Lambton, Nanticoke, and Thunder Bay) by December 31, 2014, citing environmental and health concerns [*7*]. Units 1 and 2 of Lambton and units 3 and 4 of Nanticoke are scheduled to be decommissioned by the end of 2010 [*8*]. The government plans to replace coal-fired generation with natural gas, nuclear, hydropower, and wind. It also plans to increase conservation measures. At present, coal provides about 19 percent of Ontario's electric power. With the planned retirements in Ontario, Canada's coal-fired generation declines from about 115 billion kilowatthours in 2007 to 97 billion kilowatthours in 2035.

The renewable share of Canada's overall generation remains roughly constant throughout the projection. Hydroelectric power is, and is expected to remain, the primary source of electricity in Canada. In 2007, hydroelectric generation provided 59 percent of the country's total generation; it falls to 54 percent in 2035. Wind-powered generation, in contrast, is the fastest growing source of new energy in Canada; its share increases from 1 percent to 6 percent over the projection period.

As one of the few OECD countries with large untapped hydroelectric potential, Canada currently has several large- and small-scale hydroelectric facilities either planned or under construction. Hydro-Québec is continuing the construction of a 768-megawatt facility near Eastmain and a smaller 150-megawatt facility at Sarcelle in Québec, both of which are expected to be fully commissioned by 2012 [*9*]. Other hydroelectric projects are under construction, including the 1,550-megawatt Romaine River project in Québec and the 200-megawatt Wuskwatim project in Manitoba [*10*]. The *IEO2010* Reference case does not anticipate that all planned projects will be constructed, but given Canada's past experience with hydropower and the commitments for construction, new hydroelectric capacity accounts for 22,910 megawatts of additional renewable capacity added in Canada between 2007 and 2035.

Canada also has plans to continue expanding its wind power capacity. From 3.1 gigawatts of installed capacity at the end of 2009 [*11*], the total increases to nearly 17.5 gigawatts in 2035 in the Reference case. Growth in wind capacity has been so rapid that Canada's federal wind incentive program, "ecoENERGY for Renewable Power," which targeted the deployment of 4 gigawatts of renewable energy by 2011, allocated all of its funding and met its target by the end of 2009 [*12*].

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 1,168 megawatts in January 2010 [*13*]. The Standard Offer Program pays all small renewable energy generators (those with installed capacity less than 10 megawatts) 11 cents (Canadian) per kilowatthour of electricity delivered to local electricity distributors [*14*]. Continued support from Canada's federal and provincial governments—along with the sustained higher fossil fuel prices in the *IEO2010* Reference case—is expected to provide momentum for the projected increase in the country's use of wind power for electricity generation.

Mexico's electricity generation increases by an average of 3.2 percent annually from 2007 to 2035—more than double the rate for Canada and almost quadruple the rate for the United States. The Mexican government has recognized the need for the country's electricity infrastructure to keep pace with the fast-paced growth anticipated for electricity demand. In July 2007, the government unveiled its 2007-2012 National Infrastructure Program, which included plans to invest $25.3 billion to improve and expand electricity infrastructure [*15*]. As part of the program, the government has set a goal to increase installed generating capacity by 8.6 gigawatts from 2006 to 2012. The country is well on its way to meeting the government target. The 1,135-megawatt Tamazunchale combined-cycle plant became operational in June 2007, and several other plants under construction will bring on line another 1,304 megawatts in 2010 and 750 megawatts in 2012 [*16*].

Most of the increase in Mexico's electricity generation in the *IEO2010* Reference case is fueled by natural gas, as the Mexican government implements plans to reduce the country's use of diesel and fuel oil in the power sector [*17*]. Natural-gas-fired generation is more than quadrupled in the projection, from 90 billion kilowatthours in 2007 to 369 billion kilowatthours in 2035. The resulting growth in Mexico's demand for natural gas strongly outpaces its growth in production, leaving the country dependent on pipeline imports from the United States and LNG from other countries. Currently, Mexico has one LNG import terminal, Altamira, operating on the Gulf Coast and another, Costa Azul, on the Pacific Coast. A contract tender for a third terminal at Manzanillo, also on the Pacific Coast, was awarded in March 2008, and the project is scheduled for completion by 2011 [*18*].

Although much of the growth in Mexico's electric power sector is expected to be in the form of natural-gas-fired generation, renewable energy resources are the second fastest-growing source of generation in the projection. Mexico's renewable generation increases by 2.9 percent per year from 2007 to 2035, compared with 5.2 percent per year for natural-gas-fired generation. The country's current renewable generation energy mix is split largely between hydroelectricity (73 percent) and geothermal energy (19 percent). Two major hydroelectric projects are underway: the 750-megawatt La Yesca facility, scheduled for completion by 2012, and the planned 900-megawatt La Parota project, which has been delayed and may not be completed until 2018[*19*]). In the *IEO2010* Reference case, hydroelectric power increases by 2.3 percent per year and accounts for more than 60 percent of Mexico's total net generation from renewable energy sources in 2035.

Although there is virtually no wind or solar generation in Mexico at present, the Mexican government's goal of installing 2.5 gigawatts of wind capacity on the Tehuantepec Isthmus by 2012 is expected to encourage wind development in the short term [*20*]. Furthermore, Mexico's goal of reducing national greenhouse gas emissions to 50 percent of the 2002 levels by 2050 will spur wind and solar installations, and those two forms of renewable electricity account for double-digit growth over the projection period [*21*]. Their combined share of total renewable electricity generation rises from less than 1 percent in 2007 to 10 percent in 2035.

OECD Europe

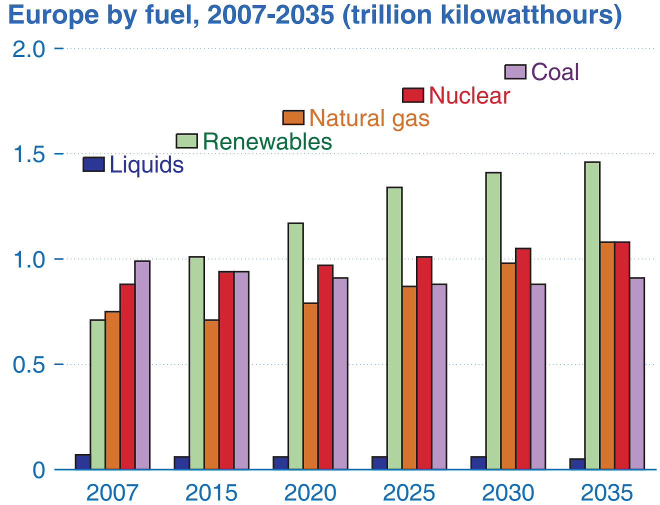
Electricity generation in the nations of OECD Europe increases by an average of 1.1 percent per year in the *IEO2010* Reference case, from 3.4 trillion kilowatthours in 2007 to 4.4 trillion kilowatthours in 2030 and 4.6 trillion kilowatthours in 2035. Because most of the countries in OECD Europe have relatively stable populations and mature electricity markets, most growth in electricity demand is expected to come from those nations 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. In addition, as environmental concerns remain prominent in the region, there is a concerted effort in the industrial sector to switch from coal and liquid fuels to electricity.

Renewable energy is OECD Europe's fastest-growing source of electricity generation in the Reference case (Figure 74), growing by 2.6 percent per year through 2035. The increase is almost entirely from nonhydropower sources. OECD Europe's leading position worldwide in wind power capacity is maintained through 2035, with growth in generation from wind sources averaging 6.5 percent per year, even though the Reference case assumes no enactment of additional legislation to limit greenhouse gas emissions. Strong growth in offshore wind capacity is currently underway, with 577 megawatts added to the grid in 2009, representing an increase of 54 percent over capacity added in 2008 [*22*].

The growth of nonhydropower renewable energy sources in OECD Europe is encouraged by some of the world's most favorable renewable energy policies. The European Union has set a binding target to produce 21 percent of electricity generation from renewable sources by 2010 [*23*] and has reaffirmed the goal of increasing renewable energy use with its December 2008 "climate and energy policy," which mandates that 20 percent of total energy production must come from renewables by 2020 [*24*]. Approximately 21 percent of the European Union's electricity came from renewable sources in 2007.

The *IEO2010* Reference case does not anticipate that all future renewable energy targets in the European Union will be met on time. Nevertheless, current laws are

Figure 74. Net electricity generation in OECD Europe by fuel, 2007-2035 (trillion kilowatthours)



expected to lead to the construction of more renewable capacity than would have occurred in their absence. In addition, some individual countries provide economic incentives to promote the expansion of renewable electricity. Germany, Spain, and Denmark—the leaders in OECD Europe's installed wind capacity—have enacted feed-in tariffs (FITs) that guarantee above-market rates for electricity generated from renewable sources and, typically, last for 20 years after a project's completion. As long as European governments support such price premiums for renewable electricity, robust growth in renewable generation is likely to continue.

There have been drawbacks, however, to relying on FITs. Spain's generous solar subsidy led to an overabundance of solar photovoltaic (PV) projects in the country in 2008, overheating the global PV market and committing Spanish taxpayers to an estimated $26.5 billion to cover the total FIT costs over the lifetime of the projects. When the Spanish FIT was lowered after September 2008, a PV supply glut resulted, driving down the price of solar panels and lowering profits throughout the industry [*25*]. Germany has been considering a reduction of its solar FIT to avoid the same outcome.

Natural gas is the second fastest-growing source of power generation after renewables in the outlook for OECD Europe, increasing at an average rate of 1.3 percent per year from 2007 to 2035. Although growth still is strong, considering that total electricity demand increases by only 1.1 percent per year, it is slower than the 2.3-percent annual increase projected for natural-gas-fired generation in last year's outlook. The difference results primarily from revised growth projections for the region's nuclear and, to a lesser extent, renewable generation.

Nuclear power has gained renewed interest in Europe as concerns about greenhouse gas emissions and secure electricity supplies have increased. Electricity generation from nuclear power increases slightly over the projection period, as compared with a slight decrease in *IEO2009*. Many European nations that were previously opposed to nuclear power have revisited their stances, and Sweden and Italy reversed their nuclear policies in the first half of 2009. Further, Belgium has postponed its nuclear phaseout by 10 years [*26*], and the German government elected in September 2009 has announced its plans to rescind Germany's phaseout policy [*27*].

Renewed interest and moves to reverse legislative bans on nuclear power have led to more license extensions and fewer retirements of operating nuclear power plants than were expected in previous outlooks. In addition, the *IEO2010* Reference case anticipates some new builds in France, Finland, Poland, Turkey, and possibly other countries of OECD Europe. As a result, OECD Europe's total nuclear capacity increases from 131 gigawatts in 2007 to 144 gigawatts in 2035.

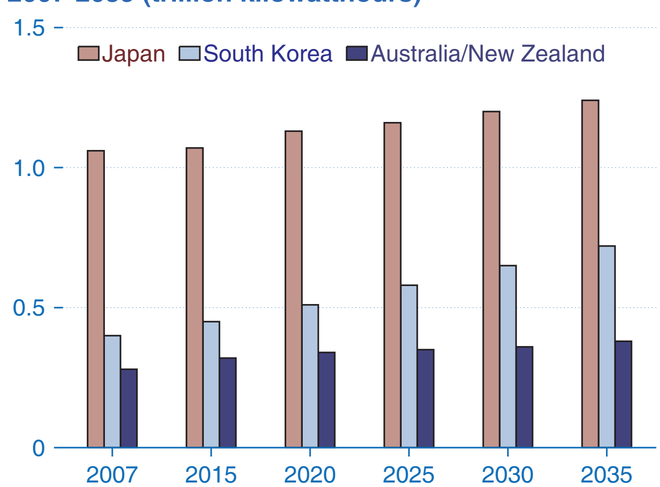
The new assessment of the potential for nuclear power in OECD Europe results in a substantial change in the projected fuel mix compared to last year's outlook. In the *IEO2009* Reference case, natural gas generation in OECD Europe was expected to exceed nuclear generation in 2015, and in 2030 natural gas generation exceeded nuclear generation by nearly 40 percent. The *IEO2010* Reference case instead projects that regional nuclear generation will remain greater than natural-gas-fired generation until 2035, when electricity generation totals from the two sources are expected to be approximately equal.

Coal accounted for nearly 30 percent of OECD Europe's net electricity generation in 2007, but concerns about the contribution of carbon dioxide emissions to climate change could reduce that share in the future. In the *IEO2010* Reference case, electricity from coal slowly loses its prominence in OECD Europe, decreasing by 0.3 percent per year from 2007 to 2035 and ultimately falling behind renewables, natural gas, and nuclear energy as a source of electricity.

OECD Asia

Total electricity generation in OECD Asia increases by an average of 1.0 percent per year in the Reference case, from 1.7 trillion kilowatthours in 2007 to 2.3 trillion kilowatthours in 2035. Japan accounts for the largest share of electricity generation in the region today and continues to do so in the mid-term projection, despite having the slowest-growing electricity market in the region and the slowest among all OECD countries, averaging 0.5 percent per year, as compared with 1.0 percent per year for Australia/New Zealand and 2.1 percent per year for South Korea (Figure 75). Japan's electricity markets are well established, and its aging population and

Figure 75. Net electricity generation in OECD Asia, 2007-2035 (trillion kilowatthours)



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 economic 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 51 percent of total generation and coal another 31 percent. The remaining portion is split between renewables and petroleum-based liquid fuels. Japan's reliance on nuclear power increases over the projection period, from 24 percent of total generation in 2007 to 34 percent in 2035. The natural gas share of generation declines slightly over the same period, from 28 percent to 27 percent, and coal's share declines to 23 percent, being displaced by nuclear and—to a much smaller extent—renewable energy sources.

Solar power, increasing by 27.2 percent per year from 2007 to 2035, is Japan's fastest growing source of renewable electricity, although it starts from a negligible amount in 2007. A recipient of favorable government policies, the growth in solar power outpaces wind power, which increases by 3.8 percent per year. Both solar and wind power, however, remain minor sources of electricity, each supplying less than 1 percent of total generation in 2035, as compared with hydropower's 8-percent share.

Australia and New Zealand, as a region, rely on coal for about 70 percent of electricity generation, based largely on Australia's rich coal resource base (9 percent of the world's total coal reserves). The remaining regional generation is supplied by natural gas and renewable energy sources—mostly hydropower, wind, and, in New Zealand, geothermal. 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 2.4 percent per year from 2007 to 2035, reducing the coal share to 58 percent in 2035.

In South Korea, coal and nuclear power currently provide 43 percent and 34 percent of total electricity generation, respectively. Natural-gas-fired generation grows quickly in the Reference case, but despite a near doubling of electricity generation from natural gas, its share of total generation increases only slightly, from 17 percent in 2007 to 18 percent in 2035. Coal and nuclear power continue to provide most of South Korea's electricity generation, with a combined 78 percent of total electricity in 2035.

Non-OECD electricity

Non-OECD Europe and Eurasia

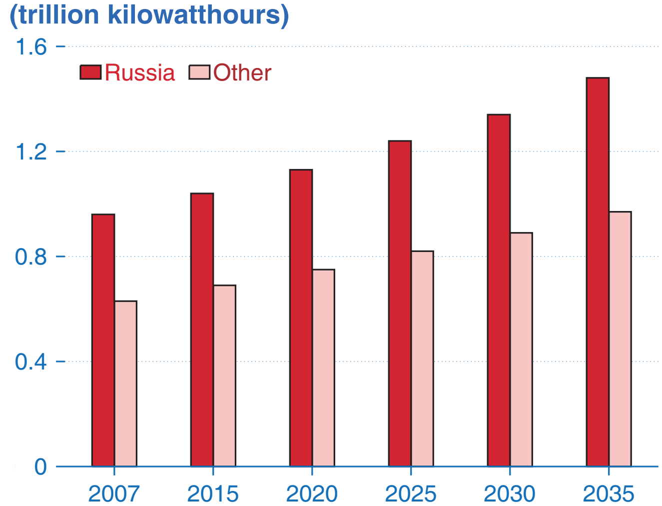
Total electricity generation in non-OECD Europe and Eurasia grows at an average rate of 1.6 percent per year in the *IEO2010* Reference case, from 1.6 trillion kilowatthours in 2007 to 2.2 trillion kilowatthours in 2030 and 2.5 trillion kilowatthours in 2035. Russia, with the largest economy in non-OECD Europe and Eurasia, accounted for around 60 percent of the region's total generation in 2007 and is expected to retain approximately that share throughout the period (Figure 76).

Natural gas and nuclear power supply much of the growth in electricity generation in the region. Although non-OECD Europe and Eurasia has nearly one-third of the world's total proved natural gas reserves, some countries, notably Russia, plan to export natural gas instead of burning it for electricity. As a result, natural-gas-fired generation grows modestly in the outlook, at an average annual rate of 1.2 percent from 2007 to 2035.

Generation from nuclear power grows strongly in the region, averaging 2.8 percent per year. Much of the increase is expected in Russia, which continues to shift generation from natural gas to nuclear because natural gas exports are more profitable than the domestic use of natural gas for electricity generation.

In 2006, the Russian government released Resolution 605, which set a federal target program for nuclear power development. Although the federal target program was updated and scaled back in July 2009 due to the recession, eight nuclear power reactors still are slated for completion by 2015 [*28*]. According to the Russian plan, an additional 40 reactors are to be constructed by 2030, raising Russia's nuclear generating capacity by 2 gigawatts per year from 2012 to 2014 and by 3 gigawatts per year from 2014 to 2020 [*29*]. This plan would

Figure 76. Net electricity generation in Non-OECD Europe and Eurasia, 2007-2035 (trillion kilowatthours)



bring total capacity to 40 gigawatts and increase nuclear generation to 25 or 30 percent of total generation in 2030 [***30***]. The *IEO2010* Reference case takes a more conservative view of the rate at which new nuclear power plants will come online in Russia and assumes some delay in meeting the current construction schedule. In the Reference case, Russia's existing 23 gigawatts of nuclear generating capacity is supplemented by a net total of 5 gigawatts by 2015 and another 20 gigawatts by 2035.

Renewable generation in non-OECD Europe and Eurasia, almost entirely from hydropower facilities, increases relatively slowly, by an average of 1.3 percent per year, largely as a result of repairs and expansions at existing sites. The repairs include reconstruction of turbines in the 6.4-gigawatt Sayano-Shushenskaya hydroelectric plant, which was damaged in an August 2009 accident that killed 75 people. Repairs are expected to be completed no earlier than 2012 [***31***]. Notable new projects include the 3-gigawatt Boguchanskaya Hydroelectric Power Station in Russia and the 3.6-gigawatt Rogun Dam in Tajikistan. Construction began on Boguchanskaya in 1980 and on Rogun in 1976, but work ceased when the former Soviet Union experienced economic difficulties in the 1980s. Despite the recent recession, construction continues on Boguchanskaya, which is on track for completion by 2012 [***32***]. In May 2008, Tajikistan's president announced that construction had resumed on Rogun Dam, although it is still uncertain how the large project will be financed [***33***]. Growth of nonhydropower renewable generation is projected to be small.

Non-OECD Asia

Non-OECD Asia—led by China and India—has the fastest projected regional growth in electric power generation worldwide, averaging 4.1 percent per year from 2007 to 2035 in the Reference case. Although the global economic recession has an impact on the region's short-term economic growth, in the long term the economies of non-OECD Asia are expected to expand strongly, with corresponding increases in demand for electricity in both the building and industrial sectors. Total electricity generation in non-OECD Asia rises by 42 percent from 2007 to 2015, from 4.8 trillion kilowatthours to 6.8 trillion kilowatthours. Electricity demand increases by 56 percent between 2015 and 2025, and by another 40 percent between 2025 and 2035. In 2035, net generation in non-OECD Asia totals 14.8 trillion kilowatthours in the Reference case.

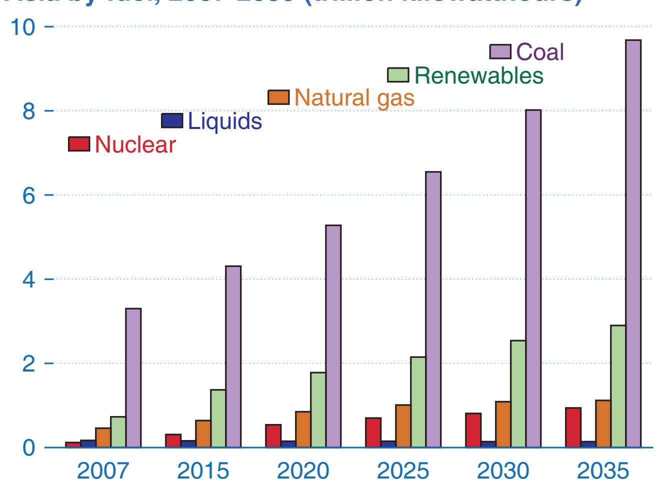
Coal accounts for more than two-thirds of electricity generation in non-OECD Asia (Figure 77), dominated by generation in China and India. Both countries already rely heavily on coal to produce electric power. In 2007, coal's share of generation was an estimated 80 percent in China and 71 percent in India. Under existing policies, it is likely that coal will remain the predominant source of power generation in both countries. In the *IEO2010* Reference case, coal's share of electricity generation declines to 74 percent in China and 51 percent in India in 2035.

Non-OECD Asia leads the world in installing new nuclear capacity in the *IEO2010* Reference case, accounting for 48 percent of the net increment in nuclear capacity worldwide (or 102 gigawatts of the total 211-gigawatt increase). China, in particular, has aggressive plans for nuclear power, with 21 nuclear power plants currently under construction and a total of 66 gigawatts of new capacity expected to be installed by 2035 [***34***]. The nuclear share of total generation in China increases from 2 percent in 2007 to 6 percent in 2035.

India also has plans to boost its nuclear power generation. From 4 gigawatts of installed nuclear power capacity in operation today, India has set an ambitious goal of increasing its nuclear generating capacity to 20 gigawatts by 2020 and to as much as 63 gigawatts by 2032 [***35***]. Five nuclear reactors are currently under construction, three of which are scheduled for completion by the end of 2010 [***36***]. The *IEO2010* Reference case assumes a somewhat slower increase in nuclear capacity than what is anticipated by India's government. The outlook projects that an additional 23 gigawatts of net installed capacity will become operational by 2035.

In addition to China and India, several other countries in non-OECD Asia are expected to begin or expand nuclear power programs. In the Reference case, new nuclear power capacity is installed in Vietnam, Indonesia, and Pakistan by 2020. The impact of high fossil fuel prices, combined with concerns about security of energy supplies and greenhouse gas emissions, leads many nations in the region to consider diversifying the fuel mix for their power generation by adding a nuclear component.

Figure 77. Net electricity generation in Non-OECD Asia by fuel, 2007-2035 (trillion kilowatthours)



Electricity generation from renewable energy sources in non-OECD Asia grows at an average annual rate of 5.0 percent, increasing the renewable share of the region's total generation from 15 percent in 2007 to 20 percent in 2035. Small-, mid-, and large-scale hydroelectric facilities all contribute to the projected growth. Several countries in non-OECD Asia have hydropower facilities either planned or under construction, including Vietnam, Malaysia, Pakistan, and Myanmar (the former Burma). Almost 50 hydropower facilities, with a combined 3,398 megawatts of capacity, are under construction in Vietnam's Son La province, including the 2,400-megawatt Son La and 520-megawatt Houi Quang projects, both of which are scheduled for completion before 2015 [***37***]. Malaysia expects to complete its 2,400-megawatt Bakun Dam by 2011, although the project has experienced delays and setbacks in the past [***38***]. Pakistan and Myanmar also have substantial hydropower development plans, but those plans have been discounted in the *IEO2010* Reference case to reflect the two countries' historical difficulties in acquiring foreign direct investment for infrastructure projects.

India has plans to more than double its installed hydropower capacity by 2030. In its Eleventh and Twelfth Five-Year Plans, which span 2007 through 2017, India's Central Electricity Authority has identified 40.9 gigawatts of hydroelectric capacity that it intends to build. Although the *IEO2010* Reference case does not assume that all the planned capacity will be completed, more than one-third of the announced projects are under construction already and are expected to be completed by 2020 [***39***].

India's federal government is attempting to provide incentives for 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 and allow generators to improve their returns by selling up to 40 percent of their electricity on the spot market. In addition, India's federal hydropower intentions are being supported by state authorities. The state government in Himachal Pradesh has plans to commercialize a substantial portion of the state's reported 21 gigawatts of hydroelectric power potential, adding 5.7 gigawatts of hydroelectric capacity before 2015, which would nearly double the existing capacity [***40***]. At the end of 2009, 11 projects with a combined installed capacity of 4.4 gigawatts were in development in Himachal Pradesh [***41***].

Similar to India, China also has many large-scale hydroelectric projects under construction. The 18.2-gigawatt Three Gorges Dam project's final generator went on line in October 2008, and the Three Gorges Project Development Corporation plans to further increase the project's total installed capacity to 22.4 gigawatts by 2012 [***42***]. In addition, work continues on the 12.6-gigawatt Xiluodu project on the Jinsha River, which is scheduled for completion in 2015 as part of a 14-facility hydropower development plan [***43***]. China also has the world's second tallest dam (at nearly 985 feet) currently under construction, as part of the 3.6-gigawatt Jinping I project on the Yalong River. It is scheduled for completion in 2014 as part of a plan by the Ertan Hydropower Development Company to construct 21 facilities with 34.6 gigawatts of hydroelectric capacity on the Yalong [***44***].

The Chinese government has set a 300-gigawatt target for hydroelectric capacity in 2020. Including those mentioned above, the country has a sufficient number of projects under construction or in development to meet the target. China's aggressive hydropower development plan is expected to increase hydroelectricity generation by 3.9 percent per year, almost tripling the country's total hydroelectricity generation by 2035.

Although hydroelectric projects dominate the renewable energy mix in non-OECD Asia, generation from nonhydroelectric renewable energy sources, especially wind, is also expected to grow significantly. At the end of 2008, China completed installation of its 10th gigawatt of wind capacity, achieving its 2010 target a full year ahead of the schedule set out by the National Development and Reform Commission [***45***]. In May 2009, China increased its 2020 wind capacity target from 30 gigawatts to 100 gigawatts [***46***]. Although that goal has been discounted in the *IEO2010* Reference case because of indications that up to one-third of Chinese installed wind capacity is not grid-connected [***47***], the new target is expected to significantly increase the rate of wind farm construction. In the *IEO2010* Reference case, electricity generation from wind plants in China grows by 15.6 percent per year, from 6 billion kilowatthours in 2007 to 374 billion kilowatthours in 2035.

New government policies in China and India are also encouraging the growth of solar generation. Under its "Golden Sun" program, announced in July 2009, the Chinese Ministry of Finance plans to subsidize 50 percent of the construction costs of grid-connected solar plants [***48***]. India's National Solar Mission, launched in November 2009, aims to have 20 gigawatts of installed solar capacity (both PV and solar thermal) by 2020, 100 gigawatts by 2030, and 200 gigawatts by 2050 [***49***]. India's targets have been discounted in the *IEO2010* Reference case because of the substantial uncertainty about the future of government-provided financial incentives [***50***]. However, the policies support robust growth rates in solar generation for China and India, at 19 percent per year and 27 percent per year, respectively, in the *IEO2010* Reference case.

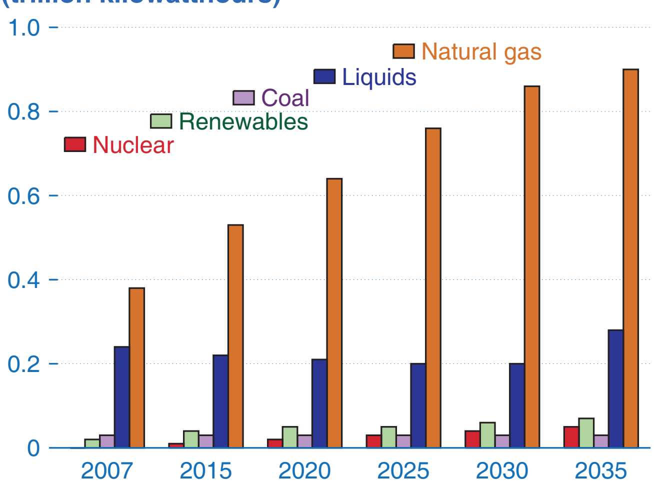
Geothermal energy, while a small contributor to non-OECD Asia's total electricity generation, plays an important role in the Philippines and Indonesia. With the second largest amount of installed geothermal capacity in the world, the Philippines generated almost 18 percent of its total electricity from geothermal sources in 2008 [*51*]. Indonesia, with the fifth largest installed geothermal capacity, generated 5 percent of its electricity from geothermal energy in 2007 and has more than 20 gigawatts of geothermal potential available [*52*]. Both the Philippines and Indonesia have announced plans to increase their installed geothermal capacities in the coming years. Indonesia's plans include 3.9 gigawatts of net installed capacity that it intends to build by 2014 [*53*].

Middle East

Electricity generation in the Middle East region grows by 2.5 percent per year in the Reference case, from 0.7 trillion kilowatthours in 2007 to 1.3 trillion kilowatthours in 2035. The region's young and rapidly growing population, along with a strong increase in national income, is expected to result in rapid growth in demand for electric power. Iran, Saudi Arabia, and the United Arab Emirates (UAE) account for two-thirds of the regional demand for electricity, and demand has increased sharply over the past several years in each of the countries. From 2000 to 2007, Iran's net generation increased by an average of 7.9 percent per year; Saudi Arabia's by 6.1 percent per year; and the UAE's by 9.6 percent per year.

The Middle East depends on natural gas and petroleum liquid fuels to generate most of its electricity and is projected to continue that reliance through 2035 (Figure 78). In 2007, natural gas supplied 57 percent of electricity generation in the Middle East and liquid fuels 35 percent. In 2035, the natural gas share is projected to be 68 percent and the liquid fuels share 21 percent. There has been a concerted effort by many of the petroleum

Figure 78. Net electricity generation in the Middle East by fuel, 2007-2035 (trillion kilowatthours)



exporters in the region to develop their natural gas resources for use in domestic power generation. Petroleum is a valuable export commodity for many nations in 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.

Other energy sources make only minor contributions to electricity supply in the Middle East. Israel is the only country in the region that uses significant amounts of coal to generate electric power [*54*], and Iran and the UAE are the only ones projected to add nuclear capacity. Other Middle Eastern countries recently have expressed some interest in increasing both coal-fired and nuclear generation, however, in response to concerns about diversifying the electricity fuel mix and meeting the region's fast-paced growth in electricity demand. For example, Oman announced in 2008 that it would construct the Persian Gulf's first coal-fired power plant at Duqm [*55*]. According to the plan, the 1-gigawatt plant will power a water desalinization facility and will be fully operational by 2016 [*56*]. The UAE, Saudi Arabia, and Bahrain also have considered adding coal-fired capacity [*57*].

In addition to Iran, several other Middle Eastern nations have announced intentions to pursue nuclear power programs in recent years. In 2007, the six-nation Gulf Cooperation Council[22] completed a feasibility study, in cooperation with the International Atomic Energy Agency, of the potential for a regional nuclear power and desalinization program, while also announcing their intention to pursue a peaceful nuclear program [*58*].

The UAE government in 2008 announced plans to have three 1.5-gigawatt nuclear power plants completed by 2020 and has since signed nuclear cooperation agreements with France, Japan, the United Kingdom, and the United States [*59*]. In December 2009, the Emirates Nuclear Energy Corporation in the UAE selected a South Korean consortium to build four nuclear reactors, with construction planned to begin in 2012 [*60*]. Jordan also has announced its intention to add nuclear capacity [*61*], and in 2009 the Kuwaiti cabinet announced that it would form a national committee on nuclear energy use for peaceful purposes [*62*]. Even given the considerable interest in nuclear power that has arisen in the region, however, *IEO2010* expects that economic and political issues, in concert with the long lead times usually associated with beginning a nuclear program, will mean that any reactors built in the Middle East over the course of the projection will be located in Iran or the UAE.

Although there is little economic incentive for countries in the Middle East to increase their use of renewable energy sources (the renewable share of the region's total

[22] Gulf Cooperation Council members are Saudi Arabia, Kuwait, Bahrain, the United Arab Emirates, Qatar, and Oman.

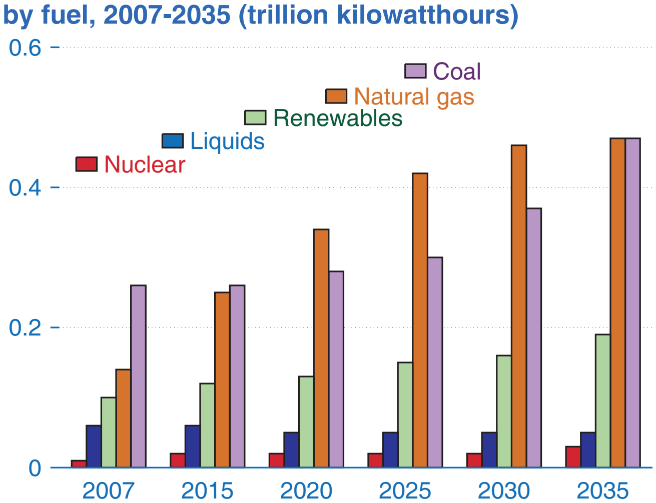
electricity generation increases from only 3 percent in 2007 to 5 percent in 2035 in the Reference case), there have been some recent developments in renewable energy use in the region. Iran, which generated 10 percent of its electricity from hydropower in 2009, is developing 94 new hydroelectric power plants, 5 of which are expected to come on line before March 2010 [*63*]. Construction also continues on Masdar City in Abu Dhabi, a "zero carbon" city that will be powered by 190 megawatts of PV cells and 20 megawatts of wind power [*64*]. The city, which was chosen as the interim headquarters of the International Renewable Energy Agency and currently has a 10-megawatt PV array, is on track to be completed in 2016 [*65*].

Africa

Demand for electricity in Africa grows at an average annual rate of 2.6 percent in the *IEO2010* Reference case. Fossil-fuel-fired generation supplied 81 percent of the region's total electricity in 2007, and reliance on fossil fuels is expected to continue through 2035. Coal-fired power plants, which were the region's largest source of electricity in 2007, accounting for 45 percent of total generation, provide a 39-percent share in 2035; and natural-gas-fired generation expands strongly, from 25 percent of the total in 2007 to 39 percent in 2035 (Figure 79).

At present, South Africa's two nuclear reactors are the only commercial reactors operating in the region, accounting for about 2 percent of Africa's total electricity generation. Reports suggest that, due to Eskom's finance problems and the termination of government funding, the construction of a new Pebble Bed Modular Reactor in South Africa will be delayed indefinitely [*66*]. The South African government plans to have another 4 gigawatts of nuclear capacity on line by mid-2018. In addition, Egypt's government has plans to construct a nuclear reactor, having signed a nuclear power cooperation agreement with Russia in 2008 and awarded a contract to U.S.-based Bechtel to design the new power plant, with tentative plans for a location at Dabaa, about 100 miles west of Alexandria [*67*]. In the Reference case, 2.3 gigawatts of net nuclear capacity becomes operational in Africa over the 2007-2035 period, although only South Africa is expected to complete construction of any reactors. The nuclear share of the region's total generation increases to 3 percent in 2035.

Figure 79. Net electricity generation in Africa by fuel, 2007-2035 (trillion kilowatthours)



Generation from hydropower and other marketed renewable energy sources is expected to grow relatively slowly in Africa. As they have in the past, non-marketed 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. 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 2035, allowing the region's consumption of marketed renewable energy to grow by 2.2 percent per year from 2007 to 2035. For example, Ethiopia finished work on two hydroelectric facilities in 2009: the 300-megawatt Takeze power station and the 420-megawatt Gilgel Gibe II. A third plant, the 460-megawatt Tana Beles, is expected to be operational in the first half of 2010 [*68*].

Central and South America

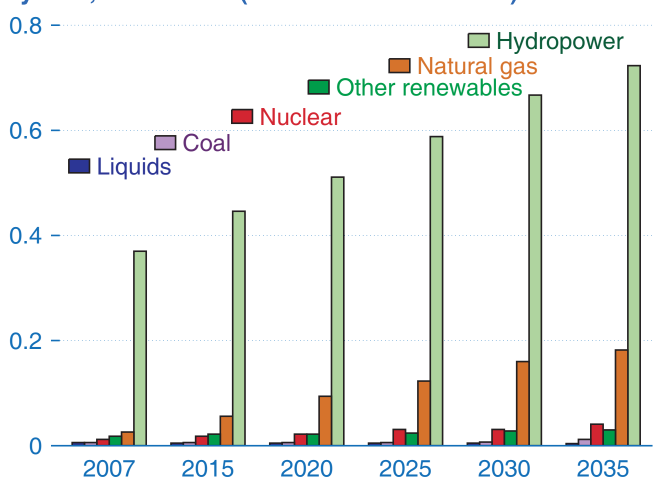
Electricity generation in Central and South America increases by 2.1 percent per year in the *IEO2010* Reference case, from 1.0 trillion kilowatthours in 2007 to 1.7 trillion kilowatthours in 2030 and 1.8 trillion kilowatthours in 2035. The recent global economic crisis slowed the region's economies and lowered demand for electricity, especially in the industrial sector. In the longer term, however, the region's electricity markets are expected to return to trend growth as the economic difficulties recede.

The fuel mix for electricity generation in Central and South America is dominated by hydroelectric power, which accounted for nearly two-thirds of the region's total net electricity generation in 2007. Of the top seven electricity-generating countries in the region, five—Brazil, Venezuela, Paraguay, Colombia, and Peru—generate more than 65 percent of their total electricity from hydropower.

In Brazil, the region's largest economy, hydropower provided almost 85 percent of electricity generation in 2007 (Figure 80). The country has been trying to diversify its electricity generation fuel mix away from hydroelectric power because of the risk of power shortages during times of severe drought. In the Brazilian National Energy Plan for 2008-2017, the government set a goal to build 54 gigawatts of installed capacity, with nonhydroelectric capacity making up the majority of additions [*69*]. To achieve that target, the government has announced plans to increase nuclear power capacity, beginning with the completion of the long-idled 1.3-gigawatt Angra-3 project [*70*]. Construction was delayed in 2009 but is now scheduled to begin in February 2010. According to the plan, the reactor is slated to begin coming on line in mid-2015 [*71*]. Brazil also has plans to construct four additional 1-gigawatt nuclear plants beginning in 2015. In the *IEO2010* Reference case, the Angra-3 project is completed by 2015, and three more planned nuclear projects are completed by 2035.

In the past, the Brazilian government has tried relatively unsuccessfully to attract substantial investment in natural-gas-fired power plants. Its lack of success has been due mostly to the higher costs of natural-gas-fired generation relative to hydroelectric power, and to concerns about the security of natural gas supplies. Brazil has relied on imported Bolivian natural gas for much of its supply, but concerns about the impact of Bolivia's nationalization of its energy sector on foreign investment in the country's natural gas production has led Brazil to look toward LNG imports for secure supplies. Brazil has invested strongly in its LNG infrastructure, and its third LNG regasification plant is scheduled for completion in 2013 [*72*]. With Brazil diversifying its natural gas supplies, substantially increasing domestic production, and resolving to reduce the hydroelectric share of generation, natural gas is projected to be its fastest-growing source of electricity, increasing by 7.2 percent per year on average from 2007 to 2035.

Figure 80. Net electricity generation in Brazil by fuel, 2007-2035 (trillion kilowatthours)

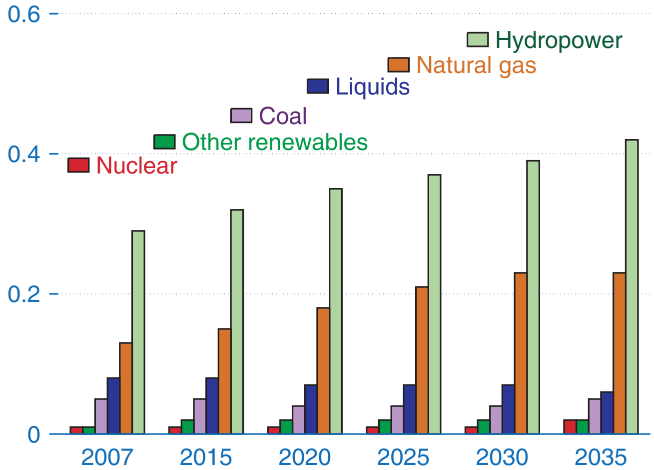


Brazil still has plans to continue expanding its hydroelectric generation over the projection period, including the construction of two plants on the Rio Madeira in Rondonia—the 3.2-gigawatt Santo Antonio and the 3.3-gigawatt Jirau hydroelectric facilities. The two plants, with completion dates scheduled for 2012-2015, are expected to help Brazil meet electricity demand in the mid-term [*73*]. In the long term, electricity demand could be met in part by the proposed 11.2-gigawatt Belo Monte dam; its tender has been delayed until April 2010 [*74*]. Each of these three projects could, however, be subject to further delay as a result of legal challenges.

Brazil is also interested in increasing the use of other, nonhydroelectric renewable resources in the future—notably, wind. In December 2009, Brazil held its first supply tender exclusively for wind farms. At the event, 1.8 gigawatts of capacity were purchased, for development by mid-2012 [*75*]. In a signal that wind power may become more economically competitive in Brazil, the average price of the power sold was 21 percent lower than the ceiling price set by the government. In the *IEO2010* Reference case, wind power generation in Brazil grows by 9.0 percent per year, from 530 million kilowatthours in 2007 to 5,990 million kilowatthours in 2035. Despite that robust growth, however, wind remains a modest component of Brazil's renewable energy mix in the Reference case, as compared with the projected growth in hydroelectric generation to 723 billion kilowatthours in 2035.

Several other nations in Central and South America have been trying to increase the amounts of natural gas used in their generation fuel mixes by increasing both pipeline and LNG supplies. Chile, for instance, relies on Argentina for its natural gas supplies, but beginning in 2004, Argentina began to restrict its exports after it was unable to meet its own domestic supply. As a result, Chile has been forced to use diesel-fueled electric generating capacity periodically to avoid power outages during the winter months [*76*]. In response to the lack of a secure source of natural gas from Argentina, Chile began construction on two LNG regasification projects. The Quintero facility became operational in June 2009, and the second facility, Mejillones, is scheduled for completion by the end of 2010. In the *IEO2010* Reference case, natural-gas-fired generation in Central and South America (excluding Brazil) increases by an average 2.2 percent per year, and the natural gas share of total electricity generation rises from 22 percent in 2007 to 29 percent in 2035 (Figure 81).

Figure 81. Net electricity generation in Other Central and South America by fuel, 2007-2035 (trillion kilowatthours)



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Chapter 6
Industrial Sector Energy Consumption

Worldwide industrial energy consumption increases by 42 percent, or an average of 1.3 percent per year, from 2007 to 2035 in the IEO2010 Reference case. Ninety-five percent of the growth occurs in non-OECD nations.

Overview

The world's industries make up a diverse sector that includes manufacturing, agriculture, mining, and construction. Industrial energy demand varies across regions and countries, depending on the level and mix of economic activity and technological development, among other factors. Energy is consumed in the industrial sector for a wide range of activities, such as processing and assembly, space conditioning, and lighting. Industrial energy use also includes natural gas and petroleum products used as feedstocks to produce non-energy products, such as plastics. In aggregate, the industrial sector uses more energy than any other end-use sector, consuming about one-half of the world's total delivered energy.

Over the 28-year projection, worldwide industrial energy consumption grows from 184 quadrillion Btu in 2007 to 262 quadrillion Btu in 2035 (Table 13). In the *IEO2010* Reference case, world industrial energy demand increases at an average annual rate of 1.3 percent through 2035. In the short term, the industrial sector accounts for a majority of the reduction in energy use in 2009 caused by the recent economic downturn (Figure 82), primarily because the impact of substantial cutbacks in manufacturing is more pronounced than the impact of marginal reductions in energy use in other sectors. In the long term, national economic growth rates and energy consumption patterns return to historical trends (Figure 83).

Most of the long-term growth in industrial sector energy demand occurs in non-OECD nations. Currently, non-OECD economies consume 60 percent of global delivered energy in the industrial sector. From 2007 to 2035, industrial energy use in non-OECD countries grows by

Table 13. World industrial delivered energy consumption by region and energy source, 2007-2035 (quadrillion Btu)

Region	2007	2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OECD							
Liquids and other petroleum	29.1	24.8	24.7	25.1	25.9	26.5	-0.3
Natural gas	19.3	20.7	21.4	21.9	21.7	22.1	0.5
Coal	8.7	6.9	7.1	7.2	7.2	7.1	-0.8
Electricity	11.4	10.9	11.6	12.3	12.9	13.7	0.6
Renewables	4.7	4.9	5.3	6.1	6.7	7.6	1.7
Total OECD	**73.4**	**68.2**	**70.2**	**72.5**	**74.4**	**76.9**	**0.2**
Non-OECD							
Liquids and other petroleum	27.8	26.9	28.6	31.7	35.2	38.4	1.2
Natural gas	23.9	33.6	37.6	39.1	39.7	41.7	2.0
Coal	34.4	36.2	41.0	45.0	48.3	50.9	1.4
Electricity	16.2	20.2	24.6	29.4	34.3	39.7	3.2
Renewables	8.7	9.3	10.4	11.6	12.8	14.2	1.8
Total Non-OECD	**111.1**	**126.1**	**142.2**	**156.8**	**170.4**	**184.9**	**1.8**
World							
Liquids and other petroleum	57.1	51.7	53.3	56.8	61.0	64.9	0.5
Natural gas	43.2	54.3	59.0	61.1	61.4	63.8	1.4
Coal	43.1	43.1	48.2	52.1	55.5	58.0	1.1
Electricity	27.6	31.1	36.3	41.6	47.3	53.3	2.4
Renewables	13.4	14.1	15.7	17.6	19.5	21.8	1.8
Total World	**184.4**	**194.3**	**212.5**	**229.3**	**244.7**	**261.8**	**1.3**

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

an average of 1.8 percent per year, compared with 0.2 percent per year in OECD countries (Figure 84). Thus, 95 percent of the growth in industrial energy use from 2007 to 2035 in the *IEO2010* Reference case occurs in non-OECD countries, and non-OECD nations consume 71 percent of total delivered energy in the world's industrial sector in 2035.

Fuel prices shape the mix of fuel consumption in the industrial sector, as industrial enterprises choose the cheapest fuels available to them, subject to process constraints. Because liquids are more expensive than other primary fuels, the world industrial sector's use of liquids increases at an average annual rate of only 0.5 percent (Figure 85), and the share of liquid fuels in the industrial fuel mix declines. Industrial electricity use grows by an average of 2.4 percent per year from 2007 to 2035. Electricity can be generated from a wide variety of sources and used in a wide variety of industrial activities.

At present, the overall industrial fuel mix differs between OECD and non-OECD countries. In 2007, liquids made up 40 percent of industrial energy use in OECD countries, compared with 25 percent in non-OECD countries. In that same year, coal represented 12 percent of OECD industrial energy use and 31 percent of non-OECD industrial energy use.

Over the projection horizon, there are large shifts in industrial energy use. From 2007 to 2035, industrial liquids use in OECD countries declines by 0.3 percent per year, while in non-OECD countries it increases by 1.2 percent per year. In 2035, non-OECD countries

Figure 82. Annual changes in world industrial and all other end-use energy consumption from previous year, 2006-2010 (quadrillion Btu)

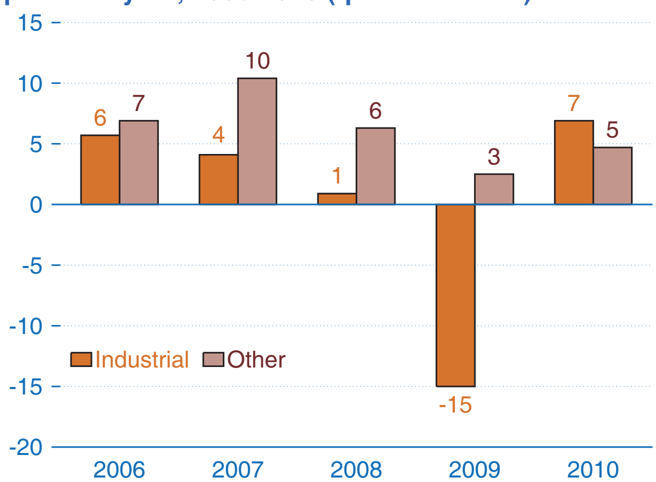


Figure 83. World delivered energy consumption in the industrial and all other end-use sectors, 2005-2035 (quadrillion Btu)

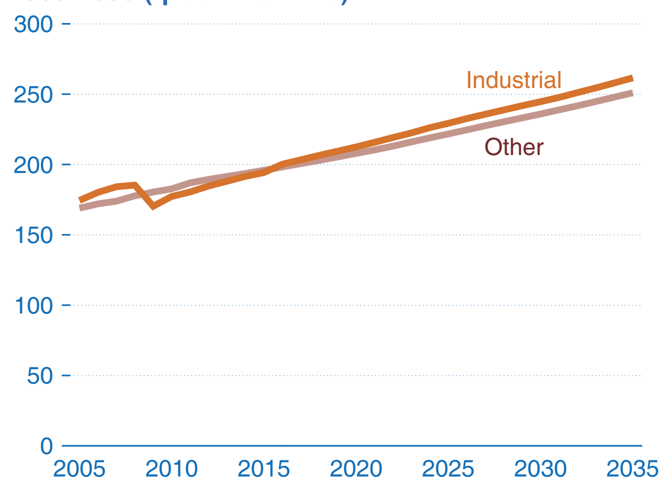


Figure 84. OECD and Non-OECD industrial sector energy consumption, 2007-2035 (quadrillion Btu)

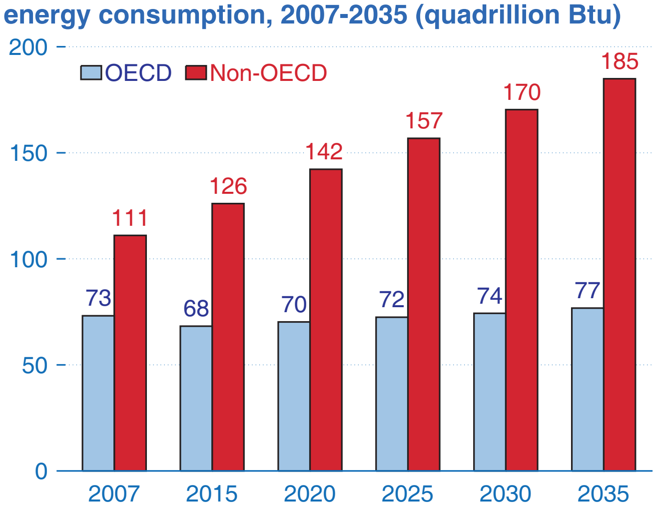
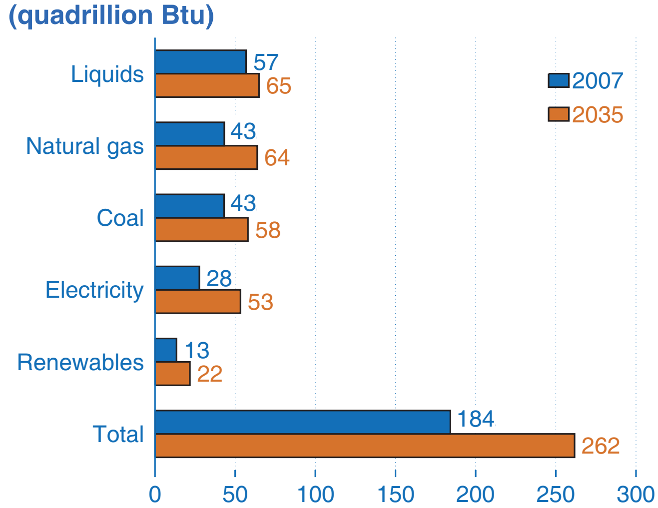


Figure 85. World industrial sector energy consumption by fuel, 2007 and 2035 (quadrillion Btu)



consume 38 quadrillion Btu of energy from liquids for industrial uses, compared with 26 quadrillion Btu for OECD countries. From 2007 to 2035, OECD coal use for industry declines by an average of 0.8 percent per year, while non-OECD industrial coal use increases by an average of 1.4 percent per year.

A new feature in *IEO2010* is the inclusion of worldwide consumption of marketed (commercial) industrial renewable energy in historical time series and projections.[23] Industrial use of renewables for purposes other than electricity generation constitutes a fairly substantial portion of industrial sector energy consumption. In 2007, the industrial sector worldwide consumed 13 quadrillion Btu of energy from renewables for non-electricity uses, or about 7 percent of the sector's total delivered energy use [*1*]. From 2007 to 2035, renewable energy use in the industrial sector grows by an average of 1.8 percent per year, and its share of total delivered energy consumption in the industrial sector grows to 8 percent. Biomass—which currently provides the vast majority of renewable energy consumed in the industrial sector (90 percent), followed by waste (7 percent) and other renewables (3 percent)—remains the largest component of the industrial sector renewable energy mix through 2035.

Industrial energy consumption in each region is a function of total industrial output and the energy intensity of the industrial sector, measured as energy consumed per unit of output. Energy-intensive industries consume about half of the energy used in the industrial sector. For years, those industries have focused on reducing energy consumption, which represents a large portion of their costs [*2*]. Enterprises can reduce energy use in a number of ways. Industrial processes can be improved to reduce energy waste and recover energy, often process heat, which would otherwise be lost. Recycling of materials and fuel inputs also improves efficiency.

Countries' development trajectories also play a major role in industrial energy consumption.. When economies initially begin to develop, industrial energy use rises as manufacturing output begins to take up a larger portion of GDP, as has occurred already in many non-OECD economies, most notably in China. When developing countries achieve higher levels of economic development, their economies tend to become more service-oriented, and their industrial energy use begins to level off, as can be seen currently in most OECD countries.

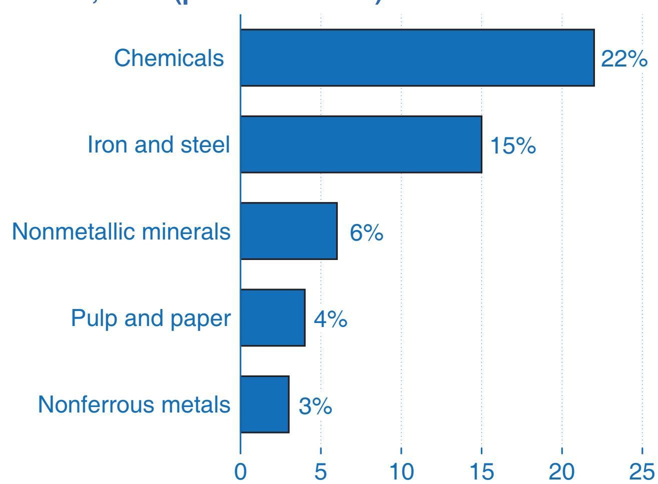
The following section describes patterns of energy use in the world's most energy-intensive industries. Subsequent sections examine specific patterns of industrial energy use in the major OECD and non-OECD regions.

Energy-intensive industries

Five industries account for one-half of all energy used in the industrial sector (Figure 86): chemicals (22 percent), iron and steel (15 percent), nonmetallic minerals (6 percent), pulp and paper (4 percent), and nonferrous metals (3 percent).[24] The quantity and fuel mix of future industrial energy consumption will be determined largely by energy use in those five industries. In addition, the same industries emit large quantities of carbon dioxide, related to both their energy use and their production processes.

The largest industrial consumer of energy is the chemical sector, which made up 22 percent of total world industrial energy consumption in 2007. Energy represents 60 percent of the industry's operating costs and an even higher percentage in the petrochemical subsector, which uses energy products as feedstocks. Petrochemical feedstocks account for 60 percent of the energy consumed in the chemicals sector. Intermediate petrochemical products, or "building blocks," which go into products such as plastics, require a fixed amount of hydrocarbon feedstock as input. In other words, for any given amount of chemical output, depending on the

Figure 86. World industrial sector energy consumption by major energy-intensive industry shares, 2007 (percent of total)



Source: International Energy Agency.

[23] U.S. marketed industrial *renewable energy*, both historical and projections from the *Annual Energy Outlook*, has always been reported in the *IEO*. As a result, incorporating the data series of industrial sector renewable energy use outside the United States means that all data series are now presented in the *IEO* on a consistent basis worldwide.

[24] These shares differ from those reported in *IEO2009*, where the numbers were based on shares reported in an International Energy Agency database. The shares now come from an internal database that conforms to EIA's definition of the industrial sector, which includes energy used in construction, mining, and agriculture. Smaller relative shares for energy-intensive industries are a reflection of this accounting change.

fundamental chemical process of production, a fixed amount of feedstock is required, which greatly reduces opportunities for decreasing fuel use [*3*].

By volume, the most important "building block" in the petrochemical sector is ethylene, which can be produced by various chemical processes. In Europe and Asia, ethylene is produced primarily from naphtha, which is refined from crude oil. In North America and the Middle East, where domestic supplies of natural gas are more abundant, ethylene is produced from ethane, which typically is obtained from natural gas reservoirs. Because petrochemical feedstocks represent such a large share of industrial energy use, patterns of feedstock use play a substantial role in determining the industrial fuel mix in each region.

In recent years, most of the expansion of petrochemical production and consumption has taken place in non-OECD Asia. The combination of high energy prices in 2008 and the global recession in 2009 that reduced demand in client industries, such as construction, had a significant impact on the chemical industry. However, although global sales dropped by 5.6 percent in 2009, continued aggressive expansion of petrochemical manufacturing capacity in Asia and the Middle East points toward further growth of the petrochemical industry in those regions. Capital expenditures in the chemical sector of the Asia-Pacific region have outpaced those in North America and Europe combined since 2005, and the trend is likely to continue through 2014 [*4*], led by China, where the petrochemical operations of domestic firms, such as Sinopec and PetroChina, have expanded rapidly, and there has been an influx of petrochemical sector investment from multinational firms, such as ExxonMobil [*5*].

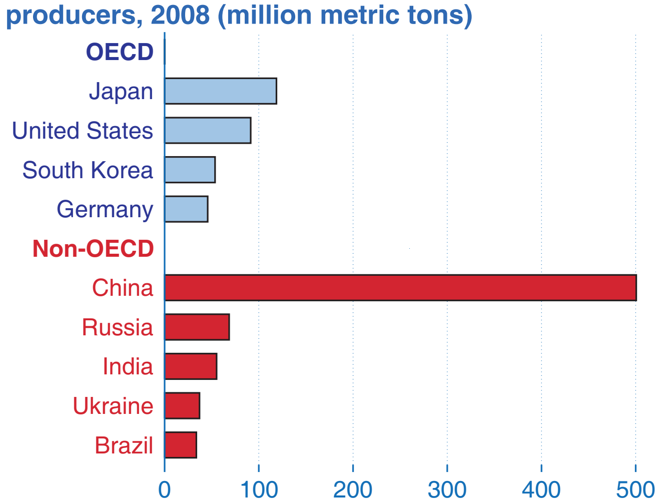
The next largest industrial user of energy is iron and steel, which accounts for about 15 percent of industrial energy consumption. Across the iron and steel sector as a whole, energy represents roughly 15 percent of production costs [*6*]. The amount of energy used in the production of steel varies greatly, however, depending on the process used. In the blast furnace process, superheated oxygen is blown into a furnace containing iron ore and coke. The iron ore is reduced (meaning that oxygen molecules in the ore bond with the carbon), leaving molten iron and carbon dioxide [*7*]. Coal use and heat generation make this process tremendously energy-intensive. In addition, it requires metallurgical coal, or coking coal, which is more costly than steam coal because of its lower ash and sulfur content.

Electric arc furnaces, the other major type of steel production facility, produce steel by using an electric current to melt scrap metal. The process is more energy-efficient and produces less carbon dioxide than the blast furnace process, but it depends on a reliable supply of scrap steel. Currently, two-thirds of global steel production uses the blast furnace process. The only major steel producers that make a majority of their steel using the electric arc furnace process are the United States (58 percent) and India (58 percent) [*8*]. Ninety-one percent of China's production employs the blast furnace method [*9*].

Over the past decade, there has been a major expansion of steel consumption in non-OECD economies, with a corresponding increase in global production. Fueled by demand from the construction and manufacturing sectors, China has become the world's largest steel producer, with more steel output than the seven next largest steel-producing nations combined (Figure 87). China's leadership in the steel market is reflected in the impact of the global recession on the steel sector, where non-OECD nations had a stabilizing influence on steel demand and prices in 2009. In the medium term, demand for steel grows steadily in the Reference case, spurred by infrastructure projects in non-OECD nations, with corresponding growth in energy use for steel production [*10*]. Over the long term, however, the growth of energy use in the steel industry should moderate slightly, as the fuel mix shifts from coal to electricity and increasing inventories of scrap iron drive input prices down and make the electric arc process more attractive.

The third largest energy-consuming industry is nonmetallic minerals, which includes cement, glass, brick, and ceramics. Production of those materials requires a substantial amount of heat and accounts for 6 percent of global industrial energy use. The most significant nonmetallic minerals industry is cement production, which accounts for 85 percent of energy use in the nonmetallic minerals sector. Although the cement industry has improved energy efficiency over the years by switching from the "wet kiln" production process to the "dry kiln"

Figure 87. OECD and Non-OECD major steel producers, 2008 (million metric tons)



Source: World Steel Association.

process, which requires less heat, energy costs still constitute between 20 and 40 percent of the total cost of cement production [*11*].

The demand base for cement—the vast majority of which is used for construction—is less diversified than that for steel sector. Consequently, the impact of the recent economic downturn on the cement industry has been severe [*12*]. The primary growth in cement production over the next few years is expected to occur in non-OECD countries. Because the production of cement directly generates carbon dioxide, the industry has responded to pressure to address climate change by focusing considerable attention on reducing fossil fuel use and improving energy efficiency. In the future, the energy efficiency of cement production is likely to improve as a result of continued improvements in kiln technology, the use of recycled material and waste as heating fuels (known as "co-processing"), and increased use of additives to reduce the amount of clinker (the primary ingredient in marketed cement) needed to produce a given amount of cement [*13*].

Pulp and paper production accounts for 4 percent of global industrial energy use. Paper manufacturing is an energy-intensive process, but paper mills typically generate about one-half of the energy they use through cogeneration, primarily with black liquor and biomass from wood waste. In some cases, integrated paper mills generate more electricity than they need and are able to sell their excess power back to the grid. As is the case in other industries, recycling significantly reduces the energy intensity of production in the paper sector. Recycled paper production produces more carbon dioxide, however, because the process energy used in recycled paper production comes from fossil fuels rather than biomass [*14*] (although this conclusion could change if assumptions about the life-cycle carbon dioxide output from biomass change).

Many observers have suggested that electronic media and digital file storage would cause global demand for paper to contract over time. Such a trend is observable only in North America, however, where reduced demand for newsprint and an aging capital stock have led the industry to reduce capacity [*15*]. In the rest of the world, output is expected to expand steadily. Support for renewable energy in OECD countries could alter the cost structure of the paper sector in the future, however, if mandates for biomass use cause wood prices to escalate, affecting the competitive position of the paper industry[*16*].

Production of nonferrous metals, which include aluminum, copper, lead, and zinc, consumed 3 percent of industrial delivered energy in 2007, mostly for aluminum production. Although aluminum is one of the most widely recycled materials on the planet, two-thirds of aluminum still comes from primary production [*17*]. Energy accounts for about 30 percent of the total cost of primary aluminum manufacturing and is the second most expensive input after alumina ore. The recent recession's impact on client sectors, such as automobile production and construction, has curtailed aluminum demand globally, but the trend has been far less severe in non-OECD countries. Although some analysts expect a greater portion of OECD aluminum production to be exported to non-OECD countries in the future [*18*], non-OECD countries still are expected to increase their market share of global aluminum production.

To guard against electricity outages and fluctuations in electric power prices, many aluminum producers have turned to hydropower, going so far as to locate plants in areas where they can operate captive hydroelectric facilities. For example, Norway, which has considerable hydroelectric resources, hosts seven aluminum smelters. Today, more than half of the electricity used in primary aluminum production comes from hydropower [*19*].

Aluminum production from recycled materials uses only one-twentieth of the energy of primary production [*20*]. Although both the aluminum industry and many governments encourage aluminum recycling, it is unlikely that the share of aluminum made from recycled product will increase much in the future, because most aluminum (which is consumed in the construction and manufacturing sectors) is used for long periods of time. Indeed, with three-fourths of the aluminum ever produced still in use [*21*], it is likely that the aluminum industry will continue to consume large amounts of electricity.

Regional industrial energy outlooks

OECD countries

OECD countries have been transitioning in recent decades from manufacturing to more service-oriented economies. As a result, in the *IEO2010* Reference case, industrial energy use in OECD countries grows at an average annual rate of only 0.2 percent from 2007 to 2035, as compared with a rate of 0.9 percent per year for energy use in the commercial sector. In addition to the shift away from industry, slow growth in OECD industrial energy consumption can be attributed to relatively slow growth in overall economic output. OECD economies grow by 2.0 percent per year on average from 2007 to 2035 in the *IEO2010* Reference case, compared with 2.1 percent per year in the *IEO2009* Reference case. Whereas OECD economies accounted for 58 percent of global economic output in 2007 (as measured in purchasing power parity terms), their share falls to about 41 percent in 2035.

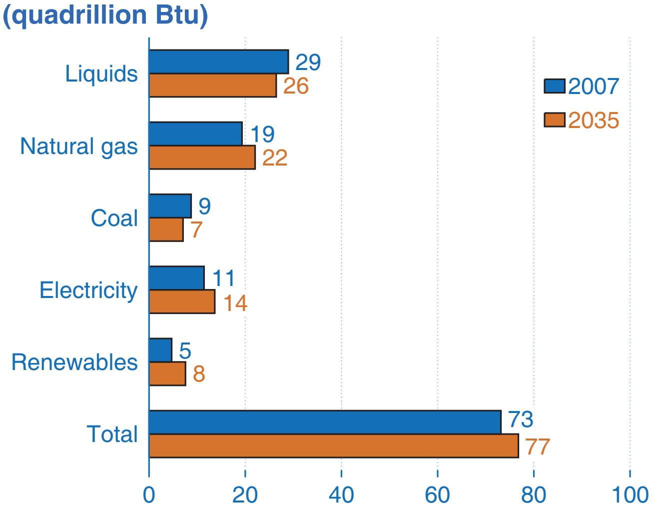
Rising oil prices in the Reference case lead to changes in the industrial fuel mix of OECD nations (Figure 88). OECD liquids use in the industrial sector contracts by 0.3 percent per year, reducing the share of liquids in industrial energy use from 40 percent in 2007 to 34 percent in 2035. Coal use in the industrial sector also declines, and coal's share of OECD delivered industrial energy use falls from 12 percent to 9 percent, as industrial uses of natural gas, electricity, and renewables expand. Industrial consumption of renewables in OECD countries grows faster than the use of any other fuel, from 4.7 quadrillion Btu in 2007 to 7.6 quadrillion Btu in 2035. In the coming decades, patterns of industrial fuel use and trends in energy intensity in OECD countries are expected to be determined as much by policies regulating energy use as by economic and technological developments.

North America

Currently, the U.S. industrial sector consumes more energy than the industrial sector of any other OECD country, and that continues to be true in the *IEO2010* Reference case through 2035. The overall increases in U.S. industrial energy use is minimal, however, from 25 quadrillion Btu in 2007 to 27 quadrillion Btu in 2035, or an average of 0.2 percent per year. The industrial share of total U.S. delivered energy consumption remains at approximately one-third through 2035. (In contrast, U.S. commercial energy use increases at more than four times that rate, reflecting the continued U.S. transition to a service economy.) With oil prices rising steadily in the Reference case, liquids consumption in the U.S. industrial sector contracts on average by 0.4 percent per year, for the steepest decline among OECD nations.

The use of renewable fuels, such as waste and biomass, in the U.S. industrial sector grows faster than the use of any other energy source in the Reference case, and its share of the industrial fuel mix rises from 8 percent in 2007 to 16 percent in 2035. Growth in U.S. industrial energy use will also be moderated by legislation aimed at reducing the energy intensity of industrial processes. For example, the U.S. Department of Energy supports reductions in energy use through its Industrial Technologies Program, guided by the Energy Policy Act of 2005, which is working toward a 25-percent reduction in the energy intensity of U.S. industrial production by 2017 [*22*]. The Energy Independence and Security Act of 2007 (EISA2007) also addresses energy-intensive industries, providing incentive programs for industries to recover additional waste heat and supporting research, development, and demonstration for efficiency-increasing technologies [*23*].

Figure 88. OECD industrial sector energy consumption by fuel, 2007 and 2035 (quadrillion Btu)



Industrial energy use in Canada grows by an average of 0.6 percent per year in the Reference case, continuing to constitute just under one-half of Canada's total delivered energy use. With world oil prices returning to sustained high levels, liquids use in Canada's industrial sector does not increase from current levels, while natural gas use increases by 1.5 percent per year. As a result, the share of liquids in the industrial fuel mix falls from 36 percent in 2007 to 27 percent in 2035, and the natural gas share increases from 35 percent to 44 percent. Increased production of unconventional liquids (oil sands) in western Canada, which requires large amounts of natural gas, contributes to the projected increase in industrial natural gas use.

Industrial energy efficiency in Canada has been increasing at an average rate of about 1.5 percent per year in recent decades, largely reflecting provisions in Canada's Energy Efficiency Act of 1992 [*24*]. The government increased those efforts in 2007, releasing its Regulatory Framework for Industrial Greenhouse Gas Emissions, which calls for a 20-percent reduction in greenhouse gas emissions by 2020. The plan stipulates that industrial enterprises must reduce their emissions intensity of production by 18 percent between 2006 and 2010 and by 2 percent per year thereafter. The proposal exempts "fixed process emissions" from industrial processes in which carbon dioxide is a basic chemical byproduct of production. Therefore, most of the abatement will have to come from increased energy efficiency and fuel switching [*25*].

Mexico's GDP grows by 3.5 percent per year from 2007 to 2035 in the Reference case, which is the highest economic growth rate among all OECD nations. Mexico also has the highest average annual rate of growth in industrial energy use, at 1.9 percent per year, to 5 quadrillion Btu in 2035 from 3 quadrillion Btu in 2007. The country's industrial sector continues to use oil and natural gas for most of its energy needs, and the combined share of liquids and natural gas in the industrial fuel mix remains close to 80 percent throughout the projection. In December 2009, the Mexican government introduced its "Special Climate Change Program 2009-2012." The plan entails many industrial sector initiatives, such as increasing the use of cogeneration and improving the operational efficiency of PEMEX (the state-owned oil company) and other Mexican industrial enterprises [*26*].

OECD Europe

In the *IEO2010* Reference case, OECD Europe continues its transition to a service economy, as its commercial sector energy use grows by 0.8 percent per year while industrial energy use contracts by 0.3 percent per year. Climate change policy is expected to affect the mix of fuels consumed in OECD Europe's industrial sector, with coal use contracting at an average rate of 1.6 percent per year, while the use of renewables increases. The use of electric power in OECD Europe's industrial sector, increasingly generated from low-carbon sources, also rises.

Energy and environmental policies are significant factors behind the trends in industrial energy use in OECD Europe. In December 2008, the European Parliament passed the "20-20-20" plan, which stipulated a 20-percent reduction in greenhouse gas emissions, a 20-percent improvement in energy efficiency, and a 20-percent share for renewables in the fuel mix of European Union member countries by 2020 [*27*]. In debates on the plan, representatives of energy-intensive industries voiced concern about the price of carbon allocations. They argued that fully auctioning carbon dioxide permits to heavy industrial enterprises exposed to global competition would simply drive industrial production from Europe and slow carbon abatement efforts at the global level [*28*]. The resulting compromise was an agreement that 100 percent of carbon allowances would be given free of charge to industries that are exposed to such "carbon leakage," provided that they adhere to efficiency benchmarks [*29*].

OECD Asia/Pacific

Japan has the slowest GDP growth among OECD regions in the Reference case, at 0.5 percent per year. Consequently, its industrial consumption of delivered energy falls by 0.7 percent per year. Along with slow economic growth, a major factor behind Japan's slowing industrial energy use is increasing efficiency. Already, the energy intensity of Japan's industrial production is among the lowest in the world. Since 1970, Japan has reduced the energy intensity of its manufacturing sector by 50 percent, mostly through efficiency improvements, along with a structural shift toward lighter manufacturing [*30*]. An amended version of Japan's Energy Conservation Law went into effect in April 2009, introducing sectoral efficiency benchmarks for energy-intensive sectors, including cement and steel [*31*].

South Korea, which experienced rapid industrial development during the later decades of the 20th century, is also beginning to make a transition to a service-oriented economy. In the *IEO2010* Reference case, South Korea's GDP grows at an average annual rate of 2.9 percent. Its industrial energy use grows by 1.3 percent per year, while its commercial energy use grows by nearly 2 percent per year. South Korea is currently the sixth-largest steel producer in the world. A large portion of its steel is already produced by electric arc furnaces [*32*], and that portion is projected to grow as inventories of discarded steel build up. As a result, coal consumption in South Korea's industrial sector increases slowly in the Reference case, and electricity is the fastest-growing source of energy for industrial uses. The largest consumer of industrial energy in South Korea is the chemical sector, and it is expected to remain in that position through 2035. Liquid fuel consumption, primarily for feedstock use, maintains a majority share of South Korea's fuel mix through 2035.

In Australia and New Zealand, industrial delivered energy consumption grows by 0.9 percent per year in the Reference case, from 2.3 quadrillion Btu in 2007 to 3.0 quadrillion Btu in 2035. Industry's share of delivered energy consumption in the region remains steady at about 50 percent. With liquids consumption in the industrial sector falling from 0.6 quadrillion Btu in 2007 to 0.5 quadrillion Btu in 2035, natural gas fuels much of the growth in industrial sector energy use, and its share of the industrial fuel mix expands from 36 percent in 2007 to 43 percent in 2035.

Non-OECD countries

Non-OECD industrial energy consumption grows at an average annual rate of 1.8 percent in the *IEO2010* Reference case—almost 10 times the average for OECD countries (Figure 89). The industrial sector accounted for about 62 percent of total non-OECD delivered energy use in 2007, and it continues to consume close to that share through 2035. With non-OECD economies expanding at an average annual rate of 4.4 percent in the Reference case, their share of global output increases from 42 percent in 2007 to 59 percent in 2035.

The key engines of non-OECD growth are the "BRIC" countries (Brazil, Russia, India, and China). The four nations have accounted for 45 percent of global economic growth since 2007, doubling their share in the period from 2000 to 2006 [*33*]. Given the predominant role that heavy industry and manufacturing play in their dynamic economies, the BRIC countries account for more than two-thirds of the growth in non-OECD industrial energy use from 2007 to 2035.

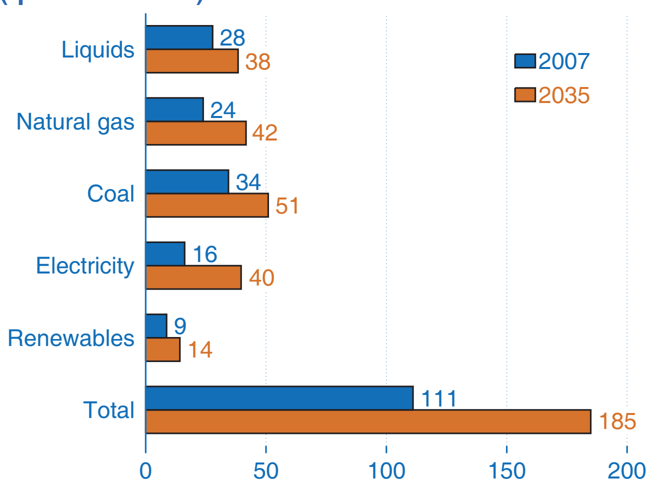
Non-OECD Asia

Non-OECD Asia is expected to be a major center of global economic growth in the coming decades. In the Reference case, the economies of non-OECD Asia, led by China, expand by an average of 5.2 percent per year, and industrial energy consumption increases across the region. China's industrial energy use nearly doubles from 2007 to 2035, averaging 2.4-percent annual growth over the period, and its growth rate is higher than the rate for any other major economy.

The industrial sector accounted for 75 percent of China's total delivered energy consumption in 2007, and its share remains above two-thirds through 2035. Since the beginning of economic reform in 1979, China's GDP growth has averaged 9.8 percent per year through 2007 [*34*]. The *IEO2010* Reference case projects slower but substantial growth, averaging 5.8 percent per year through 2035. Although 2006-2010 growth in China in *IEO2010* is somewhat lower than was projected in *IEO2009* because of the global economic slowdown, a return to strong growth is anticipated from 2011 to 2015, and China still is expected to account for more than one-fourth of total global GDP growth from 2007 to 2035.

In addition to the impact of strong economic growth on industrial energy demand in China, continued rapid increases in industrial demand can be explained in part by the structure of the Chinese economy. Although the energy intensity of production in individual industries has improved over time, heavy industry still constitutes a major portion of China's total output. Patterns of energy use in China reflect its economy: iron and steel, nonmetallic minerals, and chemicals together account for about 60 percent of the country's industrial energy consumption. These sectors provide inputs to China's massive export and construction sectors, which continue to flourish in the *IEO2010* projection. China is expected to construct an additional 65 billion square feet of building space by 2020—an amount equal to Europe's current total building stock [*35*].

Figure 89. Non-OECD industrial sector energy consumption by fuel, 2007 and 2035 (quadrillion Btu)



Government policy contributes as much to the energy-intensive structure of the Chinese economy as does demand growth. A considerable share of heavy industrial production in China is carried out by large state-owned enterprises (SOEs), which are favored by Chinese economic policy. SOEs enjoy relatively easy access to capital through state-owned banks and other forms of government support, such as subsidized energy supplies [*36*]. The Chinese government's strategy in response to the recent global economic slowdown involved expansion of credit, and SOEs benefited greatly from the policy [*37*]. The government also introduced support plans for 10 key industries. Steel, petrochemicals, and nonferrous metals are among the industries identified in the plan, which includes measures to stimulate domestic demand and exports, along with 210 billion yuan ($31 billion) in research and development funding [*38*].

China's industrial fuel mix changes somewhat over the projection period. Despite its abundant coal reserves, direct use of coal in China's industrial sector grows by an average of only 1.6 percent per year in the Reference case, while industrial use of electricity (most of which is coal-fired) grows by 4.2 percent per year. As a result, coal's share in the industrial fuel mix falls from 60 percent in 2007 to 47 percent in 2035, while electricity's share increases from 19 percent to 32 percent. At 4.5 percent per year, natural gas use is projected to grow faster than the use of any other fuel; however, it represents only 6 percent of China's industrial fuel mix in 2035.

In addition to its primary focus on economic development, the Chinese government also has introduced policy initiatives aimed at improving industrial energy efficiency. Its 11th Five Year Economic Plan, released in 2005, included a goal of reducing energy intensity by 20 percent between 2005 and 2010 [*39*]. In the *IEO2010* Reference case, China surpasses its goal, achieving a 23-percent reduction in energy intensity of GDP between 2005 and 2010. In the coming years, China is expected to focus more attention on industrial energy intensity. In December 2009, the Chinese Ministry of Industry and Information Technology announced that it will soon release plans to restructure traditional industries, including the implementation of energy efficiency standards [*40*]. In the Reference case, the energy intensity of GDP in China declines by an average of 2.5 percent per year from 2007 to 2035.

India has the world's second highest rate of GDP growth in the *IEO2010* Reference case, averaging 5.0 percent per year from 2007 to 2035, with a 1.9-percent average annual increase in delivered energy to the industrial sector. Although India's 2007-2035 economic growth rate is only slightly slower than China's, its levels of GDP and energy consumption continue to be dwarfed by those in China throughout the projection. India's economic growth over the next 27 years is expected to derive more from light manufacturing and services than from heavy industry. As a result, the industrial share of total energy consumption in India falls from 72 percent in 2007 to 64 percent in 2035, and its commercial energy use grows more than twice as fast as its industrial energy use. The changes are accompanied by shifts in India's industrial fuel mix: electricity use grows more rapidly than coal use, and natural gas use triples.

India has been successful in reducing the energy intensity of its industrial production over the past 20 years. A majority of its steel production is from electric arc furnaces, and most of its cement production uses dry kiln technology [***41***]. A major reason for the intensity reductions is Indian public policy, which provides subsidized fuel to citizens and farmers but requires industry to pay higher prices for fuel. In part because the market interventions have spurred industry to reduce energy costs, India is now one of the world's lowest cost producers of both aluminum and steel [***42***]. India is also the world's largest producer of pig iron, which can be used in place of scrap metal in the electric arc process [***43***].

The quality of India's indigenous coal supplies also has contributed to the steel industry's efforts to reduce its energy use. India's metallurgical coal (which is needed for steel production in blast furnaces) is low in quality, forcing steel producers to import metallurgical coal [***44***]. As a result, producers have invested heavily in improving the efficiency of their capital stock to lower the amount of relatively expensive imported coal used in the production process.

The Indian government has facilitated further reductions in industrial energy use over the past decade by mandating industrial energy audits in the Energy Conservation Act of 2001 and by mandating specific consumption decreases for heavy industry as part of the 2008 National Action Plan on Climate Change. The new plan also calls for fiscal and tax incentives to promote efficiency, an energy-efficiency financing platform, and a trading market for energy savings certificates, wherein firms that have exceeded their required savings levels will be able to sell the certificates to firms that have not [***45***]. Those measures contribute to a reduction in the energy intensity of India's GDP, which declines by an average of 2.6 percent per year from 2007 to 2035 in the Reference case.

GDP growth in the other nations of non-OECD Asia is slightly less rapid than in China and India, averaging 4.3 percent per year, and their industrial energy demand as a group grows from 12 quadrillion Btu in 2007 to 22 quadrillion Btu in 2035. The largest single energy-consuming industry in the rest of non-OECD Asia is the chemical sector, which accounts for more than 20 percent of industrial delivered energy use for the group. Malaysia, Taiwan, Singapore, and Indonesia account for the vast majority of the countries' chemical sector output. The most significant steel producer in the group is Taiwan, which produced about 20 million metric tons in 2008 [***46***].

Patterns of industrial energy use in the individual countries of the other non-OECD Asia grouping follow diverse trajectories in the Reference case projection. Mature economies, such as Taiwan, Hong Kong, and Singapore, will follow patterns similar to those in OECD countries—transitioning away from energy-intensive industries to activities with higher added value. Much of the growth in commercial energy use occurs in those countries. Other regional economies, notably Vietnam, can be expected to expand manufacturing and increase industrial sector energy use.

Non-OECD Europe and Eurasia

In Russia, industrial energy consumption patterns are shaped largely by its role as a major energy producer. Russia's economy grows by 2.7 percent per year on average from 2007 to 2035, with industrial energy demand increasing by 0.2 percent per year and accounting for about one-half of the nation's total delivered energy use throughout the period. The energy intensity of Russia's GDP is the highest in the world, and although its energy intensity declines in the Reference case, Russia remains among the least energy-efficient economies in the world through 2035. The relative inefficiency of Russian industry can be attributed to Soviet-era capital stock and abundant and inexpensive domestic energy supplies. In the Reference case, natural gas—Russia's most abundant domestic fuel—accounts for almost half of all Russian industrial energy use. The share of electricity, most of which is provided by nuclear and natural-gas-fired generation, increases through 2035.

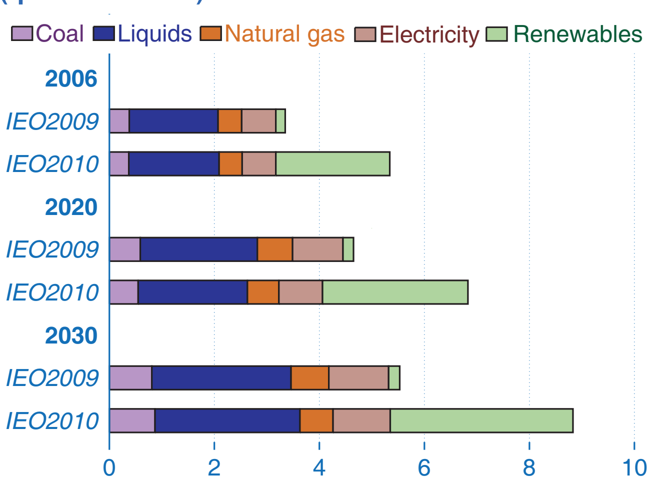
Industrial sector energy use in other parts of non-OECD Europe and Eurasia grows by an average of 0.2 percent per year through 2035. The iron and steel sector constitutes the largest single energy-consuming industry in this region, which consists primarily of states that were once part of the Soviet Union. Ukraine is the region's largest—and the world's eighth largest—steel producer. Almost half of Ukraine's steel production uses open hearth furnaces, the least energy-efficient steelmaking process [***47***]. Energy intensity of economic output in the rest of non-OECD Europe and Eurasia is almost as high as Russia's, and despite average intensity reductions of 2.1 percent per year, the region remains one of the world's least energy-efficient through 2035.

Central and South America

Brazil's industrial energy use grows by an average of 2.1 percent per year in the Reference case, as its GDP expands by 4.1 percent per year. Industrial energy use accounted for about 60 percent of delivered energy use in Brazil in 2007 and maintains that share through 2035. The inclusion of renewables in the *IEO2010* industrial sector baseline and projection constitutes more of a revision in Brazil than in any other region (Figure 90). More than 40 percent of delivered energy consumption in Brazil's industrial sector comes in the form of renewable energy. Biomass is often the fuel of choice for heat generation in industrial processes. Additionally, many Brazilian steel firms use charcoal (which is a wood-based renewable) instead of coking coal in the production of steel. The Brazilian government plans to support this practice as part of its National Plan on Climate Change [***48***]. Even with those efforts, however, coal use in the industrial sector—primarily for steelmaking—grows faster than the use of any other fuel.

Economic output in the other countries of Central and South America grows more slowly than in Brazil, averaging 2.8 percent per year, and their industrial energy consumption increases from 6.1 quadrillion Btu in 2007 to 7.7 quadrillion Btu in 2035. Chemicals and refining account for the largest shares of industrial energy use in this hydrocarbon-producing region. In the Reference case, natural gas displaces a large portion of liquids use in the industrial energy mix, fueled by growth in the region's domestic natural gas production. In 2007, liquids and natural gas each accounted for 40 percent of industrial energy use. From 2007 to 2035, natural gas consumption increases by an average of 1.5 percent per year, while liquids consumption decreases by 0.4 percent per year. As a result, the natural gas share of the region's industrial energy use increases to 47 percent, while the liquids share falls to 27 percent, in 2035.

Figure 90. Industrial sector energy consumption in Brazil by energy source, *IEO2009* and *IEO2010* Reference cases, 2006, 2020, and 2030 (quadrillion Btu)



Other Non-OECD regions

Industrial energy use in the Middle East grows on average by 2.2 percent per year from 2007 to 2035 in the *IEO2010* Reference case. In terms of energy consumption, the largest industry in the Middle East is the chemical sector. Higher world prices for oil and natural gas have spurred new investment in the region's petrochemical sector, where companies can rely on low-cost feedstocks, and the trend is expected to continue despite the current global slump in demand for chemicals. Numerous "mega" petrochemical projects currently are under construction in Saudi Arabia, Qatar, Kuwait, the UAE, and Iran [***49***]. The Middle East is becoming a major manufacturer of the olefin building blocks that constitute a large share of global petrochemical output, and the region's ethylene production capacity is expected to double between 2008 and 2012 [***50***]. Liquids and natural gas combined maintain a 94-percent share of the Middle East's industrial fuel mix through 2035 in the Reference case.

Although 14.1 percent of the world's total population lives in Africa, the continent consumes only 4.2 percent of world delivered energy for industrial uses, and its share does not change in the Reference case. Africa's total industrial energy use grows at an average annual rate of 1.4 percent in the Reference case from 2007 to 2035. Although GDP for the sub-Saharan Africa region grows by an average of 3.6 percent per year, a substantial portion of the increase comes from primary commodities. Commodity extraction is an energy-intensive process, but it does not support the expansion of industrial energy use on the same scale as development of a widespread manufacturing base. Without a substantial departure from historical patterns of governance and economic activity, low levels of industrial energy use in Africa can be expected to persist.

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Chapter 7

Transportation Sector Energy Consumption

In the IEO2010 Reference case, transportation energy use in non-OECD countries increases by an average of 2.6 percent per year from 2007 to 2035, as compared with an average of 0.3 percent per year for OECD countries.

Overview

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 used for passenger travel. Consequently, transportation sector energy demand hinges on growth rates for both economic activity and the driving-age population. Economic growth spurs increases in industrial output, which requires the movement of raw materials to manufacturing sites, as well as the movement of manufactured goods to end users.

Almost 20 percent of the world's total delivered energy is used in the transportation sector, where liquid fuels are the dominant source. Transportation alone accounts for more than 50 percent of world consumption of liquid fuels, and its share increases over the projection period (Figure 91). The transportation share of total liquid fuels consumption rises to 61 percent in 2035, as their share declines in the other end-use sectors. Because liquids play a key role in the world transportation sector, understanding how the sector is likely to evolve could be the most important factor in assessing the future of liquid fuel markets. From 2007 to 2035, growth in transportation energy use accounts for 87 percent of the total increase in world liquids consumption.

World oil prices reached historic high levels in 2008, in part because of a strong increase in demand for transportation fuels, particularly in the emerging non-OECD economies. Non-OECD energy use for transportation increased by 4.5 percent in 2007 and 7.3 percent in 2008. Even in 2009, non-OECD transportation energy use grew by an estimated 3.2 percent, in part because many countries—especially oil-rich nations, but others as well—continued to provide fuel subsidies to their citizens. With robust economic recovery expected to continue in China, India, and other non-OECD nations, growing demand for raw materials, manufactured goods, and business and personal travel supports fast-paced growth in energy use for transportation both in the short term and over the long term. In the *IEO2010* Reference case, non-OECD transportation energy use grows by 2.6 percent per year on average from 2007 to 2035 (Figure 92 and Table 14).

The impact of high oil prices and the economic recession has been more profound in OECD economies than in non-OECD economies. Transportation energy use in OECD nations declined by an estimated 1.3 percent in 2008, followed by a further decrease estimated at 2.0 percent in 2009. Indications are that a return to growth in

Figure 91. World liquids consumption by end-use sector, 2007-2035 (quadrillion Btu)

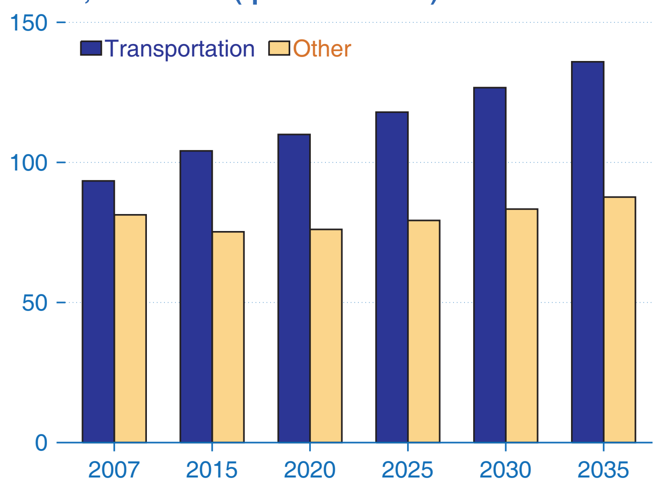
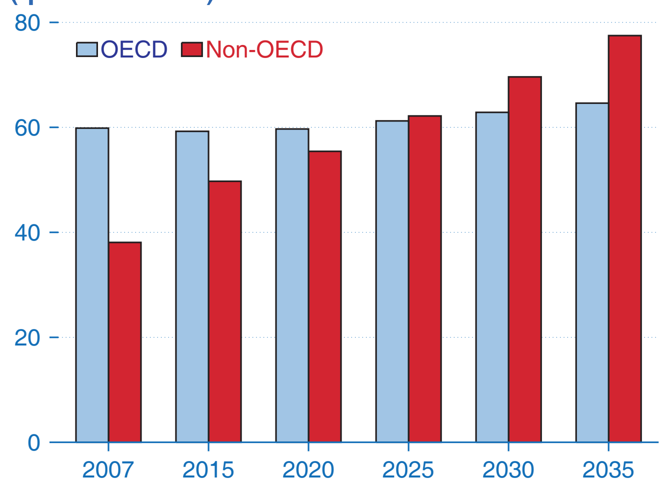


Figure 92. OECD and Non-OECD transportation sector liquids consumption, 2007-2035 (quadrillion Btu)



transportation energy use in OECD nations will not begin before mid-2010, because a relatively slow recovery from the global recession is anticipated for many of the key OECD nations. Moreover, the United States and some of the other OECD countries have instituted a number of new policy measures to increase the fuel efficiency of their vehicle fleets, as well as fuel taxation regimes to encourage fuel conservation. Thus, OECD transportation energy use grows by only 0.3 percent per year over the entire projection period and is not expected to return to its 2007 level until after 2020.

In the long term, for both non-OECD and OECD economies, steadily increasing demand for personal travel and freight transportation is the primary factor underlying increases in transportation energy demand. Passenger transportation energy use includes fuels used in light-duty vehicles, buses, aircraft, and passenger trains. Freight transportation energy use includes fuels used by large trucks, freight trains, and both domestic and international marine vessels.[25]

In 2007, about two-thirds of transportation energy use in OECD countries was for passenger travel; that share declines slightly from 2007 to 2035. For non-OECD nations, passenger travel accounted for 56 percent of total transportation energy use in 2007, and the share falls to 51 percent in 2035. In the Reference case, projected efficiency gains worldwide are much more robust for light-duty passenger vehicles than for freight modes of transport, because many of the potential freight-related transport efficiencies have been realized already in the existing fleet. As a result, although both passenger travel and freight travel increase in the Reference case, world energy consumption for freight-related travel increases at about twice the rate of energy use for passenger transportation (Tables 15 and 16).

The *IEO2010* Reference case assumes that, as personal income grows in the developing non-OECD nations, demand for personal motor vehicles will grow. The expectation is that major urban areas will address the accompanying congestion and strains on infrastructure with the development of mass transit (bus and/or rail) and urban design that reduces vehicle miles traveled, among other improvements to transportation networks. The Reference case projects robust growth in energy use both for personal motor vehicles (light-duty cars and trucks and two- and three-wheel vehicles) and for public passenger travel (rail and bus) in many developing regions.

For many of the rapidly developing and urbanizing non-OECD economies, it may be a future challenge to keep transportation infrastructure development on pace to meet growing demand for mobility services. Transportation equipment cannot provide service without roads, rail lines, ports, and airports. Such infrastructure is expensive to build and maintain, and infrastructure decisions made in the near term will affect energy use in the future. Decisions on where to build urban rail systems will influence travel modes to and from the workplace for many years to come. In the developing non-OECD regions where urbanization is still in early stages and much of the urban transportation infrastructure has not yet been built, transportation energy needs over the long-term future will be affected substantially by policy decisions made in the coming decades.

Regional transportation energy outlooks

OECD countries

In OECD economies, established transportation sectors, relatively slow rates of GDP growth and population

Table 14. World energy consumption for transportation by country grouping, 2007-2035 (quadrillion Btu)

Region	2007	2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OECD	**59.9**	**59.2**	**59.7**	**61.2**	**62.8**	**64.6**	**0.3**
North America	33.7	33.3	34.2	35.7	37.1	38.8	0.5
Europe	18.8	18.6	17.9	17.8	17.9	17.9	-0.2
Asia	7.4	7.4	7.6	7.7	7.8	7.9	0.2
Non-OECD	**38.1**	**49.7**	**55.4**	**62.2**	**69.6**	**77.5**	**2.6**
Europe and Eurasia	6.9	7.4	7.6	7.9	8.1	8.6	0.8
Asia	15.4	22.3	26.4	31.0	35.7	40.3	3.5
Middle East	5.8	7.8	8.7	9.7	10.9	12.5	2.8
Africa	3.5	4.4	4.6	5.1	5.7	6.3	2.2
Central and South America	6.5	7.8	8.1	8.5	9.2	9.8	1.5
Total World	**97.9**	**109.0**	**115.1**	**123.4**	**132.5**	**142.1**	**1.3**

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

[25] In the *IEO2010* projections, fuel use in dedicated freight aircraft is included with fuel use in passenger aircraft.

growth, and sustained high world oil prices lead to the expectation that transportation energy demand will increase only modestly, by a total of 8 percent, in the *IEO2010* Reference case, from 59.9 quadrillion Btu in 2007 to 64.6 quadrillion Btu in 2035 (Figure 93). Transportation infrastructure and driving patterns in OECD countries are generally well established. Roads and highways connect most population centers. Motorization levels (vehicles per 1,000 people), which already are high (for example, there were 765 vehicles per thousand people in the United States in 2009), are likely to reach saturation by 2035. In addition, as OECD economies have become more service-oriented, the link between income and the transportation of goods has weakened.

Other factors also slow the growth in transportation fuel demand in the OECD region, particularly with respect to the energy used for personal motor vehicle travel. Many OECD member countries, including European members and Japan, have imposed comparatively high sales taxes on motor fuels, leading many consumers to drive less and choose smaller, more energy-efficient personal motor vehicles. In France, for example, the sales tax levied on motor gasoline accounts for 70 percent of the cost

Table 15. World energy consumption for passenger transportation by country grouping, 2007-2035 (quadrillion Btu)

Region	2007	2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OECD	**36.6**	**35.6**	**35.1**	**35.4**	**35.6**	**35.8**	**-0.1**
North America	21.2	21.0	21.2	21.7	22.3	22.9	0.3
Europe	11.1	10.6	9.9	9.6	9.4	9.1	-0.7
Asia	4.3	4.0	4.1	4.0	3.9	3.9	-0.4
Non-OECD	**17.9**	**23.0**	**25.5**	**28.4**	**31.5**	**34.7**	**2.4**
Europe and Eurasia	2.9	3.0	2.9	2.9	3.0	3.1	0.3
Asia	7.4	10.5	12.4	14.5	16.6	18.7	3.4
Middle East	2.9	3.9	4.3	4.7	5.3	6.0	2.6
Africa	1.8	2.1	2.2	2.4	2.6	2.8	1.6
Central and South America	3.0	3.5	3.7	3.8	4.0	4.1	1.2
Total World	**54.5**	**58.7**	**60.6**	**63.7**	**67.1**	**70.6**	**0.9**

Notes: Passenger transportation includes travel by light-duty vehicles, two- and three-wheel vehicles, buses, passenger rail, and passenger air. Military travel is not included. Totals may not equal sum of components due to independent rounding.

Table 16. World energy consumption for freight transportation by country grouping, 2007-2035 (quadrillion Btu)

Region	2007	2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OECD	**19.4**	**19.7**	**20.4**	**21.3**	**22.3**	**23.4**	**0.7**
North America	8.6	8.5	9.0	9.4	10.0	10.7	0.8
Europe	7.6	8.0	7.9	8.2	8.5	8.8	0.5
Asia	3.1	3.3	3.5	3.7	3.8	4.0	0.9
Non-OECD	**18.1**	**24.5**	**27.6**	**31.3**	**35.5**	**40.0**	**2.9**
Europe and Eurasia	2.1	2.4	2.5	2.6	2.6	2.9	1.1
Asia	8.0	11.8	14.0	16.5	19.1	21.6	3.6
Middle East	2.9	4.0	4.4	4.9	5.6	6.5	2.9
Africa	1.6	2.2	2.3	2.6	3.0	3.4	2.7
Central and South America	3.5	4.3	4.4	4.7	5.2	5.6	1.7
Total World	**37.5**	**44.2**	**48.0**	**52.6**	**57.9**	**63.4**	**1.9**

Notes: Freight transportation includes travel by heavy and other trucks, coal and freight rail, domestic and international water, and air freight. Lubricants and pipeline transportation are not included. Totals may not equal sum of components due to independent rounding.

of a gallon of fuel, so that French drivers pay about 120 percent more for their fuel than do U.S. consumers [*1*]. In addition, a number of OECD governments have policies in place to improve fuel economy standards and encourage the replacement of old inefficient stock, and as the average energy efficiency of motor vehicles continues to improve, increases in demand for motor fuels are slowed.

North America

North America accounted for 56 percent of total OECD transportation energy use in 2007, and its share grows to 57 percent in 2020 and 60 percent in 2035 in the Reference case. The United States is the largest transportation energy consumer in North America, accounting for about 86 percent of the regional total (Figure 94). U.S. delivered energy consumption in the transportation sector grows from 29.0 quadrillion Btu in 2007 to 32.5 quadrillion Btu in 2035.

The Reference case assumes the adoption of corporate average fuel economy (CAFE) standards proposed jointly by the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Transportation's National Highway Traffic Safety Administration (NHTSA) for light-duty vehicles (both cars and light trucks) in model years 2012 through 2016. Accordingly, the average fuel economy of new light-duty vehicles rises from 29 miles per gallon in 2011 to 34 miles per gallon in 2016. After 2016, fuel economy standards are assumed to increase modestly through the 2020 model year, to 35.6 miles per gallon, in order to meet the requirements of the Energy Independence and Security Act of 2007 (EISA2007). To meet the mandated fuel economy levels, sales of unconventional vehicle technologies[26]—such as flex-fuel, hybrid, and diesel vehicles—increase over the projection period, and the growth of new light truck sales slows.

In addition to road transportation energy use, U.S. energy demand for aircraft increases by a total of 19 percent in the Reference case, from 2.7 quadrillion Btu in 2007 to 3.3 quadrillion Btu in 2035 [*2*]. Although the growth in personal air travel is based on increases in income per capita, it slows over the long term as demand for air travel reaches saturation. Furthermore, expected increases in aircraft fuel efficiency and slow growth in air freight movement due to slow growth in imports combine to dampen the growth in U.S. air transportation energy consumption in the long term. Marine and rail energy consumption increases by a combined 7 percent in the projection, as a result of growth in industrial output and increasing demand for coal transport.

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 it remains so in the 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. Canada's Fuel Consumption Program has established targets for new-vehicle fuel efficiencies that are largely in line with the U.S. CAFE standards (although the Canadian program is voluntary rather than mandated) [*3*]. Canada's total transportation energy use increases in the Reference case by an average of 0.5 percent per year from 2007 to 2035, compared with 0.4 percent per year in the United States.

In Mexico, relatively strong GDP growth (3.5 percent per year) increases energy consumption in the transportation sector at an average rate of 1.6 percent per year, from 2.2 quadrillion Btu in 2007 to 3.4 quadrillion Btu in 2035. The increase in transportation fuel use is based on expected growth in trade with the United States and the economies of Central and South America. Given the

Figure 93. OECD transportation energy use by region, 2007, 2025, and 2035 (quadrillion Btu)

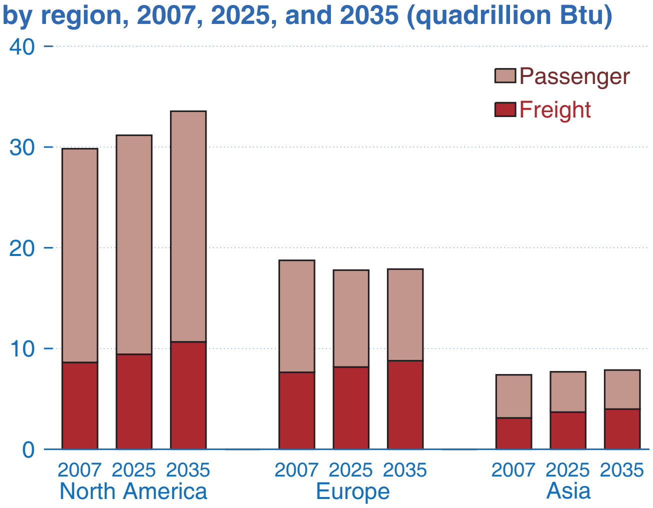
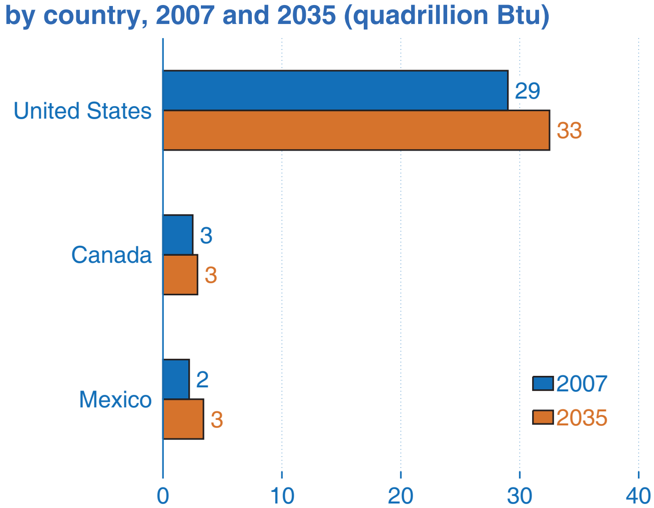


Figure 94. North America transportation energy use by country, 2007 and 2035 (quadrillion Btu)



[26] Vehicles that use alternative fuels, electric motors and advanced electricity storage, advanced engine controls, or other new technologies.

relatively underdeveloped nature of Mexico's transportation infrastructure, overall improvement in the country's standard of living supports growth in demand at more than twice the growth rate for transportation energy demand in the United States.

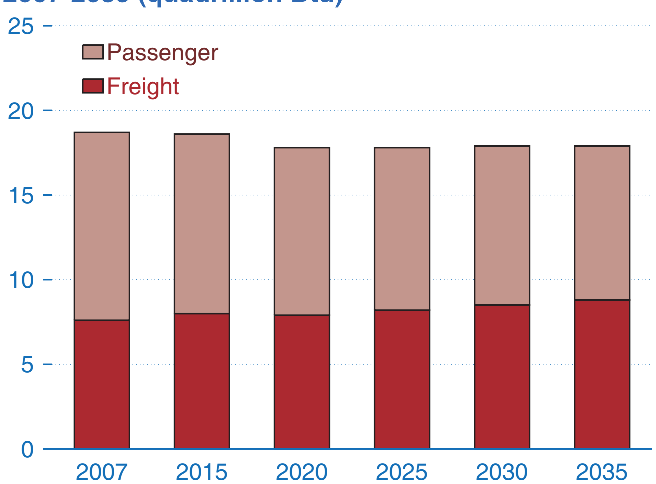
Energy use for bus and passenger rail transportation in Mexico nearly keeps pace with the rate of growth in fuel use for light-duty vehicles, expanding by 1.1 percent per year, compared with 1.4 percent per year for light-duty vehicle energy consumption. Although mass transit is not widespread in Mexico, there have been efforts to expand rapid transit as a way to improve air quality, notably in the large and congested Mexico City area.

In June 2005, Mexico City's Bus Rapid Transit (BRT), Metrobús, began operating along a 12-mile length of the Avenida de los Insurgentes—often cited as the longest urban avenue in the world [*4*]. Today, Metrobús consists of two lines with a total length of nearly 30 miles, and there are plans to extend the system with two additional lines that will nearly double the current length of the system [*5*]. Metrobús is the longest operating BRT in Latin America, transporting an average of 265,000 passengers each day, and it has been credited with dramatically improving the city's air quality [*6*]. Its success demonstrates how important mass transit may be in shaping transportation consumption trends, particularly in fast-growing urban areas with underdeveloped transportation infrastructures.

OECD Europe

In OECD Europe, slow population growth, high transportation fuel costs, and environmental policies contribute to a decline in demand for transportation energy in the Reference case. OECD Europe's population increases by only 0.2 percent per year; the countries of the region already have mature transportation systems; and improvements in energy efficiency over the course of the projection result in passenger transportation energy use that declines by an average of 0.7 percent per year from 2007 to 2035 (Figure 95). Despite slow population growth in OECD Europe, economic growth continues at an average rate of 1.7 percent per year, and energy use for freight transportation grows by an average of 0.5 percent per year. The growth in fuel use to move freight partially offsets the decline in fuel use for passenger transport over the projection period, and total transportation energy use declines by 0.2 percent per year.

Figure 95. OECD Europe transportation energy use, 2007-2035 (quadrillion Btu)



OECD Europe's transportation energy consumption declined by an estimated 1.1 percent in 2009, as the global economic recession lowered demand for both freight and passenger travel. Many countries in the region introduced "fleet renewal schemes" to encourage consumer purchases of new, energy-efficient vehicles and support economic growth as the recession deepened. The terms of the schemes varied widely, with incentives to scrap older vehicles altogether and/or replace them with new efficient vehicles. Eleven countries in OECD Europe offered the schemes in the 2008-2010 period (Table 17). The United Kingdom's scheme expired in late March 2010, and the schemes in Spain and Luxembourg are scheduled to expire in late 2010 [*7*].

Although the fleet renewal schemes did boost car sales strongly, and they provided a short-term economic benefit by increasing automobile production, sales are projected to be depressed as the stimulus packages are removed [*8*]. In the long term, OECD Europe's transportation energy use continues to decline slowly, to 17.9 quadrillion Btu in 2020, and remains at that level through 2035. The transportation share of total delivered energy use in OECD Europe falls slightly, from 31 percent in 2007 to 30 percent in 2020, and remains unchanged through 2035.

The infrastructure for mass transit to interconnect the countries of OECD Europe, particularly rail infrastructure, is well established. The 10 separate high-speed rail systems currently operating in Europe can compete successfully with air travel [*9*]. Examples include the TGV rail system, which operates in France, Switzerland, Germany, and Belgium, and the Eurostar system, which operates in England, France, and Belgium. High population densities, the convenience of relatively short travel times offered by high-speed rail, and high motor fuel taxes that encourage consumers to use mass transit have allowed rail to succeed in OECD Europe, and it should continue to be a major transportation mode in the region for the foreseeable future.

OECD Asia

OECD Asia, like OECD Europe, generally has well-established transportation infrastructures; however, with population in the region as a whole expected to contract (averaging -0.1 percent per year from 2007 to 2035), passenger transport demand declines. The region's passenger transportation energy use falls by about 0.4 percent per year from 2007 to 2035 in the *IEO2010* Reference case.

In 2008 and 2009, the global economic recession slowed the growth in demand for transportation fuels in OECD Asia, as manufacturing and consumer demand for goods and services slowed substantially. In the short term, total demand for transportation fuels in the region declines from 7.4 quadrillion Btu in 2007 to 7.0 quadrillion Btu in 2010, followed by a gradual increase to 7.9 quadrillion Btu in 2035. The largest increase is expected in South Korea, where transportation fuel use rises by 1.3 percent per year from 2007 to 2035 (Figure 96). In comparison, fuel use in Australia and New Zealand combined increases at only half that rate.

Among the economies of OECD Asia, Japan was the hardest hit by the 2008-2009 recession, with GDP contracting by 0.7 percent in 2008 and by an estimated 5.3 percent in 2009. Transportation fuel use in the country also declined strongly, from 4.0 quadrillion Btu in 2007 to 3.7 quadrillion Btu in 2009, and is expected to decline again in 2010 to 3.4 quadrillion Btu. Like other OECD economies that were severely hit by the recession, Japan announced a vehicle scrappage program in 2009, the

Table 17. Fleet renewal schemes in OECD Europe, 2009 and 2010

Country	Incentive	Vehicle age	Estimated value	Duration
Austria	$2,000	>13 years	$60 million	4/1/2009–12/12/2009
France	$1,300	>10 years	$293 million	12/4/2008–12/31/2009
Germany	$3,330	>9 years	$2.0 billion (600,000 cars)	1/14/2009–12/31/2009
Italy	$2,000-$6,660 (cars) $3,330-$8,660 (LCVs)	>9 years	—	2/7/2009–12/31/2009
Portugal				
Plan I	$1,300-$1,660	>10 years ($1,300) >15 years ($1,660)	—	1/1/2009–8/7/2009
Plan II	$1,660-$2,000	>10 years ($1,660) >13 years ($2,000)	—	8/8/2009–12/31/2009
Spain				
Plan VIVE	Interest-free loan up to $13,300	>10 years or >155,000 miles	—	12/1/2008–10/1/2010
Plan 2000E	$2,660	>10 years (with purchase of new car) >12 years (with purchase of used car)	$745 million (280,000 vehicles)	5/18/2009–5/18/2010
Luxembourg	$2,000-$2,330	>10 years	—	1/22/2009–10/1/2010
Slovakia				
Plan I	$1,330-$2,260	>10 years	—	3/9/2009–3/25/2009
Plan II	$1,330	>10 years	—	4/6/2009–12/31/2009
Netherlands	$1,000-$1,330 (motor gasoline cars and LCVs) $1,330-$2,330 (diesel cars and LCVs)	Various, >13 years	—	2009–2010
United Kingdom	$3,000	>10 years	$595 million	5/1/2009–3/31/2010
Greece	$670-$4,300 (passenger cars) $670-$4,900 (LCVs) $4,000-$17,320 (trucks, about 1.5-ton payload)	First registered before January 1, 2005	—	9/23/2009–11/2/2009

Notes: Assumed exchange rates are $1.00 = 0.75 Euro and $1.00 = 0.67 British pound. LCV = light commercial vehicle.
Source: European Automobile Manufacturers' Association.

so-called "Eco-Friendly Vehicle Purchase Program." The program provides 100,000 Yen (about $1,100) to consumers who purchase new cars that exceed 2010 emissions standards by 15 percent or more and an additional 150,000 Yen (about $1,650) to purchasers who trade in cars that are at least 13 years old for "green vehicles" [*10*]. The program was originally scheduled to run from April 2009 to March 2010, but it has been so successful that the government has extended it through September 2010 [*11*].

In the long term, Japan's demand for transportation fuels does not recover substantially from current levels. In 2035, the country's consumption of transportation fuels totals only 3.4 quadrillion Btu, in part for demographic reasons. The Japanese population is aging and is expected to decline by 9.0 percent (11 million people) from 2007 to 2035. As a result, energy use in the passenger transportation sector in 2035 is 9 percent below the 2007 level. Although Japan's GDP growth averages 0.5 percent per year over the period, its energy use for freight transportation increases on average by only 0.4 percent per year.

South Korea's transportation energy use grows by 1.3 percent per year in the Reference case. The country has the region's strongest projected GDP growth, averaging 2.9 percent per year from 2007 to 2035, and its transportation infrastructure is still relatively young compared with those in Japan and Australia/New Zealand. Although South Korea accounts for about one-fourth of OECD Asia's total population, its share of the region's transportation energy use increases from 24 percent in 2007 to 32 percent in 2035. Similarly, energy use for freight transportation in South Korea increases by an average of 1.8 percent per year, and its share of OECD Asia's total energy use for freight movement grows from 30 percent in 2007 to 39 percent in 2035, reflecting an increase in its share of OECD Asia's total GDP from 17 percent to 26 percent.

The economies of Australia and New Zealand were not as severely affected by the global recession as those of many other OECD nations. As a result, measures to increase motor vehicle sales in both countries were comparatively modest. In Australia, the government offered small businesses a 30-percent tax cut on new fleet vehicles as part of its "National Building and Jobs Plan," but it did not offer a larger car scrappage program like those that were instituted in Europe, Japan, and the United States [*12*].

In the long term, GDP in Australia and New Zealand combined grows by an average of 2.6 percent per year from 2007 to 2035, higher than the OECD average of 2.0 percent per year. That rate of increase will support the region's rising demand for transportation fuels, which grows by an average of 0.7 percent per year. As in South Korea, fuel use for freight transportation is the key factor in the increase, rising by an average of 1.5 percent per year, from 0.6 quadrillion Btu in 2007 to 0.9 quadrillion Btu in 2035.

Non-OECD countries

The average growth rate for transportation energy use in non-OECD countries from 2007 to 2035, at 2.6 percent per year, is nearly nine times the rate for OECD countries. Non-OECD transportation fuel use—much of it in the form of liquid fuels—doubles over the period (Figure 97). Large and growing populations and rising per-capita incomes spur the increases in demand for passenger and freight travel in many of the developing non-OECD economies. The pace and direction of development of their relatively young transportation infrastructures—particularly, the fuel efficiencies of personal motor vehicle fleets and the rate and extent of

Figure 96. OECD Asia transportation energy use by country, 2007-2035 (quadrillion Btu)

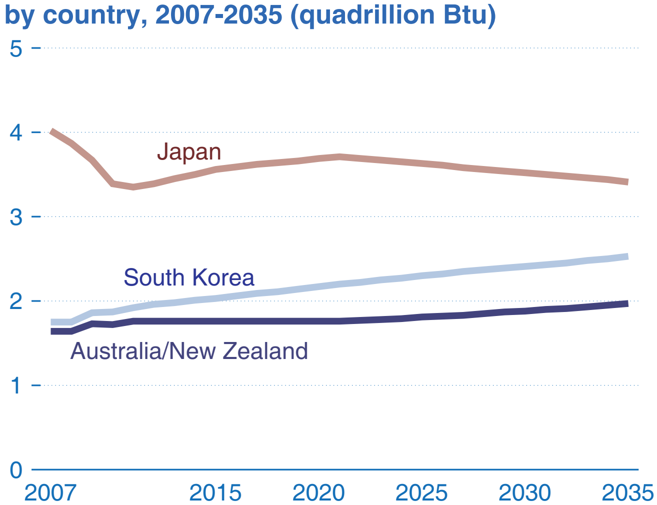
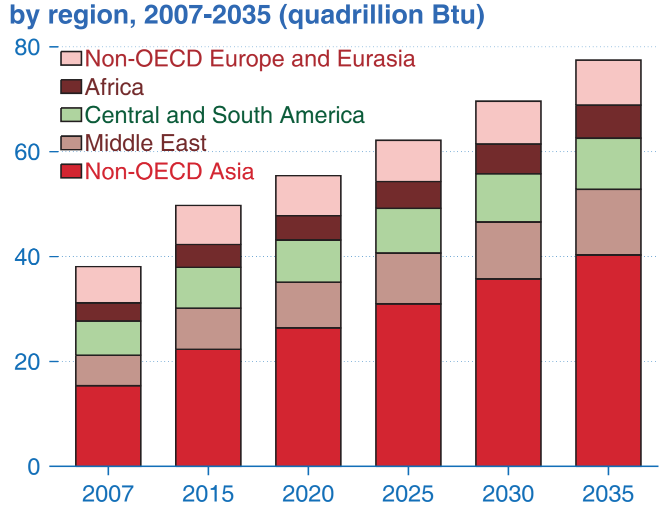


Figure 97. Non-OECD transportation energy use by region, 2007-2035 (quadrillion Btu)



market penetration by mass transit systems—will shape the future demand for transportation fuels in the non-OECD nations.

Non-OECD Asia

The nations of non-OECD Asia are among the fastest-growing consumers of transportation energy in the *IEO2010* Reference case. In non-OECD Asia, transportation energy consumption for both passenger and freight transportation increases rapidly, supported by sustained high rates of economic growth over the 2007-2035 period. In total, China, India, and the other developing countries of non-OECD Asia account for almost one-half of the world increase in GDP in the Reference case, growing from 23 percent of the world economy in 2007 to 38 percent in 2035. Over the same period, non-OECD Asia's share of world transportation liquids consumption increases from 16 percent to 28 percent.

China has been, and is projected to continue to be, the fastest-growing economy among non-OECD countries and the fastest-growing consumer of transportation fuels (Figure 98). From 2007 to 2035, China's GDP increases by an average of 5.8 percent per year in the Reference case, its use of passenger transportation fuels increases by 4.3 percent per year, and its use of freight transportation fuels increases by 4.6 percent per year. From 1997 to 2007, growth in the combined length of China's highways averaged 11.3 percent per year, and its GDP expanded by an annual average of 9.6 percent [***13***]. Over the same period, passenger-miles traveled and ton-miles of highway freight travel increased at annual rates of 7.9 and 8.0 percent, respectively. Although China's passenger transportation energy use per capita triples in the Reference case, in 2035 it still is only about one-third of South Korea's (Figure 99).

Motorization (motor vehicles per 1,000 persons[27]) is comparatively low in China, estimated at 32 motor vehicles per 1,000 persons in 2007 [***14***], as compared with an estimated 338 vehicles per 1,000 persons in South Korea. China's motorization is likely to increase strongly through 2035, but it is not expected to reach the levels of many OECD nations, including South Korea. Although China's passenger transportation energy use per capita triples in the Reference case, in 2035 it still is only about one-third of South Korea's (Figure 99).

In part, the disparities between passenger transportation energy use in China and South Korea are explained by the more significant role of nonmotorized transport—including handcarts and bicycles—in China and differences between rural and urban population shares in the two countries. In 2007, according to the United Nations, 42 percent of China's population was considered urban [***15***]. In contrast, 81 percent of South Korea's total population is urban. The urban share of total population is expected to increase in China over time, but even in 2025 the United Nations expects China's urban share of population to be only 57 percent.

China became the world's largest car market in 2009, when light-duty vehicle sales reached 13.6 million—surpassing sales in the United States, which fell to 10.3 million vehicles as the economic recession and rising unemployment reduced U.S. demand for automobiles to its lowest level in 27 years [***16***]. Car sales in China surged by nearly 50 percent in 2009, supported by some $15 billion in government-sponsored incentives, including sales tax rebates for the purchase of small cars and subsidies for buyers in rural areas [***17***]. Although sales are expected to slow as the government tightens lending terms to keep the economy from growing too quickly, analysts still project a 7- to 10-percent increase in vehicle

Figure 98. Non-OECD Asia transportation energy use by country, 2007-2035 (quadrillion Btu)

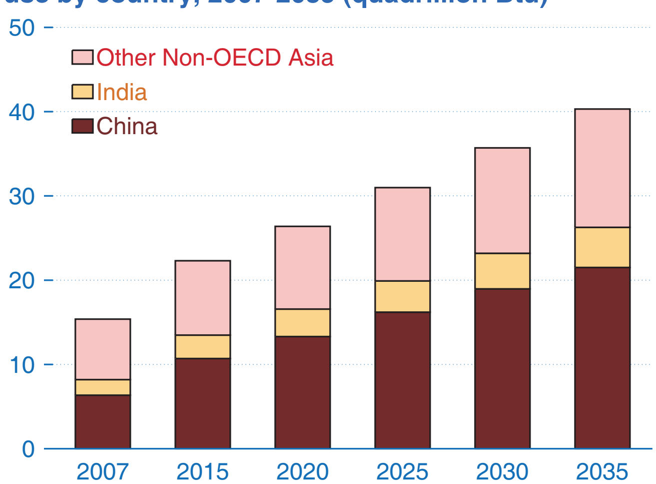
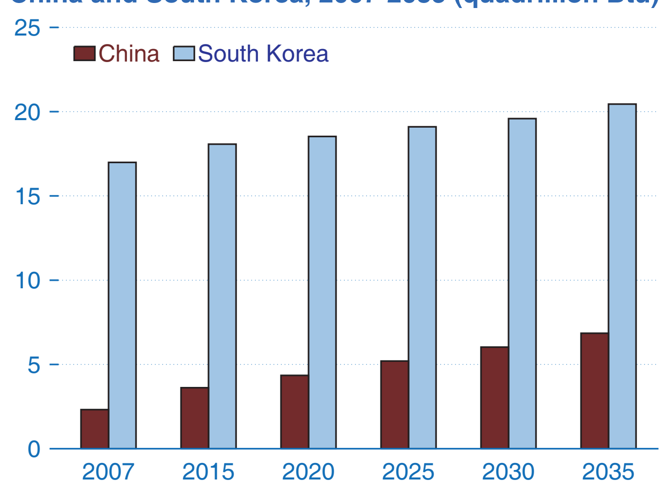


Figure 99. Transportation energy use per capita in China and South Korea, 2007-2035 (quadrillion Btu)



[27] Motor vehicles include cars, buses, and freight vehicles but do not include two-wheelers.

sales for 2010. As per-capita incomes rise, Chinese consumers purchase motor vehicles as status symbols, as well as for ease of mobility. This development has been observed particularly among younger Chinese who cannot afford to buy a home but, with the various incentive programs, can afford to purchase an automobile [*18*]. As a result, the market for light-duty vehicles in China should continue to expand strongly in the mid-term.

In addition to its rapidly expanding highway system, passenger railways are an important part of China's transportation network development. In 2008 alone, around 1.4 billion passenger trips were taken on China's railways [*19*]. The Chinese government has recognized the importance of expanding the system, making large investments in its high-speed passenger railways. Those investments will be key to improving travel times between major cities, and they will allow more freight to move along the existing slower rail lines, improving economic prospects in the rural parts of the country where growth has often lagged behind that of the industrial coast. China began construction on a national passenger rail system in 2005, with plans to provide access to rail throughout the country by 2020.

China accelerated investment in passenger rail construction as part of the economic stimulus package valued at about $585 billion (U.S. dollars) that was instituted in the wake of the global economic downturn of 2008. In 2009, the government doubled investment in high-speed rail to $50 billion in order to boost economic growth and employment levels, which had faltered as global demand for Chinese goods declined. There are additional plans to invest some $17.6 billion in a passenger rail line across the northwestern Chinese desert and $24.0 billion in a line from Beijing to Guangzhou in southeastern China. A $23.5 billion line from Beijing to Shanghai should become operational in 2011 [*20*]. The government expects to have some 8,100 miles of high-speed rail installed by 2012 and 16,000 miles by 2020 [*21*]. The high-speed rail lines are proving to be enormously popular, and they are competing successfully with air travel. Within 48 days of its opening in 2010, the 314-mile Zhengzhou-to-Xian line reduced travel time so dramatically, and proved so popular, that airline service between the two cities was discontinued.

The large-scale plans to expand high-speed passenger rail in China emphasize the importance that mass transit can have in the development of a country's transportation energy use. In the *IEO2010* Reference case, China's passenger rail system is expected to temper the growth in demand for personal motor vehicles. At top speed, China's high-speed passenger trains can reach 217 miles per hour, and trips that once took more than 6 hours can be reduced to less than 2 hours, making rail more convenient for travelers than the often congested Chinese roadways.

In India, the demand for personal transportation is advancing strongly, much of it in the form of small automobiles and vehicles with two or three wheels. Although the country's motor vehicle sales slowed as a result of the global economic downturn in 2008, government stimulus incentives for consumers helped increase motor vehicle sales in 2009. In December 2008, the government introduced a $60 billion stimulus package to help cushion the impact of the global recession, including a 4-percent cut in the nation's value-added tax [*22*]. As a result of the stimulus and improved economic prospects, Indian automobile sales grew by more than 1.4 million units in 2009, an increase in annual sales of nearly 19 percent [*23*]. The government began the process of removing the stimulus measures in February by raising the excise duty on automobiles by 2 percentage points, but analysts still expect growth in income to support 10- to 15-percent increases in Indian motor vehicle sales over the next several years [*24*].

The Reference case projection assumes robust growth in travel for both personal (cars and 2- and 3-wheel vehicles) and public (bus and rail) land transport modes in India. The personal transportation provided by motor vehicles, along with an expanding road infrastructure, will greatly increase the mobility of the labor force, helping to support continued high rates of economic growth. In the Reference case, India's total transportation energy use increases by 3.4 percent per year from 2007 to 2035, giving the country the second fastest growing transportation sector after China. Strong growth is anticipated for both passenger and freight transportation in India, with energy use for both modes of transport more than doubling over the period.

There are aspects of India's development that will act to slow the potential growth in demand for road transportation fuels. India has ambitious plans to increase the construction of transportation infrastructure, notably by expanding the country's highway network; but in the past, delays in meeting construction schedules have been typical—notably, with the National Highway Development Plan implementation. That tendency is likely to have some impact on the pace of growth in demand for road transportation fuels. For example, India's 3,683-mile Golden Quadrilateral highway project, first funded by the government in 2000, was scheduled for completion by 2009. Construction is behind schedule, however, and as *IEO2010* was being prepared for publication the project was still unfinished [*25*]. Also tempering future growth in fuel demand is the expectation that new vehicles will achieve higher levels of fuel efficiency per mile.

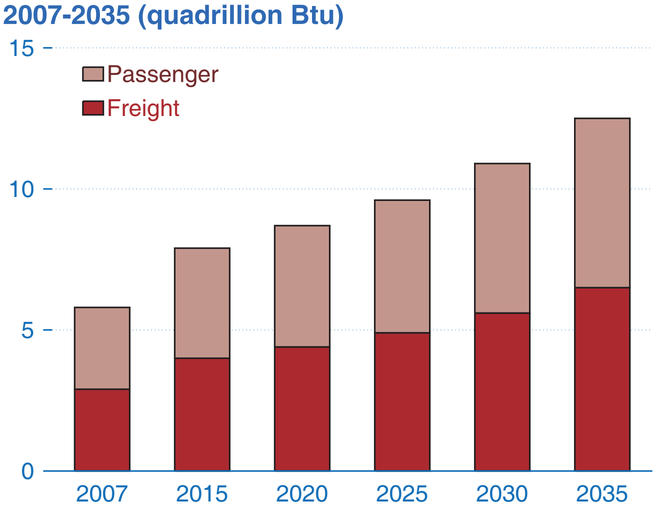
Middle East

Energy consumption for transportation in the Middle East grows by an average of 2.8 percent per year from 2007 to 2035 in the Reference case, to a total of 12.5 quadrillion Btu in 2035 (Figure 100). The Middle East has a relatively small population and is an exporter rather than a major energy-consuming region. Rapid population growth in the region, however, is expected to increase demand for transportation fuels. Transportation energy use has been expanding quickly in the Middle East, at a rate greatly exceeding the world average. From 2000 to 2007, the Middle East's total transportation energy use increased by an annual average of 5.2 percent, compared with a worldwide increase of 2.4 percent per year [*26*].

The region's oil and natural gas producing countries have had some of the fastest growth in transportation energy demand in the world. From 2000 to 2007, transportation energy use increased by 5.5 percent per year in Iran; 5.9 percent per year in Saudi Arabia; 7.5 percent per year in the United Arab Emirates (UAE); and 13.4 percent per year in Qatar. One explanation for the fast-paced growth in demand for personal transportation fuels in the region is the fact that many economies offer consumers fuel at prices that are well below market prices. Saudi Arabia, the UAE, and Iran, among other Middle Eastern nations, have maintained transportation subsidies for their citizens despite the persistent high world oil prices of the past few years, and the subsidies have discouraged conservation or efficiency of use [*27*]. For example, in 2008, one gallon of gasoline cost consumers as little as 38 cents in Iran and about 61 cents in Saudi Arabia [*28*].

The Reference case assumes that, in the long term, some subsidies are reduced to slow consumer demand for fuels, although it might take some time for governments to impose such changes effectively. Given its difficult economic circumstances, Iran has been trying for several years to find ways to reduce the subsidies it offers consumers on energy and food. At present, subsidized motor gasoline is rationed in Iran, with consumers allowed only 16 gallons per month at 38 cents per gallon. Any additional amounts have to be purchased at $1.50 per gallon [*29*]. Removing subsidies is usually very unpopular with consumers, and that makes it a challenge to exact such changes, particularly in countries with difficult sociopolitical circumstances.

Figure 100. Middle East transportation energy use, 2007-2035 (quadrillion Btu)



Through 2008, high world oil prices increased revenues from oil trade in many of the exporting nations, and substantial plans to invest in transportation infrastructure were announced as revenues became available for public spending. With the decline of oil prices and the recent economic downturn, some of the plans for infrastructure improvements in the Middle East were delayed or scaled back, and some of the more expensive projects that will need international support have had difficulty finding banks willing to provide financing [*30*]. Still, given the importance of improving transportation across countries in the region, it is likely that the projects will resume when economic growth recovers and financing opportunities improve.

Saudi Arabia has some of the most ambitious plans to improve its transportation systems. Similar in geographic size to OECD Europe, Saudi Arabia currently has a rail network consisting of only one 283-mile passenger line, between Riyadh and the port of Dammam, and one 350-mile freight line between the two cities. Three major railway projects are either planned or under construction in Saudi Arabia. One of them is the 600-mile "Saudi Land Bridge" rail that will link the capital Riyadh to the Red Sea port of Jeddah and a 75-mile line from Dammam north along the Gulf coast to Jubail. The second project is the 315-mile Haramain high-speed passenger railway between Mecca and Medina. The third project is the 1,400-mile North-South Railway freight rail, which will connect mines in northern Saudi Arabia with industrial facilities at Ras al-Zour on the Persian Gulf coast and Riyadh [*31*]. Construction on the North-South Railway is scheduled to be completed by the end of 2010 [*32*]. Construction on the Haramain high-speed rail began in July 2009 and is scheduled for completion by the end of 2012 [*33*].

Other Middle East countries are also planning extensive rail investment. The UAE completed one line of its Dubai metro system in September 2009, but plans to complete a second line were delayed because of the financial crisis that the emirate experienced in late 2009 [*34*]. The emirate of Abu Dhabi plans to invest $23 billion through 2017 to construct a 211-mile light rapid transit rail line that will connect the central business district to the airport and another 80-mile subway system that will serve a wider area. Another $45 billion will be used to improve Abu Dhabi's road infrastructure, upgrade the emirate's airport, and construct the new Khalifa Port at Taweelah. Bahrain has invested $1.8 billion in the Qatar-Bahrain Friendship causeway (elevated rail) that, upon completion, will link the two countries [*35*]. In April 2009, Jordan announced that it would begin implementation of a proposed 995-mile railway network to link major cities within the country, with the ultimate goal of linking the rail system with the GCC counties [*36*]. Qatar Railway has a $25 billion development investment plan that includes funds to upgrade the country's transportation infrastructure by 2014, in part to support its bid for the 2020 Olympic Games and the 2022 FIFA World Cup.

Air travel infrastructure is also being expanded in several Middle Eastern countries. As countries in the region become increasingly prosperous, the demand for business and leisure air travel is expected to rise. In the United Arab Emirates, construction of the Dubai World Central International Airport is currently under way. It is set to become the world's largest airport, able to handle between 120 and 150 million passengers and 12 million metric tons of cargo annually. Construction of the first of six runways was completed in 2007, and the entire project is expected to be operational by 2015 [*37*]. In Qatar, the New Doha International Airport has been under construction since 2004, with completion of the first phase scheduled for July 2011, when it will be able to accommodate 24 million passengers annually [*38*].

Central and South America

Transportation energy use in Central and South America increases by 1.5 percent per year in the Reference case from 2007 to 2035 (Figure 101). 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 access to credit, allowing vehicle sales to increase strongly [*39*]. The country suffered only a modest impact from the global economic downturn, and it appears that strong growth has already returned. In fact, total vehicle sales in Brazil (including light-duty vehicles, heavy-duty trucks, and buses) rose by 13 percent in 2009 [*40*]. Indications are that robust domestic sales will continue.

In 1975, the Brazilian government launched its National Alcohol Program to increase the use of ethanol in the transportation fuel mix [*41*]. Subsequently, ethanol consumption in Brazil rose from 0.1 billion gallons in 1975 to 4.4 billion gallons in 2007 [*42*]. 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 alternative fuel use in the face of sustained high world oil prices over recent years. Ethanol production is expected to continue to expand in Brazil, along with the country's biofuel-consuming automobile fleet, which may account for as much as one-half of the total fleet by 2013 [*43*].

Flexible-fuel vehicles (FFVs)[28] have become increasingly popular in Brazil. According to Brazil's vehicle manufacturers' association, Associação Nacional dos Fabricantes de Veículos Automotores (Anfavea), the number of FFVs sold each year in Brazil has increased strongly since their introduction in March 2003, from 49,000 in 2003 to 3 million in 2009 [*44*]. FFVs accounted for 92 percent of new vehicle sales in Brazil in 2009 [*45*].

Non-OECD Europe and Eurasia

Transportation sector energy use in non-OECD Europe and Eurasia increases by 0.8 percent per year on average from 2007 to 2035 (Figure 102). Flat or declining

Figure 101. Central and South America transportation energy use by country, 2007 and 2035 (quadrillion Btu)

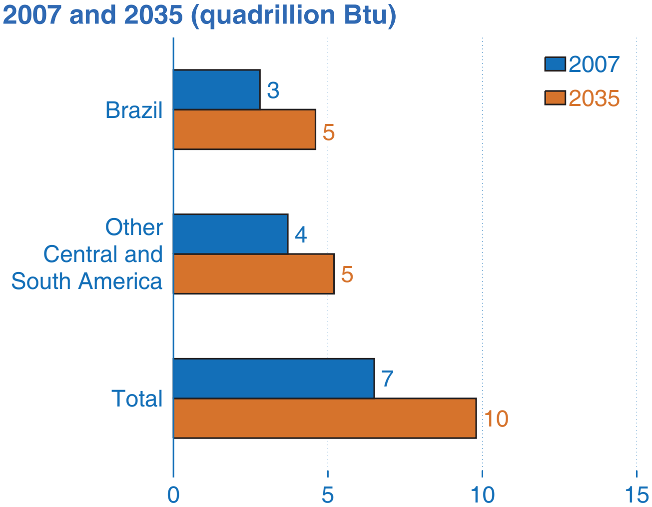
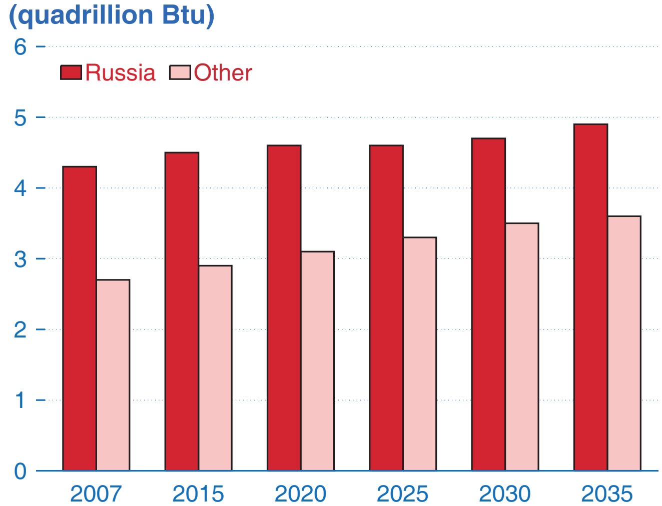


Figure 102. Non-OECD Europe and Eurasia transportation energy use by country, 2007-2035 (quadrillion Btu)



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

population growth and increasing efficiency of transport infrastructure are expected to dampen growth in the region's transportation fuel use over the period. In Russia—the region's largest economy—energy consumption for passenger transportation declines at an average rate of 0.8 percent per year from 2007 to 2035, while the Russian population declines by an average of 0.4 percent per year (for a total population reduction of 17 million).

As revenues from energy exports increased substantially from 2003 to 2008, Russia's economic growth spurred strong growth in motor vehicle sales, with sales of light-duty vehicles increasing by 29 percent from 2006 to 2007 and total vehicle sales reaching $3.2 billion in 2008 [***46***]. Not surprisingly, because of the collapse of commodity prices in late 2008 and the global economic downturn coupled with rising unemployment and plunging consumer confidence, light-duty vehicle sales fell by 49 percent in 2009. Sales plummeted despite a number of government stimulus programs aimed at supporting the domestic automobile industry, including subsidized interest rates on domestically produced vehicles and direct subsidies and guarantees to help restructure Russian automobile manufacturers [***47***]. Although the Russian economy is expected to improve somewhat in 2010, the government announced a $19.6 billion car scrappage program in March 2010 that will offer rebates toward the purchase of a new Russian-built motor vehicle when accompanied by a trade-in vehicle at least 10 years old [***48***].

In addition to Russia, some of the other large economies of non-OECD Europe and Eurasia—notably, Kazakhstan and Ukraine—also experienced severe contractions in light-duty vehicle sales as a result of the global recession. In 2009, vehicle sales declined by 23 percent in Kazakhstan and by 77 percent in Ukraine. With little or no population growth expected from 2007 to 2035 in the economies of non-OECD Europe and Eurasia (excluding Russia), energy consumption for passenger transportation increases by an average of just 0.7 percent per year from 2007 to 2035 in the *IEO2010* Reference case. The region's economy grows on average by 2.8 percent per year, and its energy use for freight transportation grows by an average of 1.7 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.

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Chapter 8

Energy-Related Carbon Dioxide Emissions

In 2007, non-OECD energy-related emissions of carbon dioxide exceeded OECD emissions by 17 percent. In the IEO2010 Reference case, energy-related carbon dioxide emissions from non-OECD countries in 2035 are about double those from OECD countries.

Overview

Because anthropogenic emissions of carbon dioxide result primarily from the combustion of fossil fuels, world energy use continues to be at the center of the climate change debate. In the *IEO2010* Reference case, world energy-related carbon dioxide emissions[29] grow from 29.7 billion metric tons in 2007 to 33.8 billion metric tons in 2020 and 42.4 billion metric tons in 2035 (Table 18).[30]

From 2006 to 2007, total energy-related carbon dioxide emissions from non-OECD countries grew by 4.9 percent, while emissions from OECD countries increased by 1.0 percent. The increase in OECD countries' carbon dioxide emissions is estimated to have been reversed in 2008 and 2009, as fossil fuel demand contracted during the global recession that began in 2008 and continued through 2009. In 2015, annual emissions from non-OECD countries exceed those from OECD countries by 43 percent in the Reference case (Figure 103). Over the 28-year projection period from 2007 to 2035, total carbon dioxide emissions from non-OECD countries increase by an average of 2.0 percent per year—20 times the rate of increase for OECD countries (0.1 percent per year). By 2035, energy-related carbon dioxide emissions in non-OECD countries (28.2 billion metric tons) are almost twice the level of those in OECD countries (14.2 billion metric tons).

The *IEO2010* Reference case projections are, to the extent possible, based on existing laws and policies. Projections

Figure 103. World energy-related carbon dioxide emissions, 2007-2035 (billion metric tons)

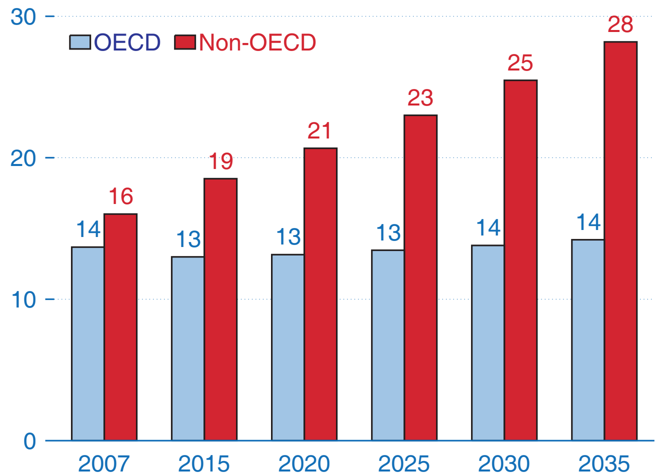


Table 18. World energy-related carbon dioxide emissions by region, 1990-2035 (billion metric tons)

Region	History 1990	History 2007	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change 1990-2007	Average annual percent change 2007-2035
OECD	**11.5**	**13.7**	**13.0**	**13.1**	**13.5**	**13.8**	**14.2**	**1.0**	**0.1**
North America	5.8	7.0	6.7	6.9	7.2	7.4	7.7	1.1	0.3
Europe	4.2	4.4	4.1	4.0	4.0	4.1	4.1	0.3	-0.2
Asia	1.6	2.3	2.1	2.2	2.3	2.3	2.4	2.1	0.2
Non-OECD	**10.0**	**16.0**	**18.5**	**20.7**	**23.0**	**25.5**	**28.2**	**2.8**	**2.0**
Europe and Eurasia	4.2	2.9	2.9	2.9	3.0	3.0	3.2	-2.2	0.3
Asia	3.7	9.4	11.2	13.0	14.9	16.9	19.0	5.7	2.5
Middle East	0.7	1.5	1.9	2.1	2.3	2.5	2.7	4.6	2.1
Africa	0.7	1.0	1.2	1.2	1.3	1.5	1.6	2.6	1.7
Central and South America	0.7	1.2	1.3	1.4	1.5	1.6	1.7	3.1	1.4
Total World	**21.5**	**29.7**	**31.5**	**33.8**	**36.5**	**39.3**	**42.4**	**1.9**	**1.3**

[29] In *IEO2010*, energy-related carbon dioxide emissions are defined as emissions related to the combustion of fossil fuels (liquid fuels, natural gas, and coal) and those associated with petroleum feedstocks. Emissions from the flaring of natural gas are not included.

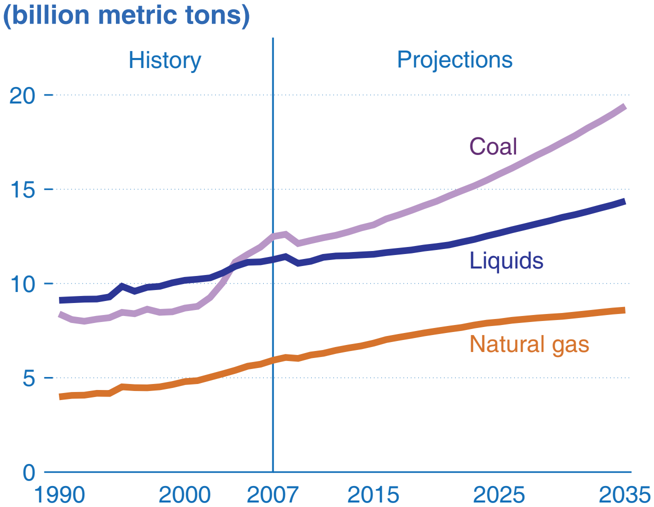
[30] In keeping with current international practice, *IEO2010* presents data on greenhouse gas emissions in billion metric tons carbon dioxide equivalent. The data can be converted to carbon equivalent units by multiplying by 12/44.

for carbon dioxide emissions may change significantly if laws and policies aimed at reducing greenhouse gas emissions are changed or new ones are introduced. In addition, beyond energy-related carbon dioxide there are other gases and sources that contribute to greenhouse gas emissions.

The relative contributions of different fossil fuels to total energy-related carbon dioxide emissions have changed over time. In 1990, carbon dioxide emissions associated with liquid fuels made up an estimated 42 percent of the world total; in 2007, their share was 38 percent; and in 2035 it is 34 percent in the Reference case (Figure 104). Carbon dioxide emissions from natural gas, which accounted for less than 19 percent of the total in 1990, increased to 20 percent of the 2007 total. From 2007 to 2035 their share of the total is relatively stable, in a range of 20 to 22 percent.

Coal's share of world carbon dioxide emissions, which grew from 39 percent in 1990 to 42 percent in 2007, increases to almost 46 percent by 2035. Coal is the most carbon-intensive of the fossil fuels, and it is the fastest-growing carbon-emitting energy source in the Reference case, 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; by 2007 their combined share had risen to 26 percent, largely because of their strong economic growth and increasing use of coal to provide energy for that growth. In 2035, carbon dioxide emissions from China and India combined account for 37 percent of the world total, with China alone responsible for 31 percent. The projected emissions from coal would be much lower if carbon capture and storage became economical (see box on page 126).

Figure 104. World energy-related carbon dioxide emissions by fuel type, 1990-2035 (billion metric tons)



In December 2009, the fifteenth session of the Conference of Parties to the United Nations Framework Convention on Climate Change (COP-15) was held in Copenhagen, Denmark. Although COP-15 did not produce a legally binding agreement to cut emissions, key developed and developing countries negotiated a Copenhagen Accord that was noted by the COP in its final session. Under the accord, a process was established for countries to enter specific mitigation pledges by January 31, 2010. Table 19 includes a list of the pledges that were submitted.

The emissions mitigation pledges submitted by countries pursuant to the Copenhagen Accord fall into two general categories: absolute reductions and intensity reductions. Absolute reductions reduce greenhouse gas emissions independent of economic or material output. Japan, Russia, the European Union, the United States, and Brazil have announced absolute reduction goals, which are expressed as percentage reductions below historical base-year amounts. (For example, Japan has announced its goal to reduce carbon dioxide emissions to 25 percent below 1990 levels by 2020.) China and India have announced intensity reduction goals, which typically are expressed as reductions in emissions per unit of output as measured by GDP. (For example, China has announced its intention to reduce its carbon emissions intensity by 2020 to a level that is 40 to 45 percent below its emissions intensity in 2005.)

In addition to voluntary reduction goals, there was a pledge from developed countries at COP-15 for $30 billion in added resources in the 2010-2012 time frame to help developing countries reduce emissions, preserve and enhance forests, and adapt to climate change [*1*]. There was a further goal of mobilizing $100 billion per year in public and private finance by 2020 to address the needs of developing countries [**2**].

Emissions by region

In the *IEO2010* Reference case, world energy-related carbon dioxide emissions increase by an average of 1.3 percent per year from 2007 to 2035 (see Table 18). For OECD countries, annual increases in carbon dioxide emissions average 0.1 percent over the 28-year period. The annual increases are not uniform, however. OECD carbon dioxide emissions in the Reference case decline from 13.7 billion metric tons in 2007 to 12.8 billion metric tons in 2010, then rise to 13.5 billion metric tons in 2025 and 14.2 billion metric tons in 2035.[31]

The average annual rate of increase in carbon dioxide emissions from OECD countries from 2007 to 2035 is 0.1 percent, which is one-tenth of the actual rate of increase from 1990 to 2007 (1.0 percent per year). Projections of

[31] For factors underlying the trends, see discussion below on carbon and energy intensity and the Kaya Identity.

U.S. emissions have been declining in recent *IEOs*. In the *IEO2009* Reference case, the projection for U.S. emissions growth was 9 percent from 2006 to 2030. In the *IEO2010* Reference case, U.S. energy-related carbon dioxide emissions grow by 5 percent from 2006 to 2030. As a result, the projection for U.S. emissions in 2030 is 3.7 percent lower in *IEO2010* than it was in *IEO2009* (Figure 105).

The highest rate of increase in annual emissions of carbon dioxide among OECD countries in the *IEO2010* Reference case is for Mexico, at 1.8 percent per year (Figure 106). Mexico is among the least industrialized of the OECD economies. South Korea (1.4 percent per year) is the only OECD country other than Mexico for which average emissions growth exceeds 1 percent per year. The GDP growth rate for Mexico in *IEO2010* (3.5 percent per year) is the highest among OECD countries, and it is more than a percentage point higher than South Korea's annual GDP growth rate of 2.4 percent.

Japan's energy-related carbon dioxide emissions *decline* in the Reference case by an average of 0.6 percent per year from 2007 to 2035, and OECD Europe's emissions decline by 0.2 percent per year. They are the only regions with declining emissions over the period, and because their combined 2007 emissions are 41 percent of the OECD total, they have a mitigating effect on emissions growth for the OECD region as a whole.

For non-OECD countries, total energy-related carbon dioxide emissions increase by an average of 2.0 percent per year from 2007 to 2035 (Figure 107). The highest rate among non-OECD countries is for China, at 2.7 percent annually from 2007 to 2035, reflecting the country's strong economic growth and heavy reliance on fossil fuels, especially coal. The lowest rate among non-OECD countries is for Russia, at 0.3 percent per year. Russia is expected to expand its reliance on nuclear power to fuel electricity generation, and a decline in its population is likely to slow its overall rate of increase in energy demand. Additionally, retirement of old, inefficient Soviet-era equipment is expected to continue.

Emissions by fuel

When 2007 carbon dioxide emissions are analyzed by fossil fuel, coal is the largest source (12.5 billion metric tons), followed by liquid fuels (11.3 billion metric tons) and natural gas (5.9 billion metric tons). World carbon dioxide emissions from the consumption of liquid fuels increase by 27.5 percent, or an average of 0.9 percent per year, from 2007 to 2035, with all the increase coming from non-OECD countries. Total carbon dioxide emissions from liquid fuel use in OECD countries decline

Table 19. Emissions mitigation goals announced by selected countries (million metric tons carbon dioxide)

Country	Reduction goal	Carbon dioxide emissions goal for goal year[a]	*IEO2010* Reference case projection for goal year	2007 emissions	Emissions reduction needed to achieve goal	Average annual percent change from 2007 emissions needed to achieve goal
Countries with goals for total emissions reductions						
United States	To 17 percent below 2005 level by 2020	4,959	5,851	5,986	893	-1.4%
European Union	To 20 percent below 1990 level by 2020[b]	3,323	4,042	4,386	719	-2.1%
	To 30 percent below 1990 level by 2020[c]	2,907	4,042	4,386	1,135	-3.1%
Japan	To 25 percent below 1990 level by 2020	788	1,114	1,262	325	-3.6%
Brazil	By 36 to 39 percent relative to projected level in 2020	347	534	394	187	-1.0%
Russia	To between 15 and 25 percent below 1990 level by 2020	1,780	1,648	1,664	—	—
Countries with goals for carbon dioxide intensity reductions						
China	To between 40 and 45 percent below 2005 level by 2020	9,810	9,057	6,284	—	—
India	To between 20 and 25 percent below 2005 level by 2020	2,314	1,751	1,399	—	—

[a]It is assumed that country goals are applied proportionally to energy-related carbon dioxide emissions and other greenhouse gases.
[b]Unilateral goal.
[c]Requires other countries to achieve similar reductions.
Source: United Nations Framework Convention on Climate Change, web site http://unfccc.int/meetings/items/5276.php.

Will carbon capture and storage reduce the world's carbon dioxide emissions?

The pursuit of greenhouse gas reductions has the potential to reduce global coal use significantly. Because coal is the most carbon-intensive of all fossil fuels, limitations on carbon dioxide emissions will raise the cost of coal relative to the costs of other fuels. Under such circumstances, the degree to which energy use shifts away from coal to other fuels will depend largely on the costs of reducing carbon dioxide emissions from coal-fired plants relative to the costs of using other, low-carbon or carbon-free energy sources. The continued widespread use of coal could rely on the cost and availability of carbon capture and storage (CCS) technologies that capture carbon dioxide and store it in geologic formations.

Widespread deployment of CCS would facilitate the use of coal in the presence of greenhouse gas policies aimed at reducing carbon dioxide emissions. Without CCS, reducing carbon dioxide emissions probably would require a significant curtailment of global coal use. The primary use of CCS is thought to be in coal-fired electricity generation, where most of the world's coal is consumed. In addition, there could be CCS applications for specific types of industrial facilities and natural-gas-fired power plants.

The CCS technology has three components:

- **Capture**, defined as the physical removal of carbon dioxide that would otherwise be emitted into the atmosphere. In the case of coal-fired power plants, capture could be accomplished by removing carbon dioxide from the waste stream after combustion (post-combustion capture) or by gasifying the coal and removing carbon dioxide before combustion (pre-combustion capture). In another process (oxy-combustion), combustion occurs in a high-oxygen environment, producing a higher concentration of carbon dioxide in the waste stream, which makes carbon capture easier.
- **Transportation**, which will be needed to move carbon dioxide from power plant sites to suitable storage sites. Given the quantities of carbon dioxide that are likely to be captured from coal-fired power plants, pipelines appear to be the most likely mode for transporting the captured gas to geologic sequestration sites.
- **Long-term storage**, which requires permanent sequestration of carbon dioxide to prevent captured emissions from entering the atmosphere. The ability to handle large amounts of carbon dioxide injections varies, depending on the geologic characteristics of a particular site, such as the depth, thickness, and permeability of a given formation. Currently, deep saline aquifers and depleted oil and gas fields are seen as the most likely candidates for long-term storage. Other types of formations also are being examined.

Different technical pieces of the CCS process have already been shown to operate successfully. For example, carbon dioxide emissions have been captured from some industrial sources for decades by the food and beverage industry, oil producers, and other industries. Approximately 3,000 miles of carbon dioxide pipelines already are in service in North America.[b] There are four sequestration sites operating on a commercial scale in the world today,[c] although they capture only a fraction of the amount of carbon dioxide that will be needed for a significant reduction in emissions from coal-fired power plants. These four sites are also used for enhanced oil recovery, a process where carbon dioxide is used to improve oil recovery from wells.

Despite the fact that examples of individual segments of the CCS process have been successful, no project on the scale needed to capture and sequester significant amounts of carbon dioxide from a typical commercial coal-fired power plant has been demonstrated to date. Therefore, there is significant uncertainty about the ultimate cost and feasibility of CCS. Recent cost estimates for integrated gasification combined-cycle (IGCC) coal-fired power plants with capture—a pre-combustion technology that is being considered in several countries—have been in the range of $120 to $180 per ton of carbon dioxide for first-of-a-kind facilities, although costs are likely to decline significantly over time.[d] Post-combustion capture technology costs, especially those applied to existing units, are even more uncertain, and information will not be available until demonstration projects are further along in the process.[e] Costs for sequestration and storage have been

(continued on page 127)

[a]International Energy Agency, *Near-Term Opportunities for Carbon Dioxide Capture and Storage* (Paris, France, 2007), p. 3.

[b]Congressional Research Service, *Carbon Dioxide (CO2) Pipelines for Carbon Sequestration: Emerging Policy Issues* (Washington, DC, 2007), p. 4, web site www.ncseonline.org/nle/crsreports/07may/rl33971.pdf.

[c]The four sites are Sleipner Gas Field in the North Sea (Norway), Snøhvit Gas Field in the Barents Sea (Norway), Weyburn Enhanced Oil Recovery Project (North Dakota, USA), and In Salah Gas Field (Algeria).

[d]M. Al-Juaied and A. Whitmore, "Realistic Costs of Carbon Capture & Storage" (Cambridge, MA: Harvard University Energy Technology Innovation Policy), Discussion Paper 2009-08 (July 2009), web site http://belfercenter.ksg.harvard.edu/files/2009_AlJuaied_Whitmore_Realistic_Costs_of_Carbon_Capture_web.pdf. This study indicates that costs could potentially be reduced to a range of the $35 to $70 per ton as the technology matures.

[e]Post-combustion capture demonstration projects at existing plants are being conducted currently at Mountaineer Power Plant in New Haven, West Virginia, and scheduled at Antelope Valley Plant in Beulah, North Dakota.

Will carbon capture and storage reduce the world's carbon dioxide emissions? (continued)

estimated to be approximately $10 to $15 per ton of carbon dioxide,[f] but as more research is conducted at specific sites, the cost estimates could change considerably, depending on location.

Other issues surrounding CCS projects include identifying who will be responsible for the sequestered carbon dioxide, establishing clear regulatory jurisdiction over pipeline construction, and overcoming potential public opposition to CCS facilities that could be a barrier to widespread deployment of the technology. Because of these uncertainties and the fact that large-scale demonstration projects are expected to be very expensive, the private financial community is likely to view initial investments in CCS as risky.

Because the first CCS projects are likely to face these barriers, the governments of several nations have pledged significant amounts of funding for CCS research and development and demonstration projects (see table below). Ultimately, in an economy where greenhouse gas emissions are constrained, CCS could have to compete with other carbon mitigation strategies, such as the use nuclear power and renewable energy sources, if it is to be deployed on a large scale. The outcomes of current demonstration projections will play a key role in future decisions. Many governments are hopeful that current or proposed demonstrations could lead to commercially applicable CCS technology within a decade.[g]

Government funding for CCS projects around the world

Country	Project
European Union	In December 2009, the EU announced that 1 billion Euros ($1.47 billion) in grants would be allocated to six CCS projects on the continent.[h]
United States	The American Recovery and Reinvestment Act, enacted in early 2009, provides $3.4 billion for additional research and development work on advanced fossil energy technologies. A significant portion of the funding was allocated to the National Energy Technology Laboratory (NETL), which is coordinating the U.S. Department of Energy's CCS programs.
China	In China, a $1 billion 650-megawatt "GreenGen" IGCC project is under construction and scheduled to be on line in 2012. The United States and China have entered into a technology-sharing agreement on CCS.
Australia	In May 2009, the Australian Government announced that $2.425 billion (Australian) will be allocated to the "CCS Flagship" program over the next 10 years.[i]

[f]J.J. Dooley, R.T. Dahowski, C.L. Davidson, M.A. Wise, N. Gupta, S.H. Kim, and E.L. Malaone, *Carbon Dioxide Capture and Geologic Storage* (Battelle Memorial Institute, April 2006), p. 36, web site www.battelle.org/news/06/CCS_Climate_Change06.pdf.

[g]White House Council on Environmental Quality, "Presidential Memorandum—A Comprehensive Federal Strategy on Carbon Capture and Storage" (Washington, DC, February 3, 2010), web site www.whitehouse.gov/the-press-office/presidential-memorandum-a-comprehensive-federal-strategy-carbon-capture-and-storage.

[h]Europa, "List of 15 Energy Projects for European Economic Recovery," Memo/09/542 (Brussels, Belgium, December 9, 2009), web site http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/09/542&format=HTML&aged=0&language=EN&guiLanguage=en.

[i]Australian Government, Department of Resources Energy and Tourism, "Clean Energy Initiative" (May 13 2009), web site www.ret.gov.au/Department/Documents/CEI_Fact_Sheet.pdf.

in the early years of the projection and remain just below 2007 levels in 2035 (Figure 108).[32] China has the highest rate of growth in carbon dioxide emissions from liquid fuel use, at 2.9 percent per year, corresponding to its growing demand for liquid fuels in the transportation and industrial sectors. Although the United States remains the largest source of petroleum-related carbon dioxide emissions throughout the period, with 2.6 billion metric tons in 2035, China comes close with 2.2 billion metric tons in 2035.

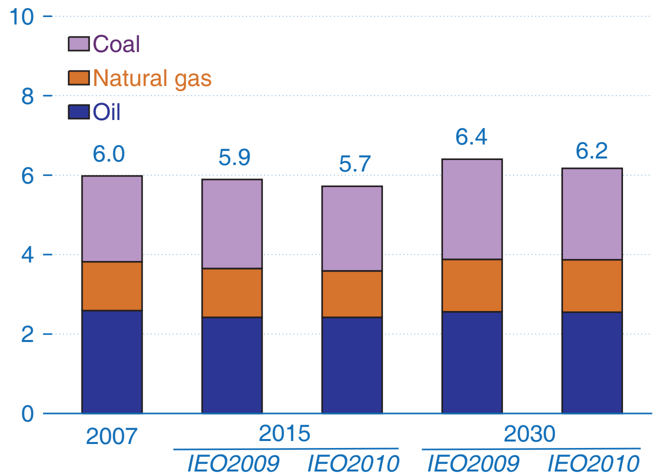
Global carbon dioxide emissions from natural gas combustion worldwide increase by 45 percent, or an average of 1.3 percent per year, to 8.6 billion metric tons in 2035, with the increase for OECD countries averaging 0.7 percent per year and the increase for non-OECD countries averaging 1.9 percent per year (Figure 109). Again, China shows the most rapid growth of emissions in the Reference case, averaging 5.0 percent annually. However, China's emissions from natural gas combustion were only 0.1 billion metric tons in 2007, and in 2035 they

[32]The *IEO2010* estimate for U.S. carbon dioxide emissions from liquids combustion, taken from EIA's *Annual Energy Outlook 2010*, does not include emissions from biofuels. However, due to modeling limitations, *IEO2010* does include carbon dioxide emissions from biofuels combustion outside the United States. In the *IEO2010* Reference case, biofuels make up 1.5 percent of total world liquids consumption outside the United States by 2035. These non-U.S. biofuels add about 0.2 billion metric tons to total world carbon dioxide emissions.

total only 0.5 billion metric tons—equivalent to 4 percent of China's total energy-related emissions and 6 percent of the world's total emissions from natural gas combustion. The much lower growth rate in U.S. emissions from natural gas use, averaging 0.3 percent per year, still results in 1.3 billion metric tons of emissions in 2035, which is almost triple the amount from China in 2035.

World carbon dioxide emissions from coal combustion increase by 56 percent, or 1.6 percent per year on average, from 12.5 billion metric tons in 2007 to 19.4 billion metric tons in 2035. Total coal-related emissions from non-OECD countries were already greater than those from OECD countries in 1990, and in 2035 they are more than 3 times the OECD total (Figure 110), in large part as a result of increases in coal use by China and India.

Figure 105. U.S. energy-related carbon dioxide emissions by fuel in *IEO2009* and *IEO2010*, 2007, 2015, and 2030 (billion metric tons)



China accounts for 78 percent of the total increase in the world's coal-related carbon dioxide emissions from 2007 to 2035, and India accounts for 7 percent. For China alone, coal-related emissions grow by an average of 2.6 percent annually, from 5.2 billion metric tons in 2007 to 10.6 billion metric tons (or 55 percent of the world total) in 2035. India's carbon dioxide emissions from coal combustion total 1.4 billion metric tons in 2035, accounting for more than 7 percent of the world total. In the United States—the world's other major coal consumer—coal-related carbon dioxide emissions rise more slowly, by 0.3 percent per year, to 2.4 billion metric tons (12 percent of the world total) in 2035.

Factors influencing trends in energy-related carbon dioxide emissions

Two key measures provide useful indications of trends in energy-related emissions:

- The *carbon intensity of energy supply* is a measure of the amount of carbon dioxide associated with each unit of energy used. It directly links changes in carbon dioxide emissions levels with changes in energy usage. Carbon emissions vary by energy source, with coal being the most carbon-intensive fuel, followed by oil and natural gas. Nuclear power and some renewable energy sources (i.e., solar and wind) do not generate carbon dioxide emissions. As changes in the fuel mix alter the share of total energy demand met by more carbon-intensive fuels relative to less carbon-intensive or "carbon-free" energy sources, overall carbon intensity changes. Over time, declining carbon intensity can offset increasing energy consumption to some extent. If energy consumption increased and carbon intensity declined at the same

Figure 106. Average annual growth in energy-related carbon dioxide emissions in OECD economies, 2007-2035 (percent per year)

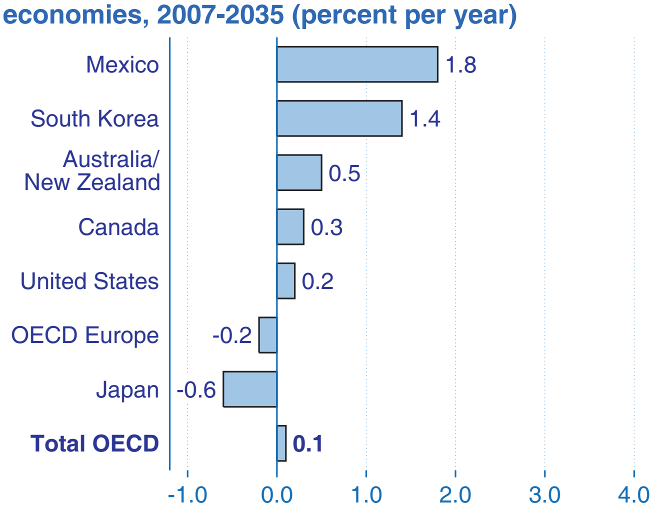
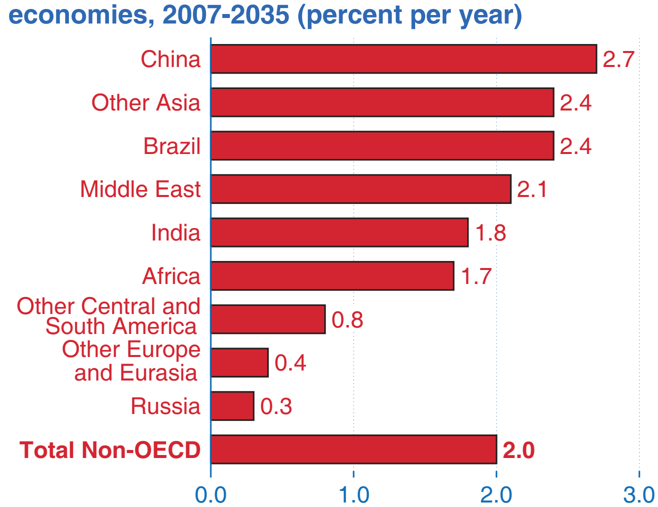


Figure 107. Average annual growth in energy-related carbon dioxide emissions in Non-OECD economies, 2007-2035 (percent per year)

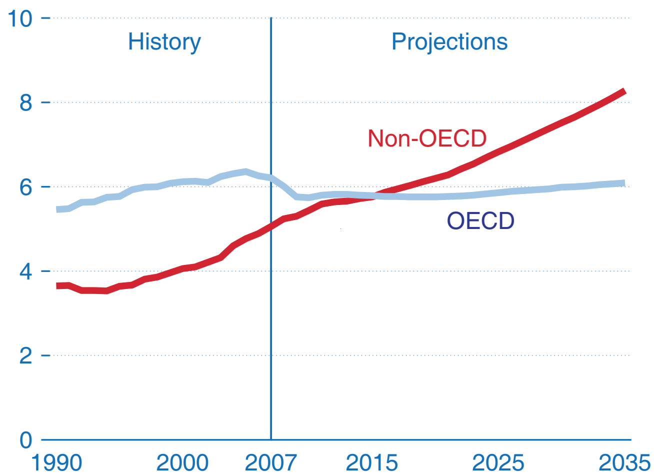


rate, carbon dioxide emissions would remain constant.

- The *energy intensity of economic activity* is a measure of energy consumption per unit of economic activity as measured by GDP. It relates changes in energy consumption to changes in economic activity. As a country's energy intensity changes, so does the influence of a given level of economic activity on carbon dioxide emissions. Increased energy use and economic growth generally occur together, although the degree to which they are linked varies across regions and stages of economic development.

As with carbon intensity, regional energy intensities do not necessarily remain constant over time. The rate at which the energy efficiency of an economy's capital stock (vehicles, appliances, manufacturing equipment, etc.) increases affects trends in energy intensity. New stock is often more energy efficient than the older equipment it replaces. In addition to the availability of more energy-efficient technologies, the rate of efficiency improvement is also determined by changes in the price of energy relative to prices for other goods and services, and by investment in research and development. These factors in combination can produce changes in regional energy intensities, with corresponding effects on expectations for future levels of energy consumption, fuel mix, and carbon dioxide emissions.

Figure 108. World carbon dioxide emissions from liquids combustion, 1990-2035 (billion metric tons)



Structural shifts in national economies also can lead to changes in energy intensity when the shares of economic output attributable to energy-intensive and non-energy-intensive industries change. For example, iron, steel, and cement are among the most energy-intensive industries, and countries whose economies rely heavily on production from those industries tend to have high energy intensities. When their economies shift toward less energy-intensive activities, their national energy intensities may decline. Other influences on regional energy intensity trends include changes in consumer tastes and preferences, climate, taxation, the availability of energy supply, government regulations, and the structure of energy markets themselves.

The Kaya decomposition of emissions trends

The Kaya Identity provides an intuitive approach to the interpretation of historical trends and future projections of energy-related carbon dioxide emissions. It is used to describe the relationship among the factors that influence trends in energy-related carbon dioxide emissions:

$$CO_2 = (CO_2 / E) \times (E / GDP) \times (GDP / POP) \times POP \quad .$$

Figure 109. World carbon dioxide emissions from natural gas combustion, 1990-2035 (billion metric tons)

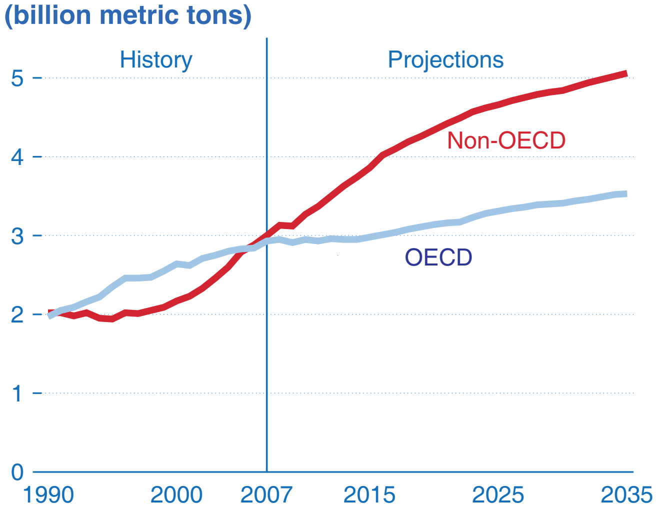
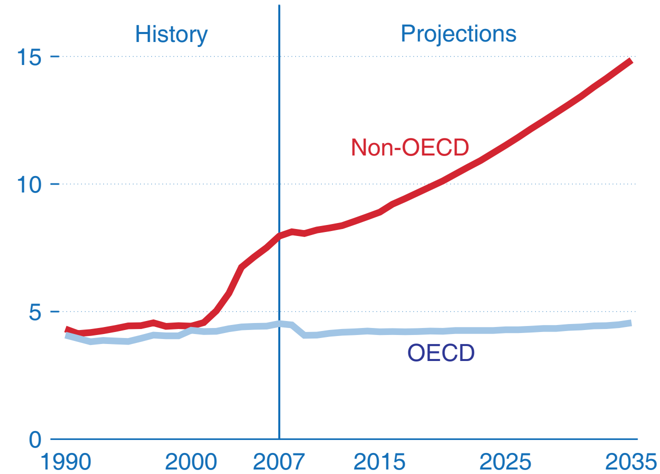


Figure 110. World carbon dioxide emissions from coal combustion, 1990-2035 (billion metric tons)



The identity links total energy-related carbon dioxide emissions (CO_2) to energy (E), the level of economic activity as measured by gross domestic product (GDP), and population size (POP). Conveniently, the percentage rate of change in carbon emission levels over time approximates the sum of the percentage rate of change across the four components. The first two components on the right-hand side of the equation represent the carbon dioxide intensity of energy supply (CO_2/E) and the energy intensity of economic activity (E/GDP). When they are multiplied together, the resulting measure is carbon dioxide emissions per dollar of GDP (CO_2/GDP)—i.e., the carbon intensity of the economy, which is another common measure used in analysis. Economic output (GDP) is decomposed into output per capita (GDP/POP) and population (POP). At any point in time, the level of energy-related carbon dioxide emissions can be seen as the product of the four Kaya Identity components—energy intensity, carbon dioxide intensity of energy supply, output per capita, and population.[33]

Using 2007 data as examples, world energy-related carbon dioxide emissions totaled 29.7 billion metric tons in that year, world energy consumption totaled 495 quadrillion Btu, world GDP totaled $63.1 trillion, and the total world population was 6,665 million. Using those figures in the Kaya equation yields the following: 60.1 metric tons of carbon dioxide per billion Btu of energy (CO_2/E), 7.8 thousand Btu of energy per dollar of GDP (E/GDP), and $9,552 of income per person (GDP/POP).

Of the four Kaya components, policymakers are most actively concerned with energy intensity of economic output (E/GDP) and carbon dioxide intensity of the energy supply (CO_2/E), because they correspond to the policy levers most available to them. Reducing growth in per-capita output would also have a mitigating influence on emissions, but governments generally pursue policies to increase rather than reduce output per capita to advance objectives other than greenhouse gas mitigation. Some countries, such as China, have policies related directly to limiting population growth, but most countries pursue policies that only indirectly influence population growth.

Table 20 shows absolute regional Kaya Identity values for selected years and average annual rates of change for three 15-year periods: (1) an historical period from 1990 to 2005, (2) a period from 2005 to 2020, and (3) the final period of the *IEO2010* projection from 2020 to 2035.[34] The three periods show distinctive patterns of emissions growth and underlying Kaya factors.

Both OECD and non-OECD economies have experienced or are expected to experience declines in energy intensity. These are the only values that are consistently negative across all time periods at the aggregate level. In the historical period, only OECD Asia showed a rise in energy intensity, reflecting an increase in the energy intensity of Japan's economy. However, Japan has the lowest energy intensity among all the fully industrialized OECD economies.

Carbon intensity varies across time and regions, but in no case does it change as much as energy intensity does. Over the 1990-2005 period, the largest annual decline worldwide (0.7 percent) is for non-OECD Europe and Eurasia, where much of the old energy infrastructure was shut down and replaced after the fall of the Soviet Union. The next largest annual decline (0.6 percent) occurred in OECD Europe, where coal consumption fell from 17.7 quadrillion Btu in 1990 to 12.9 quadrillion Btu in 2005 and was replaced by natural gas consumption, which increased from 11.2 quadrillion Btu in 1990 to 19.8 quadrillion Btu in 2005. In many regions, including North America, the carbon intensity of energy supply remained largely unchanged from 1990 to 2005. For the entire world, carbon intensity declined by only 0.1 percent annually from 1990 to 2005, compared with a 1.5-percent average annual decline in energy intensity.

Over the period from 2005 to 2020, carbon intensity declines in the *IEO2010* Reference case in every part of the world. While explicit carbon policies, such as the caps in OECD Europe, are not included in the model, analysts' judgment regarding, for example, nuclear power have taken those policies into account.[35] In other areas, declining carbon intensity is the result of policies such as renewable portfolio standards and other approaches to promote alternatives to fossil fuels. From 2020 to 2035, there is a slight decrease in carbon intensity of energy supply in OECD economies and a slight increase in non-OECD economies, so that there is virtually no change on a worldwide basis in the absence of additional policies to stem emissions growth, which are not included in the Reference case.

[33] In other analyses, EIA has combined output per capita and population as GDP, simplifying the right side of the equation to three components: GDP, E/GDP and C/E. However, because rates of output and population growth can differ dramatically across countries and regions, this analysis uses the more detailed equation. See U.S. Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2008*, DOE/EIA-0573(2008) (Washington, DC, December 2009), p. 3, web site www.eia.gov/oiaf/1605/ggrpt/pdf/0573(2008).pdf.

[34] See Appendix J for a complete regional listing of Kaya Identity components.

[35] Greenhouse gas emissions caps in Europe are not explicitly included in the *IEO2010* analysis for the following reasons: (1) greenhouse gases other than energy-related carbon dioxide are included in the caps, but they are not modeled in *IEO2010*; (2) the regional composition of the European Union differs from the OECD Europe region modeled in *IEO2010*; (3) the European Union Emissions Trading System includes offsets that involve countries outside the European Union; and (4) the *IEO2010* Reference case extends to 2035 and therefore would require further assumptions regarding emissions caps beyond the period covered under the Emissions Trading System.

For non-OECD countries, increases in output per capita, coupled with even moderate population growth, overwhelm the improvements in energy and carbon intensity. For example, the combined decrease in carbon intensity and energy intensity in non-OECD economies averages 3.0 percent per year from 2005 to 2020. With output per capita rising by 4.3 percent per year and population growing by 1.2 percent per year, however, the net increase in non-OECD carbon dioxide emissions is 2.3 percent per year.[36] Over the same period, the combined decrease (improvement) in carbon intensity and energy intensity in OECD economies averages 2.1

Table 20. Kaya component values by region and country, 1990-2035

	History			Projections		Average annual percent change		
	1990	2005	2007	2020	2035	1990-2005	2005-2020	2020-2035
Carbon intensity (metric tons per billion Btu)								
OECD	**57.7**	**55.8**	**55.7**	**51.7**	**50.6**	**-0.2**	**-0.5**	**-0.1**
North America	57.0	57.3	56.7	53.4	52.7	0.0	-0.5	-0.1
Europe	58.5	53.4	53.3	48.7	46.6	-0.6	-0.6	-0.3
Asia	58.2	56.5	57.3	52.6	51.6	-0.2	-0.5	-0.1
Non-OECD	**64.0**	**64.2**	**64.2**	**61.4**	**61.6**	**0.0**	**-0.3**	**0.0**
Europe/Eurasia	63.0	56.4	56.3	53.8	52.7	-0.7	-0.3	-0.1
Asia	74.3	74.5	74.1	69.1	68.5	0.0	-0.5	-0.1
Central and South America	42.1	42.0	41.7	39.7	37.9	0.0	-0.4	-0.3
Energy intensity (thousand Btu per 2005 U.S. dollars of GDP)								
OECD	**8.5**	**7.1**	**6.8**	**5.5**	**4.4**	**-1.2**	**-1.7**	**-1.5**
North America	10.5	8.2	7.9	6.2	4.7	-1.6	-1.9	-1.8
Europe	7.3	5.9	5.5	4.6	3.7	-1.4	-1.7	-1.4
Asia	6.7	7.0	6.8	5.9	5.4	0.4	-1.2	-0.6
Non-OECD	**12.6**	**10.0**	**9.3**	**6.6**	**5.1**	**-1.5**	**-2.8**	**-1.7**
Europe/Eurasia	20.9	16.9	14.8	11.0	8.1	-1.4	-2.9	-2.0
Asia	11.6	9.5	8.9	5.9	4.7	-1.3	-3.1	-1.5
Central and South America	7.2	7.2	6.9	5.6	4.4	0.0	-1.7	-1.5
Output per capita (2005 U.S. dollars of GDP per person)								
OECD	**22,889**	**29,440**	**30,745**	**36,416**	**47,292**	**1.7**	**1.4**	**1.8**
North America	26,887	34,472	35,554	42,032	54,766	1.7	1.3	1.8
Europe	20,280	26,030	27,427	31,923	41,234	1.7	1.4	1.7
Asia	21,909	27,697	29,140	35,078	43,460	1.6	1.6	1.4
Non-OECD	**2,907**	**4,282**	**4,897**	**8,085**	**12,654**	**2.6**	**4.3**	**3.0**
Europe/Eurasia	9,266	8,722	10,227	14,719	22,978	-0.4	3.5	3.0
Asia	1,537	3,452	4,063	7,917	13,419	5.5	5.7	3.6
Central and South America	6,370	8,001	8,757	11,827	16,998	1.5	2.6	2.4
Population (millions)								
OECD	**1,025**	**1,167**	**1,183**	**1,267**	**1,342**	**0.9**	**0.6**	**0.4**
North America	359	432	441	500	569	1.2	1.0	0.9
Europe	479	535	541	565	577	0.7	0.4	0.1
Asia	187	200	201	202	196	0.4	0.1	-0.2
Non-OECD	**4,253**	**5,332**	**5,467**	**6,343**	**7,127**	**1.5**	**1.2**	**0.8**
Europe/Eurasia	347	341	340	336	324	-0.1	-0.1	-0.2
Asia	2,780	3,446	3,525	4,021	4,398	1.4	1.0	0.6
Central and South America	358	451	464	538	606	1.6	1.2	0.8

[36] Simply summing the rates of change over time often introduces an error factor of 0.1 to 0.2 percentage points.

percent per year—lower than in non-OECD economies—but because OECD output per capita increases by 1.4 percent per year and population growth averages 0.5 percent per year, the net result is that OECD carbon dioxide emissions decline by an average of 0.2 percent per year.

Emissions per capita

Another measure of carbon dioxide intensity is emissions per person. Carbon dioxide emissions per capita in OECD economies are significantly higher than in non-OECD economies (Figure 111). Among non-OECD countries, China has the highest percentage increase in carbon dioxide emissions per capita in the Reference case, from 4.7 metric tons per person in 2007 to 9.2 metric tons per person in 2035 (Table 21 and Figure 112)—an average annual increase of 2.4 percent. Russia has the highest level of emissions per capita among non-OECD economies in 2035, at 14.4 metric tons per person. By country grouping, the lowest levels of emissions per capita are in India and Africa. India's emissions per capita increase from 1.2 metric tons in 2007 to 1.5 metric tons in 2035, and Africa's emissions per capita increase from about 1.0 metric ton in 2007 to 1.1 metric tons in 2035.[37]

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 person. In the Reference case, U.S. emissions per capita fall from 19.8 metric tons in 2007 to 16.2 metric tons in 2035 but remain among the highest, second only to the Australia/New Zealand region (Figure 113). Canada's emissions per capita fall from 17.8 metric tons to 14.8 metric tons over the same period. In Mexico, emissions per capita increase from about 4 metric tons in 2007 (the lowest level among OECD countries) to 5.5 metric tons in 2035, which still is the lowest among the OECD countries reported separately in *IEO2010*.[38]

Income per capita is the most important determinant of carbon dioxide emissions per capita, but other factors also affect the calculation. For example, climate is important, because in general more energy is used for heating per capita in colder climates than in warmer climates. Similarly, population density is important, because densely populated countries use less energy for transportation per capita than do more sparsely populated countries. For example, Canada has both a relatively cold climate and low population density, and its carbon

Figure 111. World carbon dioxide emissions per capita, 1990-2035 (metric tons per person)

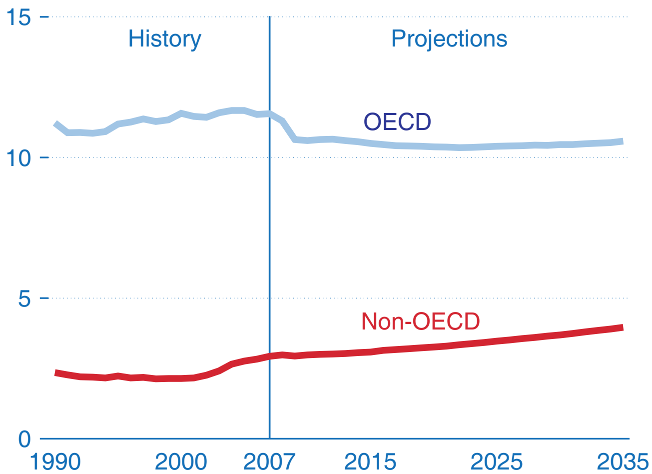


Figure 112. Non-OECD carbon dioxide emissions per capita by country and region, 1990-2035 (metric tons per person)

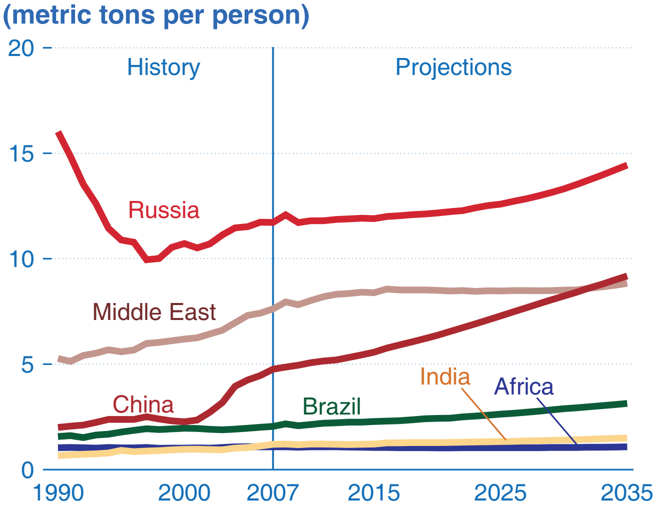
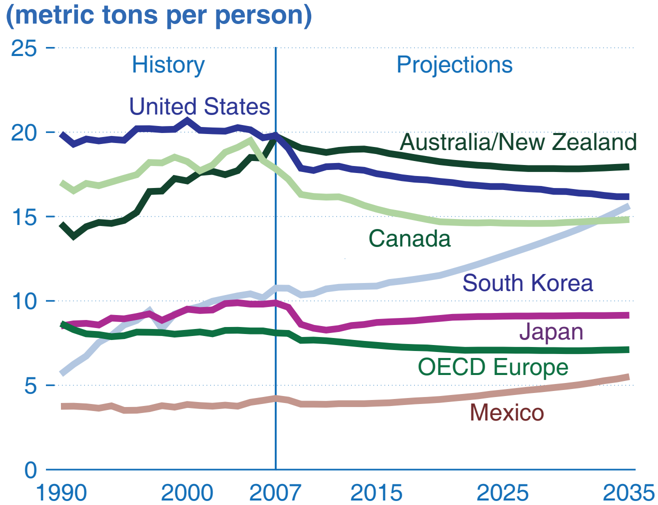


Figure 113. OECD carbon dioxide emissions per capita by country and region, 1990-2035 (metric tons per person)



[37] These values do not include positive carbon flux (emissions) from deforestation.
[38] Because Turkey is an OECD country with per-capita income lower than Mexico's, this may mean lower per-capita emissions. EIA does not project Turkey's emissions separately.

Table 21. Energy-related carbon dioxide emissions per capita by region and country, 1990-2035 (metric tons per person)

Region	History		Projections					Average annual percent change	
	1990	2007	2015	2020	2025	2030	2035	1990-2007	2007-2035
OECD	**11.0**	**11.6**	**10.5**	**10.4**	**10.4**	**10.5**	**10.6**	**0.3**	**-0.3**
North America	**16.0**	**15.8**	**14.1**	**13.8**	**13.7**	**13.6**	**13.5**	**-0.1**	**-0.6**
United States	20.0	19.8	17.5	17.1	16.8	16.5	16.2	-0.1	-0.7
Canada	17.0	17.8	15.4	14.7	14.6	14.7	14.8	0.3	-0.7
Mexico	3.6	4.1	3.9	4.2	4.5	4.9	5.5	0.8	1.0
Europe	**8.4**	**8.1**	**7.4**	**7.2**	**7.1**	**7.1**	**7.1**	**-0.2**	**-0.5**
Asia	**8.5**	**11.4**	**10.6**	**10.9**	**11.3**	**11.7**	**12.2**	**1.7**	**0.2**
Japan	8.5	9.9	8.7	9.0	9.1	9.1	9.1	0.9	-0.3
South Korea	5.7	10.8	10.9	11.5	12.7	14.0	15.6	3.9	1.3
Australia/New Zealand	14.6	19.8	18.9	18.3	17.9	17.8	18.0	1.8	-0.3
Non-OECD	**2.4**	**2.9**	**3.1**	**3.3**	**3.5**	**3.7**	**4.0**	**1.3**	**1.1**
Europe/Eurasia	**12.3**	**8.5**	**8.5**	**8.7**	**8.9**	**9.3**	**9.8**	**-2.1**	**0.5**
Russia	16.0	11.7	11.9	12.2	12.6	13.3	14.4	-1.8	0.8
Other	9.4	6.3	6.2	6.3	6.5	6.6	6.9	-2.4	0.3
Asia	**1.3**	**2.7**	**2.9**	**3.2**	**3.6**	**3.9**	**4.3**	**4.2**	**1.7**
China	2.0	4.7	5.6	6.4	7.3	8.2	9.2	5.2	2.4
India	0.7	1.2	1.2	1.3	1.3	1.4	1.5	3.6	0.8
Other	1.1	1.7	1.7	1.8	1.9	2.1	2.4	2.7	1.2
Middle East	**5.2**	**7.5**	**8.4**	**8.5**	**8.5**	**8.5**	**8.8**	**2.2**	**0.6**
Africa	**1.0**	**1.0**	**1.1**	**1.0**	**1.0**	**1.0**	**1.1**	**0.1**	**0.1**
Central and South America	**1.9**	**2.5**	**2.6**	**2.6**	**2.7**	**2.8**	**2.9**	**1.6**	**0.4**
Brazil	1.6	2.1	2.3	2.4	2.6	2.9	3.1	1.7	1.5
Other	2.2	2.8	2.8	2.7	2.7	2.7	2.7	1.5	-0.2
Total World	**4.1**	**4.5**	**4.3**	**4.4**	**4.6**	**4.8**	**5.0**	**0.5**	**0.4**

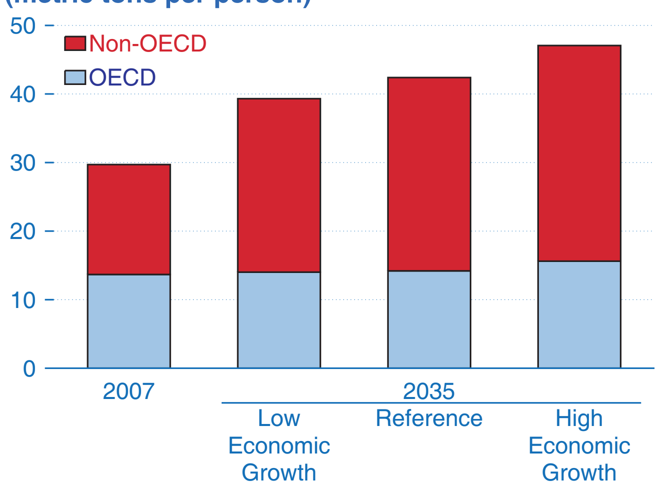
dioxide emissions in 2007 are estimated at 17.8 metric tons per capita, whereas Japan has a more temperate climate and a much higher population density, and its emissions in 2007 are estimated at 9.9 metric tons per capita (44 percent lower than in Canada). Japan's income per capita, by comparison, was only 15 percent lower than Canada's in 2007.

Alternative Economic Growth cases

In *IEO2010*, economic growth is the most significant factor analyzed that underlies the projections for growth in energy-related carbon dioxide emissions in the midterm, 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 Low Economic Growth case and higher in the High Economic Growth case than in the Reference case.

In 2035, total energy-related carbon dioxide emissions worldwide (Figure 114) range from a projected 39.3 billion metric tons in the Low Economic Growth case to 47.1 billion metric tons in the High Economic Growth case—19.7 percent higher than projected in the Low Economic Growth case. The projections for emissions by fuel show similar variations across the cases.

Figure 114. Carbon dioxide emissions in three Economic Growth cases, 2007 and 2035 (metric tons per person)



In the High Economic Growth case, world carbon dioxide emissions increase by an average of 1.7 percent annually from 2007 to 2035, as compared with 1.3 percent in the Reference case. For OECD countries, the projected average increase in the High Economic Growth case is 0.5 percent per year; for non-OECD countries, the average is 2.4 percent per year. In the Low Economic Growth case, world carbon dioxide emissions increase by 1.0 percent per year from 2007 to 2035, with averages of -0.1 percent per year for OECD countries and 1.6 percent per year for non-OECD countries (compared with 0.1 percent and 2.0 percent, respectively, in the Reference case).

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Data Sources

Highlights

Figure 1. World marketed energy consumption, 2007-2035: ***2007:*** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 2. World marketed energy use by fuel type, 1990-2035: ***History:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 3. World liquids production, 1990-2035: ***1990-2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, Generate World Oil Balance Model (2010).

Figure 4. Net change in world natural gas production by region, 2007-2035: ***2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. EIA, International Natural Gas Model (2010).

Figure 5. World coal consumption by region, 1990-2035: ***1990-2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 6. World net electricity generation by fuel, 2007-2035: ***2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 7. World renewable electricity generation by energy source, excluding wind and hydropower, 2007-2035: ***2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 8. World delivered energy consumption in the industrial sector, 2007-2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 9. World delivered energy consumption in the transportation sector, 2005-2035: ***2005-2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 10. World energy-related carbon dioxide emissions, 2007-2035: ***2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 11. Impacts of four Kaya factors on world carbon dioxide emissions, 1990-2035: ***1990-2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

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Figure 12. World marketed energy consumption, 1990-2035: ***History:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Table 1. World marketed energy consumption by country grouping, 2007-2035: ***2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 13. World marketed energy consumption: OECD and Non-OECD, 1990-2035: ***History:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 14. Shares of world energy consumption in the United States, China, and India, 1990-2035: ***History:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 15. Marketed energy use in Non-OECD economies by region, 1990-2035: ***History:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 16. World marketed energy use by fuel type, 1990-2035: ***History:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 17. Coal consumption in selected world regions, 1990-2035: ***History:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 18. World electricity generation by fuel, 2007-2035: ***History:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 19. Renewable electricity generation in China by energy source, 2007-2035: ***2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 20. World nuclear generating capacity by region, 2007 and 2035: ***2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 21. OECD and Non-OECD total gross domestic product, 1990-2035: ***History:*** IHS Global Insight, *World Overview* (Lexington, MA, various issues). ***Projections:*** Derived from IHS Global Insight, *World Overview, Third Quarter 2009* (Lexington, MA, November 2009); and EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo.

Table 2. World gross domestic product by country grouping, 2007-2035: ***History:*** IHS Global Insight, *World Overview* (Lexington, MA, various issues). ***Projections:*** Derived from IHS Global Insight, *World Overview, Third Quarter 2009* (Lexington, MA, November 2009); and EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo.

Figure 22. World marketed energy consumption in three Economic Growth cases, 1990-2035: ***1990-2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 23. World oil prices in three Oil Price cases, 1990-2035: EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), web site www.eia.gov/oiaf/aeo.

Figure 24. World marketed energy consumption in three Oil Price cases, 2007-2035: ***2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 25. World marketed energy consumption by fuel in three Oil Price cases, 2035: EIA, World Energy Projection System Plus (2010).

Figure 26. World liquids consumption by sector in three Oil Price cases, 2035: EIA, World Energy Projection System Plus (2010).

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Figure 27. World liquids consumption by region and country group, 2007 and 2035: ***2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***2035:*** EIA, World Energy Projection System Plus (2010).

Figure 28. World liquid fuels production in three cases, 2007 and 2035: ***2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***2035:*** EIA, Generate World Oil Balance Model (2010).

Table 3. World liquid fuels production in the Reference case, 2007-2035: ***2007:*** EIA, Office of Energy Markets and End Use. ***Projections:*** EIA, Generate World Oil Balance Model (2010).

Figure 29. World total liquids production, 1990-2035: ***1990-2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, Generate World Oil Balance Model (2010).

Figure 30. World production of unconventional liquid fuels in three cases, 2007 and 2035: ***2007:*** EIA, Office of Energy Markets and End Use. ***2035:*** EIA, Generate World Oil Balance Model (2010).

Figure 31. World liquids consumption by sector, 2007-2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

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Figure 33. Non-OPEC conventional liquids production by region, 2007 and 2035: ***2007:*** EIA, Office of Energy Markets and End Use. ***2035:*** EIA, Generate World Oil Balance Model (2010).

Figure 34. OPEC conventional liquids production by region, 2007 and 2035: ***2007:*** EIA, Office of Energy Markets and End Use. ***2035:*** EIA, Generate World Oil Balance Model (2010).

Figure 35. World proved oil reserves by geographic region as of January 1, 2010: "Worldwide Look at Reserves and Production," *Oil & Gas Journal*, Vol. 105, No. 48 (December 24, 2009), pp. 22-23.

Table 5. World oil reserves by country as of January 1, 2010: "Worldwide Look at Reserves and Production," *Oil & Gas Journal*, Vol. 105, No. 48 (December 24, 2009), pp. 22-23.

Chapter 3. Natural Gas

Figure 36. World natural gas consumption, 2007-2035: ***2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 37. Change in world natural gas production by region, 2007-2035: EIA, International Natural Gas Model (2010).

Figure 38. Natural gas consumption in North America by country, 2007-2035: ***2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010); and *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo.

Figure 39. Natural gas consumption in OECD Europe by end-use sector, 2007-2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 40. Natural gas consumption in OECD Asia by country and end-use sector, 2007 and 2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***2035:*** EIA, World Energy Projection System Plus (2010).

Figure 41. Natural gas consumption in Non-OECD Europe and Eurasia, 2007-2035: ***2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

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Figure 43. OECD natural gas production by country, 1990-2035: ***1990-2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, International Natural Gas Model (2010); and *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo.

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Figure 44. OECD Europe natural gas production, 1990-2035: ***1990-2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, International Natural Gas Model (2010).

Figure 45. Middle East natural gas production, 1990-2035: ***1990-2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, International Natural Gas Model (2010).

Figure 46. Non-OECD Europe and Eurasia natural gas production, 1992-2035: ***1992-2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, International Natural Gas Model (2010).

Figure 47. Africa natural gas production, 1990-2035: ***1990-2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, International Natural Gas Model (2010).

Figure 48. Non-OECD Asia natural gas production, 1990-2035: ***1990, 2000, and 2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, International Natural Gas Model (2010).

Figure 49. China natural gas production, 1990-2035: ***1990, 2000, and 2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, International Natural Gas Model (2010).

Figure 50. Central and South America natural gas production, 1990-2035: ***1990-2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, International Natural Gas Model (2010).

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Figure 52. OECD Asia net natural gas trade, 2007-2035: ***2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, International Natural Gas Model (2010).

Figure 53. Non-OECD Europe and Eurasia net natural gas trade, 2007-2035: ***2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, International Natural Gas Model (2010).

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Figure 55. Middle East net natural gas trade, 2007-2035: ***2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, International Natural Gas Model (2010).

Figure 56. Africa net natural gas trade, 2007-2035: ***2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, International Natural Gas Model (2010).

Figure 57. Non-OECD Central and South America net natural gas trade, 2007-2035: ***2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, International Natural Gas Model (2010).

Figure 58. World natural gas reserves by geographic region as of January 1, 2010: "Worldwide Look at Reserves and Production," *Oil & Gas Journal*, Vol. 105, No. 48 (December 24, 2009), pp. 22-23.

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Figure 60. World coal consumption by country grouping, 1980-2035: ***1980-2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 61. Coal share of world energy consumption by sector, 2007, 2020, and 2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 62. OECD coal consumption by region, 1980, 2007, 2020, and 2035: ***1980 and 2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

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Figure 65. Coal imports by major importing region, 1995-2035: ***History:*** SSY Consultancy and Research, Ltd., *SSY's Coal Trade Forecast*, Vol. 17, No. 4 (London, United Kingdom, June 2009), and previous issues; International Energy Agency, *Coal Information 2009* (Paris, France, August 2009), and previous issues; and EIA, *Quarterly Coal Report, October-December 2008*, DOE/EIA-0121(2008/4Q) (Washington, DC, March 2009), and previous issues; Btu conversions from short tons are estimates by EIA's Office of Integrated Analysis and Forecasting. ***Projections:*** EIA, IEO2010 National Energy Modeling System run IEO2010.D050710A.

Figure 66. Coal imports to Asia by major importing region, 2007 and 2035: ***2007:*** EIA, *Quarterly Coal Report*, DOE/EIA-0121(2007/4Q) (December 2007); and derived from SSY Consultancy and Research, Ltd., *SSY's Coal Trade Forecast*, Vol. 17, No. 1 (London, United Kingdom, July 2008). ***2035:*** EIA, IEO2010 National Energy Modeling System run IEO2010.D050710A.

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Figure 67. Growth in world electric power generation and total energy consumption, 1990-2035: ***1990-2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

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Table 11. OECD and Non-OECD net electricty generation by energy source, 2007-2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 70. World net electricity generation by fuel, 2006-2030: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 71. World net electricity generation from nuclear power by region, 2007-2030: ***2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Table 12. OECD and Non-OECD net renewable electricity generation by energy source, 2007-2035: ***2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 72. Net electricity generation in North America, 1990-2035: ***1990-2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 73. Net electricity generation in North America by fuel, 2007 and 2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***2035:*** EIA, World Energy Projection System Plus (2010).

Figure 74. Net electricity generation in OECD Europe by fuel, 2007-2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 75. Net electricity generation in OECD Asia, 2007-2035: ***2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 76. Net electricity generation in Non-OECD Europe and Eurasia, 2007-2035: ***2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 77. Net electricity generation in Non-OECD Asia by fuel, 2007-2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 78. Net electricity generation in the Middle East by fuel, 2007-2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

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Table 13. World industrial energy consumption by region and energy source, 2007-2035: ***2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, "Balances of OECD and Non-OECD Statistics" (2009), web site www.iea.org (subscription site). ***Projections:*** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010); AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Figure 82. Annual changes in world industrial and all other end-use energy consumption from previous year, 2006-2010: ***2006-2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***2008-2010:*** EIA, World Energy Projection System Plus (2010).

Figure 83. World delivered energy consumption in the industrial and all other end-use sectors, 2005-2035: ***2005-2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 84. OECD and Non-OECD industrial sector energy consumption, 2007-2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 85. World industrial sector energy consumption by fuel, 2007 and 2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***2035:*** EIA, World Energy Projection System Plus (2010).

Figure 86. World industrial sector energy consumption by major energy-intensive industry shares, 2007: International Energy Agency Data Services, *World Energy Balances* (2009), web site www.iea.org (subscription site).

Figure 87. OECD and Non-OECD major steel producers, 2008: World Steel Association, "World Steel in Figures 2009" (October 2009), web site www.worldsteel.org.

Figure 88. OECD industrial sector energy consumption by fuel, 2007 and 2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***2035:*** EIA, World Energy Projection System Plus (2010).

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Figure 90. Industrial sector energy consumption in Brazil by energy source, *IEO2009* and *IEO2010* Reference cases, 2006, 2020, and 2030: ***2006:*** Derived from EIA, Intenational Energy Statistics database (various dates). ***Projections:*** EIA, *International Energy Outlook 2009*, DOE/EIA-0484 (Washington, DC, May 2009) and EIA, World Energy Projection System Plus (2010).

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Figure 91. World liquids consumption by end-use sector, 2007-2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 92. OECD and Non-OECD transportation sector liquids consumption, 2007-2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Table 14. World energy consumption for transportation by country grouping, 2007-2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Table 15. World energy consumption for passenger transportation by country grouping, 2007-2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Table 16. World energy consumption for freight transportation by country grouping, 2007-2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 93. OECD transportation energy use by region, 2007, 2025, and 2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 94. North America transportation energy use by country, 2007 and 2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***2035:*** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383 (2010) (Washington, DC, April 2010); and EIA, World Energy Projection System Plus (2010).

Figure 95. OECD Europe transportation energy use, 2007-2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

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Figure 96. OECD Asia transportation energy use by country, 2007-2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 97. Non-OECD transportation energy use by region, 2007-2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 98. Non-OECD Asia transportation energy use by country, 2007-2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 99. Transportation energy use per capita in China and South Korea, 2007-2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 100. Middle East transportation energy use, 2007-2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 101. Central and South America transportation energy use by country, 2007 and 2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***2035:*** EIA, World Energy Projection System Plus (2010).

Figure 102. Non-OECD Europe and Eurasia transportation energy use by country, 2007-2035: ***2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

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Figure 103. World energy-related carbon dioxide emissions, 2007-2035: ***2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 104. World energy-related carbon dioxide emissions by fuel type, 1990-2035: ***1990-2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Table 18. World energy-related carbon dioxide emissions by region, 1990-2035: ***1990 and 2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Table 19. Emissions mitigation goals announced by selected countries: ***Reduction goals:*** United Nations Framework Convention on Climate Change, National Reports, Appendix I—Quantified Economy-Wide Emissions Targets for 2020, web site http://unfccc.int/home/items/5264.php, and Appendix II—Nationally Appropriate Mitigation Actions of Developing Country Parties, web site http://unfccc.int/home/items/5265.php. ***2007 emissions:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Goal year projected carbon dioxide emissions:*** EIA, World Energy Projection System Plus (2010).

Figure 105. U.S. energy-related carbon dioxide emissions by fuel in *IEO2009* and *IEO2010*, 2007, 2015, and 2030: EIA, *Annual Energy Outlook 2009*, DOE/EIA-0383 (2009) (Washington, DC, June 2009), and EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010).

Figure 106. Average annual growth in energy-related carbon dioxide emissions in OECD economies, 2007-2035: EIA, World Energy Projection System Plus (2010).

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Figure 108. World carbon dioxide emissions from liquids combustion, 1990-2035: ***1990-2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 109. World carbon dioxide emissions from natural gas combustion, 1990-2035: ***1990-2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 110. World carbon dioxide emissions from coal combustion, 1990-2035: ***1990-2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Table 20. Kaya component values by region and country, 1990-2035: ***History:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010). ***Population (history and projections):*** *United States:* EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo. *Other Countries:* IHS Global Insight, *World Overview* (Lexington, MA, various issues).

Table 21. Energy-related carbon dioxide emissions per capita by region and country, 1990-2035: ***History:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 111. World carbon dioxide emissions per capita, 1990-2035: ***1990-2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

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Figure 113. OECD carbon dioxide emissions per capita by country and region, 1990-2035: ***1990-2007:*** Derived from EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***Projections:*** EIA, World Energy Projection System Plus (2010).

Figure 114. Carbon dioxide emissions in three Economic Growth cases, 2007 and 2035: ***2007:*** EIA, International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. ***2035:*** EIA, World Energy Projection System Plus (2010).

Appendix A

Reference Case Projections:

- World energy consumption
- Gross domestic product
- Carbon dioxide emissions
- World population

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Table A1. World total primary energy consumption by region, Reference case, 2005-2035
(Quadrillion Btu)

Region/Country	History 2005	History 2006	History 2007	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD									
OECD North America	**122.4**	**121.8**	**123.7**	**124.3**	**129.4**	**134.9**	**140.2**	**146.3**	**0.6**
United States[a]	100.5	99.8	101.7	101.6	105.0	108.3	111.2	114.5	0.4
Canada	14.8	14.5	14.3	14.6	15.4	16.3	17.2	18.2	0.9
Mexico	7.1	7.4	7.7	8.1	9.0	10.4	11.8	13.5	2.0
OECD Europe	**82.4**	**82.9**	**82.3**	**82.0**	**83.0**	**85.0**	**86.5**	**88.2**	**0.2**
OECD Asia	**39.0**	**39.5**	**39.7**	**39.7**	**41.8**	**43.3**	**44.8**	**46.3**	**0.5**
Japan	23.1	23.3	22.8	21.1	21.9	22.1	22.1	22.2	-0.1
South Korea	9.3	9.4	9.7	10.6	11.7	12.7	13.8	14.9	1.5
Australia/New Zealand	6.6	6.7	7.2	8.0	8.2	8.5	8.9	9.2	0.9
Total OECD	**243.8**	**244.1**	**245.7**	**246.0**	**254.2**	**263.2**	**271.4**	**280.7**	**0.5**
Non-OECD									
Non-OECD Europe and Eurasia	**50.4**	**51.0**	**51.5**	**52.4**	**54.2**	**56.2**	**57.8**	**60.2**	**0.6**
Russia	29.7	30.5	30.5	30.7	31.6	32.8	33.9	35.5	0.5
Other	20.7	20.6	21.0	21.7	22.5	23.3	23.9	24.7	0.6
Non-OECD Asia	**112.6**	**119.6**	**127.1**	**159.3**	**187.8**	**217.0**	**246.9**	**277.3**	**2.8**
China	68.4	73.0	78.0	101.4	121.4	142.4	162.7	181.9	3.1
India	17.5	18.8	20.3	24.3	28.2	31.1	34.1	37.6	2.2
Other Non-OECD Asia	26.7	27.8	28.8	33.7	38.2	43.5	50.2	57.8	2.5
Middle East	**22.8**	**23.9**	**25.1**	**32.9**	**36.5**	**39.1**	**41.8**	**45.7**	**2.2**
Africa	**17.2**	**17.3**	**17.8**	**20.8**	**22.5**	**24.6**	**26.5**	**29.0**	**1.8**
Central and South America	**26.0**	**27.1**	**28.0**	**32.1**	**35.5**	**38.7**	**42.2**	**45.7**	**1.8**
Brazil	11.2	11.7	12.3	14.9	16.9	19.3	21.9	24.3	2.4
Other Central and South America	14.8	15.4	15.7	17.2	18.6	19.3	20.3	21.4	1.1
Total Non-OECD	**229.0**	**239.0**	**249.5**	**297.5**	**336.3**	**375.5**	**415.2**	**458.0**	**2.2**
Total World	**472.7**	**483.1**	**495.2**	**543.5**	**590.5**	**638.7**	**686.5**	**738.7**	**1.4**

[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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, "Balances of OECD and Non-OECD Statistics" (2009), web site www.iea.org (subscription site). **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table A2. World total energy consumption by region and fuel, Reference case, 2005-2035
(Quadrillion Btu)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America									
Liquids	49.5	49.0	49.4	47.5	48.1	49.4	50.9	52.5	0.2
Natural gas	28.1	28.1	29.2	28.3	30.1	32.2	34.0	35.8	0.7
Coal	24.7	24.3	24.6	23.8	24.4	25.0	25.8	26.9	0.3
Nuclear	9.2	9.4	9.6	10.1	10.8	10.9	11.0	11.3	0.6
Other	10.9	11.1	11.0	14.6	16.0	17.4	18.4	19.8	2.1
Total	**122.4**	**121.8**	**123.7**	**124.3**	**129.4**	**134.9**	**140.2**	**146.3**	**0.6**
OECD Europe									
Liquids	32.3	32.4	31.6	29.0	27.7	27.7	28.0	28.3	-0.4
Natural gas	19.7	19.7	19.8	20.8	21.7	22.1	22.2	22.6	0.5
Coal	12.7	13.1	13.2	11.5	11.2	10.9	10.8	11.0	-0.6
Nuclear	9.7	9.6	9.1	9.7	10.0	10.5	10.9	11.2	0.8
Other	7.9	8.1	8.7	11.0	12.4	13.8	14.5	15.1	2.0
Total	**82.4**	**82.9**	**82.3**	**82.0**	**83.0**	**85.0**	**86.5**	**88.2**	**0.2**
OECD Asia									
Liquids	17.5	17.2	16.9	15.6	16.1	16.5	16.7	17.0	0.0
Natural gas	5.9	6.3	6.7	7.4	7.7	8.2	8.3	8.5	0.8
Coal	9.2	9.3	10.1	9.2	9.2	9.5	9.8	10.4	0.1
Nuclear	4.3	4.3	3.9	4.9	5.7	6.0	6.5	7.0	2.1
Other	2.1	2.2	2.1	2.6	3.0	3.2	3.3	3.5	1.7
Total	**39.0**	**39.5**	**39.7**	**39.7**	**41.8**	**43.3**	**44.8**	**46.3**	**0.5**
Total OECD									
Liquids	99.3	98.6	97.9	92.1	92.0	93.5	95.6	97.7	0.0
Natural gas	53.7	54.1	55.6	56.5	59.5	62.6	64.6	66.8	0.7
Coal	46.7	46.7	47.9	44.5	44.8	45.4	46.4	48.3	0.0
Nuclear	23.2	23.3	22.6	24.7	26.5	27.4	28.5	29.5	1.0
Other	20.9	21.4	21.7	28.2	31.4	34.3	36.3	38.3	2.0
Total	**243.8**	**244.1**	**245.7**	**246.0**	**254.2**	**263.2**	**271.4**	**280.7**	**0.5**
Non-OECD									
Non-OECD Europe and Eurasia									
Liquids	10.1	10.3	10.4	10.1	10.0	10.2	10.5	11.0	0.2
Natural gas	25.8	25.8	26.3	27.3	28.0	28.6	28.7	29.0	0.3
Coal	8.4	8.8	8.7	8.0	7.9	8.0	8.5	9.4	0.3
Nuclear	2.9	2.9	3.0	3.7	4.6	5.5	5.8	6.3	2.7
Other	3.2	3.2	3.1	3.3	3.6	3.8	4.1	4.5	1.4
Total	**50.4**	**51.0**	**51.5**	**52.4**	**54.2**	**56.2**	**57.8**	**60.2**	**0.6**
Non-OECD Asia									
Liquids	31.7	33.4	34.6	41.5	46.9	53.4	60.0	66.5	2.4
Natural gas	8.6	9.8	10.8	17.2	20.9	24.0	26.2	28.2	3.5
Coal	61.9	65.4	70.3	81.2	93.9	108.2	123.7	140.3	2.5
Nuclear	1.1	1.1	1.2	3.2	5.6	7.2	8.5	9.8	7.7
Other	9.3	9.9	10.2	16.2	20.4	24.2	28.5	32.5	4.2
Total	**112.6**	**119.6**	**127.1**	**159.3**	**187.8**	**217.0**	**246.9**	**277.3**	**2.8**

See notes at end of table.

Table A2. World total energy consumption by region and fuel, Reference case, 2005-2035 (continued)
(Quadrillion Btu)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
Non-OECD (continued)									
Middle East									
Liquids	12.0	12.5	13.3	15.0	16.1	17.7	19.7	22.7	1.9
Natural gas	10.2	10.8	11.2	17.0	19.3	20.2	20.7	21.5	2.4
Coal	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.4	-0.2
Nuclear	0.0	0.0	0.0	0.1	0.2	0.3	0.4	0.5	—
Other	0.3	0.3	0.3	0.4	0.5	0.5	0.6	0.6	3.1
Total	**22.8**	**23.9**	**25.1**	**32.9**	**36.5**	**39.1**	**41.8**	**45.7**	**2.2**
Africa									
Liquids	6.1	6.2	6.4	7.2	7.4	8.0	8.7	9.4	1.4
Natural gas	3.2	3.1	3.3	5.1	6.1	6.9	7.1	7.4	2.9
Coal	4.2	4.2	4.2	4.2	4.3	4.7	5.3	6.2	1.4
Nuclear	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	3.6
Other	3.6	3.6	3.7	4.2	4.5	4.9	5.3	5.8	1.6
Total	**17.2**	**17.3**	**17.8**	**20.8**	**22.5**	**24.6**	**26.5**	**29.0**	**1.8**
Central and South America									
Liquids	11.3	11.8	12.2	13.4	13.6	14.4	15.4	16.3	1.0
Natural gas	4.7	4.8	4.9	6.0	7.4	8.0	8.4	9.1	2.3
Coal	0.8	0.9	0.9	0.9	1.0	1.2	1.4	1.7	2.1
Nuclear	0.2	0.2	0.2	0.3	0.4	0.5	0.5	0.7	4.2
Other	9.0	9.4	9.8	11.4	13.0	14.6	16.5	17.9	2.2
Total	**26.0**	**27.1**	**28.0**	**32.1**	**35.5**	**38.7**	**42.2**	**45.7**	**1.8**
Total Non-OECD									
Liquids	71.1	74.2	76.8	87.3	94.1	103.7	114.4	125.9	1.8
Natural gas	52.5	54.2	56.5	72.6	81.7	87.7	91.2	95.2	1.9
Coal	75.7	79.7	84.6	94.6	107.6	122.4	139.2	157.9	2.3
Nuclear	4.3	4.4	4.5	7.5	10.9	13.7	15.4	17.5	4.9
Other	25.3	26.5	27.1	35.6	42.0	48.1	55.0	61.4	3.0
Total	**229.0**	**239.0**	**249.5**	**297.5**	**336.3**	**375.5**	**415.2**	**458.0**	**2.2**
Total World									
Liquids	170.4	172.8	174.7	179.3	186.0	197.2	210.0	223.6	0.9
Natural gas	106.3	108.3	112.1	129.1	141.2	150.2	155.8	162.0	1.3
Coal	122.3	126.4	132.4	139.1	152.4	167.8	185.6	206.3	1.6
Nuclear	27.5	27.8	27.1	32.2	37.4	41.1	43.9	47.1	2.0
Other	46.2	47.9	48.8	63.8	73.4	82.4	91.2	99.8	2.6
Total	**472.7**	**483.1**	**495.2**	**543.5**	**590.5**	**638.7**	**686.5**	**738.7**	**1.4**

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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, "Balances of OECD and Non-OECD Statistics" (2009), web site www.iea.org (subscription site). **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table A3. World gross domestic product (GDP) by region expressed in purchasing power parity, Reference case, 2005-2035
(Billion 2005 dollars)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**14,883**	**15,327**	**15,662**	**18,081**	**21,023**	**24,072**	**27,445**	**31,142**	**2.5**
United States[a]	12,422	12,768	13,027	15,022	17,427	19,851	22,475	25,278	2.4
Canada	1,167	1,200	1,231	1,436	1,606	1,779	1,975	2,192	2.1
Mexico	1,293	1,359	1,405	1,624	1,990	2,442	2,994	3,672	3.5
OECD Europe	**13,928**	**14,412**	**14,849**	**16,208**	**18,035**	**19,864**	**21,771**	**23,807**	**1.7**
OECD Asia	**5,535**	**5,681**	**5,850**	**6,530**	**7,089**	**7,557**	**8,044**	**8,531**	**1.4**
Japan	3,872	3,951	4,041	4,258	4,437	4,520	4,601	4,665	0.5
South Korea	892	938	986	1,263	1,494	1,725	1,958	2,189	2.9
Australia/New Zealand	771	792	823	1,009	1,157	1,311	1,485	1,677	2.6
Total OECD	**34,345**	**35,420**	**36,361**	**40,819**	**46,146**	**51,492**	**57,260**	**63,480**	**2.0**
Non-OECD									
Non-OECD Europe and Eurasia	**2,977**	**3,218**	**3,481**	**4,193**	**4,940**	**5,731**	**6,557**	**7,440**	**2.7**
Russia	1,703	1,834	1,982	2,349	2,751	3,202	3,685	4,222	2.7
Other	1,275	1,384	1,499	1,844	2,189	2,529	2,872	3,218	2.8
Non-OECD Asia	**11,897**	**13,013**	**14,323**	**24,055**	**31,832**	**40,307**	**49,366**	**59,023**	**5.2**
China	5,408	6,035	6,820	12,732	17,353	22,446	27,596	32,755	5.8
India	2,440	2,676	2,918	4,847	6,342	7,833	9,529	11,454	5.0
Other Non-OECD Asia	4,049	4,302	4,585	6,476	8,137	10,028	12,241	14,814	4.3
Middle East	**1,985**	**2,145**	**2,261**	**3,071**	**3,742**	**4,473**	**5,336**	**6,328**	**3.7**
Africa	**2,360**	**2,494**	**2,638**	**3,639**	**4,406**	**5,221**	**6,102**	**7,094**	**3.6**
Central and South America	**3,612**	**3,822**	**4,066**	**5,343**	**6,366**	**7,516**	**8,818**	**10,294**	**3.4**
Brazil	1,534	1,595	1,685	2,350	2,877	3,505	4,250	5,126	4.1
Other Central and South America	2,079	2,227	2,381	2,993	3,489	4,011	4,568	5,168	2.8
Total Non-OECD	**22,832**	**24,692**	**26,769**	**40,301**	**51,286**	**63,247**	**76,179**	**90,179**	**4.4**
Total World	**57,177**	**60,112**	**63,130**	**81,120**	**97,433**	**114,740**	**133,439**	**153,658**	**3.2**

[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 non-OECD Europe and Eurasia (excluding Russia), China, India, Africa, and Central and South America (excluding Brazil) were adjusted, based on the analyst's judgment.

Sources: **History:** IHS Global Insight, *World Overview* (Lexington, MA, various issues). **Projections:** IHS Global Insight, *World Overview*, Third Quarter 2009 (Lexington, MA, November 2009); and U.S. Energy Information Administration (EIA), *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R. D111809A, web site www.eia.gov/ oiaf/aeo.

Table A4. World gross domestic product (GDP) by region expressed in market exchange rates, Reference case, 2005-2035
(Billion 2005 dollars)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**14,406**	**14,827**	**15,145**	**17,483**	**20,294**	**23,183**	**26,361**	**29,819**	**2.4**
United States[a]	12,422	12,768	13,027	15,022	17,427	19,851	22,475	25,278	2.4
Canada	1,134	1,166	1,196	1,395	1,561	1,729	1,920	2,130	2.1
Mexico	849	893	922	1,066	1,307	1,603	1,966	2,411	3.5
OECD Europe	**14,672**	**15,157**	**15,594**	**16,889**	**18,665**	**20,453**	**22,319**	**24,306**	**1.6**
OECD Asia	**6,222**	**6,382**	**6,567**	**7,282**	**7,870**	**8,351**	**8,852**	**9,350**	**1.3**
Japan	4,557	4,649	4,755	5,011	5,222	5,320	5,415	5,490	0.5
South Korea	845	888	934	1,197	1,415	1,634	1,854	2,073	2.9
Australia/New Zealand	821	844	877	1,075	1,233	1,397	1,582	1,787	2.6
Total OECD	**35,301**	**36,366**	**37,306**	**41,655**	**44,019**	**49,098**	**57,532**	**63,475**	**1.9**
Non-OECD									
Non-OECD Europe and Eurasia	**1,348**	**1,456**	**1,573**	**1,890**	**2,225**	**2,578**	**2,946**	**3,340**	**2.7**
Russia	764	823	889	1,053	1,234	1,436	1,653	1,894	2.7
Other	584	633	684	837	991	1,142	1,293	1,447	2.7
Non-OECD Asia	**4,751**	**5,190**	**5,710**	**9,526**	**12,573**	**15,886**	**19,402**	**23,123**	**5.1**
China	2,244	2,504	2,830	5,283	7,200	9,313	11,450	13,591	5.8
India	813	892	973	1,616	2,114	2,611	3,176	3,818	5.0
Other Non-OECD Asia	1,693	1,794	1,908	2,628	3,259	3,962	4,776	5,714	4.0
Middle East	**1,079**	**1,162**	**1,224**	**1,685**	**2,054**	**2,454**	**2,924**	**3,463**	**3.8**
Africa	**983**	**1,039**	**1,100**	**1,493**	**1,813**	**2,160**	**2,541**	**2,978**	**3.6**
Central and South America	**1,956**	**2,067**	**2,194**	**2,887**	**3,457**	**4,101**	**4,836**	**5,678**	**3.5**
Brazil	882	917	969	1,351	1,654	2,015	2,443	2,947	4.1
Other Central and South America	1,075	1,150	1,226	1,537	1,803	2,085	2,393	2,731	2.9
Total Non-OECD	**10,117**	**10,914**	**11,801**	**17,482**	**22,121**	**27,179**	**32,650**	**38,582**	**4.3**
Total World	**45,417**	**47,280**	**49,106**	**59,136**	**66,140**	**76,277**	**90,181**	**102,057**	**2.6**

[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 non-OECD Europe and Eurasia (excluding Russia), China, India, Africa, and Central and South America (excluding Brazil) were adjusted, based on the analyst's judgment.

Sources: **History:** IHS Global Insight, *World Overview* (Lexington, MA, various issues). **Projections:** IHS Global Insight, *World Overview*, Third Quarter 2009 (Lexington, MA, November 2009); and U.S. Energy Information Administration (EIA), *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), Table A19.

Table A5. World liquids consumption by region, Reference case, 2005-2035
(Million barrels per day)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**25.2**	**25.0**	**25.1**	**24.6**	**25.0**	**25.7**	**26.4**	**27.4**	**0.3**
United States[a]	20.8	20.7	20.6	20.2	20.6	21.0	21.5	22.1	0.2
Canada	2.3	2.3	2.3	2.2	2.2	2.2	2.3	2.4	0.1
Mexico	2.1	2.1	2.1	2.2	2.3	2.4	2.7	2.9	1.1
OECD Europe	**15.7**	**15.7**	**15.3**	**14.0**	**13.4**	**13.4**	**13.6**	**13.7**	**-0.4**
OECD Asia	**8.6**	**8.5**	**8.4**	**7.7**	**8.0**	**8.1**	**8.3**	**8.4**	**0.0**
Japan	5.3	5.2	5.0	4.2	4.3	4.3	4.2	4.1	-0.7
South Korea	2.2	2.2	2.2	2.4	2.5	2.7	2.9	3.1	1.1
Australia/New Zealand	1.1	1.1	1.1	1.1	1.1	1.1	1.2	1.2	0.4
Total OECD	**49.5**	**49.1**	**48.8**	**46.3**	**46.4**	**47.2**	**48.3**	**49.5**	**0.0**
Non-OECD									
Non-OECD Europe and Eurasia	**4.9**	**5.0**	**5.1**	**4.9**	**4.9**	**5.0**	**5.1**	**5.4**	**0.2**
Russia	2.8	2.9	2.9	2.8	2.7	2.7	2.7	2.8	0.0
Other	2.1	2.2	2.2	2.1	2.2	2.3	2.4	2.5	0.5
Non-OECD Asia	**15.4**	**16.2**	**16.8**	**20.1**	**22.7**	**25.9**	**29.1**	**32.3**	**2.4**
China	6.7	7.3	7.6	10.0	11.6	13.5	15.3	16.9	2.9
India	2.5	2.7	2.8	3.2	3.6	3.9	4.3	4.7	1.8
Other Non-OECD Asia	6.2	6.2	6.3	6.9	7.6	8.5	9.5	10.7	1.9
Middle East	**5.8**	**6.0**	**6.4**	**7.2**	**7.8**	**8.5**	**9.5**	**11.0**	**1.9**
Africa	**3.0**	**3.0**	**3.1**	**3.5**	**3.6**	**3.9**	**4.2**	**4.6**	**1.4**
Central and South America	**5.5**	**5.8**	**6.0**	**6.6**	**6.7**	**7.0**	**7.5**	**8.0**	**1.0**
Brazil	2.2	2.3	2.4	2.8	3.0	3.3	3.6	4.0	1.9
Other Central and South America	3.3	3.5	3.6	3.7	3.7	3.8	3.9	4.0	0.4
Total Non-OECD	**34.6**	**36.1**	**37.3**	**42.4**	**45.7**	**50.4**	**55.6**	**61.1**	**1.8**
Total World	**84.0**	**85.2**	**86.1**	**88.7**	**92.1**	**97.6**	**103.9**	**110.6**	**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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table A6. World natural gas consumption by region, Reference case, 2005-2035
(Trillion cubic feet)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**27.3**	**27.2**	**28.3**	**27.4**	**29.2**	**31.2**	**32.9**	**34.6**	**0.7**
United States[a]	22.0	21.7	23.0	21.7	22.6	23.6	24.3	24.9	0.3
Canada	3.4	3.3	2.9	3.2	3.4	3.7	4.0	4.3	1.4
Mexico	1.9	2.2	2.4	2.5	3.1	3.9	4.6	5.5	3.0
OECD Europe	**19.2**	**19.1**	**19.2**	**20.2**	**21.0**	**21.5**	**21.5**	**21.9**	**0.5**
OECD Asia	**5.3**	**5.8**	**6.3**	**6.9**	**7.3**	**7.7**	**7.8**	**8.0**	**0.8**
Japan	3.1	3.4	3.7	3.8	3.9	4.0	4.0	4.0	0.2
South Korea	1.1	1.1	1.2	1.5	1.6	1.8	1.8	1.8	1.4
Australia/New Zealand	1.1	1.2	1.3	1.7	1.8	1.9	2.0	2.1	1.7
Total OECD	**51.8**	**52.1**	**53.7**	**54.5**	**57.4**	**60.3**	**62.3**	**64.4**	**0.6**
Non-OECD									
Non-OECD Europe and Eurasia	**25.3**	**25.3**	**25.9**	**26.8**	**27.5**	**28.1**	**28.2**	**28.5**	**0.3**
Russia	16.2	16.6	16.7	16.7	16.9	17.2	17.3	17.6	0.2
Other	9.1	8.7	9.1	10.1	10.6	10.9	10.9	10.9	0.6
Non-OECD Asia	**8.5**	**9.6**	**10.5**	**16.7**	**20.4**	**23.3**	**25.5**	**27.5**	**3.5**
China	1.7	2.0	2.5	4.9	6.3	7.6	8.7	9.7	5.0
India	1.3	1.4	1.5	3.1	3.9	4.3	4.4	4.5	4.1
Other Non-OECD Asia	5.6	6.2	6.6	8.7	10.2	11.4	12.3	13.3	2.6
Middle East	**9.8**	**10.3**	**10.7**	**16.2**	**18.4**	**19.3**	**19.8**	**20.5**	**2.4**
Africa	**3.0**	**2.9**	**3.1**	**4.8**	**5.7**	**6.4**	**6.6**	**6.8**	**2.9**
Central and South America	**4.4**	**4.5**	**4.6**	**5.6**	**7.0**	**7.5**	**7.9**	**8.6**	**2.3**
Brazil	0.7	0.7	0.7	1.1	1.5	1.7	2.0	2.3	4.3
Other Central and South America	3.7	3.8	3.9	4.6	5.5	5.7	5.9	6.3	1.7
Total Non-OECD	**50.9**	**52.6**	**54.7**	**70.1**	**78.9**	**84.6**	**88.0**	**91.9**	**1.9**
Total World	**102.7**	**104.6**	**108.5**	**124.7**	**136.3**	**144.9**	**150.3**	**156.3**	**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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table A7. World coal consumption by region, Reference case, 2005-2035
(Quadrillion Btu)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**24.7**	**24.3**	**24.6**	**23.8**	**24.4**	**25.0**	**25.8**	**26.9**	**0.3**
United States[a]	22.8	22.5	22.7	22.3	23.0	23.6	24.3	25.1	0.4
Canada	1.5	1.4	1.5	1.1	1.0	1.1	1.1	1.2	-0.8
Mexico	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.6	1.7
OECD Europe	**12.7**	**13.1**	**13.2**	**11.5**	**11.2**	**10.9**	**10.8**	**11.0**	**-0.6**
OECD Asia	**9.2**	**9.3**	**10.1**	**9.2**	**9.2**	**9.5**	**9.8**	**10.4**	**0.1**
Japan	4.6	4.6	4.9	4.2	4.1	3.9	3.8	3.8	-0.9
South Korea	2.1	2.1	2.3	2.2	2.3	2.7	3.1	3.6	1.6
Australia/New Zealand	2.6	2.6	2.9	2.8	2.8	2.9	2.9	3.0	0.2
Total OECD	**46.7**	**46.7**	**47.9**	**44.5**	**44.8**	**45.4**	**46.4**	**48.3**	**0.0**
Non-OECD									
Non-OECD Europe and Eurasia	**8.4**	**8.8**	**8.7**	**8.0**	**7.9**	**8.0**	**8.5**	**9.4**	**0.3**
Russia	4.3	4.4	4.3	4.1	4.1	4.2	4.6	5.3	0.8
Other	4.1	4.4	4.4	3.9	3.8	3.8	3.9	4.1	-0.2
Non-OECD Asia	**61.9**	**65.4**	**70.3**	**81.2**	**93.9**	**108.2**	**123.7**	**140.3**	**2.5**
China	48.3	51.0	54.8	65.2	76.4	88.5	100.5	112.4	2.6
India	8.6	9.2	10.2	10.5	11.5	12.4	13.7	15.5	1.5
Other Non-OECD Asia	4.9	5.1	5.4	5.5	6.0	7.3	9.6	12.4	3.0
Middle East	**0.4**	**0.4**	**0.4**	**0.4**	**0.3**	**0.3**	**0.3**	**0.4**	**-0.2**
Africa	**4.2**	**4.2**	**4.2**	**4.2**	**4.3**	**4.7**	**5.3**	**6.2**	**1.4**
Central and South America	**0.8**	**0.9**	**0.9**	**0.9**	**1.0**	**1.2**	**1.4**	**1.7**	**2.1**
Brazil	0.4	0.4	0.5	0.5	0.6	0.8	1.0	1.2	3.4
Other Central and South America	0.4	0.4	0.5	0.4	0.4	0.4	0.4	0.5	0.1
Total Non-OECD	**75.7**	**79.7**	**84.6**	**94.6**	**107.6**	**122.4**	**139.2**	**157.9**	**2.3**
Total World	**122.3**	**126.4**	**132.4**	**139.1**	**152.4**	**167.8**	**185.6**	**206.3**	**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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table A8. World nuclear energy consumption by region, Reference case, 2005-2035
(Billion kilowatthours)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**880**	**891**	**905**	**958**	**1,020**	**1,031**	**1,046**	**1,074**	**0.6**
United States[a]	782	787	806	834	883	886	886	898	0.4
Canada	87	93	89	113	127	134	142	158	2.1
Mexico	10	10	10	11	11	11	18	18	2.2
OECD Europe	**932**	**929**	**879**	**935**	**967**	**1,011**	**1,055**	**1,084**	**0.8**
OECD Asia	**429**	**430**	**386**	**486**	**560**	**591**	**641**	**683**	**2.1**
Japan	290	288	251	311	342	358	388	417	1.8
South Korea	139	141	136	175	218	233	254	266	2.4
Australia/New Zealand	0	0	0	0	0	0	0	0	—
Total OECD	**2,240**	**2,250**	**2,171**	**2,379**	**2,548**	**2,634**	**2,742**	**2,841**	**1.0**
Non-OECD									
Non-OECD Europe and Eurasia	**264**	**269**	**273**	**342**	**425**	**512**	**545**	**588**	**2.8**
Russia	140	144	148	197	258	324	345	364	3.3
Other	124	124	125	145	167	188	200	224	2.1
Non-OECD Asia	**106**	**111**	**119**	**312**	**543**	**698**	**814**	**942**	**7.7**
China	50	55	63	186	335	437	512	598	8.4
India	16	16	16	66	119	156	179	203	9.5
Other Non-OECD Asia	40	40	41	61	89	105	123	141	4.5
Middle East	**0**	**0**	**0**	**6**	**20**	**29**	**39**	**49**	**—**
Africa	**12**	**10**	**12**	**15**	**15**	**21**	**21**	**31**	**3.5**
Central and South America	**16**	**21**	**19**	**28**	**34**	**43**	**43**	**62**	**4.3**
Brazil	10	14	12	18	22	31	31	41	4.4
Other Central and South America	6	7	7	10	12	12	12	21	4.2
Total Non-OECD	**399**	**411**	**423**	**704**	**1,038**	**1,303**	**1,462**	**1,672**	**5.0**
Total World	**2,639**	**2,660**	**2,593**	**3,083**	**3,586**	**3,937**	**4,204**	**4,514**	**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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table A9. World consumption of hydroelectricity and other renewable energy by region, Reference case, 2005-2035
(Quadrillion Btu)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**10.9**	**11.1**	**11.0**	**14.6**	**16.0**	**17.4**	**18.4**	**19.8**	**2.1**
United States[a]	6.1	6.4	6.2	9.3	10.1	11.0	11.5	12.4	2.5
Canada	4.2	4.1	4.2	4.5	5.0	5.4	5.8	6.1	1.4
Mexico	0.6	0.6	0.5	0.8	0.8	1.0	1.1	1.3	3.1
OECD Europe	**7.9**	**8.1**	**8.7**	**11.0**	**12.4**	**13.8**	**14.5**	**15.1**	**2.0**
OECD Asia	**2.1**	**2.2**	**2.1**	**2.6**	**3.0**	**3.2**	**3.3**	**3.5**	**1.7**
Japan	1.3	1.4	1.3	1.3	1.5	1.6	1.6	1.7	0.8
South Korea	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	3.0
Australia/New Zealand	0.7	0.7	0.7	1.2	1.3	1.4	1.5	1.5	2.8
Total OECD	**20.9**	**21.4**	**21.7**	**28.2**	**31.4**	**34.3**	**36.3**	**38.3**	**2.0**
Non-OECD									
Non-OECD Europe and Eurasia	**3.2**	**3.2**	**3.1**	**3.3**	**3.6**	**3.8**	**4.1**	**4.5**	**1.4**
Russia	1.9	1.9	1.9	2.0	2.2	2.4	2.6	2.8	1.5
Other	1.4	1.3	1.2	1.4	1.4	1.5	1.6	1.7	1.3
Non-OECD Asia	**9.3**	**9.9**	**10.2**	**16.2**	**20.4**	**24.2**	**28.5**	**32.5**	**4.2**
China	4.1	4.5	4.5	8.7	11.2	13.8	16.4	18.5	5.2
India	2.3	2.4	2.5	3.2	4.0	4.5	5.1	5.8	3.0
Other Non-OECD Asia	2.9	3.0	3.1	4.3	5.2	5.9	7.0	8.2	3.5
Middle East	**0.3**	**0.3**	**0.3**	**0.4**	**0.5**	**0.5**	**0.6**	**0.6**	**3.1**
Africa	**3.6**	**3.6**	**3.7**	**4.2**	**4.5**	**4.9**	**5.3**	**5.8**	**1.6**
Central and South America	**9.0**	**9.4**	**9.8**	**11.4**	**13.0**	**14.6**	**16.5**	**17.9**	**2.2**
Brazil	5.5	5.7	6.2	7.3	8.4	9.7	11.0	12.2	2.4
Other Central and South America	3.5	3.7	3.6	4.2	4.6	5.0	5.4	5.8	1.7
Total Non-OECD	**25.3**	**26.5**	**27.1**	**35.6**	**42.0**	**48.1**	**55.0**	**61.4**	**3.0**
Total World	**46.2**	**47.9**	**48.8**	**63.8**	**73.4**	**82.4**	**91.2**	**99.8**	**2.6**

[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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, “Balances of OECD and Non-OECD Statistics” (2009), web site www.iea.org (subscription site). **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table A10. World carbon dioxide emissions by region, Reference case, 2005-2035
(Million metric tons carbon dioxide)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**7,012**	**6,915**	**7,017**	**6,734**	**6,904**	**7,163**	**7,426**	**7,704**	**0.3**
United States[a]	5,974	5,894	5,986	5,731	5,851	6,016	6,176	6,320	0.2
Canada	628	596	586	553	554	579	609	643	0.3
Mexico	410	426	444	451	499	568	641	741	1.8
OECD Europe	**4,398**	**4,426**	**4,386**	**4,110**	**4,042**	**4,037**	**4,052**	**4,107**	**-0.2**
OECD Asia	**2,203**	**2,197**	**2,273**	**2,149**	**2,200**	**2,262**	**2,317**	**2,389**	**0.2**
Japan	1,254	1,253	1,262	1,102	1,114	1,106	1,085	1,064	-0.6
South Korea	496	486	516	535	570	627	687	757	1.4
Australia/New Zealand	453	457	495	512	517	530	546	567	0.5
Total OECD	**13,613**	**13,538**	**13,676**	**12,993**	**13,147**	**13,462**	**13,796**	**14,200**	**0.1**
Non-OECD									
Non-OECD Europe and Eurasia	**2,842**	**2,876**	**2,897**	**2,882**	**2,915**	**2,966**	**3,042**	**3,172**	**0.3**
Russia	1,650	1,672	1,663	1,642	1,648	1,666	1,715	1,811	0.3
Other	1,193	1,204	1,233	1,240	1,266	1,299	1,327	1,361	0.4
Non-OECD Asia	**8,382**	**8,831**	**9,425**	**11,228**	**12,972**	**14,897**	**16,905**	**18,984**	**2.5**
China	5,558	5,862	6,284	7,716	9,057	10,514	11,945	13,326	2.7
India	1,187	1,287	1,399	1,566	1,751	1,905	2,079	2,296	1.8
Other Non-OECD Asia	1,637	1,681	1,743	1,946	2,163	2,478	2,882	3,362	2.4
Middle East	**1,395**	**1,446**	**1,515**	**1,939**	**2,134**	**2,287**	**2,450**	**2,692**	**2.1**
Africa	**982**	**988**	**1,011**	**1,157**	**1,237**	**1,347**	**1,461**	**1,610**	**1.7**
Central and South America	**1,092**	**1,133**	**1,169**	**1,311**	**1,408**	**1,501**	**1,613**	**1,734**	**1.4**
Brazil	366	380	394	478	534	601	682	761	2.4
Other Central and South America	726	753	775	833	873	901	931	973	0.8
Total Non-OECD	**14,693**	**15,274**	**16,017**	**18,516**	**20,665**	**22,998**	**25,472**	**28,193**	**2.0**
Total World	**28,306**	**28,812**	**29,694**	**31,509**	**33,812**	**36,460**	**39,268**	**42,392**	**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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table A11. World carbon dioxide emissions from liquids use by region, Reference case, 2005-2035
(Million metric tons carbon dioxide)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**3,194**	**3,142**	**3,150**	**2,977**	**3,005**	**3,085**	**3,182**	**3,260**	**0.1**
United States[a]	2,626	2,595	2,589	2,422	2,445	2,496	2,554	2,588	0.0
Canada	301	281	288	279	272	278	287	297	0.1
Mexico	267	265	273	275	288	312	341	374	1.1
OECD Europe	**2,133**	**2,125**	**2,082**	**1,907**	**1,825**	**1,825**	**1,846**	**1,861**	**-0.4**
OECD Asia	**1,031**	**991**	**980**	**902**	**930**	**946**	**958**	**970**	**0.0**
Japan	646	622	603	504	520	515	504	492	-0.7
South Korea	239	221	227	242	257	275	294	312	1.1
Australia/New Zealand	147	148	150	156	153	156	161	166	0.4
Total OECD	**6,358**	**6,258**	**6,212**	**5,786**	**5,760**	**5,857**	**5,986**	**6,091**	**-0.1**
Non-OECD									
Non-OECD Europe and Eurasia	**686**	**677**	**682**	**684**	**682**	**695**	**718**	**747**	**0.3**
Russia	383	368	366	372	365	363	367	382	0.2
Other	303	310	316	312	317	332	351	366	0.5
Non-OECD Asia	**2,081**	**2,147**	**2,225**	**2,669**	**3,012**	**3,430**	**3,856**	**4,271**	**2.4**
China	889	928	969	1,281	1,487	1,735	1,966	2,171	2.9
India	314	349	369	416	465	507	556	606	1.8
Other Non-OECD Asia	878	870	887	971	1,060	1,188	1,334	1,494	1.9
Middle East	**817**	**839**	**886**	**1,004**	**1,079**	**1,183**	**1,319**	**1,519**	**1.9**
Africa	**423**	**428**	**441**	**498**	**510**	**548**	**596**	**645**	**1.4**
Central and South America	**762**	**796**	**823**	**906**	**918**	**969**	**1,036**	**1,093**	**1.0**
Brazil	288	301	311	373	396	434	480	521	1.9
Other Central and South America	474	495	512	533	521	535	556	572	0.4
Total Non-OECD	**4,768**	**4,888**	**5,057**	**5,761**	**6,200**	**6,825**	**7,524**	**8,276**	**1.8**
Total World	**11,126**	**11,146**	**11,268**	**11,547**	**11,960**	**12,682**	**13,510**	**14,367**	**0.9**

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

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table A12. World carbon dioxide emissions from natural gas use by region, Reference case, 2005-2035
(Million metric tons carbon dioxide)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**1,468**	**1,463**	**1,524**	**1,486**	**1,583**	**1,697**	**1,794**	**1,887**	**0.8**
United States[a]	1,176	1,157	1,232	1,171	1,220	1,272	1,315	1,345	0.3
Canada	186	181	157	174	186	203	218	233	1.4
Mexico	106	125	135	141	177	221	262	309	3.0
OECD Europe	**1,048**	**1,045**	**1,049**	**1,105**	**1,149**	**1,175**	**1,178**	**1,198**	**0.5**
OECD Asia	**311**	**336**	**355**	**391**	**410**	**433**	**441**	**449**	**0.8**
Japan	183	202	208	212	217	225	225	223	0.2
South Korea	64	68	73	87	96	104	107	108	1.4
Australia/New Zealand	65	66	73	91	98	104	110	118	1.7
Total OECD	**2,827**	**2,843**	**2,928**	**2,983**	**3,142**	**3,305**	**3,413**	**3,534**	**0.7**
Non-OECD									
Non-OECD Europe and Eurasia	**1,367**	**1,367**	**1,397**	**1,453**	**1,491**	**1,524**	**1,530**	**1,545**	**0.4**
Russia	865	889	897	892	904	919	926	941	0.2
Other	502	478	500	561	587	606	604	604	0.7
Non-OECD Asia	**459**	**518**	**572**	**911**	**1,111**	**1,271**	**1,390**	**1,498**	**3.5**
China	92	111	138	273	348	420	485	537	5.0
India	70	75	80	170	216	238	243	245	4.1
Other Non-OECD Asia	297	332	354	468	547	614	663	716	2.6
Middle East	**543**	**571**	**594**	**902**	**1,023**	**1,073**	**1,100**	**1,140**	**2.4**
Africa	**169**	**166**	**176**	**271**	**323**	**366**	**375**	**390**	**2.9**
Central and South America	**250**	**256**	**259**	**318**	**393**	**422**	**448**	**484**	**2.3**
Brazil	36	38	39	59	81	96	113	127	4.3
Other Central and South America	214	218	220	260	313	326	335	357	1.7
Total Non-OECD	**2,788**	**2,877**	**2,997**	**3,855**	**4,342**	**4,656**	**4,844**	**5,056**	**1.9**
Total World	**5,614**	**5,720**	**5,925**	**6,838**	**7,484**	**7,961**	**8,257**	**8,590**	**1.3**

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

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table A13. World carbon dioxide emissions from coal use by region, Reference case, 2005-2035
(Million metric tons carbon dioxide)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**2,339**	**2,299**	**2,331**	**2,259**	**2,305**	**2,369**	**2,439**	**2,546**	**0.3**
United States[a]	2,161	2,130	2,155	2,125	2,175	2,236	2,296	2,376	0.3
Canada	142	133	141	100	97	99	105	112	-0.8
Mexico	36	36	36	34	34	35	39	58	1.7
OECD Europe	**1,217**	**1,256**	**1,256**	**1,098**	**1,068**	**1,037**	**1,028**	**1,048**	**-0.6**
OECD Asia	**861**	**870**	**938**	**856**	**860**	**883**	**917**	**970**	**0.1**
Japan	425	429	451	386	376	366	355	349	-0.9
South Korea	193	197	216	206	217	247	286	337	1.6
Australia/New Zealand	242	244	271	265	267	270	276	284	0.2
Total OECD	**4,417**	**4,425**	**4,525**	**4,213**	**4,233**	**4,289**	**4,384**	**4,563**	**0.0**
Non-OECD									
Non-OECD Europe and Eurasia	**790**	**832**	**819**	**746**	**742**	**746**	**794**	**880**	**0.3**
Russia	402	416	401	378	379	385	422	489	0.7
Other	388	417	417	368	363	361	372	391	-0.2
Non-OECD Asia	**5,843**	**6,165**	**6,629**	**7,648**	**8,849**	**10,196**	**11,659**	**13,216**	**2.5**
China	4,578	4,824	5,177	6,162	7,222	8,359	9,494	10,618	2.6
India	803	863	950	979	1,070	1,160	1,280	1,445	1.5
Other Non-OECD Asia	461	479	502	507	556	677	885	1,153	3.0
Middle East	**36**	**36**	**35**	**33**	**32**	**31**	**32**	**33**	**-0.2**
Africa	**390**	**394**	**395**	**387**	**404**	**433**	**490**	**575**	**1.4**
Central and South America	**80**	**81**	**87**	**86**	**97**	**110**	**129**	**158**	**2.1**
Brazil	42	41	44	46	57	71	89	113	3.4
Other Central and South America	38	40	43	40	39	39	40	44	0.1
Total Non-OECD	**7,138**	**7,509**	**7,964**	**8,900**	**10,124**	**11,517**	**13,105**	**14,861**	**2.3**
Total World	**11,555**	**11,934**	**12,489**	**13,113**	**14,357**	**15,806**	**17,489**	**19,424**	**1.6**

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

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table A14. World population by region, Reference case, 2005-2035
(Millions)

Region/Country	History 2005	History 2006	History 2007	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD									
OECD North America	**432**	**436**	**441**	**477**	**500**	**523**	**546**	**569**	**0.9**
United States[a]	297	300	302	327	343	359	375	391	0.9
Canada	32	33	33	36	38	40	42	43	1.0
Mexico	103	104	105	114	120	125	130	135	0.9
OECD Europe	**535**	**538**	**541**	**558**	**565**	**571**	**575**	**577**	**0.2**
OECD Asia	**200**	**200**	**201**	**203**	**202**	**201**	**199**	**196**	**-0.1**
Japan	128	128	128	126	124	122	119	116	-0.3
South Korea	48	48	48	49	49	49	49	48	0.0
Australia/New Zealand	25	25	25	27	28	30	31	32	0.8
Total OECD	**1,167**	**1,175**	**1,183**	**1,238**	**1,267**	**1,294**	**1,319**	**1,342**	**0.5**
Non-OECD									
Non-OECD Europe and Eurasia	**341**	**341**	**340**	**338**	**336**	**333**	**329**	**324**	**-0.2**
Russia	143	143	142	138	135	132	129	125	-0.4
Other	198	198	198	200	200	201	200	198	0.0
Non-OECD Asia	**3,446**	**3,486**	**3,525**	**3,841**	**4,021**	**4,175**	**4,299**	**4,398**	**0.8**
China	1,308	1,314	1,321	1,386	1,421	1,443	1,452	1,452	0.3
India	1,131	1,148	1,165	1,294	1,367	1,431	1,485	1,528	1.0
Other Non-OECD Asia	1,008	1,024	1,039	1,160	1,233	1,300	1,363	1,418	1.1
Middle East	**191**	**195**	**199**	**231**	**251**	**270**	**288**	**305**	**1.5**
Africa	**902**	**919**	**939**	**1,098**	**1,197**	**1,297**	**1,395**	**1,494**	**1.7**
Central and South America	**451**	**458**	**464**	**511**	**538**	**563**	**586**	**606**	**1.0**
Brazil	187	190	192	210	220	229	236	243	0.8
Other Central and South America	265	268	272	301	318	334	349	363	1.0
Total Non-OECD	**5,332**	**5,398**	**5,467**	**6,018**	**6,343**	**6,638**	**6,897**	**7,127**	**1.0**
Total World	**6,498**	**6,573**	**6,650**	**7,256**	**7,610**	**7,932**	**8,217**	**8,469**	**0.9**

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

Sources: **United States:** U.S. Energy Information Administration (EIA), *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo. **Other Countries:** IHS Global Insight, *World Overview* (Lexington, MA, various issues).

Appendix B

High Economic Growth Case Projections:

- World energy consumption
- Gross domestic product
- Carbon dioxide emissions

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Table B1. World Total primary energy consumption by region, High Economic Growth case, 2005-2035
(Quadrillion Btu)

Region/Country	History 2005	History 2006	History 2007	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD									
OECD North America	**122.4**	**121.8**	**123.7**	**128.1**	**135.5**	**143.3**	**151.8**	**161.6**	**1.0**
United States[a]	100.5	99.8	101.7	105.0	110.2	115.3	120.6	126.7	0.8
Canada	14.8	14.5	14.3	14.9	15.9	17.1	18.4	19.9	1.2
Mexico	7.1	7.4	7.7	8.2	9.3	11.0	12.7	15.0	2.4
OECD Europe	**82.4**	**82.9**	**82.3**	**83.0**	**85.1**	**88.5**	**91.4**	**94.8**	**0.5**
OECD Asia	**39.0**	**39.5**	**39.7**	**40.4**	**43.2**	**45.5**	**47.9**	**50.5**	**0.9**
Japan	23.1	23.3	22.8	21.4	22.6	23.1	23.6	24.1	0.2
South Korea	9.3	9.4	9.7	10.8	12.1	13.4	14.9	16.4	1.9
Australia/New Zealand	6.6	6.7	7.2	8.2	8.5	8.9	9.4	10.0	1.2
Total OECD	**243.8**	**244.1**	**245.7**	**251.5**	**263.7**	**277.3**	**291.1**	**306.9**	**0.8**
Non-OECD									
Non-OECD Europe and Eurasia	**50.4**	**51.0**	**51.5**	**52.8**	**55.2**	**58.0**	**60.5**	**64.1**	**0.8**
Russia	29.7	30.5	30.5	30.9	32.2	33.8	35.4	37.6	0.8
Other	20.7	20.6	21.0	21.9	23.0	24.2	25.1	26.5	0.8
Non-OECD Asia	**112.6**	**119.6**	**127.1**	**162.1**	**194.8**	**229.7**	**266.8**	**306.0**	**3.2**
China	68.4	73.0	78.0	103.2	126.0	150.8	175.8	200.5	3.4
India	17.5	18.8	20.3	24.6	29.1	32.8	36.7	41.5	2.6
Other Non-OECD Asia	26.7	27.8	28.8	34.3	39.6	46.1	54.3	64.0	2.9
Middle East	**22.8**	**23.9**	**25.1**	**33.4**	**37.7**	**41.1**	**44.8**	**50.0**	**2.5**
Africa	**17.2**	**17.3**	**17.8**	**21.2**	**23.3**	**26.0**	**28.6**	**32.0**	**2.1**
Central and South America	**26.0**	**27.1**	**28.0**	**32.7**	**36.9**	**41.1**	**45.8**	**50.7**	**2.1**
Brazil	11.2	11.7	12.3	15.1	17.6	20.5	23.8	27.0	2.8
Other Central and South America	14.8	15.4	15.7	17.6	19.3	20.5	22.0	23.8	1.5
Total Non-OECD	**229.0**	**239.0**	**249.5**	**302.2**	**347.8**	**395.9**	**446.4**	**502.9**	**2.5**
Total World	**472.7**	**483.1**	**495.2**	**553.6**	**611.5**	**673.2**	**737.5**	**809.8**	**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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, "Balances of OECD and Non-OECD Statistics" (2009), web site www.iea.org (subscription site). **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HM2010.D020310A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table B2. World total energy consumption by region and fuel, High Economic Growth case, 2005-2035
(Quadrillion Btu)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America									
Liquids	49.5	49.0	49.4	49.1	50.6	53.0	55.9	58.6	0.6
Natural gas	28.1	28.1	29.2	28.7	31.0	34.3	36.7	38.6	1.0
Coal	24.7	24.3	24.6	24.0	25.5	26.0	27.2	29.5	0.6
Nuclear	9.2	9.4	9.6	10.1	10.8	10.9	11.1	11.9	0.8
Other	10.9	11.1	11.0	16.1	17.5	19.1	20.9	23.0	2.7
Total	**122.4**	**121.8**	**123.7**	**128.1**	**135.5**	**143.3**	**151.8**	**161.6**	**1.0**
OECD Europe									
Liquids	32.3	32.4	31.6	29.4	28.7	29.3	30.2	31.0	-0.1
Natural gas	19.7	19.7	19.8	20.9	22.2	23.2	23.5	24.1	0.7
Coal	12.7	13.1	13.2	11.6	11.4	11.3	11.6	12.6	-0.2
Nuclear	9.7	9.6	9.1	9.7	10.1	10.6	11.0	11.3	0.8
Other	7.9	8.1	8.7	11.3	12.6	14.1	15.1	15.7	2.2
Total	**82.4**	**82.9**	**82.3**	**83.0**	**85.1**	**88.5**	**91.4**	**94.8**	**0.5**
OECD Asia									
Liquids	17.5	17.2	16.9	15.9	16.8	17.5	18.2	18.9	0.4
Natural gas	5.9	6.3	6.7	7.4	8.0	8.6	8.8	9.1	1.1
Coal	9.2	9.3	10.1	9.3	9.5	10.1	10.8	11.9	0.6
Nuclear	4.3	4.3	3.9	5.0	5.7	6.1	6.6	7.1	2.1
Other	2.1	2.2	2.1	2.7	3.0	3.2	3.5	3.7	1.9
Total	**39.0**	**39.5**	**39.7**	**40.4**	**43.2**	**45.5**	**47.9**	**50.5**	**0.9**
Total OECD									
Liquids	99.3	98.6	97.9	94.4	96.2	99.8	104.2	108.5	0.4
Natural gas	53.7	54.1	55.6	57.1	61.3	66.1	69.0	71.8	0.9
Coal	46.7	46.7	47.9	45.0	46.5	47.4	49.7	53.9	0.4
Nuclear	23.2	23.3	22.6	24.8	26.6	27.6	28.8	30.3	1.1
Other	20.9	21.4	21.7	30.1	33.1	36.4	39.5	42.4	2.4
Total	**243.8**	**244.1**	**245.7**	**251.5**	**263.7**	**277.3**	**291.1**	**306.9**	**0.8**
Non-OECD									
Non-OECD Europe and Eurasia									
Liquids	10.1	10.3	10.4	10.2	10.4	10.9	11.4	12.1	0.6
Natural gas	25.8	25.8	26.3	27.4	28.3	29.1	29.3	29.7	0.4
Coal	8.4	8.8	8.7	8.1	8.2	8.5	9.6	11.2	0.9
Nuclear	2.9	2.9	3.0	3.7	4.6	5.5	5.9	6.3	2.7
Other	3.2	3.2	3.1	3.3	3.6	3.9	4.3	4.8	1.6
Total	**50.4**	**51.0**	**51.5**	**52.8**	**55.2**	**58.0**	**60.5**	**64.1**	**0.8**
Non-OECD Asia									
Liquids	31.7	33.4	34.6	42.4	49.2	57.5	66.2	75.1	2.8
Natural gas	8.6	9.8	10.8	17.3	21.1	24.1	26.4	28.7	3.6
Coal	61.9	65.4	70.3	82.9	98.3	116.3	136.5	158.5	2.9
Nuclear	1.1	1.1	1.2	3.2	5.7	7.3	8.5	9.8	7.7
Other	9.3	9.9	10.2	16.3	20.6	24.6	29.2	33.9	4.4
Total	**112.6**	**119.6**	**127.1**	**162.1**	**194.8**	**229.7**	**266.8**	**306.0**	**3.2**

See notes at end of table.

Table B2. World total energy consumption by region and fuel, High Economic Growth case, 2005-2035 (continued)
(Quadrillion Btu)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
Non-OECD (continued)									
Middle East									
Liquids	12.0	12.5	13.3	15.3	16.9	19.0	22.0	25.3	2.3
Natural gas	10.2	10.8	11.2	17.2	19.7	21.0	21.4	23.0	2.6
Coal	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.5	0.8
Nuclear	0.0	0.0	0.0	0.1	0.2	0.3	0.4	0.5	—
Other	0.3	0.3	0.3	0.4	0.5	0.6	0.6	0.7	3.2
Total	**22.8**	**23.9**	**25.1**	**33.4**	**37.7**	**41.1**	**44.8**	**50.0**	**2.5**
Africa									
Liquids	6.1	6.2	6.4	7.4	7.8	8.5	9.5	10.5	1.8
Natural gas	3.2	3.1	3.3	5.2	6.2	6.9	7.1	7.4	2.9
Coal	4.2	4.2	4.2	4.2	4.6	5.1	6.1	7.4	2.0
Nuclear	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	3.6
Other	3.6	3.6	3.7	4.2	4.6	5.2	5.7	6.4	1.9
Total	**17.2**	**17.3**	**17.8**	**21.2**	**23.3**	**26.0**	**28.6**	**32.0**	**2.1**
Central and South America									
Liquids	11.3	11.8	12.2	13.7	14.3	15.5	16.9	18.3	1.5
Natural gas	4.7	4.8	4.9	6.3	8.0	8.9	9.6	10.6	2.8
Coal	0.8	0.9	0.9	0.9	1.1	1.2	1.5	1.9	2.6
Nuclear	0.2	0.2	0.2	0.3	0.4	0.5	0.5	0.7	4.2
Other	9.0	9.4	9.8	11.5	13.2	15.0	17.3	19.3	2.4
Total	**26.0**	**27.1**	**28.0**	**32.7**	**36.9**	**41.1**	**45.8**	**50.7**	**2.1**
Total Non-OECD									
Liquids	71.1	74.2	76.8	89.0	98.5	111.3	126.0	141.4	2.2
Natural gas	52.5	54.2	56.5	73.4	83.3	90.0	93.8	99.4	2.0
Coal	75.7	79.7	84.6	96.4	112.4	131.6	154.1	179.4	2.7
Nuclear	4.3	4.4	4.5	7.5	11.0	13.8	15.5	17.6	5.0
Other	25.3	26.5	27.1	35.9	42.5	49.3	57.1	65.0	3.2
Total	**229.0**	**239.0**	**249.5**	**302.2**	**347.8**	**395.9**	**446.4**	**502.9**	**2.5**
Total World									
Liquids	170.4	172.8	174.7	183.4	194.7	211.1	230.3	249.9	1.3
Natural gas	106.3	108.3	112.1	130.6	144.6	156.1	162.8	171.3	1.5
Coal	122.3	126.4	132.4	141.4	158.9	178.9	203.7	233.3	2.0
Nuclear	27.5	27.8	27.1	32.3	37.6	41.4	44.2	47.9	2.1
Other	46.2	47.9	48.8	66.0	75.7	85.7	96.6	107.4	2.9
Total	**472.7**	**483.1**	**495.2**	**553.6**	**611.5**	**673.2**	**737.5**	**809.8**	**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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, "Balances of OECD and Non-OECD Statistics" (2009), web site www.iea.org (subscription site). **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HM2010.D020310A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table B3. World gross domestic product (GDP) by region expressed in purchasing power parity, High Economic Growth case, 2005-2035
(Billion 2005 dollars)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**14,883**	**15,327**	**15,662**	**19,069**	**22,552**	**26,519**	**31,040**	**35,942**	**3.0**
United States[a]	12,422	12,768	13,027	15,920	18,760	21,959	25,541	29,295	2.9
Canada	1,167	1,200	1,231	1,478	1,694	1,923	2,188	2,488	2.5
Mexico	1,293	1,359	1,405	1,671	2,098	2,636	3,311	4,159	4.0
OECD Europe	**13,928**	**14,412**	**14,849**	**16,691**	**19,030**	**21,479**	**24,126**	**27,036**	**2.2**
OECD Asia	**5,535**	**5,681**	**5,850**	**6,724**	**7,480**	**8,172**	**8,916**	**9,691**	**1.8**
Japan	3,872	3,951	4,041	4,385	4,684	4,892	5,104	5,305	1.0
South Korea	892	938	986	1,300	1,576	1,864	2,167	2,483	3.4
Australia/New Zealand	771	792	823	1,038	1,220	1,417	1,645	1,902	3.0
Total OECD	**34,345**	**35,420**	**36,361**	**42,484**	**49,062**	**56,171**	**64,082**	**72,669**	**2.5**
Non-OECD									
Non-OECD Europe and Eurasia	**2,977**	**3,218**	**3,481**	**4,316**	**5,209**	**6,191**	**7,258**	**8,438**	**3.2**
Russia	1,703	1,834	1,982	2,418	2,901	3,459	4,079	4,788	3.2
Other	1,275	1,384	1,499	1,898	2,308	2,732	3,178	3,650	3.2
Non-OECD Asia	**11,897**	**13,013**	**14,323**	**24,738**	**33,517**	**43,461**	**54,520**	**66,773**	**5.7**
China	5,408	6,035	6,820	13,090	18,264	24,191	30,462	37,039	6.2
India	2,440	2,676	2,918	4,985	6,678	8,448	10,526	12,961	5.5
Other Non-OECD Asia	4,049	4,302	4,585	6,663	8,574	10,822	13,531	16,773	4.7
Middle East	**1,985**	**2,145**	**2,261**	**3,160**	**3,945**	**4,829**	**5,901**	**7,169**	**4.2**
Africa	**2,360**	**2,494**	**2,638**	**3,746**	**4,644**	**5,638**	**6,750**	**8,040**	**4.1**
Central and South America	**3,612**	**3,822**	**4,066**	**5,499**	**6,712**	**8,118**	**9,757**	**11,668**	**3.8**
Brazil	1,534	1,595	1,685	2,418	3,033	3,784	4,699	5,806	4.5
Other Central and South America	2,079	2,227	2,381	3,081	3,680	4,334	5,057	5,862	3.3
Total Non-OECD	**22,832**	**24,692**	**26,769**	**41,458**	**54,026**	**68,237**	**84,185**	**102,087**	**4.9**
Total World	**57,177**	**60,112**	**63,130**	**83,942**	**103,089**	**124,408**	**148,267**	**174,756**	**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:** IHS Global Insight, *World Overview* (Lexington, MA, various issues). **Projections:** Derived from IHS Global Insight, *World Overview*, Third Quarter 2009 (Lexington, MA, September 2009); and U.S. Energy Information Administration, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), Table B4.

Table B4. World liquids consumption by region, High Economic Growth case, 2005-2035
(Million barrels per day)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**25.2**	**25.0**	**25.1**	**25.4**	**26.2**	**27.5**	**29.1**	**30.7**	**0.7**
United States[a]	20.8	20.7	20.6	20.9	21.6	22.5	23.6	24.7	0.6
Canada	2.3	2.3	2.3	2.3	2.3	2.4	2.5	2.7	0.5
Mexico	2.1	2.1	2.1	2.2	2.4	2.6	2.9	3.3	1.6
OECD Europe	**15.7**	**15.7**	**15.3**	**14.3**	**13.9**	**14.2**	**14.6**	**15.0**	**-0.1**
OECD Asia	**8.6**	**8.5**	**8.4**	**7.9**	**8.3**	**8.7**	**9.0**	**9.3**	**0.4**
Japan	5.3	5.2	5.0	4.3	4.5	4.6	4.6	4.5	-0.4
South Korea	2.2	2.2	2.2	2.4	2.6	2.9	3.1	3.4	1.5
Australia/New Zealand	1.1	1.1	1.1	1.2	1.2	1.2	1.3	1.4	0.8
Total OECD	**49.5**	**49.1**	**48.8**	**47.5**	**48.5**	**50.4**	**52.7**	**55.1**	**0.4**
Non-OECD									
Non-OECD Europe and Eurasia	**4.9**	**5.0**	**5.1**	**5.0**	**5.1**	**5.3**	**5.6**	**5.9**	**0.6**
Russia	2.8	2.9	2.9	2.8	2.8	2.8	2.9	3.1	0.3
Other	2.1	2.2	2.2	2.2	2.3	2.5	2.6	2.8	0.9
Non-OECD Asia	**15.4**	**16.2**	**16.8**	**20.5**	**23.9**	**27.9**	**32.1**	**36.5**	**2.8**
China	6.7	7.3	7.6	10.2	12.1	14.5	16.9	19.1	3.4
India	2.5	2.7	2.8	3.3	3.8	4.2	4.7	5.3	2.3
Other Non-OECD Asia	6.2	6.2	6.3	7.1	7.9	9.1	10.5	12.0	2.3
Middle East	**5.8**	**6.0**	**6.4**	**7.4**	**8.1**	**9.2**	**10.6**	**12.2**	**2.3**
Africa	**3.0**	**3.0**	**3.1**	**3.6**	**3.8**	**4.2**	**4.6**	**5.1**	**1.8**
Central and South America	**5.5**	**5.8**	**6.0**	**6.7**	**7.0**	**7.6**	**8.3**	**9.0**	**1.5**
Brazil	2.2	2.3	2.4	2.9	3.2	3.6	4.0	4.5	2.3
Other Central and South America	3.3	3.5	3.6	3.8	3.8	4.0	4.2	4.5	0.8
Total Non-OECD	**34.6**	**36.1**	**37.3**	**43.2**	**47.9**	**54.1**	**61.2**	**68.7**	**2.2**
Total World	**84.0**	**85.2**	**86.1**	**90.7**	**96.4**	**104.5**	**114.0**	**123.7**	**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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HM2010.D020310A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table B5. World natural gas consumption by region, High Economic Growth case, 2005-2035
(Trillion cubic feet)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**27.3**	**27.2**	**28.3**	**27.9**	**30.1**	**33.3**	**35.5**	**37.4**	**1.0**
United States[a]	22.0	21.7	23.0	22.1	23.3	25.2	26.3	26.9	0.6
Canada	3.4	3.3	2.9	3.2	3.5	4.0	4.3	4.7	1.8
Mexico	1.9	2.2	2.4	2.5	3.2	4.1	4.8	5.7	3.2
OECD Europe	**19.2**	**19.1**	**19.2**	**20.3**	**21.5**	**22.5**	**22.7**	**23.4**	**0.7**
OECD Asia	**5.3**	**5.8**	**6.3**	**7.0**	**7.5**	**8.1**	**8.3**	**8.5**	**1.1**
Japan	3.1	3.4	3.7	3.8	4.1	4.3	4.4	4.4	0.6
South Korea	1.1	1.1	1.2	1.5	1.7	1.8	1.8	1.9	1.5
Australia/New Zealand	1.1	1.2	1.3	1.7	1.8	1.9	2.1	2.2	1.9
Total OECD	**51.8**	**52.1**	**53.7**	**55.2**	**59.1**	**63.8**	**66.5**	**69.3**	**0.9**
Non-OECD									
Non-OECD Europe and Eurasia	**25.3**	**25.3**	**25.9**	**26.9**	**27.8**	**28.6**	**28.7**	**29.2**	**0.4**
Russia	16.2	16.6	16.7	16.8	17.1	17.5	17.7	18.0	0.3
Other	9.1	8.7	9.1	10.1	10.7	11.1	11.1	11.2	0.7
Non-OECD Asia	**8.5**	**9.6**	**10.5**	**16.9**	**20.5**	**23.5**	**25.7**	**28.0**	**3.5**
China	1.7	2.0	2.5	4.9	6.2	7.5	8.8	9.9	5.0
India	1.3	1.4	1.5	3.1	3.9	4.3	4.4	4.4	4.0
Other Non-OECD Asia	5.6	6.2	6.6	8.8	10.4	11.6	12.5	13.7	2.6
Middle East	**9.8**	**10.3**	**10.7**	**16.4**	**18.8**	**20.0**	**20.4**	**22.0**	**2.6**
Africa	**3.0**	**2.9**	**3.1**	**4.8**	**5.7**	**6.4**	**6.6**	**6.8**	**2.9**
Central and South America	**4.4**	**4.5**	**4.6**	**5.9**	**7.5**	**8.4**	**9.0**	**10.0**	**2.8**
Brazil	0.7	0.7	0.7	1.2	1.7	2.1	2.4	2.7	5.0
Other Central and South America	3.7	3.8	3.9	4.7	5.9	6.3	6.6	7.2	2.3
Total Non-OECD	**50.9**	**52.6**	**54.7**	**70.9**	**80.4**	**86.8**	**90.5**	**95.9**	**2.0**
Total World	**102.7**	**104.6**	**108.5**	**126.1**	**139.6**	**150.6**	**157.0**	**165.2**	**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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HM2010.D020310A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table B6. World coal consumption by region, High Economic Growth case, 2005-2035
(Quadrillion Btu)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**24.7**	**24.3**	**24.6**	**24.0**	**25.5**	**26.0**	**27.2**	**29.5**	**0.6**
United States[a]	22.8	22.5	22.7	22.6	24.1	24.4	25.4	27.1	0.6
Canada	1.5	1.4	1.5	1.1	1.1	1.1	1.3	1.5	-0.1
Mexico	0.4	0.4	0.4	0.4	0.4	0.4	0.5	1.0	3.3
OECD Europe	**12.7**	**13.1**	**13.2**	**11.6**	**11.4**	**11.3**	**11.6**	**12.6**	**-0.2**
OECD Asia	**9.2**	**9.3**	**10.1**	**9.3**	**9.5**	**10.1**	**10.8**	**11.9**	**0.6**
Japan	4.6	4.6	4.9	4.2	4.2	4.1	4.1	4.2	-0.5
South Korea	2.1	2.1	2.3	2.2	2.4	2.9	3.6	4.3	2.3
Australia/New Zealand	2.6	2.6	2.9	2.9	2.9	3.0	3.1	3.3	0.5
Total OECD	**46.7**	**46.7**	**47.9**	**45.0**	**46.5**	**47.4**	**49.7**	**53.9**	**0.4**
Non-OECD									
Non-OECD Europe and Eurasia	**8.4**	**8.8**	**8.7**	**8.1**	**8.2**	**8.5**	**9.6**	**11.2**	**0.9**
Russia	4.3	4.4	4.3	4.1	4.3	4.5	5.2	6.3	1.4
Other	4.1	4.4	4.4	3.9	4.0	4.1	4.4	4.9	0.4
Non-OECD Asia	**61.9**	**65.4**	**70.3**	**82.9**	**98.3**	**116.3**	**136.5**	**158.5**	**2.9**
China	48.3	51.0	54.8	66.6	79.9	94.7	110.3	126.0	3.0
India	8.6	9.2	10.2	10.6	12.0	13.4	15.2	17.5	2.0
Other Non-OECD Asia	4.9	5.1	5.4	5.6	6.4	8.2	11.1	14.9	3.7
Middle East	**0.4**	**0.4**	**0.4**	**0.4**	**0.3**	**0.3**	**0.3**	**0.5**	**0.8**
Africa	**4.2**	**4.2**	**4.2**	**4.2**	**4.6**	**5.1**	**6.1**	**7.4**	**2.0**
Central and South America	**0.8**	**0.9**	**0.9**	**0.9**	**1.1**	**1.2**	**1.5**	**1.9**	**2.6**
Brazil	0.4	0.4	0.5	0.5	0.6	0.8	1.0	1.4	3.9
Other Central and South America	0.4	0.4	0.5	0.4	0.4	0.4	0.4	0.5	0.4
Total Non-OECD	**75.7**	**79.7**	**84.6**	**96.4**	**112.4**	**131.6**	**154.1**	**179.4**	**2.7**
Total World	**122.3**	**126.4**	**132.4**	**141.4**	**158.9**	**178.9**	**203.7**	**233.3**	**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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HM2010.D020310A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table B7. World nuclear energy consumption by region, High Economic Growth case, 2005-2035
(Billion kilowatthours)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**880**	**891**	**905**	**958**	**1,025**	**1,037**	**1,053**	**1,128**	**0.8**
United States[a]	782	787	806	834	887	892	891	951	0.6
Canada	87	93	89	113	127	135	143	159	2.1
Mexico	10	10	10	11	11	11	18	18	2.2
OECD Europe	**932**	**929**	**879**	**937**	**972**	**1,019**	**1,066**	**1,094**	**0.8**
OECD Asia	**429**	**430**	**386**	**495**	**564**	**596**	**647**	**690**	**2.1**
Japan	290	288	251	320	345	362	393	423	1.9
South Korea	139	141	136	175	219	234	255	267	2.4
Australia/New Zealand	0	0	0	0	0	0	0	0	—
Total OECD	**2,240**	**2,250**	**2,171**	**2,390**	**2,561**	**2,653**	**2,766**	**2,912**	**1.1**
Non-OECD									
Non-OECD Europe and Eurasia	**264**	**269**	**273**	**343**	**428**	**517**	**551**	**593**	**2.8**
Russia	140	144	148	198	260	328	349	368	3.3
Other	124	124	125	145	168	189	202	226	2.1
Non-OECD Asia	**106**	**111**	**119**	**313**	**545**	**700**	**817**	**946**	**7.7**
China	50	55	63	186	336	437	513	599	8.4
India	16	16	16	66	120	157	180	205	9.6
Other Non-OECD Asia	40	40	41	61	89	105	123	142	4.5
Middle East	**0**	**0**	**0**	**6**	**21**	**30**	**39**	**50**	**—**
Africa	**12**	**10**	**12**	**15**	**16**	**22**	**22**	**31**	**3.5**
Central and South America	**16**	**21**	**19**	**28**	**34**	**43**	**43**	**62**	**4.3**
Brazil	10	14	12	18	22	31	31	41	4.4
Other Central and South America	6	7	7	10	12	12	12	21	4.2
Total Non-OECD	**399**	**411**	**423**	**705**	**1,043**	**1,311**	**1,472**	**1,683**	**5.1**
Total World	**2,639**	**2,660**	**2,593**	**3,096**	**3,604**	**3,964**	**4,238**	**4,595**	**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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HM2010.D020310A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table B8. World consumption of hydroelectricity and other renewable energy by region, High Economic Growth case, 2005-2035
(Quadrillion Btu)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**10.9**	**11.1**	**11.0**	**16.1**	**17.5**	**19.1**	**20.9**	**23.0**	**2.7**
United States[a]	6.1	6.4	6.2	10.7	11.4	12.4	13.7	15.2	3.3
Canada	4.2	4.1	4.2	4.6	5.2	5.6	6.0	6.5	1.5
Mexico	0.6	0.6	0.5	0.8	0.9	1.0	1.2	1.3	3.3
OECD Europe	**7.9**	**8.1**	**8.7**	**11.3**	**12.6**	**14.1**	**15.1**	**15.7**	**2.2**
OECD Asia	**2.1**	**2.2**	**2.1**	**2.7**	**3.0**	**3.2**	**3.5**	**3.7**	**1.9**
Japan	1.3	1.4	1.3	1.3	1.6	1.6	1.7	1.8	1.1
South Korea	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	3.3
Australia/New Zealand	0.7	0.7	0.7	1.2	1.3	1.4	1.5	1.6	3.0
Total OECD	**20.9**	**21.4**	**21.7**	**30.1**	**33.1**	**36.4**	**39.5**	**42.4**	**2.4**
Non-OECD									
Non-OECD Europe and Eurasia	**3.2**	**3.2**	**3.1**	**3.3**	**3.6**	**3.9**	**4.3**	**4.8**	**1.6**
Russia	1.9	1.9	1.9	2.0	2.2	2.4	2.7	3.0	1.7
Other	1.4	1.3	1.2	1.4	1.4	1.5	1.6	1.8	1.4
Non-OECD Asia	**9.3**	**9.9**	**10.2**	**16.3**	**20.6**	**24.6**	**29.2**	**33.9**	**4.4**
China	4.1	4.5	4.5	8.7	11.2	13.8	16.5	18.9	5.2
India	2.3	2.4	2.5	3.3	4.1	4.6	5.4	6.3	3.3
Other Non-OECD Asia	2.9	3.0	3.1	4.4	5.3	6.1	7.3	8.8	3.8
Middle East	**0.3**	**0.3**	**0.3**	**0.4**	**0.5**	**0.6**	**0.6**	**0.7**	**3.2**
Africa	**3.6**	**3.6**	**3.7**	**4.2**	**4.6**	**5.2**	**5.7**	**6.4**	**1.9**
Central and South America	**9.0**	**9.4**	**9.8**	**11.5**	**13.2**	**15.0**	**17.3**	**19.3**	**2.4**
Brazil	5.5	5.7	6.2	7.3	8.5	10.0	11.7	13.1	2.7
Other Central and South America	3.5	3.7	3.6	4.2	4.6	5.1	5.6	6.2	1.9
Total Non-OECD	**25.3**	**26.5**	**27.1**	**35.9**	**42.5**	**49.3**	**57.1**	**65.0**	**3.2**
Total World	**46.2**	**47.9**	**48.8**	**66.0**	**75.7**	**85.7**	**96.6**	**107.4**	**2.9**

[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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, “Balances of OECD and Non-OECD Statistics” (2009), web site www.iea.org (subscription site). **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HM2010.D020310A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table B9. World carbon dioxide emissions by region, High Economic Growth case, 2005-2035
(Million metric tons carbon dioxide)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**7,012**	**6,915**	**7,017**	**6,876**	**7,212**	**7,582**	**7,992**	**8,434**	**0.7**
United States[a]	5,974	5,894	5,986	5,857	6,117	6,358	6,622	6,867	0.5
Canada	628	596	586	560	577	619	669	729	0.8
Mexico	410	426	444	459	519	605	700	838	2.3
OECD Europe	**4,398**	**4,426**	**4,386**	**4,154**	**4,162**	**4,237**	**4,338**	**4,519**	**0.1**
OECD Asia	**2,203**	**2,197**	**2,273**	**2,180**	**2,283**	**2,401**	**2,519**	**2,665**	**0.6**
Japan	1,254	1,253	1,262	1,116	1,154	1,169	1,172	1,181	-0.2
South Korea	496	486	516	544	594	673	760	862	1.8
Australia/New Zealand	453	457	495	521	535	559	587	622	0.8
Total OECD	**13,613**	**13,538**	**13,676**	**13,210**	**13,657**	**14,220**	**14,849**	**15,619**	**0.5**
Non-OECD									
Non-OECD Europe and Eurasia	**2,842**	**2,876**	**2,897**	**2,911**	**2,983**	**3,086**	**3,233**	**3,451**	**0.6**
Russia	1,650	1,672	1,663	1,657	1,684	1,727	1,816	1,958	0.6
Other	1,193	1,204	1,233	1,254	1,299	1,359	1,417	1,493	0.7
Non-OECD Asia	**8,382**	**8,831**	**9,425**	**11,449**	**13,537**	**15,931**	**18,518**	**21,276**	**3.0**
China	5,558	5,862	6,284	7,874	9,454	11,235	13,070	14,907	3.1
India	1,187	1,287	1,399	1,592	1,823	2,034	2,272	2,569	2.2
Other Non-OECD Asia	1,637	1,681	1,743	1,984	2,260	2,662	3,176	3,800	2.8
Middle East	**1,395**	**1,446**	**1,515**	**1,970**	**2,209**	**2,413**	**2,639**	**2,959**	**2.4**
Africa	**982**	**988**	**1,011**	**1,175**	**1,285**	**1,432**	**1,592**	**1,798**	**2.1**
Central and South America	**1,092**	**1,133**	**1,169**	**1,343**	**1,486**	**1,625**	**1,785**	**1,967**	**1.9**
Brazil	366	380	394	494	569	658	763	872	2.9
Other Central and South America	726	753	775	849	916	967	1,022	1,095	1.2
Total Non-OECD	**14,693**	**15,274**	**16,017**	**18,849**	**21,500**	**24,488**	**27,768**	**31,451**	**2.4**
Total World	**28,306**	**28,812**	**29,694**	**32,059**	**35,157**	**38,707**	**42,617**	**47,070**	**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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HM2010.D020310A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table B10. World carbon dioxide emissions from liquids use by region, High Economic Growth case, 2005-2035
(Million metric tons carbon dioxide)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**3,194**	**3,142**	**3,150**	**3,070**	**3,156**	**3,306**	**3,471**	**3,599**	**0.5**
United States[a]	2,626	2,595	2,589	2,504	2,569	2,672	2,779	2,840	0.3
Canada	301	281	288	285	285	298	316	335	0.5
Mexico	267	265	273	281	302	336	377	424	1.6
OECD Europe	**2,133**	**2,125**	**2,082**	**1,937**	**1,893**	**1,928**	**1,987**	**2,040**	**-0.1**
OECD Asia	**1,031**	**991**	**980**	**918**	**969**	**1,008**	**1,043**	**1,079**	**0.3**
Japan	646	622	603	514	542	547	546	545	-0.4
South Korea	239	221	227	246	267	293	320	348	1.5
Australia/New Zealand	147	148	150	159	160	167	176	186	0.8
Total OECD	**6,358**	**6,258**	**6,212**	**5,926**	**6,018**	**6,242**	**6,501**	**6,719**	**0.3**
Non-OECD									
Non-OECD Europe and Eurasia	**686**	**677**	**682**	**695**	**709**	**738**	**777**	**827**	**0.7**
Russia	383	368	366	377	378	383	393	417	0.5
Other	303	310	316	318	331	356	384	410	0.9
Non-OECD Asia	**2,081**	**2,147**	**2,225**	**2,723**	**3,160**	**3,690**	**4,252**	**4,824**	**2.8**
China	889	928	969	1,306	1,558	1,864	2,163	2,450	3.4
India	314	349	369	425	489	548	616	689	2.3
Other Non-OECD Asia	878	870	887	992	1,113	1,278	1,473	1,685	2.3
Middle East	**817**	**839**	**886**	**1,023**	**1,129**	**1,270**	**1,470**	**1,693**	**2.3**
Africa	**423**	**428**	**441**	**508**	**534**	**587**	**653**	**724**	**1.8**
Central and South America	**762**	**796**	**823**	**924**	**960**	**1,038**	**1,136**	**1,227**	**1.4**
Brazil	288	301	311	382	417	468	531	591	2.3
Other Central and South America	474	495	512	542	543	570	605	637	0.8
Total Non-OECD	**4,768**	**4,888**	**5,057**	**5,873**	**6,493**	**7,324**	**8,289**	**9,295**	**2.2**
Total World	**11,126**	**11,146**	**11,268**	**11,799**	**12,511**	**13,566**	**14,790**	**16,014**	**1.3**

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

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HM2010.D020310A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table B11. World carbon dioxide emissions from natural gas use by region, High Economic Growth case, 2005-2035
(Million metric tons carbon dioxide)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**1,468**	**1,463**	**1,524**	**1,510**	**1,631**	**1,807**	**1,932**	**2,037**	**1.0**
United States[a]	1,176	1,157	1,232	1,192	1,257	1,361	1,423	1,456	0.6
Canada	186	181	157	175	193	215	234	256	1.8
Mexico	106	125	135	144	181	231	275	325	3.2
OECD Europe	**1,048**	**1,045**	**1,049**	**1,111**	**1,179**	**1,231**	**1,245**	**1,280**	**0.7**
OECD Asia	**311**	**336**	**355**	**395**	**426**	**455**	**468**	**480**	**1.1**
Japan	183	202	208	212	227	241	245	246	0.6
South Korea	64	68	73	89	98	106	108	110	1.5
Australia/New Zealand	65	66	73	93	100	107	114	124	1.9
Total OECD	**2,827**	**2,843**	**2,928**	**3,016**	**3,236**	**3,493**	**3,645**	**3,797**	**0.9**
Non-OECD									
Non-OECD Europe and Eurasia	**1,367**	**1,367**	**1,397**	**1,461**	**1,506**	**1,549**	**1,560**	**1,583**	**0.4**
Russia	865	889	897	898	914	933	943	960	0.2
Other	502	478	500	563	592	616	616	623	0.8
Non-OECD Asia	**459**	**518**	**572**	**918**	**1,118**	**1,278**	**1,402**	**1,524**	**3.6**
China	92	111	138	272	345	418	489	548	5.0
India	70	75	80	173	216	235	239	242	4.0
Other Non-OECD Asia	297	332	354	473	557	625	674	735	2.6
Middle East	**543**	**571**	**594**	**914**	**1,048**	**1,112**	**1,137**	**1,222**	**2.6**
Africa	**169**	**166**	**176**	**275**	**327**	**368**	**374**	**390**	**2.9**
Central and South America	**250**	**256**	**259**	**332**	**426**	**472**	**510**	**562**	**2.8**
Brazil	36	38	39	65	92	113	133	151	5.0
Other Central and South America	214	218	220	267	334	358	376	411	2.3
Total Non-OECD	**2,788**	**2,877**	**2,997**	**3,900**	**4,425**	**4,778**	**4,982**	**5,280**	**2.0**
Total World	**5,614**	**5,720**	**5,925**	**6,916**	**7,661**	**8,271**	**8,626**	**9,078**	**1.5**

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

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HM2010.D020310A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table B12. World carbon dioxide emissions from coal use by region, High Economic Growth case, 2005-2035
(Million metric tons carbon dioxide)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**2,339**	**2,299**	**2,331**	**2,284**	**2,413**	**2,457**	**2,577**	**2,787**	**0.6**
United States[a]	2,161	2,130	2,155	2,150	2,278	2,313	2,409	2,560	0.6
Canada	142	133	141	100	100	106	119	137	-0.1
Mexico	36	36	36	34	35	38	49	90	3.3
OECD Europe	**1,217**	**1,256**	**1,256**	**1,106**	**1,090**	**1,078**	**1,106**	**1,199**	**-0.2**
OECD Asia	**861**	**870**	**938**	**867**	**888**	**939**	**1,008**	**1,106**	**0.6**
Japan	425	429	451	390	385	380	381	391	-0.5
South Korea	193	197	216	209	228	274	332	404	2.3
Australia/New Zealand	242	244	271	269	275	284	296	311	0.5
Total OECD	**4,417**	**4,425**	**4,525**	**4,257**	**4,391**	**4,474**	**4,692**	**5,091**	**0.4**
Non-OECD									
Non-OECD Europe and Eurasia	**790**	**832**	**819**	**755**	**768**	**798**	**896**	**1,041**	**0.9**
Russia	402	416	401	382	392	411	480	581	1.3
Other	388	417	417	373	376	387	416	460	0.4
Non-OECD Asia	**5,843**	**6,165**	**6,629**	**7,808**	**9,259**	**10,962**	**12,864**	**14,928**	**2.9**
China	4,578	4,824	5,177	6,296	7,552	8,953	10,418	11,910	3.0
India	803	863	950	994	1,118	1,251	1,418	1,638	2.0
Other Non-OECD Asia	461	479	502	519	590	758	1,029	1,381	3.7
Middle East	**36**	**36**	**35**	**33**	**32**	**32**	**32**	**43**	**0.8**
Africa	**390**	**394**	**395**	**392**	**424**	**477**	**565**	**684**	**2.0**
Central and South America	**80**	**81**	**87**	**87**	**100**	**115**	**139**	**179**	**2.6**
Brazil	42	41	44	47	60	76	98	131	4.0
Other Central and South America	38	40	43	40	40	39	41	48	0.4
Total Non-OECD	**7,138**	**7,509**	**7,964**	**9,075**	**10,582**	**12,385**	**14,498**	**16,876**	**2.7**
Total World	**11,555**	**11,934**	**12,489**	**13,332**	**14,973**	**16,859**	**19,189**	**21,967**	**2.0**

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

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HM2010.D020310A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

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Appendix C

Low Economic Growth Case Projections:

- World energy consumption
- Gross domestic product
- Carbon dioxide emissions

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Table C1. World total energy consumption by region, Low Economic Growth case, 2005-2035
(Quadrillion Btu)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**122.4**	**121.8**	**123.7**	**121.2**	**124.3**	**126.6**	**129.5**	**132.7**	**0.3**
United States[a]	100.5	99.8	101.7	98.9	100.8	101.4	102.6	103.6	0.1
Canada	14.8	14.5	14.3	14.4	14.8	15.5	16.1	16.8	0.6
Mexico	7.1	7.4	7.7	7.9	8.7	9.8	10.9	12.3	1.7
OECD Europe	**82.4**	**82.9**	**82.3**	**80.8**	**80.9**	**81.8**	**82.0**	**82.3**	**0.0**
OECD Asia	**39.0**	**39.5**	**39.7**	**39.0**	**40.5**	**41.3**	**41.9**	**42.5**	**0.2**
Japan	23.1	23.3	22.8	20.6	21.2	21.0	20.7	20.4	-0.4
South Korea	9.3	9.4	9.7	10.5	11.3	12.1	12.8	13.6	1.2
Australia/New Zealand	6.6	6.7	7.2	7.9	8.0	8.1	8.3	8.5	0.6
Total OECD	**243.8**	**244.1**	**245.7**	**241.0**	**245.7**	**249.7**	**253.4**	**257.4**	**0.2**
Non-OECD									
Non-OECD Europe and Eurasia	**50.4**	**51.0**	**51.5**	**51.9**	**53.2**	**54.5**	**55.3**	**56.7**	**0.3**
Russia	29.7	30.5	30.5	30.4	31.1	31.9	32.5	33.6	0.4
Other	20.7	20.6	21.0	21.5	22.1	22.6	22.7	23.1	0.3
Non-OECD Asia	**112.6**	**119.6**	**127.1**	**156.6**	**181.1**	**205.1**	**228.7**	**251.7**	**2.5**
China	68.4	73.0	78.0	99.6	117.0	134.5	150.7	165.1	2.7
India	17.5	18.8	20.3	23.9	27.2	29.5	31.6	34.2	1.9
Other Non-OECD Asia	26.7	27.8	28.8	33.1	36.8	41.1	46.4	52.4	2.2
Middle East	**22.8**	**23.9**	**25.1**	**32.4**	**35.3**	**37.1**	**39.0**	**41.8**	**1.8**
Africa	**17.2**	**17.3**	**17.8**	**20.5**	**21.7**	**23.3**	**24.7**	**26.4**	**1.4**
Central and South America	**26.0**	**27.1**	**28.0**	**31.5**	**34.1**	**36.4**	**38.9**	**41.2**	**1.4**
Brazil	11.2	11.7	12.3	14.6	16.2	18.2	20.2	21.9	2.0
Other Central and South America	14.8	15.4	15.7	16.9	17.9	18.2	18.7	19.3	0.8
Total Non-OECD	**229.0**	**239.0**	**249.5**	**292.9**	**325.3**	**356.5**	**386.6**	**417.9**	**1.9**
Total World	**472.7**	**483.1**	**495.2**	**533.9**	**571.0**	**606.2**	**640.0**	**675.3**	**1.1**

[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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, "Balances of OECD and Non-OECD Statistics" (2009), web site www.iea.org (subscription site). **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LM2010.D011110A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table C2. World total energy consumption by region and fuel, Low Economic Growth case, 2005-2035
(Quadrillion Btu)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America									
Liquids	49.5	49.0	49.4	46.1	45.9	46.1	46.4	46.8	-0.2
Natural gas	28.1	28.1	29.2	28.0	29.0	30.1	31.4	32.8	0.4
Coal	24.7	24.3	24.6	23.4	23.7	23.6	24.2	24.6	0.0
Nuclear	9.2	9.4	9.6	10.1	10.8	10.9	11.0	11.2	0.6
Other	10.9	11.1	11.0	13.6	15.0	15.9	16.5	17.4	1.7
Total	**122.4**	**121.8**	**123.7**	**121.2**	**124.3**	**126.6**	**129.5**	**132.7**	**0.3**
OECD Europe									
Liquids	32.3	32.4	31.6	28.5	26.7	26.3	26.1	25.8	-0.7
Natural gas	19.7	19.7	19.8	20.7	21.0	21.0	20.7	20.8	0.2
Coal	12.7	13.1	13.2	11.4	11.0	10.6	10.3	10.1	-1.0
Nuclear	9.7	9.6	9.1	9.7	10.0	10.4	10.8	11.1	0.7
Other	7.9	8.1	8.7	10.5	12.2	13.5	14.0	14.4	1.8
Total	**82.4**	**82.9**	**82.3**	**80.8**	**80.9**	**81.8**	**82.0**	**82.3**	**0.0**
OECD Asia									
Liquids	17.5	17.2	16.9	15.3	15.5	15.5	15.4	15.3	-0.4
Natural gas	5.9	6.3	6.7	7.3	7.4	7.7	7.7	7.8	0.5
Coal	9.2	9.3	10.1	9.0	9.0	9.0	9.1	9.3	-0.3
Nuclear	4.3	4.3	3.9	4.7	5.7	6.0	6.5	6.9	2.1
Other	2.1	2.2	2.1	2.6	2.9	3.1	3.2	3.3	1.5
Total	**39.0**	**39.5**	**39.7**	**39.0**	**40.5**	**41.3**	**41.9**	**42.5**	**0.2**
Total OECD									
Liquids	99.3	98.6	97.9	89.9	88.1	87.8	87.9	87.9	-0.4
Natural gas	53.7	54.1	55.6	56.0	57.5	58.8	59.8	61.3	0.3
Coal	46.7	46.7	47.9	43.9	43.7	43.2	43.6	44.0	-0.3
Nuclear	23.2	23.3	22.6	24.5	26.4	27.3	28.3	29.2	0.9
Other	20.9	21.4	21.7	26.7	30.1	32.5	33.7	35.1	1.7
Total	**243.8**	**244.1**	**245.7**	**241.0**	**245.7**	**249.7**	**253.4**	**257.4**	**0.2**
Non-OECD									
Non-OECD Europe and Eurasia									
Liquids	10.1	10.3	10.4	9.9	9.7	9.6	9.8	9.9	-0.1
Natural gas	25.8	25.8	26.3	27.1	27.7	28.0	28.0	28.1	0.2
Coal	8.4	8.8	8.7	7.9	7.7	7.6	7.8	8.1	-0.2
Nuclear	2.9	2.9	3.0	3.7	4.5	5.4	5.8	6.2	2.6
Other	3.2	3.2	3.1	3.3	3.6	3.8	4.0	4.3	1.2
Total	**50.4**	**51.0**	**51.5**	**51.9**	**53.2**	**54.5**	**55.3**	**56.7**	**0.3**
Non-OECD Asia									
Liquids	31.7	33.4	34.6	40.7	44.7	49.7	54.5	58.9	1.9
Natural gas	8.6	9.8	10.8	17.0	20.6	23.5	25.6	27.4	3.4
Coal	61.9	65.4	70.3	79.6	89.9	100.8	112.3	124.3	2.1
Nuclear	1.1	1.1	1.2	3.2	5.6	7.2	8.4	9.8	7.7
Other	9.3	9.9	10.2	16.2	20.2	23.9	27.9	31.3	4.1
Total	**112.6**	**119.6**	**127.1**	**156.6**	**181.1**	**205.1**	**228.7**	**251.7**	**2.5**

See notes at end of table.

Table C2. World total energy consumption by region and fuel, Low Economic Growth case, 2005-2035 (continued)
(Quadrillion Btu)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
Non-OECD (continued)									
Middle East									
Liquids	12.0	12.5	13.3	14.7	15.4	16.5	17.9	19.6	1.4
Natural gas	10.2	10.8	11.2	16.8	18.8	19.5	19.8	20.7	2.2
Coal	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	-0.3
Nuclear	0.0	0.0	0.0	0.1	0.2	0.3	0.4	0.5	—
Other	0.3	0.3	0.3	0.4	0.5	0.5	0.6	0.6	2.9
Total	**22.8**	**23.9**	**25.1**	**32.4**	**35.3**	**37.1**	**39.0**	**41.8**	**1.8**
Africa									
Liquids	6.1	6.2	6.4	7.1	7.1	7.4	7.9	8.4	1.0
Natural gas	3.2	3.1	3.3	5.0	6.0	6.7	7.0	7.3	2.8
Coal	4.2	4.2	4.2	4.1	4.2	4.3	4.7	5.3	0.8
Nuclear	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	3.5
Other	3.6	3.6	3.7	4.1	4.3	4.6	4.9	5.2	1.2
Total	**17.2**	**17.3**	**17.8**	**20.5**	**21.7**	**23.3**	**24.7**	**26.4**	**1.4**
Central and South America									
Liquids	11.3	11.8	12.2	13.2	13.0	13.5	14.1	14.5	0.6
Natural gas	4.7	4.8	4.9	5.8	6.8	7.1	7.4	7.8	1.7
Coal	0.8	0.9	0.9	0.9	1.0	1.1	1.3	1.5	1.7
Nuclear	0.2	0.2	0.2	0.3	0.4	0.5	0.5	0.7	4.2
Other	9.0	9.4	9.8	11.3	12.9	14.3	15.7	16.7	1.9
Total	**26.0**	**27.1**	**28.0**	**31.5**	**34.1**	**36.4**	**38.9**	**41.2**	**1.4**
Total Non-OECD									
Liquids	71.1	74.2	76.8	85.6	89.9	96.8	104.1	111.4	1.3
Natural gas	52.5	54.2	56.5	71.7	79.9	84.9	87.8	91.3	1.7
Coal	75.7	79.7	84.6	92.8	103.1	114.2	126.3	139.5	1.8
Nuclear	4.3	4.4	4.5	7.5	10.9	13.6	15.3	17.5	4.9
Other	25.3	26.5	27.1	35.3	41.5	47.1	53.0	58.2	2.8
Total	**229.0**	**239.0**	**249.5**	**292.9**	**325.3**	**356.5**	**386.6**	**417.9**	**1.9**
Total World									
Liquids	170.4	172.8	174.7	175.6	178.0	184.6	192.1	199.3	0.5
Natural gas	106.3	108.3	112.1	127.6	137.4	143.7	147.6	152.6	1.1
Coal	122.3	126.4	132.4	136.7	146.8	157.4	169.9	183.5	1.2
Nuclear	27.5	27.8	27.1	32.0	37.3	40.9	43.6	46.7	2.0
Other	46.2	47.9	48.8	62.0	71.5	79.6	86.7	93.3	2.3
Total	**472.7**	**483.1**	**495.2**	**533.9**	**571.0**	**606.2**	**640.0**	**675.3**	**1.1**

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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, "Balances of OECD and Non-OECD Statistics" (2009), web site www.iea.org (subscription site). **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LM2010.D011110A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table C3. World gross domestic product (GDP) by region expressed in purchasing power parity, Low Economic Growth case, 2005-2035
(Billion 2005 dollars)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**14,883**	**15,327**	**15,662**	**17,172**	**19,570**	**21,768**	**24,018**	**26,444**	**1.9**
United States[a]	12,422	12,768	13,027	14,201	16,161	17,863	19,530	21,275	1.8
Canada	1,167	1,200	1,231	1,394	1,522	1,645	1,782	1,930	1.6
Mexico	1,293	1,359	1,405	1,577	1,887	2,260	2,706	3,239	3.0
OECD Europe	**13,928**	**14,412**	**14,849**	**15,737**	**17,086**	**18,362**	**19,636**	**20,951**	**1.2**
OECD Asia	**5,535**	**5,681**	**5,850**	**6,341**	**6,716**	**6,985**	**7,254**	**7,505**	**0.9**
Japan	3,872	3,951	4,041	4,134	4,203	4,176	4,145	4,099	0.1
South Korea	892	938	986	1,227	1,417	1,597	1,768	1,929	2.4
Australia/New Zealand	771	792	823	980	1,097	1,213	1,341	1,477	2.1
Total OECD	**34,345**	**35,420**	**36,361**	**39,251**	**43,373**	**47,115**	**50,908**	**54,899**	**1.5**
Non-OECD									
Non-OECD Europe and Eurasia	**2,977**	**3,218**	**3,481**	**4,073**	**4,684**	**5,303**	**5,921**	**6,556**	**2.3**
Russia	1,703	1,834	1,982	2,281	2,608	2,962	3,328	3,720	2.3
Other	1,275	1,384	1,499	1,791	2,076	2,341	2,593	2,836	2.3
Non-OECD Asia	**11,897**	**13,013**	**14,323**	**23,388**	**30,225**	**37,368**	**44,679**	**52,143**	**4.7**
China	5,408	6,035	6,820	12,382	16,483	20,819	24,989	28,950	5.3
India	2,440	2,676	2,918	4,712	6,021	7,260	8,622	10,116	4.5
Other Non-OECD Asia	4,049	4,302	4,585	6,294	7,720	9,289	11,069	13,076	3.8
Middle East	**1,985**	**2,145**	**2,261**	**2,984**	**3,550**	**4,141**	**4,822**	**5,582**	**3.3**
Africa	**2,360**	**2,494**	**2,638**	**3,536**	**4,178**	**4,833**	**5,513**	**6,255**	**3.1**
Central and South America	**3,612**	**3,822**	**4,066**	**5,190**	**6,037**	**6,956**	**7,966**	**9,076**	**2.9**
Brazil	1,534	1,595	1,685	2,283	2,730	3,246	3,842	4,523	3.6
Other Central and South America	2,079	2,227	2,381	2,907	3,307	3,710	4,124	4,553	2.3
Total Non-OECD	**22,832**	**24,692**	**26,769**	**39,171**	**48,674**	**58,602**	**68,901**	**79,612**	**4.0**
Total World	**57,177**	**60,112**	**63,130**	**78,422**	**92,046**	**105,717**	**119,809**	**134,511**	**2.7**

[a]Includes the 50 States and the District of Columbia.
Note: Totals may not equal sum of components due to independent rounding.
Sources: **History:** IHS Global Insight, *World Overview* (Lexington, MA, various issues). **Projections:** Derived from IHS Global Insight, *World Overview*, Third Quarter 2009 (Lexington, MA, September 2009); and U.S. Energy Information Administration, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), Table B4.

Table C4. World liquids consumption by region, Low Economic Growth case, 2005-2035
(Million barrels per day)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**25.2**	**25.0**	**25.1**	**23.9**	**23.8**	**23.9**	**24.1**	**24.3**	**-0.1**
United States[a]	20.8	20.7	20.6	19.6	19.6	19.6	19.6	19.6	-0.2
Canada	2.3	2.3	2.3	2.2	2.1	2.1	2.1	2.1	-0.3
Mexico	2.1	2.1	2.1	2.1	2.2	2.3	2.4	2.6	0.7
OECD Europe	**15.7**	**15.7**	**15.3**	**13.8**	**13.0**	**12.7**	**12.7**	**12.5**	**-0.7**
OECD Asia	**8.6**	**8.5**	**8.4**	**7.6**	**7.7**	**7.7**	**7.6**	**7.6**	**-0.4**
Japan	5.3	5.2	5.0	4.1	4.2	4.1	3.9	3.7	-1.1
South Korea	2.2	2.2	2.2	2.3	2.4	2.5	2.6	2.8	0.7
Australia/New Zealand	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	-0.1
Total OECD	**49.5**	**49.1**	**48.8**	**45.3**	**44.5**	**44.3**	**44.4**	**44.4**	**-0.3**
Non-OECD									
Non-OECD Europe and Eurasia	**4.9**	**5.0**	**5.1**	**4.8**	**4.7**	**4.7**	**4.8**	**4.9**	**-0.2**
Russia	2.8	2.9	2.9	2.7	2.6	2.6	2.5	2.6	-0.3
Other	2.1	2.2	2.2	2.1	2.1	2.1	2.2	2.3	0.1
Non-OECD Asia	**15.4**	**16.2**	**16.8**	**19.7**	**21.7**	**24.1**	**26.5**	**28.6**	**1.9**
China	6.7	7.3	7.6	9.8	11.1	12.6	13.9	15.0	2.5
India	2.5	2.7	2.8	3.1	3.4	3.6	3.9	4.1	1.3
Other Non-OECD Asia	6.2	6.2	6.3	6.8	7.2	7.9	8.7	9.4	1.4
Middle East	**5.8**	**6.0**	**6.4**	**7.1**	**7.4**	**8.0**	**8.6**	**9.5**	**1.4**
Africa	**3.0**	**3.0**	**3.1**	**3.5**	**3.5**	**3.6**	**3.9**	**4.1**	**1.0**
Central and South America	**5.5**	**5.8**	**6.0**	**6.4**	**6.4**	**6.6**	**6.9**	**7.1**	**0.6**
Brazil	2.2	2.3	2.4	2.8	2.9	3.0	3.3	3.5	1.4
Other Central and South America	3.3	3.5	3.6	3.7	3.5	3.5	3.6	3.6	0.0
Total Non-OECD	**34.6**	**36.1**	**37.3**	**41.6**	**43.7**	**47.0**	**50.6**	**54.1**	**1.3**
Total World	**84.0**	**85.2**	**86.1**	**86.9**	**88.1**	**91.3**	**95.0**	**98.5**	**0.5**

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

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

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LM2010.D011110A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table C5. World natural gas consumption by region, Low Economic Growth case, 2005-2035
(Trillion cubic feet)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**27.3**	**27.2**	**28.3**	**27.1**	**28.1**	**29.1**	**30.3**	**31.7**	**0.4**
United States[a]	22.0	21.7	23.0	21.5	21.8	21.9	22.3	22.7	-0.1
Canada	3.4	3.3	2.9	3.2	3.3	3.5	3.7	3.9	1.0
Mexico	1.9	2.2	2.4	2.5	3.0	3.7	4.3	5.1	2.8
OECD Europe	**19.2**	**19.1**	**19.2**	**20.1**	**20.3**	**20.3**	**20.1**	**20.1**	**0.2**
OECD Asia	**5.3**	**5.8**	**6.3**	**6.9**	**7.0**	**7.2**	**7.3**	**7.3**	**0.5**
Japan	3.1	3.4	3.7	3.8	3.7	3.7	3.6	3.5	-0.2
South Korea	1.1	1.1	1.2	1.4	1.6	1.7	1.7	1.8	1.3
Australia/New Zealand	1.1	1.2	1.3	1.6	1.7	1.8	1.9	2.0	1.5
Total OECD	**51.8**	**52.1**	**53.7**	**54.0**	**55.5**	**56.7**	**57.7**	**59.1**	**0.3**
Non-OECD									
Non-OECD Europe and Eurasia	**25.3**	**25.3**	**25.9**	**26.6**	**27.1**	**27.5**	**27.5**	**27.6**	**0.2**
Russia	16.2	16.6	16.7	16.6	16.7	16.9	16.9	17.1	0.1
Other	9.1	8.7	9.1	10.0	10.4	10.7	10.5	10.4	0.5
Non-OECD Asia	**8.5**	**9.6**	**10.5**	**16.5**	**20.1**	**22.9**	**24.9**	**26.7**	**3.4**
China	1.7	2.0	2.5	4.9	6.3	7.5	8.6	9.4	4.9
India	1.3	1.4	1.5	3.0	3.9	4.3	4.4	4.4	4.0
Other Non-OECD Asia	5.6	6.2	6.6	8.6	9.9	11.1	11.9	12.8	2.4
Middle East	**9.8**	**10.3**	**10.7**	**16.0**	**17.9**	**18.6**	**18.9**	**19.7**	**2.2**
Africa	**3.0**	**2.9**	**3.1**	**4.7**	**5.6**	**6.3**	**6.5**	**6.7**	**2.8**
Central and South America	**4.4**	**4.5**	**4.6**	**5.4**	**6.4**	**6.7**	**7.0**	**7.4**	**1.7**
Brazil	0.7	0.7	0.7	1.0	1.3	1.4	1.7	1.9	3.6
Other Central and South America	3.7	3.8	3.9	4.5	5.2	5.2	5.3	5.5	1.2
Total Non-OECD	**50.9**	**52.6**	**54.7**	**69.2**	**77.1**	**81.9**	**84.8**	**88.1**	**1.7**
Total World	**102.7**	**104.6**	**108.5**	**123.3**	**132.6**	**138.6**	**142.4**	**147.2**	**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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LM2010.D011110A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table C6. World coal consumption by region, Low Economic Growth case, 2005-2035
(Quadrillion Btu)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**24.7**	**24.3**	**24.6**	**23.4**	**23.7**	**23.6**	**24.2**	**24.6**	**0.0**
United States[a]	22.8	22.5	22.7	22.0	22.3	22.3	22.8	23.1	0.1
Canada	1.5	1.4	1.5	1.1	1.0	1.0	1.0	1.0	-1.3
Mexico	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5
OECD Europe	**12.7**	**13.1**	**13.2**	**11.4**	**11.0**	**10.6**	**10.3**	**10.1**	**-1.0**
OECD Asia	**9.2**	**9.3**	**10.1**	**9.0**	**9.0**	**9.0**	**9.1**	**9.3**	**-0.3**
Japan	4.6	4.6	4.9	4.1	4.0	3.8	3.7	3.5	-1.2
South Korea	2.1	2.1	2.3	2.2	2.2	2.4	2.7	3.0	1.0
Australia/New Zealand	2.6	2.6	2.9	2.8	2.8	2.8	2.8	2.8	-0.1
Total OECD	**46.7**	**46.7**	**47.9**	**43.9**	**43.7**	**43.2**	**43.6**	**44.0**	**-0.3**
Non-OECD									
Non-OECD Europe and Eurasia	**8.4**	**8.8**	**8.7**	**7.9**	**7.7**	**7.6**	**7.8**	**8.1**	**-0.2**
Russia	4.3	4.4	4.3	4.1	4.0	4.0	4.2	4.5	0.2
Other	4.1	4.4	4.4	3.8	3.7	3.6	3.6	3.6	-0.7
Non-OECD Asia	**61.9**	**65.4**	**70.3**	**79.6**	**89.9**	**100.8**	**112.3**	**124.3**	**2.1**
China	48.3	51.0	54.8	63.8	73.1	82.6	91.5	100.1	2.2
India	8.6	9.2	10.2	10.3	11.0	11.6	12.5	13.7	1.1
Other Non-OECD Asia	4.9	5.1	5.4	5.4	5.7	6.6	8.3	10.5	2.4
Middle East	**0.4**	**0.4**	**0.4**	**0.4**	**0.3**	**0.3**	**0.3**	**0.3**	**-0.3**
Africa	**4.2**	**4.2**	**4.2**	**4.1**	**4.2**	**4.3**	**4.7**	**5.3**	**0.8**
Central and South America	**0.8**	**0.9**	**0.9**	**0.9**	**1.0**	**1.1**	**1.3**	**1.5**	**1.7**
Brazil	0.4	0.4	0.5	0.5	0.6	0.7	0.9	1.1	2.9
Other Central and South America	0.4	0.4	0.5	0.4	0.4	0.4	0.4	0.4	-0.2
Total Non-OECD	**75.7**	**79.7**	**84.6**	**92.8**	**103.1**	**114.2**	**126.3**	**139.5**	**1.8**
Total World	**122.3**	**126.4**	**132.4**	**136.7**	**146.8**	**157.4**	**169.9**	**183.5**	**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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LM2010.D011110A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table C7. World nuclear energy consumption by region, Low Economic Growth case, 2005-2035
(Billion kilowatthours)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**880**	**891**	**905**	**958**	**1,020**	**1,030**	**1,045**	**1,058**	**0.6**
United States[a]	782	787	806	834	883	886	886	883	0.3
Canada	87	93	89	113	127	134	141	157	2.1
Mexico	10	10	10	11	11	10	18	18	2.2
OECD Europe	**932**	**929**	**879**	**934**	**964**	**1,006**	**1,046**	**1,074**	**0.7**
OECD Asia	**429**	**430**	**386**	**468**	**557**	**587**	**635**	**677**	**2.0**
Japan	290	288	251	293	340	355	383	411	1.8
South Korea	139	141	136	175	217	232	253	266	2.4
Australia/New Zealand	0	0	0	0	0	0	0	0	—
Total OECD	**2,240**	**2,250**	**2,171**	**2,360**	**2,541**	**2,623**	**2,727**	**2,826**	**0.9**
Non-OECD									
Non-OECD Europe and Eurasia	**264**	**269**	**273**	**341**	**422**	**508**	**540**	**584**	**2.8**
Russia	140	144	148	196	256	321	342	361	3.2
Other	124	124	125	145	166	186	198	222	2.1
Non-OECD Asia	**106**	**111**	**119**	**312**	**542**	**696**	**812**	**940**	**7.6**
China	50	55	63	186	335	436	512	597	8.4
India	16	16	16	65	118	155	178	203	9.5
Other Non-OECD Asia	40	40	41	61	89	105	122	141	4.5
Middle East	**0**	**0**	**0**	**6**	**20**	**29**	**38**	**49**	**—**
Africa	**12**	**10**	**12**	**15**	**15**	**21**	**21**	**31**	**3.5**
Central and South America	**16**	**21**	**19**	**28**	**34**	**43**	**43**	**62**	**4.3**
Brazil	10	14	12	18	22	31	31	40	4.3
Other Central and South America	6	7	7	10	12	12	12	21	4.2
Total Non-OECD	**399**	**411**	**423**	**703**	**1,034**	**1,298**	**1,455**	**1,665**	**5.0**
Total World	**2,639**	**2,660**	**2,593**	**3,062**	**3,575**	**3,921**	**4,181**	**4,491**	**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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LM2010.D011110A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table C8. World consumption of hydroelectricity and other renewable energy by region, Low Economic Growth case, 2005-2035
(Quadrillion Btu)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**10.9**	**11.1**	**11.0**	**13.6**	**15.0**	**15.9**	**16.5**	**17.4**	**1.7**
United States[a]	6.1	6.4	6.2	8.5	9.4	9.8	9.9	10.4	1.9
Canada	4.2	4.1	4.2	4.4	4.8	5.2	5.5	5.8	1.1
Mexico	0.6	0.6	0.5	0.8	0.8	1.0	1.1	1.2	2.8
OECD Europe	**7.9**	**8.1**	**8.7**	**10.5**	**12.2**	**13.5**	**14.0**	**14.4**	**1.8**
OECD Asia	**2.1**	**2.2**	**2.1**	**2.6**	**2.9**	**3.1**	**3.2**	**3.3**	**1.5**
Japan	1.3	1.4	1.3	1.3	1.5	1.5	1.5	1.6	0.6
South Korea	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	2.8
Australia/New Zealand	0.7	0.7	0.7	1.2	1.3	1.4	1.4	1.5	2.7
Total OECD	**20.9**	**21.4**	**21.7**	**26.7**	**30.1**	**32.5**	**33.7**	**35.1**	**1.7**
Non-OECD									
Non-OECD Europe and Eurasia	**3.2**	**3.2**	**3.1**	**3.3**	**3.6**	**3.8**	**4.0**	**4.3**	**1.2**
Russia	1.9	1.9	1.9	1.9	2.1	2.3	2.5	2.6	1.3
Other	1.4	1.3	1.2	1.4	1.4	1.5	1.5	1.6	1.1
Non-OECD Asia	**9.3**	**9.9**	**10.2**	**16.2**	**20.2**	**23.9**	**27.9**	**31.3**	**4.1**
China	4.1	4.5	4.5	8.7	11.2	13.8	16.3	18.2	5.1
India	2.3	2.4	2.5	3.2	3.9	4.3	4.8	5.4	2.7
Other Non-OECD Asia	2.9	3.0	3.1	4.3	5.1	5.8	6.7	7.8	3.3
Middle East	**0.3**	**0.3**	**0.3**	**0.4**	**0.5**	**0.5**	**0.6**	**0.6**	**2.9**
Africa	**3.6**	**3.6**	**3.7**	**4.1**	**4.3**	**4.6**	**4.9**	**5.2**	**1.2**
Central and South America	**9.0**	**9.4**	**9.8**	**11.3**	**12.9**	**14.3**	**15.7**	**16.7**	**1.9**
Brazil	5.5	5.7	6.2	7.2	8.3	9.4	10.5	11.3	2.2
Other Central and South America	3.5	3.7	3.6	4.0	4.6	4.9	5.2	5.4	1.4
Total Non-OECD	**25.3**	**26.5**	**27.1**	**35.3**	**41.5**	**47.1**	**53.0**	**58.2**	**2.8**
Total World	**46.2**	**47.9**	**48.8**	**62.0**	**71.5**	**79.6**	**86.7**	**93.3**	**2.3**

[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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, “Balances of OECD and Non-OECD Statistics” (2009), web site www.iea.org (subscription site). **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LM2010.D011110A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table C9. World carbon dioxide emissions by region, Low Economic Growth case, 2005-2035
(Million metric tons carbon dioxide)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**7,012**	**6,915**	**7,017**	**6,600**	**6,644**	**6,725**	**6,876**	**7,001**	**0.0**
United States[a]	5,974	5,894	5,986	5,613	5,627	5,647	5,729	5,768	-0.1
Canada	628	596	586	545	537	544	557	571	-0.1
Mexico	410	426	444	443	480	535	589	663	1.4
OECD Europe	**4,398**	**4,426**	**4,386**	**4,064**	**3,926**	**3,855**	**3,802**	**3,766**	**-0.5**
OECD Asia	**2,203**	**2,197**	**2,273**	**2,115**	**2,124**	**2,136**	**2,139**	**2,151**	**-0.2**
Japan	1,254	1,253	1,262	1,086	1,076	1,048	1,007	965	-1.0
South Korea	496	486	516	526	547	585	622	666	0.9
Australia/New Zealand	453	457	495	503	501	503	510	520	0.2
Total OECD	**13,613**	**13,538**	**13,676**	**12,779**	**12,695**	**12,716**	**12,817**	**12,918**	**-0.2**
Non-OECD									
Non-OECD Europe and Eurasia	**2,842**	**2,876**	**2,897**	**2,854**	**2,852**	**2,859**	**2,877**	**2,929**	**0.0**
Russia	1,650	1,672	1,663	1,628	1,616	1,613	1,630	1,682	0.0
Other	1,193	1,204	1,233	1,227	1,236	1,247	1,248	1,248	0.0
Non-OECD Asia	**8,382**	**8,831**	**9,425**	**11,011**	**12,436**	**13,940**	**15,439**	**16,949**	**2.1**
China	5,558	5,862	6,284	7,561	8,677	9,836	10,911	11,908	2.3
India	1,187	1,287	1,399	1,542	1,686	1,790	1,906	2,056	1.4
Other Non-OECD Asia	1,637	1,681	1,743	1,909	2,074	2,315	2,621	2,985	1.9
Middle East	**1,395**	**1,446**	**1,515**	**1,908**	**2,061**	**2,168**	**2,279**	**2,444**	**1.7**
Africa	**982**	**988**	**1,011**	**1,138**	**1,194**	**1,273**	**1,349**	**1,450**	**1.3**
Central and South America	**1,092**	**1,133**	**1,169**	**1,281**	**1,333**	**1,386**	**1,458**	**1,530**	**1.0**
Brazil	366	380	394	463	501	547	609	663	1.9
Other Central and South America	726	753	775	818	832	839	849	866	0.4
Total Non-OECD	**14,693**	**15,274**	**16,017**	**18,193**	**19,876**	**21,626**	**23,402**	**25,303**	**1.6**
Total World	**28,306**	**28,812**	**29,694**	**30,972**	**32,571**	**34,342**	**36,219**	**38,221**	**0.9**

[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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LM2010.D011110A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table C10. World carbon dioxide emissions from liquids use by region, Low Economic Growth case, 2005-2035
(Million metric tons carbon dioxide)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**3,194**	**3,142**	**3,150**	**2,895**	**2,871**	**2,896**	**2,921**	**2,935**	**-0.3**
United States[a]	2,626	2,595	2,589	2,352	2,336	2,347	2,350	2,340	-0.4
Canada	301	281	288	274	259	259	262	265	-0.3
Mexico	267	265	273	270	275	290	309	330	0.7
OECD Europe	**2,133**	**2,125**	**2,082**	**1,877**	**1,761**	**1,730**	**1,719**	**1,702**	**-0.7**
OECD Asia	**1,031**	**991**	**980**	**885**	**893**	**890**	**882**	**874**	**-0.4**
Japan	646	622	603	495	500	486	466	446	-1.1
South Korea	239	221	227	238	247	259	270	280	0.8
Australia/New Zealand	147	148	150	152	146	146	147	148	-0.1
Total OECD	**6,358**	**6,258**	**6,212**	**5,658**	**5,525**	**5,516**	**5,522**	**5,511**	**-0.4**
Non-OECD									
Non-OECD Europe and Eurasia	**686**	**677**	**682**	**673**	**656**	**656**	**663**	**677**	**0.0**
Russia	383	368	366	368	353	345	342	349	-0.2
Other	303	310	316	306	303	311	322	328	0.1
Non-OECD Asia	**2,081**	**2,147**	**2,225**	**2,616**	**2,872**	**3,192**	**3,502**	**3,783**	**1.9**
China	889	928	969	1,257	1,420	1,616	1,786	1,926	2.5
India	314	349	369	408	442	470	502	534	1.3
Other Non-OECD Asia	878	870	887	952	1,011	1,106	1,213	1,323	1.4
Middle East	**817**	**839**	**886**	**986**	**1,031**	**1,103**	**1,196**	**1,314**	**1.4**
Africa	**423**	**428**	**441**	**489**	**487**	**512**	**544**	**576**	**1.0**
Central and South America	**762**	**796**	**823**	**889**	**877**	**905**	**945**	**975**	**0.6**
Brazil	288	301	311	365	376	402	434	459	1.4
Other Central and South America	474	495	512	524	501	503	512	515	0.0
Total Non-OECD	**4,768**	**4,888**	**5,057**	**5,653**	**5,924**	**6,368**	**6,851**	**7,324**	**1.3**
Total World	**11,126**	**11,146**	**11,268**	**11,311**	**11,449**	**11,884**	**12,373**	**12,835**	**0.5**

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

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LM2010.D011110A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table C11. World carbon dioxide emissions from natural gas use by region, Low Economic Growth case, 2005-2035
(Million metric tons carbon dioxide)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**1,468**	**1,463**	**1,524**	**1,469**	**1,528**	**1,585**	**1,654**	**1,729**	**0.5**
United States[a]	1,176	1,157	1,232	1,158	1,174	1,183	1,206	1,228	0.0
Canada	186	181	157	172	182	191	201	210	1.0
Mexico	106	125	135	139	172	211	247	291	2.8
OECD Europe	**1,048**	**1,045**	**1,049**	**1,100**	**1,115**	**1,114**	**1,100**	**1,102**	**0.2**
OECD Asia	**311**	**336**	**355**	**387**	**394**	**408**	**410**	**411**	**0.5**
Japan	183	202	208	212	207	208	203	197	-0.2
South Korea	64	68	73	85	92	101	103	104	1.3
Australia/New Zealand	65	66	73	90	95	99	104	110	1.5
Total OECD	**2,827**	**2,843**	**2,928**	**2,956**	**3,036**	**3,107**	**3,163**	**3,242**	**0.4**
Non-OECD									
Non-OECD Europe and Eurasia	**1,367**	**1,367**	**1,397**	**1,443**	**1,473**	**1,493**	**1,490**	**1,495**	**0.2**
Russia	865	889	897	886	893	901	905	915	0.1
Other	502	478	500	557	580	592	585	579	0.5
Non-OECD Asia	**459**	**518**	**572**	**900**	**1,095**	**1,248**	**1,360**	**1,454**	**3.4**
China	92	111	138	272	349	418	479	524	4.9
India	70	75	80	167	212	235	241	242	4.0
Other Non-OECD Asia	297	332	354	460	533	595	640	688	2.4
Middle East	**543**	**571**	**594**	**890**	**998**	**1,034**	**1,052**	**1,098**	**2.2**
Africa	**169**	**166**	**176**	**267**	**317**	**358**	**370**	**385**	**2.8**
Central and South America	**250**	**256**	**259**	**307**	**362**	**375**	**392**	**415**	**1.7**
Brazil	36	38	39	53	70	78	94	105	3.6
Other Central and South America	214	218	220	254	292	297	299	311	1.2
Total Non-OECD	**2,788**	**2,877**	**2,997**	**3,806**	**4,245**	**4,507**	**4,664**	**4,847**	**1.7**
Total World	**5,614**	**5,720**	**5,925**	**6,762**	**7,281**	**7,614**	**7,827**	**8,089**	**1.1**

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

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LM2010.D011110A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table C12. World carbon dioxide emissions from coal use by region, Low Economic Growth case, 2005-2035
(Million metric tons carbon dioxide)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**2,339**	**2,299**	**2,331**	**2,224**	**2,235**	**2,232**	**2,291**	**2,326**	**0.0**
United States[a]	2,161	2,130	2,155	2,091	2,105	2,105	2,161	2,188	0.1
Canada	142	133	141	99	96	94	95	97	-1.3
Mexico	36	36	36	34	33	33	34	41	0.5
OECD Europe	**1,217**	**1,256**	**1,256**	**1,086**	**1,050**	**1,011**	**982**	**962**	**-0.9**
OECD Asia	**861**	**870**	**938**	**843**	**837**	**838**	**847**	**866**	**-0.3**
Japan	425	429	451	379	369	354	339	323	-1.2
South Korea	193	197	216	203	208	226	249	281	0.9
Australia/New Zealand	242	244	271	261	260	259	259	262	-0.1
Total OECD	**4,417**	**4,425**	**4,525**	**4,153**	**4,122**	**4,082**	**4,120**	**4,154**	**-0.3**
Non-OECD									
Non-OECD Europe and Eurasia	**790**	**832**	**819**	**738**	**723**	**711**	**724**	**758**	**-0.3**
Russia	402	416	401	374	369	367	383	417	0.1
Other	388	417	417	364	353	344	341	341	-0.7
Non-OECD Asia	**5,843**	**6,165**	**6,629**	**7,496**	**8,470**	**9,500**	**10,578**	**11,713**	**2.1**
China	4,578	4,824	5,177	6,032	6,907	7,802	8,647	9,459	2.2
India	803	863	950	967	1,032	1,085	1,163	1,279	1.1
Other Non-OECD Asia	461	479	502	497	531	614	768	974	2.4
Middle East	**36**	**36**	**35**	**33**	**32**	**31**	**31**	**32**	**-0.3**
Africa	**390**	**394**	**395**	**382**	**390**	**403**	**435**	**489**	**0.8**
Central and South America	**80**	**81**	**87**	**85**	**94**	**105**	**120**	**139**	**1.7**
Brazil	42	41	44	45	55	67	82	99	2.9
Other Central and South America	38	40	43	40	39	38	39	40	-0.2
Total Non-OECD	**7,138**	**7,509**	**7,964**	**8,734**	**9,708**	**10,750**	**11,887**	**13,131**	**1.8**
Total World	**11,555**	**11,934**	**12,489**	**12,887**	**13,830**	**14,832**	**16,007**	**17,285**	**1.2**

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

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LM2010.D011110A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

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Appendix D

High Oil Price Case Projections:

- World energy consumption
- Gross domestic product
- Carbon dioxide emissions

Table D1. World total primary energy consumption by region, High Oil Price case, 2005-2035
(Quadrillion Btu)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**122.4**	**121.8**	**123.7**	**122.5**	**126.7**	**133.1**	**139.5**	**145.6**	**0.6**
United States[a]	100.5	99.8	101.7	100.3	103.2	107.4	111.5	114.7	0.4
Canada	14.8	14.5	14.3	14.4	15.0	15.8	16.8	17.9	0.8
Mexico	7.1	7.4	7.7	7.8	8.6	9.9	11.3	13.0	1.9
OECD Europe	**82.4**	**82.9**	**82.3**	**80.0**	**79.9**	**81.7**	**83.2**	**85.1**	**0.1**
OECD Asia	**39.0**	**39.5**	**39.7**	**38.8**	**40.2**	**41.6**	**43.1**	**44.7**	**0.4**
Japan	23.1	23.3	22.8	20.6	21.1	21.2	21.3	21.4	-0.2
South Korea	9.3	9.4	9.7	10.3	11.2	12.2	13.2	14.4	1.4
Australia/New Zealand	6.6	6.7	7.2	7.9	8.0	8.3	8.6	9.0	0.8
Total OECD	**243.8**	**244.1**	**245.7**	**241.3**	**246.8**	**256.4**	**265.8**	**275.4**	**0.4**
Non-OECD									
Non-OECD Europe and Eurasia	**50.4**	**51.0**	**51.5**	**51.7**	**52.8**	**54.7**	**56.4**	**58.9**	**0.5**
Russia	29.7	30.5	30.5	30.3	31.0	32.2	33.3	35.0	0.5
Other	20.7	20.6	21.0	21.3	21.8	22.6	23.1	23.9	0.5
Non-OECD Asia	**112.6**	**119.6**	**127.1**	**156.4**	**182.5**	**211.0**	**240.7**	**271.0**	**2.7**
China	68.4	73.0	78.0	99.7	118.4	138.9	159.1	178.2	3.0
India	17.5	18.8	20.3	23.8	27.4	30.2	33.2	36.8	2.1
Other Non-OECD Asia	26.7	27.8	28.8	32.8	36.7	41.8	48.4	56.0	2.4
Middle East	**22.8**	**23.9**	**25.1**	**32.4**	**35.6**	**38.0**	**40.5**	**44.1**	**2.0**
Africa	**17.2**	**17.3**	**17.8**	**20.2**	**21.5**	**23.5**	**25.4**	**27.9**	**1.6**
Central and South America	**26.0**	**27.1**	**28.0**	**31.0**	**33.8**	**36.9**	**40.6**	**44.3**	**1.7**
Brazil	11.2	11.7	12.3	14.4	16.2	18.6	21.2	23.6	2.4
Other Central and South America	14.8	15.4	15.7	16.6	17.5	18.4	19.4	20.7	1.0
Total Non-OECD	**229.0**	**239.0**	**249.5**	**291.6**	**326.1**	**364.2**	**403.6**	**446.2**	**2.1**
Total World	**472.7**	**483.1**	**495.2**	**532.9**	**572.9**	**620.5**	**669.4**	**721.6**	**1.4**

[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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, "Balances of OECD and Non-OECD Statistics" (2009), web site www.iea.org (subscription site). **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HP2010.D011910A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table D2. World total energy consumption by region and fuel, High Oil Price case, 2005-2035
(Quadrillion Btu)

Region/Country	History 2005	History 2006	History 2007	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD									
OECD North America									
Liquids	49.5	49.0	49.4	45.7	44.8	45.1	46.1	47.3	-0.2
Natural gas	28.1	28.1	29.2	27.9	30.3	32.8	34.9	36.7	0.8
Coal	24.7	24.3	24.6	24.0	24.8	26.1	27.3	28.8	0.6
Nuclear	9.2	9.4	9.6	10.1	10.8	10.9	11.0	11.4	0.6
Other	10.9	11.1	11.0	14.7	16.2	18.2	20.2	21.5	2.4
Total	**122.4**	**121.8**	**123.7**	**122.5**	**126.7**	**133.1**	**139.5**	**145.6**	**0.6**
OECD Europe									
Liquids	32.3	32.4	31.6	26.8	24.0	23.6	23.6	23.7	-1.0
Natural gas	19.7	19.7	19.8	21.1	22.1	22.8	22.9	23.4	0.6
Coal	12.7	13.1	13.2	11.6	11.3	11.0	11.1	11.6	-0.5
Nuclear	9.7	9.6	9.1	9.7	10.0	10.5	10.9	11.2	0.8
Other	7.9	8.1	8.7	10.9	12.4	13.8	14.6	15.2	2.0
Total	**82.4**	**82.9**	**82.3**	**80.0**	**79.9**	**81.7**	**83.2**	**85.1**	**0.1**
OECD Asia									
Liquids	17.5	17.2	16.9	14.5	14.1	14.2	14.4	14.6	-0.5
Natural gas	5.9	6.3	6.7	7.4	8.0	8.5	8.7	8.9	1.0
Coal	9.2	9.3	10.1	9.2	9.3	9.7	10.2	10.8	0.3
Nuclear	4.3	4.3	3.9	5.0	5.7	6.0	6.5	7.0	2.1
Other	2.1	2.2	2.1	2.7	3.0	3.2	3.3	3.5	1.8
Total	**39.0**	**39.5**	**39.7**	**38.8**	**40.2**	**41.6**	**43.1**	**44.7**	**0.4**
Total OECD									
Liquids	99.3	98.6	97.9	87.0	82.9	82.9	84.1	85.6	-0.5
Natural gas	53.7	54.1	55.6	56.4	60.4	64.1	66.5	68.9	0.8
Coal	46.7	46.7	47.9	44.8	45.4	46.8	48.6	51.2	0.2
Nuclear	23.2	23.3	22.6	24.8	26.5	27.4	28.5	29.6	1.0
Other	20.9	21.4	21.7	28.2	31.6	35.2	38.2	40.2	2.2
Total	**243.8**	**244.1**	**245.7**	**241.3**	**246.8**	**256.4**	**265.8**	**275.4**	**0.4**
Non-OECD									
Non-OECD Europe and Eurasia									
Liquids	10.1	10.3	10.4	9.4	8.8	8.8	9.0	9.3	-0.4
Natural gas	25.8	25.8	26.3	27.3	27.9	28.5	28.6	28.8	0.3
Coal	8.4	8.8	8.7	8.0	8.0	8.1	8.9	10.0	0.5
Nuclear	2.9	2.9	3.0	3.7	4.6	5.5	5.8	6.3	2.7
Other	3.2	3.2	3.1	3.3	3.6	3.8	4.2	4.6	1.4
Total	**50.4**	**51.0**	**51.5**	**51.7**	**52.8**	**54.7**	**56.4**	**58.9**	**0.5**
Non-OECD Asia									
Liquids	31.7	33.4	34.6	38.3	40.6	45.7	51.2	56.6	1.8
Natural gas	8.6	9.8	10.8	17.4	21.4	24.5	26.8	29.0	3.6
Coal	61.9	65.4	70.3	81.2	94.4	109.3	125.7	142.9	2.6
Nuclear	1.1	1.1	1.2	3.2	5.6	7.2	8.5	9.8	7.7
Other	9.3	9.9	10.2	16.2	20.4	24.2	28.6	32.7	4.2
Total	**112.6**	**119.6**	**127.1**	**156.4**	**182.5**	**211.0**	**240.7**	**271.0**	**2.7**

See notes at end of table.

Table D2. World total energy consumption by region and fuel, High Oil Price case, 2005-2035 (continued)
(Quadrillion Btu)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
Non-OECD (continued)									
Middle East									
Liquids	12.0	12.5	13.3	14.3	14.8	15.8	17.3	19.2	1.3
Natural gas	10.2	10.8	11.2	17.2	19.7	21.0	21.8	23.2	2.6
Coal	0.4	0.4	0.4	0.4	0.3	0.3	0.4	0.5	0.9
Nuclear	0.0	0.0	0.0	0.1	0.2	0.3	0.4	0.5	—
Other	0.3	0.3	0.3	0.4	0.5	0.6	0.6	0.7	3.2
Total	**22.8**	**23.9**	**25.1**	**32.4**	**35.6**	**38.0**	**40.5**	**44.1**	**2.0**
Africa									
Liquids	6.1	6.2	6.4	6.6	6.3	6.6	7.1	7.7	0.7
Natural gas	3.2	3.1	3.3	5.1	6.1	6.9	7.1	7.4	2.9
Coal	4.2	4.2	4.2	4.2	4.4	4.9	5.6	6.7	1.6
Nuclear	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	3.6
Other	3.6	3.6	3.7	4.1	4.4	4.9	5.3	5.9	1.6
Total	**17.2**	**17.3**	**17.8**	**20.2**	**21.5**	**23.5**	**25.4**	**27.9**	**1.6**
Central and South America									
Liquids	11.3	11.8	12.2	12.5	12.0	12.4	13.2	13.8	0.5
Natural gas	4.7	4.8	4.9	5.9	7.4	8.2	8.9	9.8	2.5
Coal	0.8	0.9	0.9	0.9	1.0	1.2	1.4	1.7	2.3
Nuclear	0.2	0.2	0.2	0.3	0.4	0.5	0.5	0.7	4.2
Other	9.0	9.4	9.8	11.3	13.0	14.6	16.6	18.3	2.3
Total	**26.0**	**27.1**	**28.0**	**31.0**	**33.8**	**36.9**	**40.6**	**44.3**	**1.7**
Total Non-OECD									
Liquids	71.1	74.2	76.8	81.2	82.5	89.4	97.8	106.6	1.2
Natural gas	52.5	54.2	56.5	72.9	82.6	89.1	93.2	98.1	2.0
Coal	75.7	79.7	84.6	94.6	108.2	123.8	141.9	161.9	2.3
Nuclear	4.3	4.4	4.5	7.5	10.9	13.7	15.4	17.5	4.9
Other	25.3	26.5	27.1	35.5	41.9	48.1	55.3	62.1	3.0
Total	**229.0**	**239.0**	**249.5**	**291.6**	**326.1**	**364.2**	**403.6**	**446.2**	**2.1**
Total World									
Liquids	170.4	172.8	174.7	168.2	165.4	172.3	181.8	192.2	0.3
Natural gas	106.3	108.3	112.1	129.3	143.0	153.1	159.7	167.0	1.4
Coal	122.3	126.4	132.4	139.5	153.6	170.7	190.5	213.0	1.7
Nuclear	27.5	27.8	27.1	32.3	37.4	41.1	43.9	47.1	2.0
Other	46.2	47.9	48.8	63.7	73.5	83.4	93.5	102.3	2.7
Total	**472.7**	**483.1**	**495.2**	**532.9**	**572.9**	**620.5**	**669.4**	**721.6**	**1.4**

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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, "Balances of OECD and Non-OECD Statistics" (2009), web site www.iea.org (subscription site). **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HP2010.D011910A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table D3. World gross domestic product (GDP) by region expressed in purchasing power parity, High Oil Price case, 2005-2035
(Billion 2005 dollars)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**14,883**	**15,327**	**15,662**	**17,929**	**21,002**	**24,205**	**27,610**	**31,358**	**2.5**
United States[a]	12,422	12,768	13,027	14,877	17,417	19,999	22,656	25,513	2.4
Canada	1,167	1,200	1,231	1,436	1,606	1,779	1,975	2,192	2.1
Mexico	1,293	1,359	1,405	1,617	1,978	2,427	2,978	3,652	3.5
OECD Europe	**13,928**	**14,412**	**14,849**	**16,115**	**17,900**	**19,713**	**21,620**	**23,642**	**1.7**
OECD Asia	**5,535**	**5,681**	**5,850**	**6,489**	**7,031**	**7,495**	**7,985**	**8,469**	**1.3**
Japan	3,872	3,951	4,041	4,226	4,394	4,476	4,559	4,623	0.5
South Korea	892	938	986	1,254	1,480	1,708	1,940	2,169	2.9
Australia/New Zealand	771	792	823	1,009	1,157	1,311	1,485	1,677	2.6
Total OECD	**34,345**	**35,420**	**36,361**	**40,532**	**45,933**	**51,414**	**57,215**	**63,468**	**2.0**
Non-OECD									
Non-OECD Europe and Eurasia	**2,977**	**3,218**	**3,481**	**4,193**	**4,939**	**5,731**	**6,557**	**7,440**	**2.7**
Russia	1,703	1,834	1,982	2,359	2,767	3,220	3,705	4,244	2.8
Other	1,275	1,384	1,499	1,833	2,173	2,510	2,852	3,196	2.7
Non-OECD Asia	**11,897**	**13,013**	**14,323**	**23,905**	**31,574**	**39,975**	**48,993**	**58,578**	**5.2**
China	5,408	6,035	6,820	12,647	17,204	22,250	27,375	32,493	5.7
India	2,440	2,676	2,918	4,810	6,280	7,755	9,442	11,350	5.0
Other Non-OECD Asia	4,049	4,302	4,585	6,448	8,090	9,970	12,176	14,735	4.3
Middle East	**1,985**	**2,145**	**2,261**	**3,119**	**3,818**	**4,564**	**5,435**	**6,446**	**3.8**
Africa	**2,360**	**2,494**	**2,638**	**3,615**	**4,368**	**5,175**	**6,053**	**7,037**	**3.6**
Central and South America	**3,612**	**3,822**	**4,066**	**5,323**	**6,336**	**7,481**	**8,782**	**10,253**	**3.4**
Brazil	1,534	1,595	1,685	2,350	2,877	3,505	4,250	5,126	4.1
Other Central and South America	2,079	2,227	2,381	2,973	3,459	3,976	4,531	5,126	2.8
Total Non-OECD	**22,832**	**24,692**	**26,769**	**40,154**	**51,035**	**62,926**	**75,820**	**89,753**	**4.4**
Total World	**57,177**	**60,112**	**63,130**	**80,686**	**96,968**	**114,340**	**133,034**	**153,221**	**3.2**

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

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

Sources: **History:** IHS Global Insight, *World Overview* (Lexington, MA, various issues). **Projections:** Derived from IHS Global Insight, *World Overview*, Third Quarter 2009 (Lexington, MA, September 2009); and U.S. Energy Information Administration, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), Table B4.

Table D4. World liquids consumption by region, High Oil Price case, 2005-2035
(Million barrels per day)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**25.2**	**25.0**	**25.1**	**23.8**	**23.4**	**23.8**	**24.4**	**25.1**	**0.0**
United States[a]	20.8	20.7	20.6	19.8	19.6	19.9	20.3	20.8	0.0
Canada	2.3	2.3	2.3	2.0	1.9	1.9	1.9	1.9	-0.6
Mexico	2.1	2.1	2.1	2.0	1.9	2.0	2.2	2.3	0.3
OECD Europe	**15.7**	**15.7**	**15.3**	**13.0**	**11.7**	**11.4**	**11.5**	**11.5**	**-1.0**
OECD Asia	**8.6**	**8.5**	**8.4**	**7.2**	**7.0**	**7.0**	**7.1**	**7.2**	**-0.5**
Japan	5.3	5.2	5.0	3.9	3.7	3.6	3.5	3.4	-1.4
South Korea	2.2	2.2	2.2	2.2	2.3	2.4	2.6	2.7	0.7
Australia/New Zealand	1.1	1.1	1.1	1.1	1.0	1.0	1.0	1.0	-0.2
Total OECD	**49.5**	**49.1**	**48.8**	**44.0**	**42.1**	**42.3**	**42.9**	**43.8**	**-0.4**
Non-OECD									
Non-OECD Europe and Eurasia	**4.9**	**5.0**	**5.1**	**4.6**	**4.3**	**4.3**	**4.4**	**4.5**	**-0.4**
Russia	2.8	2.9	2.9	2.6	2.4	2.4	2.4	2.5	-0.5
Other	2.1	2.2	2.2	2.0	1.9	1.9	2.0	2.1	-0.2
Non-OECD Asia	**15.4**	**16.2**	**16.8**	**18.6**	**19.7**	**22.2**	**24.8**	**27.5**	**1.8**
China	6.7	7.3	7.6	9.2	10.0	11.6	13.1	14.4	2.3
India	2.5	2.7	2.8	2.9	3.1	3.3	3.6	3.9	1.2
Other Non-OECD Asia	6.2	6.2	6.3	6.5	6.6	7.3	8.2	9.1	1.3
Middle East	**5.8**	**6.0**	**6.4**	**6.9**	**7.1**	**7.6**	**8.3**	**9.3**	**1.3**
Africa	**3.0**	**3.0**	**3.1**	**3.2**	**3.1**	**3.2**	**3.5**	**3.8**	**0.7**
Central and South America	**5.5**	**5.8**	**6.0**	**6.1**	**5.9**	**6.1**	**6.5**	**6.8**	**0.5**
Brazil	2.2	2.3	2.4	2.7	2.7	2.9	3.2	3.4	1.3
Other Central and South America	3.3	3.5	3.6	3.5	3.2	3.2	3.3	3.4	-0.2
Total Non-OECD	**34.6**	**36.1**	**37.3**	**39.4**	**40.1**	**43.4**	**47.5**	**51.8**	**1.2**
Total World	**84.0**	**85.2**	**86.1**	**83.4**	**82.1**	**85.7**	**90.4**	**95.5**	**0.4**

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

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

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HP2010.D011910A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table D5. World natural gas consumption by region, High Oil Price case, 2005-2035
(Trillion cubic feet)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**27.3**	**27.2**	**28.3**	**27.0**	**29.5**	**32.1**	**34.5**	**36.4**	**0.9**
United States[a]	22.0	21.7	23.0	21.2	22.6	24.0	25.2	26.0	0.4
Canada	3.4	3.3	2.9	3.3	3.6	3.9	4.2	4.6	1.6
Mexico	1.9	2.2	2.4	2.6	3.3	4.2	5.0	5.8	3.3
OECD Europe	**19.2**	**19.1**	**19.2**	**20.4**	**21.4**	**22.1**	**22.2**	**22.6**	**0.6**
OECD Asia	**5.3**	**5.8**	**6.3**	**7.0**	**7.6**	**8.0**	**8.2**	**8.3**	**1.0**
Japan	3.1	3.4	3.7	3.9	4.2	4.4	4.4	4.4	0.6
South Korea	1.1	1.1	1.2	1.5	1.6	1.7	1.8	1.8	1.3
Australia/New Zealand	1.1	1.2	1.3	1.6	1.8	1.9	2.0	2.2	1.8
Total OECD	**51.8**	**52.1**	**53.7**	**54.4**	**58.4**	**62.2**	**64.9**	**67.4**	**0.8**
Non-OECD									
Non-OECD Europe and Eurasia	**25.3**	**25.3**	**25.9**	**26.8**	**27.4**	**28.0**	**28.0**	**28.3**	**0.3**
Russia	16.2	16.6	16.7	16.7	16.9	17.2	17.3	17.5	0.2
Other	9.1	8.7	9.1	10.1	10.5	10.8	10.8	10.8	0.6
Non-OECD Asia	**8.5**	**9.6**	**10.5**	**17.0**	**20.9**	**23.8**	**26.1**	**28.2**	**3.6**
China	1.7	2.0	2.5	5.0	6.4	7.8	9.0	10.0	5.1
India	1.3	1.4	1.5	3.2	4.0	4.4	4.5	4.5	4.1
Other Non-OECD Asia	5.6	6.2	6.6	8.8	10.4	11.7	12.6	13.7	2.6
Middle East	**9.8**	**10.3**	**10.7**	**16.4**	**18.8**	**20.0**	**20.8**	**22.1**	**2.6**
Africa	**3.0**	**2.9**	**3.1**	**4.7**	**5.7**	**6.4**	**6.6**	**6.8**	**2.9**
Central and South America	**4.4**	**4.5**	**4.6**	**5.5**	**7.0**	**7.7**	**8.4**	**9.2**	**2.5**
Brazil	0.7	0.7	0.7	1.1	1.5	1.9	2.3	2.6	4.8
Other Central and South America	3.7	3.8	3.9	4.5	5.5	5.8	6.1	6.6	1.9
Total Non-OECD	**50.9**	**52.6**	**54.7**	**70.4**	**79.7**	**85.9**	**89.9**	**94.6**	**2.0**
Total World	**102.7**	**104.6**	**108.5**	**124.8**	**138.2**	**148.1**	**154.8**	**162.0**	**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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HP2010.D011910A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table D6. World coal consumption by region, High Oil Price case, 2005-2035
(Quadrillion Btu)

Region/Country	History 2005	History 2006	History 2007	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD									
OECD North America	**24.7**	**24.3**	**24.6**	**24.0**	**24.8**	**26.1**	**27.3**	**28.8**	**0.6**
United States[a]	22.8	22.5	22.7	22.6	23.4	24.6	25.7	26.6	0.6
Canada	1.5	1.4	1.5	1.1	1.1	1.1	1.2	1.3	-0.5
Mexico	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.9	2.9
OECD Europe	**12.7**	**13.1**	**13.2**	**11.6**	**11.3**	**11.0**	**11.1**	**11.6**	**-0.5**
OECD Asia	**9.2**	**9.3**	**10.1**	**9.2**	**9.3**	**9.7**	**10.2**	**10.8**	**0.3**
Japan	4.6	4.6	4.9	4.2	4.1	4.0	4.0	3.9	-0.8
South Korea	2.1	2.1	2.3	2.2	2.4	2.7	3.2	3.8	1.8
Australia/New Zealand	2.6	2.6	2.9	2.8	2.8	2.9	3.0	3.1	0.3
Total OECD	**46.7**	**46.7**	**47.9**	**44.8**	**45.4**	**46.8**	**48.6**	**51.2**	**0.2**
Non-OECD									
Non-OECD Europe and Eurasia	**8.4**	**8.8**	**8.7**	**8.0**	**8.0**	**8.1**	**8.9**	**10.0**	**0.5**
Russia	4.3	4.4	4.3	4.1	4.1	4.2	4.8	5.6	1.0
Other	4.1	4.4	4.4	3.9	3.9	3.9	4.1	4.4	0.0
Non-OECD Asia	**61.9**	**65.4**	**70.3**	**81.2**	**94.4**	**109.3**	**125.7**	**142.9**	**2.6**
China	48.3	51.0	54.8	65.1	76.6	88.9	101.3	113.4	2.6
India	8.6	9.2	10.2	10.5	11.7	12.7	14.1	16.0	1.6
Other Non-OECD Asia	4.9	5.1	5.4	5.5	6.2	7.7	10.3	13.5	3.3
Middle East	**0.4**	**0.4**	**0.4**	**0.4**	**0.3**	**0.3**	**0.4**	**0.5**	**0.9**
Africa	**4.2**	**4.2**	**4.2**	**4.2**	**4.4**	**4.9**	**5.6**	**6.7**	**1.6**
Central and South America	**0.8**	**0.9**	**0.9**	**0.9**	**1.0**	**1.2**	**1.4**	**1.7**	**2.3**
Brazil	0.4	0.4	0.5	0.5	0.6	0.8	1.0	1.2	3.5
Other Central and South America	0.4	0.4	0.5	0.4	0.4	0.4	0.4	0.5	0.3
Total Non-OECD	**75.7**	**79.7**	**84.6**	**94.6**	**108.2**	**123.8**	**141.9**	**161.9**	**2.3**
Total World	**122.3**	**126.4**	**132.4**	**139.5**	**153.6**	**170.7**	**190.5**	**213.0**	**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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HP2010.D011910A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table D7. World nuclear energy consumption by region, High Oil Price case, 2005-2035
(Billion kilowatthours)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**880**	**891**	**905**	**958**	**1,020**	**1,031**	**1,046**	**1,077**	**0.6**
United States[a]	782	787	806	834	883	886	886	900	0.4
Canada	87	93	89	113	127	134	142	158	2.1
Mexico	10	10	10	11	11	11	18	18	2.2
OECD Europe	**932**	**929**	**879**	**935**	**967**	**1,011**	**1,055**	**1,084**	**0.8**
OECD Asia	**429**	**430**	**386**	**494**	**560**	**591**	**641**	**683**	**2.1**
Japan	290	288	251	319	342	358	388	417	1.8
South Korea	139	141	136	175	218	233	254	266	2.4
Australia/New Zealand	0	0	0	0	0	0	0	0	—
Total OECD	**2,240**	**2,250**	**2,171**	**2,387**	**2,548**	**2,634**	**2,742**	**2,844**	**1.0**
Non-OECD									
Non-OECD Europe and Eurasia	**264**	**269**	**273**	**342**	**425**	**512**	**545**	**588**	**2.8**
Russia	140	144	148	197	258	324	345	364	3.3
Other	124	124	125	145	167	188	200	224	2.1
Non-OECD Asia	**106**	**111**	**119**	**312**	**543**	**698**	**814**	**942**	**7.7**
China	50	55	63	186	335	437	512	598	8.4
India	16	16	16	66	119	156	179	203	9.5
Other Non-OECD Asia	40	40	41	61	89	105	123	141	4.5
Middle East	**0**	**0**	**0**	**6**	**20**	**29**	**39**	**49**	**—**
Africa	**12**	**10**	**12**	**15**	**15**	**21**	**21**	**31**	**3.5**
Central and South America	**16**	**21**	**19**	**28**	**34**	**43**	**43**	**62**	**4.3**
Brazil	10	14	12	18	22	31	31	41	4.4
Other Central and South America	6	7	7	10	12	12	12	21	4.2
Total Non-OECD	**399**	**411**	**423**	**704**	**1,038**	**1,303**	**1,462**	**1,672**	**5.0**
Total World	**2,639**	**2,660**	**2,593**	**3,091**	**3,586**	**3,937**	**4,204**	**4,516**	**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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HP2010.D011910A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table D8. World consumption of hydroelectricity and other renewable energy by region, High Oil Price case, 2005-2035
(Quadrillion Btu)

Region/Country	History 2005	History 2006	History 2007	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD									
OECD North America	**10.9**	**11.1**	**11.0**	**14.7**	**16.2**	**18.2**	**20.2**	**21.5**	**2.4**
United States[a]	6.1	6.4	6.2	9.4	10.2	11.8	13.3	14.0	2.9
Canada	4.2	4.1	4.2	4.6	5.1	5.5	5.8	6.2	1.4
Mexico	0.6	0.6	0.5	0.8	0.9	1.0	1.1	1.3	3.1
OECD Europe	**7.9**	**8.1**	**8.7**	**10.9**	**12.4**	**13.8**	**14.6**	**15.2**	**2.0**
OECD Asia	**2.1**	**2.2**	**2.1**	**2.7**	**3.0**	**3.2**	**3.3**	**3.5**	**1.8**
Japan	1.3	1.4	1.3	1.3	1.5	1.6	1.6	1.7	0.9
South Korea	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	3.1
Australia/New Zealand	0.7	0.7	0.7	1.2	1.3	1.4	1.5	1.5	2.9
Total OECD	**20.9**	**21.4**	**21.7**	**28.2**	**31.6**	**35.2**	**38.2**	**40.2**	**2.2**
Non-OECD									
Non-OECD Europe and Eurasia	**3.2**	**3.2**	**3.1**	**3.3**	**3.6**	**3.8**	**4.2**	**4.6**	**1.4**
Russia	1.9	1.9	1.9	2.0	2.2	2.4	2.6	2.8	1.5
Other	1.4	1.3	1.2	1.4	1.4	1.5	1.6	1.7	1.3
Non-OECD Asia	**9.3**	**9.9**	**10.2**	**16.2**	**20.4**	**24.2**	**28.6**	**32.7**	**4.2**
China	4.1	4.5	4.5	8.7	11.2	13.8	16.4	18.6	5.2
India	2.3	2.4	2.5	3.2	4.0	4.5	5.1	5.8	3.0
Other Non-OECD Asia	2.9	3.0	3.1	4.3	5.2	5.9	7.0	8.3	3.5
Middle East	**0.3**	**0.3**	**0.3**	**0.4**	**0.5**	**0.6**	**0.6**	**0.7**	**3.2**
Africa	**3.6**	**3.6**	**3.7**	**4.1**	**4.4**	**4.9**	**5.3**	**5.9**	**1.6**
Central and South America	**9.0**	**9.4**	**9.8**	**11.3**	**13.0**	**14.6**	**16.6**	**18.3**	**2.3**
Brazil	5.5	5.7	6.2	7.2	8.4	9.7	11.1	12.3	2.5
Other Central and South America	3.5	3.7	3.6	4.1	4.6	5.0	5.5	6.0	1.8
Total Non-OECD	**25.3**	**26.5**	**27.1**	**35.5**	**41.9**	**48.1**	**55.3**	**62.1**	**3.0**
Total World	**46.2**	**47.9**	**48.8**	**63.7**	**73.5**	**83.4**	**93.5**	**102.3**	**2.7**

[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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, "Balances of OECD and Non-OECD Statistics" (2009), web site www.iea.org (subscription site). **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HP2010.D011910A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table D9. World carbon dioxide emissions by region, High Oil Price case, 2005-2035
(Million metric tons carbon dioxide)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**7,012**	**6,915**	**7,017**	**6,609**	**6,679**	**6,910**	**7,161**	**7,453**	**0.2**
United States[a]	5,974	5,894	5,986	5,642	5,684	5,829	5,980	6,134	0.1
Canada	628	596	586	533	525	548	579	614	0.2
Mexico	410	426	444	434	470	533	602	705	1.7
OECD Europe	**4,398**	**4,426**	**4,386**	**3,985**	**3,829**	**3,811**	**3,829**	**3,903**	**-0.4**
OECD Asia	**2,203**	**2,197**	**2,273**	**2,093**	**2,111**	**2,169**	**2,231**	**2,310**	**0.1**
Japan	1,254	1,253	1,262	1,070	1,065	1,054	1,036	1,020	-0.8
South Korea	496	486	516	520	546	603	665	739	1.3
Australia/New Zealand	453	457	495	503	501	512	529	551	0.4
Total OECD	**13,613**	**13,538**	**13,676**	**12,687**	**12,619**	**12,890**	**13,220**	**13,666**	**0.0**
Non-OECD									
Non-OECD Europe and Eurasia	**2,842**	**2,876**	**2,897**	**2,834**	**2,828**	**2,873**	**2,957**	**3,096**	**0.2**
Russia	1,650	1,672	1,663	1,620	1,607	1,624	1,680	1,783	0.2
Other	1,193	1,204	1,233	1,214	1,221	1,249	1,277	1,313	0.2
Non-OECD Asia	**8,382**	**8,831**	**9,425**	**11,035**	**12,644**	**14,538**	**16,552**	**18,635**	**2.5**
China	5,558	5,862	6,284	7,609	8,873	10,309	11,742	13,123	2.7
India	1,187	1,287	1,399	1,537	1,708	1,861	2,036	2,254	1.7
Other Non-OECD Asia	1,637	1,681	1,743	1,889	2,062	2,369	2,774	3,257	2.3
Middle East	**1,395**	**1,446**	**1,515**	**1,904**	**2,066**	**2,204**	**2,349**	**2,563**	**1.9**
Africa	**982**	**988**	**1,011**	**1,114**	**1,172**	**1,276**	**1,392**	**1,542**	**1.5**
Central and South America	**1,092**	**1,133**	**1,169**	**1,244**	**1,297**	**1,382**	**1,489**	**1,609**	**1.1**
Brazil	366	380	394	453	492	553	631	708	2.1
Other Central and South America	726	753	775	791	805	828	858	901	0.5
Total Non-OECD	**14,693**	**15,274**	**16,017**	**18,132**	**20,007**	**22,273**	**24,739**	**27,444**	**1.9**
Total World	**28,306**	**28,812**	**29,694**	**30,819**	**32,626**	**35,162**	**37,959**	**41,111**	**1.2**

[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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HP2010.D011910A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table D10. World carbon dioxide emissions from liquids use by region, High Oil Price case, 2005-2035
(Million metric tons carbon dioxide)

Region/Country	History 2005	History 2006	History 2007	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD									
OECD North America	**3,194**	**3,142**	**3,150**	**2,850**	**2,741**	**2,721**	**2,755**	**2,826**	**-0.4**
United States[a]	2,626	2,595	2,589	2,340	2,261	2,230	2,244	2,288	-0.4
Canada	301	281	288	256	232	232	237	243	-0.6
Mexico	267	265	273	254	248	259	275	295	0.3
OECD Europe	**2,133**	**2,125**	**2,082**	**1,765**	**1,583**	**1,552**	**1,557**	**1,560**	**-1.0**
OECD Asia	**1,031**	**991**	**980**	**838**	**813**	**816**	**822**	**830**	**-0.6**
Japan	646	622	603	464	448	435	422	410	-1.4
South Korea	239	221	227	227	230	245	262	280	0.7
Australia/New Zealand	147	148	150	147	136	136	138	141	-0.2
Total OECD	**6,358**	**6,258**	**6,212**	**5,453**	**5,137**	**5,089**	**5,135**	**5,217**	**-0.6**
Non-OECD									
Non-OECD Europe and Eurasia	**686**	**677**	**682**	**636**	**596**	**597**	**609**	**630**	**-0.3**
Russia	383	368	366	349	324	317	318	331	-0.4
Other	303	310	316	287	273	279	290	299	-0.2
Non-OECD Asia	**2,081**	**2,147**	**2,225**	**2,463**	**2,612**	**2,936**	**3,288**	**3,634**	**1.8**
China	889	928	969	1,177	1,283	1,481	1,674	1,849	2.3
India	314	349	369	382	400	430	469	509	1.2
Other Non-OECD Asia	878	870	887	903	929	1,025	1,145	1,276	1.3
Middle East	**817**	**839**	**886**	**959**	**987**	**1,060**	**1,156**	**1,286**	**1.3**
Africa	**423**	**428**	**441**	**456**	**434**	**457**	**491**	**529**	**0.7**
Central and South America	**762**	**796**	**823**	**845**	**807**	**836**	**886**	**928**	**0.4**
Brazil	288	301	311	349	350	378	415	450	1.3
Other Central and South America	474	495	512	496	456	459	470	478	-0.2
Total Non-OECD	**4,768**	**4,888**	**5,057**	**5,358**	**5,436**	**5,886**	**6,430**	**7,006**	**1.2**
Total World	**11,126**	**11,146**	**11,268**	**10,811**	**10,573**	**10,975**	**11,565**	**12,222**	**0.3**

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

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HP2010.D011910A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table D11. World carbon dioxide emissions from natural gas use by region, High Oil Price case, 2005-2035
(Million metric tons carbon dioxide)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**1,468**	**1,463**	**1,524**	**1,466**	**1,585**	**1,711**	**1,811**	**1,901**	**0.8**
United States[a]	1,176	1,157	1,232	1,143	1,203	1,260	1,299	1,323	0.3
Canada	186	181	157	178	195	214	231	248	1.6
Mexico	106	125	135	146	187	236	281	330	3.3
OECD Europe	**1,048**	**1,045**	**1,049**	**1,119**	**1,172**	**1,208**	**1,217**	**1,239**	**0.6**
OECD Asia	**311**	**336**	**355**	**393**	**426**	**451**	**461**	**470**	**1.0**
Japan	183	202	208	215	234	245	247	246	0.6
South Korea	64	68	73	87	95	103	104	105	1.3
Australia/New Zealand	65	66	73	91	97	103	110	119	1.8
Total OECD	**2,827**	**2,843**	**2,928**	**2,977**	**3,183**	**3,370**	**3,490**	**3,610**	**0.8**
Non-OECD									
Non-OECD Europe and Eurasia	**1,367**	**1,367**	**1,397**	**1,451**	**1,485**	**1,517**	**1,521**	**1,532**	**0.3**
Russia	865	889	897	893	902	916	922	933	0.1
Other	502	478	500	559	583	601	599	599	0.6
Non-OECD Asia	**459**	**518**	**572**	**924**	**1,137**	**1,299**	**1,423**	**1,537**	**3.6**
China	92	111	138	277	356	431	500	555	5.1
India	70	75	80	173	220	240	245	248	4.1
Other Non-OECD Asia	297	332	354	473	561	629	678	734	2.6
Middle East	**543**	**571**	**594**	**912**	**1,047**	**1,112**	**1,159**	**1,232**	**2.6**
Africa	**169**	**166**	**176**	**270**	**325**	**367**	**376**	**390**	**2.9**
Central and South America	**250**	**256**	**259**	**313**	**394**	**435**	**472**	**518**	**2.5**
Brazil	36	38	39	58	84	104	125	142	4.8
Other Central and South America	214	218	220	255	310	331	347	376	1.9
Total Non-OECD	**2,788**	**2,877**	**2,997**	**3,870**	**4,388**	**4,730**	**4,951**	**5,210**	**2.0**
Total World	**5,614**	**5,720**	**5,925**	**6,848**	**7,571**	**8,101**	**8,441**	**8,820**	**1.4**

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

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HP2010.D011910A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table D12. World carbon dioxide emissions from coal use by region, High Oil Price case, 2005-2035
(Million metric tons carbon dioxide)

Region/Country	History 2005	History 2006	History 2007	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD									
OECD North America	**2,339**	**2,299**	**2,331**	**2,282**	**2,341**	**2,467**	**2,582**	**2,714**	**0.5**
United States[a]	2,161	2,130	2,155	2,148	2,208	2,328	2,426	2,511	0.5
Canada	142	133	141	100	99	102	111	123	-0.5
Mexico	36	36	36	34	35	37	46	81	2.9
OECD Europe	**1,217**	**1,256**	**1,256**	**1,102**	**1,075**	**1,050**	**1,054**	**1,103**	**-0.5**
OECD Asia	**861**	**870**	**938**	**862**	**871**	**902**	**947**	**1,010**	**0.3**
Japan	425	429	451	390	383	374	367	365	-0.8
South Korea	193	197	216	206	220	255	300	354	1.8
Australia/New Zealand	242	244	271	265	267	273	281	291	0.3
Total OECD	**4,417**	**4,425**	**4,525**	**4,245**	**4,287**	**4,419**	**4,584**	**4,828**	**0.2**
Non-OECD									
Non-OECD Europe and Eurasia	**790**	**832**	**819**	**747**	**746**	**759**	**827**	**935**	**0.5**
Russia	402	416	401	378	381	391	440	519	0.9
Other	388	417	417	369	366	368	388	416	0.0
Non-OECD Asia	**5,843**	**6,165**	**6,629**	**7,649**	**8,895**	**10,303**	**11,841**	**13,463**	**2.6**
China	4,578	4,824	5,177	6,155	7,234	8,397	9,569	10,719	2.6
India	803	863	950	982	1,089	1,191	1,322	1,497	1.6
Other Non-OECD Asia	461	479	502	512	573	715	950	1,247	3.3
Middle East	**36**	**36**	**35**	**33**	**32**	**32**	**33**	**45**	**0.9**
Africa	**390**	**394**	**395**	**389**	**413**	**453**	**525**	**623**	**1.6**
Central and South America	**80**	**81**	**87**	**86**	**97**	**110**	**131**	**163**	**2.3**
Brazil	42	41	44	46	57	72	90	116	3.5
Other Central and South America	38	40	43	40	39	39	41	47	0.3
Total Non-OECD	**7,138**	**7,509**	**7,964**	**8,904**	**10,183**	**11,656**	**13,358**	**15,229**	**2.3**
Total World	**11,555**	**11,934**	**12,489**	**13,149**	**14,470**	**16,075**	**17,941**	**20,057**	**1.7**

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

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HP2010.D011910A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

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Appendix E

Low Oil Price Case Projections:

- World energy consumption
- Gross domestic product
- Carbon dioxide emissions

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Table E1. World total energy consumption by region, Low Oil Price case, 2005-2035
(Quadrillion Btu)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**122.4**	**121.8**	**123.7**	**126.8**	**133.0**	**138.2**	**144.0**	**150.3**	**0.7**
United States[a]	100.5	99.8	101.7	103.8	108.1	111.2	114.7	118.2	0.5
Canada	14.8	14.5	14.3	14.9	15.7	16.6	17.5	18.6	1.0
Mexico	7.1	7.4	7.7	8.2	9.1	10.4	11.8	13.6	2.1
OECD Europe	**82.4**	**82.9**	**82.3**	**83.7**	**85.4**	**87.5**	**89.0**	**90.6**	**0.3**
OECD Asia	**39.0**	**39.5**	**39.7**	**40.6**	**43.2**	**44.7**	**46.2**	**47.8**	**0.7**
Japan	23.1	23.3	22.8	21.5	22.6	22.8	22.9	22.9	0.0
South Korea	9.3	9.4	9.7	10.9	12.2	13.2	14.3	15.5	1.7
Australia/New Zealand	6.6	6.7	7.2	8.2	8.4	8.7	9.0	9.4	0.9
Total OECD	**243.8**	**244.1**	**245.7**	**251.2**	**261.6**	**270.4**	**279.2**	**288.7**	**0.6**
Non-OECD									
Non-OECD Europe and Eurasia	**50.4**	**51.0**	**51.5**	**53.0**	**55.1**	**57.1**	**58.8**	**61.2**	**0.6**
Russia	29.7	30.5	30.5	31.0	32.1	33.3	34.3	35.9	0.6
Other	20.7	20.6	21.0	22.0	23.0	23.8	24.5	25.3	0.7
Non-OECD Asia	**112.6**	**119.6**	**127.1**	**162.1**	**192.2**	**221.7**	**251.7**	**282.2**	**2.9**
China	68.4	73.0	78.0	102.9	123.8	144.9	165.4	184.5	3.1
India	17.5	18.8	20.3	24.7	28.9	31.9	35.0	38.5	2.3
Other Non-OECD Asia	26.7	27.8	28.8	34.5	39.4	44.8	51.4	59.1	2.6
Middle East	**22.8**	**23.9**	**25.1**	**33.2**	**36.9**	**39.3**	**41.8**	**45.4**	**2.1**
Africa	**17.2**	**17.3**	**17.8**	**21.5**	**23.4**	**25.5**	**27.4**	**29.9**	**1.9**
Central and South America	**26.0**	**27.1**	**28.0**	**33.2**	**37.0**	**40.2**	**43.7**	**47.2**	**1.9**
Brazil	11.2	11.7	12.3	15.3	17.5	20.0	22.6	24.9	2.5
Other Central and South America	14.8	15.4	15.7	17.9	19.4	20.2	21.1	22.2	1.3
Total Non-OECD	**229.0**	**239.0**	**249.5**	**302.9**	**344.5**	**383.8**	**423.4**	**466.0**	**2.3**
Total World	**472.7**	**483.1**	**495.2**	**554.1**	**606.1**	**654.2**	**702.6**	**754.7**	**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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, "Balances of OECD and Non-OECD Statistics" (2009), web site www.iea.org (subscription site). **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LP2010.D011910A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table E2. World total energy consumption by region and fuel, Low Oil Price case, 2005-2035
(Quadrillion Btu)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America									
Liquids	49.5	49.0	49.4	50.0	51.8	53.7	56.2	59.0	0.6
Natural gas	28.1	28.1	29.2	29.0	30.6	32.1	34.2	36.1	0.8
Coal	24.7	24.3	24.6	23.5	24.3	24.8	25.1	25.8	0.2
Nuclear	9.2	9.4	9.6	10.1	10.8	10.9	11.0	11.2	0.6
Other	10.9	11.1	11.0	14.2	15.6	16.8	17.4	18.3	1.9
Total	**122.4**	**121.8**	**123.7**	**126.8**	**133.0**	**138.2**	**144.0**	**150.3**	**0.7**
OECD Europe									
Liquids	32.3	32.4	31.6	31.0	30.4	30.5	31.0	31.5	0.0
Natural gas	19.7	19.7	19.8	20.5	21.5	21.9	21.9	22.1	0.4
Coal	12.7	13.1	13.2	11.5	11.1	10.8	10.6	10.7	-0.7
Nuclear	9.7	9.6	9.1	9.7	10.0	10.5	10.9	11.2	0.8
Other	7.9	8.1	8.7	11.2	12.4	13.8	14.5	15.1	2.0
Total	**82.4**	**82.9**	**82.3**	**83.7**	**85.4**	**87.5**	**89.0**	**90.6**	**0.3**
OECD Asia									
Liquids	17.5	17.2	16.9	16.6	17.6	18.0	18.4	18.8	0.4
Natural gas	5.9	6.3	6.7	7.4	7.8	8.2	8.3	8.4	0.8
Coal	9.2	9.3	10.1	9.1	9.1	9.3	9.6	10.1	0.0
Nuclear	4.3	4.3	3.9	5.0	5.7	6.0	6.5	7.0	2.1
Other	2.1	2.2	2.1	2.6	3.0	3.2	3.3	3.4	1.7
Total	**39.0**	**39.5**	**39.7**	**40.6**	**43.2**	**44.7**	**46.2**	**47.8**	**0.7**
Total OECD									
Liquids	99.3	98.6	97.9	97.6	99.8	102.2	105.6	109.3	0.4
Natural gas	53.7	54.1	55.6	56.9	59.8	62.2	64.5	66.6	0.6
Coal	46.7	46.7	47.9	44.0	44.6	44.9	45.4	46.6	-0.1
Nuclear	23.2	23.3	22.6	24.8	26.5	27.4	28.5	29.4	0.9
Other	20.9	21.4	21.7	27.9	31.0	33.7	35.2	36.8	1.9
Total	**243.8**	**244.1**	**245.7**	**251.2**	**261.6**	**270.4**	**279.2**	**288.7**	**0.6**
Non-OECD									
Non-OECD Europe and Eurasia									
Liquids	10.1	10.3	10.4	10.8	11.1	11.5	12.1	12.8	0.7
Natural gas	25.8	25.8	26.3	27.2	27.9	28.4	28.5	28.6	0.3
Coal	8.4	8.8	8.7	7.9	7.9	7.9	8.3	9.0	0.1
Nuclear	2.9	2.9	3.0	3.7	4.6	5.5	5.8	6.3	2.7
Other	3.2	3.2	3.1	3.3	3.6	3.8	4.1	4.5	1.4
Total	**50.4**	**51.0**	**51.5**	**53.0**	**55.1**	**57.1**	**58.8**	**61.2**	**0.6**
Non-OECD Asia									
Liquids	31.7	33.4	34.6	44.9	52.5	60.1	68.0	75.7	2.8
Natural gas	8.6	9.8	10.8	16.9	20.5	23.4	25.5	27.2	3.4
Coal	61.9	65.4	70.3	80.9	93.2	106.9	121.5	137.2	2.4
Nuclear	1.1	1.1	1.2	3.2	5.6	7.2	8.5	9.8	7.7
Other	9.3	9.9	10.2	16.2	20.4	24.1	28.4	32.4	4.2
Total	**112.6**	**119.6**	**127.1**	**162.1**	**192.2**	**221.7**	**251.7**	**282.2**	**2.9**

See notes at end of table.

Table E2. World total energy consumption by region and fuel, Low Oil Price case, 2005-2035 (continued)
(Quadrillion Btu)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
Non-OECD (continued)									
Middle East									
Liquids	12.0	12.5	13.3	15.3	16.6	18.2	20.4	23.2	2.0
Natural gas	10.2	10.8	11.2	17.0	19.2	19.9	20.1	20.7	2.2
Coal	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	-0.3
Nuclear	0.0	0.0	0.0	0.1	0.2	0.3	0.4	0.5	—
Other	0.3	0.3	0.3	0.4	0.5	0.5	0.6	0.6	3.1
Total	**22.8**	**23.9**	**25.1**	**33.2**	**36.9**	**39.3**	**41.8**	**45.4**	**2.1**
Africa									
Liquids	6.1	6.2	6.4	7.7	8.2	8.8	9.6	10.5	1.8
Natural gas	3.2	3.1	3.3	5.2	6.2	7.0	7.2	7.5	2.9
Coal	4.2	4.2	4.2	4.1	4.3	4.6	5.1	6.0	1.2
Nuclear	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	3.6
Other	3.6	3.6	3.7	4.2	4.5	4.9	5.3	5.7	1.5
Total	**17.2**	**17.3**	**17.8**	**21.5**	**23.4**	**25.5**	**27.4**	**29.9**	**1.9**
Central and South America									
Liquids	11.3	11.8	12.2	14.2	14.7	15.5	16.5	17.5	1.3
Natural gas	4.7	4.8	4.9	6.3	7.8	8.4	8.9	9.5	2.4
Coal	0.8	0.9	0.9	0.9	1.0	1.2	1.4	1.6	2.0
Nuclear	0.2	0.2	0.2	0.3	0.4	0.5	0.5	0.7	4.2
Other	9.0	9.4	9.8	11.5	13.1	14.7	16.5	17.9	2.2
Total	**26.0**	**27.1**	**28.0**	**33.2**	**37.0**	**40.2**	**43.7**	**47.2**	**1.9**
Total Non-OECD									
Liquids	71.1	74.2	76.8	92.9	103.0	114.1	126.6	139.6	2.2
Natural gas	52.5	54.2	56.5	72.5	81.6	87.0	90.1	93.6	1.8
Coal	75.7	79.7	84.6	94.2	106.8	120.8	136.6	154.2	2.2
Nuclear	4.3	4.4	4.5	7.5	10.9	13.7	15.4	17.5	4.9
Other	25.3	26.5	27.1	35.7	42.1	48.1	54.8	61.1	2.9
Total	**229.0**	**239.0**	**249.5**	**302.9**	**344.5**	**383.8**	**423.4**	**466.0**	**2.3**
Total World									
Liquids	170.4	172.8	174.7	190.5	202.8	216.3	232.2	248.9	1.3
Natural gas	106.3	108.3	112.1	129.4	141.5	149.2	154.5	160.2	1.3
Coal	122.3	126.4	132.4	138.3	151.4	165.8	181.9	200.8	1.5
Nuclear	27.5	27.8	27.1	32.2	37.4	41.1	43.9	46.9	2.0
Other	46.2	47.9	48.8	63.7	73.0	81.8	90.1	98.0	2.5
Total	**472.7**	**483.1**	**495.2**	**554.1**	**606.1**	**654.2**	**702.6**	**754.7**	**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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, "Balances of OECD and Non-OECD Statistics" (2009), web site www.iea.org (subscription site). **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LP2010.D011910A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table E3. World gross domestic product (GDP) by region expressed in purchasing power parity, Low Oil Price case, 2005-2035
(Billion 2005 dollars)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**14,883**	**15,327**	**15,662**	**18,247**	**21,093**	**24,108**	**27,492**	**31,159**	**2.5**
United States[a]	12,422	12,768	13,027	15,180	17,486	19,873	22,504	25,273	2.4
Canada	1,167	1,200	1,231	1,436	1,606	1,779	1,975	2,192	2.1
Mexico	1,293	1,359	1,405	1,632	2,001	2,456	3,012	3,694	3.5
OECD Europe	**13,928**	**14,412**	**14,849**	**16,310**	**18,166**	**20,014**	**21,944**	**23,996**	**1.7**
OECD Asia	**5,535**	**5,681**	**5,850**	**6,576**	**7,145**	**7,619**	**8,113**	**8,602**	**1.4**
Japan	3,872	3,951	4,041	4,293	4,480	4,565	4,649	4,713	0.6
South Korea	892	938	986	1,274	1,509	1,742	1,979	2,212	2.9
Australia/New Zealand	771	792	823	1,009	1,157	1,311	1,485	1,677	2.6
Total OECD	**34,345**	**35,420**	**36,361**	**41,133**	**46,404**	**51,740**	**57,549**	**63,758**	**2.0**
Non-OECD									
Non-OECD Europe and Eurasia	**2,977**	**3,218**	**3,481**	**4,193**	**4,940**	**5,732**	**6,557**	**7,440**	**2.7**
Russia	1,703	1,834	1,982	2,337	2,736	3,183	3,663	4,196	2.7
Other	1,275	1,384	1,499	1,856	2,205	2,548	2,895	3,244	2.8
Non-OECD Asia	**11,897**	**13,013**	**14,323**	**24,219**	**32,084**	**40,639**	**49,793**	**59,533**	**5.2**
China	5,408	6,035	6,820	12,824	17,499	22,642	27,850	33,056	5.8
India	2,440	2,676	2,918	4,887	6,403	7,910	9,628	11,573	5.0
Other Non-OECD Asia	4,049	4,302	4,585	6,508	8,182	10,087	12,316	14,905	4.3
Middle East	**1,985**	**2,145**	**2,261**	**3,019**	**3,669**	**4,381**	**5,221**	**6,192**	**3.7**
Africa	**2,360**	**2,494**	**2,638**	**3,666**	**4,443**	**5,266**	**6,158**	**7,159**	**3.6**
Central and South America	**3,612**	**3,822**	**4,066**	**5,365**	**6,396**	**7,551**	**8,860**	**10,341**	**3.4**
Brazil	1,534	1,595	1,685	2,350	2,877	3,505	4,250	5,126	4.1
Other Central and South America	2,079	2,227	2,381	3,015	3,518	4,046	4,610	5,215	2.8
Total Non-OECD	**22,832**	**24,692**	**26,769**	**40,461**	**51,532**	**63,570**	**76,590**	**90,665**	**4.5**
Total World	**57,177**	**60,112**	**63,130**	**81,595**	**97,936**	**115,310**	**134,139**	**154,423**	**3.2**

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

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

Sources: **History:** IHS Global Insight *World Overview* (Lexington, MA, various issues). **Projections:** Derived from IHS Global Insight, *World Overview*, Third Quarter 2009 (Lexington, MA, September 2009); and U.S. Energy Information Administration, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), Table B4.

Table E4. World liquids consumption by region, Low Oil Price case, 2005-2035
(Million barrels per day)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**25.2**	**25.0**	**25.1**	**25.8**	**26.7**	**27.7**	**28.9**	**30.3**	**0.7**
United States[a]	20.8	20.7	20.6	21.2	21.9	22.7	23.6	24.5	0.6
Canada	2.3	2.3	2.3	2.4	2.4	2.5	2.6	2.7	0.5
Mexico	2.1	2.1	2.1	2.2	2.4	2.5	2.8	3.1	1.3
OECD Europe	**15.7**	**15.7**	**15.3**	**15.0**	**14.8**	**14.8**	**15.0**	**15.3**	**0.0**
OECD Asia	**8.6**	**8.5**	**8.4**	**8.2**	**8.7**	**8.9**	**9.1**	**9.3**	**0.4**
Japan	5.3	5.2	5.0	4.5	4.8	4.7	4.7	4.6	-0.3
South Korea	2.2	2.2	2.2	2.5	2.8	3.0	3.2	3.4	1.5
Australia/New Zealand	1.1	1.1	1.1	1.2	1.2	1.2	1.3	1.3	0.6
Total OECD	**49.5**	**49.1**	**48.8**	**49.0**	**50.1**	**51.4**	**53.1**	**54.9**	**0.4**
Non-OECD									
Non-OECD Europe and Eurasia	**4.9**	**5.0**	**5.1**	**5.3**	**5.4**	**5.6**	**5.9**	**6.2**	**0.7**
Russia	2.8	2.9	2.9	2.9	2.9	3.0	3.0	3.2	0.4
Other	2.1	2.2	2.2	2.3	2.5	2.7	2.9	3.0	1.2
Non-OECD Asia	**15.4**	**16.2**	**16.8**	**21.8**	**25.5**	**29.2**	**33.0**	**36.7**	**2.8**
China	6.7	7.3	7.6	10.9	13.2	15.5	17.6	19.5	3.4
India	2.5	2.7	2.8	3.5	4.0	4.4	4.8	5.2	2.2
Other Non-OECD Asia	6.2	6.2	6.3	7.4	8.3	9.3	10.6	12.0	2.3
Middle East	**5.8**	**6.0**	**6.4**	**7.4**	**8.0**	**8.8**	**9.8**	**11.2**	**2.0**
Africa	**3.0**	**3.0**	**3.1**	**3.8**	**4.0**	**4.3**	**4.7**	**5.1**	**1.8**
Central and South America	**5.5**	**5.8**	**6.0**	**6.9**	**7.2**	**7.6**	**8.1**	**8.5**	**1.3**
Brazil	2.2	2.3	2.4	3.0	3.2	3.5	3.9	4.3	2.1
Other Central and South America	3.3	3.5	3.6	3.9	3.9	4.0	4.2	4.3	0.6
Total Non-OECD	**34.6**	**36.1**	**37.3**	**45.2**	**50.1**	**55.4**	**61.5**	**67.8**	**2.2**
Total World	**84.0**	**85.2**	**86.1**	**94.2**	**100.2**	**106.8**	**114.6**	**122.7**	**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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LP2010.D011910A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table E5. World natural gas consumption by region, Low Oil Price case, 2005-2035
(Trillion cubic feet)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**27.3**	**27.2**	**28.3**	**28.1**	**29.6**	**31.0**	**33.1**	**34.9**	**0.8**
United States[a]	22.0	21.7	23.0	22.6	23.2	23.6	24.8	25.5	0.4
Canada	3.4	3.3	2.9	3.1	3.3	3.6	3.9	4.1	1.3
Mexico	1.9	2.2	2.4	2.5	3.1	3.8	4.5	5.3	2.9
OECD Europe	**19.2**	**19.1**	**19.2**	**19.8**	**20.8**	**21.2**	**21.2**	**21.4**	**0.4**
OECD Asia	**5.3**	**5.8**	**6.3**	**6.9**	**7.3**	**7.7**	**7.8**	**7.9**	**0.8**
Japan	3.1	3.4	3.7	3.8	3.9	4.0	4.0	3.9	0.2
South Korea	1.1	1.1	1.2	1.5	1.6	1.8	1.8	1.8	1.5
Australia/New Zealand	1.1	1.2	1.3	1.7	1.8	1.9	2.0	2.1	1.7
Total OECD	**51.8**	**52.1**	**53.7**	**54.9**	**57.7**	**60.0**	**62.2**	**64.2**	**0.6**
Non-OECD									
Non-OECD Europe and Eurasia	**25.3**	**25.3**	**25.9**	**26.7**	**27.4**	**27.9**	**27.9**	**28.1**	**0.3**
Russia	16.2	16.6	16.7	16.7	16.9	17.2	17.3	17.5	0.2
Other	9.1	8.7	9.1	10.0	10.4	10.7	10.6	10.6	0.5
Non-OECD Asia	**8.5**	**9.6**	**10.5**	**16.4**	**19.9**	**22.7**	**24.8**	**26.5**	**3.3**
China	1.7	2.0	2.5	4.8	6.0	7.2	8.4	9.2	4.8
India	1.3	1.4	1.5	3.1	3.9	4.3	4.4	4.5	4.1
Other Non-OECD Asia	5.6	6.2	6.6	8.6	10.0	11.2	12.0	12.8	2.4
Middle East	**9.8**	**10.3**	**10.7**	**16.2**	**18.3**	**19.0**	**19.1**	**19.8**	**2.2**
Africa	**3.0**	**2.9**	**3.1**	**4.9**	**5.8**	**6.5**	**6.7**	**6.9**	**2.9**
Central and South America	**4.4**	**4.5**	**4.6**	**5.9**	**7.4**	**7.9**	**8.3**	**9.0**	**2.4**
Brazil	0.7	0.7	0.7	1.1	1.6	1.8	2.1	2.4	4.5
Other Central and South America	3.7	3.8	3.9	4.8	5.8	6.1	6.2	6.6	1.9
Total Non-OECD	**50.9**	**52.6**	**54.7**	**70.0**	**78.8**	**84.0**	**86.9**	**90.3**	**1.8**
Total World	**102.7**	**104.6**	**108.5**	**125.0**	**136.5**	**144.0**	**149.1**	**154.5**	**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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LP2010.D011910A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table E6. World coal consumption by region, Low Oil Price case, 2005-2035
(Quadrillion Btu)

Region/Country	History 2005	History 2006	History 2007	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD									
OECD North America	**24.7**	**24.3**	**24.6**	**23.5**	**24.3**	**24.8**	**25.1**	**25.8**	**0.2**
United States[a]	22.8	22.5	22.7	22.1	22.9	23.4	23.6	24.1	0.2
Canada	1.5	1.4	1.5	1.1	1.0	1.0	1.1	1.1	-1.0
Mexico	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.6	1.3
OECD Europe	**12.7**	**13.1**	**13.2**	**11.5**	**11.1**	**10.8**	**10.6**	**10.7**	**-0.7**
OECD Asia	**9.2**	**9.3**	**10.1**	**9.1**	**9.1**	**9.3**	**9.6**	**10.1**	**0.0**
Japan	4.6	4.6	4.9	4.1	4.0	3.8	3.7	3.6	-1.1
South Korea	2.1	2.1	2.3	2.2	2.3	2.6	3.0	3.5	1.5
Australia/New Zealand	2.6	2.6	2.9	2.8	2.8	2.9	2.9	3.0	0.1
Total OECD	**46.7**	**46.7**	**47.9**	**44.0**	**44.6**	**44.9**	**45.4**	**46.6**	**-0.1**
Non-OECD									
Non-OECD Europe and Eurasia	**8.4**	**8.8**	**8.7**	**7.9**	**7.9**	**7.9**	**8.3**	**9.0**	**0.1**
Russia	4.3	4.4	4.3	4.1	4.1	4.2	4.5	5.1	0.6
Other	4.1	4.4	4.4	3.9	3.8	3.7	3.8	3.9	-0.4
Non-OECD Asia	**61.9**	**65.4**	**70.3**	**80.9**	**93.2**	**106.9**	**121.5**	**137.2**	**2.4**
China	48.3	51.0	54.8	65.0	75.9	87.4	98.9	110.3	2.5
India	8.6	9.2	10.2	10.5	11.4	12.3	13.6	15.3	1.5
Other Non-OECD Asia	4.9	5.1	5.4	5.4	5.9	7.1	9.0	11.6	2.8
Middle East	**0.4**	**0.4**	**0.4**	**0.4**	**0.3**	**0.3**	**0.3**	**0.3**	**-0.3**
Africa	**4.2**	**4.2**	**4.2**	**4.1**	**4.3**	**4.6**	**5.1**	**6.0**	**1.2**
Central and South America	**0.8**	**0.9**	**0.9**	**0.9**	**1.0**	**1.2**	**1.4**	**1.6**	**2.0**
Brazil	0.4	0.4	0.5	0.5	0.6	0.8	0.9	1.2	3.4
Other Central and South America	0.4	0.4	0.5	0.4	0.4	0.4	0.4	0.4	-0.1
Total Non-OECD	**75.7**	**79.7**	**84.6**	**94.2**	**106.8**	**120.8**	**136.6**	**154.2**	**2.2**
Total World	**122.3**	**126.4**	**132.4**	**138.3**	**151.4**	**165.8**	**181.9**	**200.8**	**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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LP2010.D011910A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table E7. World nuclear energy consumption by region, Low Oil Price case, 2005-2035
(Billion kilowatthours)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**880**	**891**	**905**	**958**	**1,020**	**1,031**	**1,046**	**1,059**	**0.6**
United States[a]	782	787	806	834	883	886	886	883	0.3
Canada	87	93	89	113	127	134	142	158	2.1
Mexico	10	10	10	11	11	11	18	18	2.2
OECD Europe	**932**	**929**	**879**	**935**	**967**	**1,011**	**1,055**	**1,084**	**0.8**
OECD Asia	**429**	**430**	**386**	**490**	**560**	**591**	**641**	**683**	**2.1**
Japan	290	288	251	315	342	358	388	417	1.8
South Korea	139	141	136	175	218	233	254	266	2.4
Australia/New Zealand	0	0	0	0	0	0	0	0	—
Total OECD	**2,240**	**2,250**	**2,171**	**2,383**	**2,548**	**2,634**	**2,742**	**2,827**	**0.9**
Non-OECD									
Non-OECD Europe and Eurasia	**264**	**269**	**273**	**342**	**425**	**512**	**545**	**588**	**2.8**
Russia	140	144	148	197	258	324	345	364	3.3
Other	124	124	125	145	167	188	200	224	2.1
Non-OECD Asia	**106**	**111**	**119**	**312**	**543**	**698**	**814**	**942**	**7.7**
China	50	55	63	186	335	437	512	598	8.4
India	16	16	16	66	119	156	179	203	9.5
Other Non-OECD Asia	40	40	41	61	89	105	123	141	4.5
Middle East	**0**	**0**	**0**	**6**	**20**	**29**	**39**	**49**	**—**
Africa	**12**	**10**	**12**	**15**	**15**	**21**	**21**	**31**	**3.5**
Central and South America	**16**	**21**	**19**	**28**	**34**	**43**	**43**	**62**	**4.3**
Brazil	10	14	12	18	22	31	31	41	4.4
Other Central and South America	6	7	7	10	12	12	12	21	4.2
Total Non-OECD	**399**	**411**	**423**	**704**	**1,038**	**1,303**	**1,462**	**1,672**	**5.0**
Total World	**2,639**	**2,660**	**2,593**	**3,087**	**3,586**	**3,937**	**4,204**	**4,499**	**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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LP2010.D011910A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table E8. World consumption of hydroelectricity and other renewable energy by region, Low Oil Price case, 2005-2035
(Quadrillion Btu)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**10.9**	**11.1**	**11.0**	**14.2**	**15.6**	**16.8**	**17.4**	**18.3**	**1.9**
United States[a]	6.1	6.4	6.2	8.9	9.7	10.4	10.6	11.0	2.1
Canada	4.2	4.1	4.2	4.5	5.0	5.4	5.7	6.1	1.3
Mexico	0.6	0.6	0.5	0.8	0.8	1.0	1.1	1.2	3.0
OECD Europe	**7.9**	**8.1**	**8.7**	**11.2**	**12.4**	**13.8**	**14.5**	**15.1**	**2.0**
OECD Asia	**2.1**	**2.2**	**2.1**	**2.6**	**3.0**	**3.2**	**3.3**	**3.4**	**1.7**
Japan	1.3	1.4	1.3	1.3	1.5	1.6	1.6	1.7	0.8
South Korea	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	2.9
Australia/New Zealand	0.7	0.7	0.7	1.2	1.3	1.4	1.5	1.5	2.8
Total OECD	**20.9**	**21.4**	**21.7**	**27.9**	**31.0**	**33.7**	**35.2**	**36.8**	**1.9**
Non-OECD									
Non-OECD Europe and Eurasia	**3.2**	**3.2**	**3.1**	**3.3**	**3.6**	**3.8**	**4.1**	**4.5**	**1.4**
Russia	1.9	1.9	1.9	2.0	2.2	2.4	2.6	2.8	1.5
Other	1.4	1.3	1.2	1.4	1.4	1.5	1.6	1.7	1.3
Non-OECD Asia	**9.3**	**9.9**	**10.2**	**16.2**	**20.4**	**24.1**	**28.4**	**32.4**	**4.2**
China	4.1	4.5	4.5	8.7	11.2	13.8	16.4	18.5	5.1
India	2.3	2.4	2.5	3.2	4.0	4.4	5.0	5.7	2.9
Other Non-OECD Asia	2.9	3.0	3.1	4.3	5.2	5.9	7.0	8.2	3.5
Middle East	**0.3**	**0.3**	**0.3**	**0.4**	**0.5**	**0.5**	**0.6**	**0.6**	**3.1**
Africa	**3.6**	**3.6**	**3.7**	**4.2**	**4.5**	**4.9**	**5.3**	**5.7**	**1.5**
Central and South America	**9.0**	**9.4**	**9.8**	**11.5**	**13.1**	**14.7**	**16.5**	**17.9**	**2.2**
Brazil	5.5	5.7	6.2	7.3	8.4	9.7	11.1	12.1	2.4
Other Central and South America	3.5	3.7	3.6	4.2	4.6	5.0	5.4	5.8	1.7
Total Non-OECD	**25.3**	**26.5**	**27.1**	**35.7**	**42.1**	**48.1**	**54.8**	**61.1**	**2.9**
Total World	**46.2**	**47.9**	**48.8**	**63.7**	**73.0**	**81.8**	**90.1**	**98.0**	**2.5**

[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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, “Balances of OECD and Non-OECD Statistics” (2009), web site www.iea.org (subscription site). **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LP2010.D011910A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table E9. World carbon dioxide emissions by region, Low Oil Price case, 2005-2035
(Million metric tons carbon dioxide)

Region/Country	History 2005	History 2006	History 2007	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD									
OECD North America	**7,012**	**6,915**	**7,017**	**6,930**	**7,192**	**7,454**	**7,783**	**8,143**	**0.5**
United States[a]	5,974	5,894	5,986	5,903	6,106	6,278	6,505	6,732	0.4
Canada	628	596	586	567	577	603	633	666	0.5
Mexico	410	426	444	460	509	574	646	745	1.9
OECD Europe	**4,398**	**4,426**	**4,386**	**4,217**	**4,205**	**4,201**	**4,217**	**4,268**	**-0.1**
OECD Asia	**2,203**	**2,197**	**2,273**	**2,198**	**2,277**	**2,340**	**2,394**	**2,463**	**0.3**
Japan	1,254	1,253	1,262	1,127	1,156	1,149	1,128	1,105	-0.5
South Korea	496	486	516	550	593	651	710	781	1.5
Australia/New Zealand	453	457	495	520	528	541	556	577	0.6
Total OECD	**13,613**	**13,538**	**13,676**	**13,344**	**13,674**	**13,995**	**14,395**	**14,874**	**0.3**
Non-OECD									
Non-OECD Europe and Eurasia	**2,842**	**2,876**	**2,897**	**2,924**	**2,979**	**3,033**	**3,111**	**3,237**	**0.4**
Russia	1,650	1,672	1,663	1,662	1,679	1,697	1,744	1,836	0.4
Other	1,193	1,204	1,233	1,262	1,300	1,337	1,368	1,401	0.5
Non-OECD Asia	**8,382**	**8,831**	**9,425**	**11,399**	**13,241**	**15,165**	**17,160**	**19,229**	**2.6**
China	5,558	5,862	6,284	7,803	9,196	10,645	12,065	13,436	2.8
India	1,187	1,287	1,399	1,597	1,801	1,957	2,133	2,352	1.9
Other Non-OECD Asia	1,637	1,681	1,743	1,999	2,245	2,562	2,961	3,441	2.5
Middle East	**1,395**	**1,446**	**1,515**	**1,959**	**2,161**	**2,305**	**2,460**	**2,685**	**2.1**
Africa	**982**	**988**	**1,011**	**1,195**	**1,293**	**1,405**	**1,520**	**1,670**	**1.8**
Central and South America	**1,092**	**1,133**	**1,169**	**1,373**	**1,499**	**1,595**	**1,708**	**1,830**	**1.6**
Brazil	366	380	394	502	571	639	723	804	2.6
Other Central and South America	726	753	775	871	929	956	985	1,025	1.0
Total Non-OECD	**14,693**	**15,274**	**16,017**	**18,851**	**21,173**	**23,503**	**25,958**	**28,650**	**2.1**
Total World	**28,306**	**28,812**	**29,694**	**32,196**	**34,847**	**37,498**	**40,353**	**43,524**	**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:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LP2010.D011910A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table E10. World carbon dioxide emissions from liquids use by region, Low Oil Price case, 2005-2035
(Million metric tons carbon dioxide)

Region/Country	History 2005	History 2006	History 2007	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD									
OECD North America	**3,194**	**3,142**	**3,150**	**3,162**	**3,276**	**3,408**	**3,592**	**3,786**	**0.7**
United States[a]	2,626	2,595	2,589	2,577	2,676	2,775	2,920	3,059	0.6
Canada	301	281	288	299	299	309	320	335	0.5
Mexico	267	265	273	287	302	323	352	392	1.3
OECD Europe	**2,133**	**2,125**	**2,082**	**2,039**	**2,003**	**2,009**	**2,041**	**2,077**	**0.0**
OECD Asia	**1,031**	**991**	**980**	**959**	**1,013**	**1,036**	**1,056**	**1,075**	**0.3**
Japan	646	622	603	538	570	567	560	552	-0.3
South Korea	239	221	227	258	280	302	324	346	1.5
Australia/New Zealand	147	148	150	163	163	166	172	177	0.6
Total OECD	**6,358**	**6,258**	**6,212**	**6,160**	**6,293**	**6,452**	**6,689**	**6,938**	**0.4**
Non-OECD									
Non-OECD Europe and Eurasia	**686**	**677**	**682**	**734**	**757**	**784**	**822**	**868**	**0.9**
Russia	383	368	366	394	397	397	405	426	0.5
Other	303	310	316	340	360	387	417	442	1.2
Non-OECD Asia	**2,081**	**2,147**	**2,225**	**2,885**	**3,371**	**3,856**	**4,363**	**4,858**	**2.8**
China	889	928	969	1,397	1,686	1,982	2,257	2,502	3.4
India	314	349	369	451	519	568	622	680	2.2
Other Non-OECD Asia	878	870	887	1,037	1,166	1,306	1,484	1,675	2.3
Middle East	**817**	**839**	**886**	**1,026**	**1,110**	**1,219**	**1,364**	**1,552**	**2.0**
Africa	**423**	**428**	**441**	**534**	**561**	**605**	**662**	**721**	**1.8**
Central and South America	**762**	**796**	**823**	**955**	**987**	**1,041**	**1,111**	**1,172**	**1.3**
Brazil	288	301	311	394	428	468	517	561	2.1
Other Central and South America	474	495	512	561	559	573	594	611	0.6
Total Non-OECD	**4,768**	**4,888**	**5,057**	**6,133**	**6,786**	**7,504**	**8,321**	**9,171**	**2.1**
Total World	**11,126**	**11,146**	**11,268**	**12,293**	**13,079**	**13,956**	**15,010**	**16,109**	**1.3**

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

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LP2010.D011910A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table E11. World carbon dioxide emissions from natural gas use by region, Low Oil Price case, 2005-2035
(Million metric tons carbon dioxide)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**1,468**	**1,463**	**1,524**	**1,525**	**1,607**	**1,687**	**1,804**	**1,903**	**0.8**
United States[a]	1,176	1,157	1,232	1,217	1,252	1,274	1,338	1,379	0.4
Canada	186	181	157	169	182	196	210	223	1.3
Mexico	106	125	135	139	173	216	256	301	2.9
OECD Europe	**1,048**	**1,045**	**1,049**	**1,086**	**1,140**	**1,163**	**1,163**	**1,172**	**0.4**
OECD Asia	**311**	**336**	**355**	**391**	**413**	**435**	**441**	**447**	**0.8**
Japan	183	202	208	211	217	225	223	220	0.2
South Korea	64	68	73	88	97	106	108	109	1.4
Australia/New Zealand	65	66	73	92	99	104	110	118	1.7
Total OECD	**2,827**	**2,843**	**2,928**	**3,002**	**3,160**	**3,285**	**3,408**	**3,522**	**0.7**
Non-OECD									
Non-OECD Europe and Eurasia	**1,367**	**1,367**	**1,397**	**1,447**	**1,484**	**1,512**	**1,516**	**1,525**	**0.3**
Russia	865	889	897	891	904	917	924	937	0.2
Other	502	478	500	556	580	595	591	588	0.6
Non-OECD Asia	**459**	**518**	**572**	**894**	**1,086**	**1,239**	**1,351**	**1,443**	**3.4**
China	92	111	138	264	335	401	464	510	4.8
India	70	75	80	169	215	237	243	244	4.1
Other Non-OECD Asia	297	332	354	461	536	601	644	689	2.4
Middle East	**543**	**571**	**594**	**901**	**1,019**	**1,055**	**1,065**	**1,100**	**2.2**
Africa	**169**	**166**	**176**	**277**	**330**	**373**	**382**	**395**	**2.9**
Central and South America	**250**	**256**	**259**	**332**	**416**	**444**	**470**	**505**	**2.4**
Brazil	36	38	39	62	86	101	118	132	4.5
Other Central and South America	214	218	220	270	330	344	352	373	1.9
Total Non-OECD	**2,788**	**2,877**	**2,997**	**3,852**	**4,335**	**4,623**	**4,784**	**4,969**	**1.8**
Total World	**5,614**	**5,720**	**5,925**	**6,854**	**7,495**	**7,908**	**8,192**	**8,491**	**1.3**

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

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LP2010.D011910A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table E12. World carbon dioxide emissions from coal use by region, Low Oil Price case, 2005-2035
(Million metric tons carbon dioxide)

Region/Country	History 2005	History 2006	History 2007	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD									
OECD North America	**2,339**	**2,299**	**2,331**	**2,231**	**2,297**	**2,348**	**2,376**	**2,442**	**0.2**
United States[a]	2,161	2,130	2,155	2,097	2,166	2,217	2,236	2,283	0.2
Canada	142	133	141	100	97	97	102	107	-1.0
Mexico	36	36	36	34	34	34	38	52	1.3
OECD Europe	**1,217**	**1,256**	**1,256**	**1,091**	**1,061**	**1,029**	**1,013**	**1,019**	**-0.7**
OECD Asia	**861**	**870**	**938**	**848**	**851**	**869**	**897**	**942**	**0.0**
Japan	425	429	451	379	368	356	344	333	-1.1
South Korea	193	197	216	204	216	243	278	326	1.5
Australia/New Zealand	242	244	271	265	267	270	274	282	0.1
Total OECD	**4,417**	**4,425**	**4,525**	**4,170**	**4,209**	**4,246**	**4,287**	**4,402**	**-0.1**
Non-OECD									
Non-OECD Europe and Eurasia	**790**	**832**	**819**	**742**	**738**	**737**	**774**	**844**	**0.1**
Russia	402	416	401	377	378	383	414	474	0.6
Other	388	417	417	365	360	355	360	371	-0.4
Non-OECD Asia	**5,843**	**6,165**	**6,629**	**7,620**	**8,785**	**10,070**	**11,445**	**12,928**	**2.4**
China	4,578	4,824	5,177	6,142	7,174	8,263	9,344	10,424	2.5
India	803	863	950	978	1,067	1,153	1,268	1,427	1.5
Other Non-OECD Asia	461	479	502	500	543	655	833	1,076	2.8
Middle East	**36**	**36**	**35**	**33**	**32**	**31**	**31**	**32**	**-0.3**
Africa	**390**	**394**	**395**	**385**	**401**	**427**	**475**	**553**	**1.2**
Central and South America	**80**	**81**	**87**	**86**	**97**	**109**	**127**	**153**	**2.0**
Brazil	42	41	44	46	57	71	88	111	3.4
Other Central and South America	38	40	43	40	39	39	39	42	-0.1
Total Non-OECD	**7,138**	**7,509**	**7,964**	**8,867**	**10,052**	**11,375**	**12,853**	**14,510**	**2.2**
Total World	**11,555**	**11,934**	**12,489**	**13,037**	**14,262**	**15,622**	**17,140**	**18,912**	**1.5**

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

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LP2010.D011910A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

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Appendix F

Reference Case Projections by End-Use Sector and Country Grouping

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Table F1. Total world delivered energy consumption by end-use sector and fuel, 2007-2035
(Quadrillion Btu)

Sector/Fuel	2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
Residential							
Liquids	9.7	10.0	9.8	9.8	9.9	10.0	0.1
Natural gas	20.3	23.1	24.2	24.9	25.1	25.8	0.8
Coal	3.8	3.9	3.9	3.9	3.8	3.7	-0.1
Electricity	15.8	19.2	21.7	24.2	26.7	29.1	2.2
Renewables	0.4	0.4	0.4	0.4	0.4	0.4	0.2
Total	**50.1**	**56.6**	**60.0**	**63.2**	**65.9**	**69.0**	**1.1**
Commercial							
Liquids	4.3	4.2	4.1	4.1	4.1	4.1	-0.2
Natural gas	7.8	8.9	9.2	9.5	9.6	9.8	0.8
Coal	0.8	0.9	0.9	1.0	1.0	1.0	0.7
Electricity	13.5	16.3	18.3	20.6	23.0	25.4	2.3
Renewables	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total	**26.5**	**30.4**	**32.7**	**35.3**	**37.8**	**40.4**	**1.5**
Industrial							
Liquids	57.0	51.7	53.3	56.8	61.0	64.9	0.5
Natural gas	43.2	54.3	59.0	61.1	61.4	63.8	1.4
Coal	43.1	43.1	48.2	52.1	55.5	58.0	1.1
Electricity	27.6	31.1	36.3	41.6	47.3	53.3	2.4
Renewables	13.4	14.1	15.7	17.6	19.5	21.9	1.8
Total	**184.4**	**194.3**	**212.5**	**229.3**	**244.7**	**261.8**	**1.3**
Transportation							
Liquids	93.4	104.1	110.0	117.9	126.7	135.9	1.3
Natural gas	3.5	3.7	4.0	4.3	4.6	4.9	1.3
Coal	0.1	0.2	0.1	0.0	0.0	0.0	—
Electricity	0.9	1.0	1.1	1.1	1.2	1.3	1.1
Total	**97.9**	**109.0**	**115.1**	**123.4**	**132.5**	**142.1**	**1.3**
All End-Use Sectors							
Liquids	164.4	170.0	177.1	188.7	201.8	214.9	1.0
Natural gas	74.8	90.0	96.4	99.7	100.7	104.3	1.2
Coal	47.9	48.0	53.1	57.0	60.3	62.7	1.0
Electricity	57.8	67.6	77.3	87.6	98.1	109.0	2.3
Renewables	13.9	14.6	16.3	18.1	20.1	22.4	1.7
Delivered Energy	**359.0**	**390.2**	**420.3**	**451.2**	**481.0**	**513.3**	**1.3**
Electricity-Related Losses	136.2	153.3	170.2	187.5	205.6	225.4	1.8
Total	**495.2**	**543.5**	**590.5**	**638.7**	**686.5**	**738.7**	**1.4**
Electric Power[a]							
Liquids	10.2	9.3	8.9	8.5	8.3	8.7	-0.6
Natural gas	37.3	39.1	44.8	50.5	55.1	57.8	1.6
Coal	84.5	91.1	99.3	110.7	125.4	143.6	1.9
Nuclear	27.1	32.2	37.4	41.1	43.9	47.1	2.0
Renewables	34.8	49.0	57.0	64.2	71.0	77.3	2.9
Total	**194.1**	**220.8**	**247.5**	**275.1**	**303.7**	**334.5**	**2.0**
Total Energy Consumption							
Liquids	174.7	179.3	186.0	197.2	210.0	223.6	0.9
Natural gas	112.1	129.1	141.2	150.2	155.8	162.0	1.3
Coal	132.4	139.1	152.4	167.8	185.6	206.3	1.6
Nuclear	27.1	32.2	37.4	41.1	43.9	47.1	2.0
Renewables	48.8	63.8	73.4	82.4	91.2	99.8	2.6
Total	**495.2**	**543.5**	**590.5**	**638.7**	**686.5**	**738.7**	**1.4**

[a]Fuel inputs used in the production of electricity and heat at central-station generators.

Sources: **2007:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, "Balances of OECD and Non-OECD Statistics" (2009), web site www.iea.org (subscription site). **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table F2. Total OECD delivered energy consumption by end-use sector and fuel, 2007-2035
(Quadrillion Btu)

Sector/Fuel	2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
Residential							
Liquids	4.3	4.0	3.8	3.8	3.7	3.6	-0.6
Natural gas	11.5	12.2	12.5	12.5	12.3	12.2	0.2
Coal	0.6	0.5	0.5	0.5	0.4	0.4	-1.4
Electricity	10.0	10.9	11.6	12.3	12.9	13.4	1.1
Renewables	0.4	0.4	0.4	0.4	0.4	0.4	0.2
Total	**26.8**	**28.1**	**28.8**	**29.4**	**29.7**	**30.1**	**0.4**
Commercial							
Liquids	2.6	2.4	2.3	2.3	2.3	2.2	-0.5
Natural gas	6.2	6.9	7.0	7.1	7.1	7.2	0.5
Coal	0.2	0.2	0.2	0.2	0.2	0.2	-0.6
Electricity	9.9	11.3	12.2	13.1	14.0	14.9	1.5
Renewables	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total	**19.0**	**20.9**	**21.8**	**22.8**	**23.7**	**24.6**	**0.9**
Industrial							
Liquids	29.1	24.8	24.7	25.1	25.9	26.5	-0.3
Natural gas	19.3	20.7	21.4	21.9	21.7	22.1	0.5
Coal	8.7	6.9	7.1	7.2	7.2	7.1	-0.8
Electricity	11.4	10.9	11.6	12.3	12.9	13.7	0.6
Renewables	4.7	4.9	5.3	6.0	6.7	7.6	1.7
Total	**73.4**	**68.2**	**70.2**	**72.5**	**74.4**	**76.9**	**0.2**
Transportation							
Liquids	58.5	57.8	58.2	59.6	61.1	62.8	0.3
Natural gas	1.0	1.0	1.1	1.2	1.3	1.4	1.2
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Total	**59.9**	**59.2**	**59.7**	**61.2**	**62.8**	**64.6**	**0.3**
All End-Use Sectors							
Liquids	94.5	89.0	89.0	90.7	92.9	95.1	0.0
Natural gas	38.1	40.8	42.0	42.8	42.4	42.8	0.4
Coal	9.5	7.7	7.8	7.8	7.8	7.6	-0.8
Electricity	31.8	33.5	35.8	38.1	40.3	42.5	1.0
Renewables	5.2	5.4	5.9	6.6	7.2	8.2	1.6
Delivered Energy	**179.1**	**176.4**	**180.6**	**186.0**	**190.6**	**196.2**	**0.3**
Electricity-Related Losses	66.7	69.6	73.6	77.2	80.8	84.5	0.9
Total	**245.7**	**246.0**	**254.2**	**263.2**	**271.4**	**280.7**	**0.5**
Electric Power[a]							
Liquids	3.5	3.0	2.9	2.8	2.7	2.6	-1.0
Natural gas	17.6	15.7	17.5	19.8	22.2	24.0	1.1
Coal	38.3	36.8	37.0	37.6	38.6	40.7	0.2
Nuclear	22.6	24.7	26.5	27.4	28.5	29.5	1.0
Renewables	16.4	22.7	25.4	27.6	28.9	30.0	2.2
Total	**98.5**	**103.1**	**109.4**	**115.3**	**121.0**	**127.0**	**0.9**
Total Energy Consumption							
Liquids	97.9	92.1	92.1	93.5	95.6	97.7	0.0
Natural gas	55.6	56.5	59.5	62.6	64.6	66.8	0.7
Coal	47.9	44.5	44.8	45.4	46.4	48.3	0.0
Nuclear	22.6	24.7	26.5	27.4	28.5	29.5	1.0
Renewables	21.7	28.2	31.4	34.3	36.3	38.3	2.0
Total	**245.7**	**246.0**	**254.2**	**263.2**	**271.4**	**280.7**	**0.5**

[a]Fuel inputs used in the production of electricity and heat at central-station generators.

Sources: **2007:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, "Balances of OECD and Non-OECD Statistics" (2009), web site www.iea.org (subscription site). **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table F3. Delivered energy consumption in the United States by end-use sector and fuel, 2007-2035
(Quadrillion Btu)

Sector/Fuel	2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
Residential							
Liquids	1.3	1.0	1.0	0.9	0.9	0.8	-1.4
Natural gas	4.8	4.8	5.0	5.0	5.0	5.0	0.1
Coal	0.0	0.0	0.0	0.0	0.0	0.0	-1.1
Electricity	4.8	4.8	5.0	5.3	5.6	5.8	0.7
Renewables	0.4	0.4	0.4	0.4	0.4	0.4	0.2
Total	**11.3**	**11.1**	**11.4**	**11.7**	**11.9**	**12.1**	**0.3**
Commercial							
Liquids	0.6	0.6	0.5	0.5	0.5	0.5	-0.6
Natural gas	3.1	3.3	3.4	3.6	3.7	3.8	0.7
Coal	0.1	0.1	0.1	0.1	0.1	0.1	0.2
Electricity	4.6	5.0	5.4	5.8	6.2	6.6	1.3
Renewables	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total	**8.4**	**9.0**	**9.5**	**10.0**	**10.5**	**11.0**	**1.0**
Industrial							
Liquids	9.8	9.0	9.0	8.9	8.8	8.7	-0.4
Natural gas	8.0	8.2	8.4	8.4	8.2	8.2	0.1
Coal	1.8	1.8	1.9	1.9	2.0	2.0	0.2
Electricity	3.5	3.4	3.5	3.5	3.5	3.5	0.0
Renewables	2.0	2.4	2.7	3.2	3.7	4.4	2.8
Total	**25.2**	**24.8**	**25.4**	**25.9**	**26.1**	**26.7**	**0.2**
Transportation							
Liquids	28.3	27.7	28.4	29.3	30.4	31.5	0.4
Natural gas	0.7	0.7	0.7	0.8	0.9	0.9	1.2
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.0	0.0	0.0	0.0	0.0	0.1	3.4
Total	29.0	28.4	29.1	30.2	31.3	32.5	0.4
All End-Use Sectors							
Liquids	39.9	38.4	38.9	39.7	40.6	41.5	0.1
Natural gas	16.6	17.0	17.5	17.8	17.8	17.9	0.3
Coal	1.9	1.8	1.9	2.0	2.0	2.0	0.2
Electricity	12.8	13.2	13.9	14.6	15.3	15.9	0.8
Renewables	2.5	2.9	3.2	3.8	4.2	4.9	2.4
Delivered Energy	**73.8**	**73.3**	**75.5**	**77.8**	**79.9**	**82.3**	**0.4**
Electricity-Related Losses	27.8	28.3	29.5	30.5	31.3	32.2	0.5
Total	**101.7**	**101.6**	**105.0**	**108.3**	**111.2**	**114.5**	**0.4**
Electric Power[a]							
Liquids	0.7	0.5	0.5	0.5	0.5	0.5	-1.1
Natural gas	7.0	5.3	5.8	6.5	7.2	7.6	0.3
Coal	20.8	20.5	21.1	21.6	22.2	23.1	0.4
Nuclear	8.5	8.8	9.3	9.3	9.3	9.4	0.4
Renewables	3.6	6.3	6.8	7.1	7.2	7.3	2.6
Total	**40.6**	**41.5**	**43.5**	**45.1**	**46.6**	**48.1**	**0.6**
Total Energy Consumption							
Liquids	40.6	38.8	39.4	40.1	41.1	42.0	0.1
Natural gas	23.7	22.4	23.3	24.2	25.0	25.6	0.3
Coal	22.7	22.3	23.0	23.6	24.3	25.1	0.4
Nuclear	8.5	8.8	9.3	9.3	9.3	9.4	0.4
Renewables	6.2	9.3	10.1	11.0	11.5	12.4	2.5
Total	**101.7**	**101.6**	**105.0**	**108.3**	**111.2**	**114.5**	**0.4**

[a]Fuel inputs used in the production of electricity and heat at central-station generators.

Sources: **2007:** Based on U.S. Energy Information Administration (EIA), *Annual Energy Review 2008*, DOE/EIA-0384(2008) (Washington, DC, June 2009). **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo.

Table F4. Delivered energy consumption in Canada by end-use sector and fuel, 2007-2035
(Quadrillion Btu)

Sector/Fuel	2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
Residential							
Liquids	0.1	0.1	0.1	0.1	0.1	0.1	-0.1
Natural gas	0.5	0.6	0.6	0.6	0.6	0.6	0.5
Coal	0.0	0.0	0.0	0.0	0.0	0.0	-1.3
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	—
Total	**1.2**	**1.3**	**1.3**	**1.4**	**1.5**	**1.5**	**0.9**
Commercial							
Liquids	0.4	0.4	0.3	0.3	0.4	0.4	0.1
Natural gas	0.4	0.4	0.5	0.5	0.5	0.5	1.3
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.5	0.6	0.7	0.7	0.8	0.9	2.3
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**1.2**	**1.4**	**1.5**	**1.6**	**1.7**	**1.8**	**1.4**
Industrial							
Liquids	1.7	1.4	1.3	1.4	1.4	1.5	-0.3
Natural gas	1.6	1.9	2.0	2.2	2.3	2.5	1.5
Coal	0.1	0.1	0.1	0.1	0.1	0.1	-0.5
Electricity	0.8	0.7	0.8	0.8	0.9	0.9	0.7
Renewables	0.5	0.5	0.5	0.5	0.5	0.5	0.3
Total	**4.7**	**4.5**	**4.7**	**5.0**	**5.3**	**5.6**	**0.6**
Transportation							
Liquids	2.3	2.5	2.5	2.5	2.6	2.7	0.5
Natural gas	0.1	0.1	0.1	0.1	0.2	0.2	0.2
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**	**2.6**	**2.6**	**2.7**	**2.8**	**2.9**	**0.5**
All End-Use Sectors							
Liquids	4.5	4.3	4.2	4.3	4.5	4.7	0.2
Natural gas	2.7	3.0	3.2	3.4	3.6	3.7	1.2
Coal	0.1	0.1	0.1	0.1	0.1	0.1	-0.5
Electricity	1.8	1.9	2.1	2.3	2.5	2.7	1.4
Renewables	0.5	0.5	0.5	0.5	0.5	0.5	0.3
Delivered Energy	**9.6**	**9.8**	**10.1**	**10.6**	**11.2**	**11.7**	**0.7**
Electricity-Related Losses	4.8	4.8	5.2	5.6	6.0	6.5	1.1
Total	**14.3**	**14.6**	**15.4**	**16.3**	**17.2**	**18.2**	**0.9**
Electric Power[a]							
Liquids	0.2	0.2	0.2	0.2	0.2	0.2	-1.0
Natural gas	0.3	0.3	0.3	0.4	0.5	0.6	2.7
Coal	1.4	0.9	0.9	0.9	1.0	1.1	-0.8
Nuclear	1.0	1.3	1.4	1.5	1.6	1.7	1.9
Renewables	3.7	4.1	4.6	4.9	5.3	5.6	1.5
Total	**6.6**	**6.7**	**7.3**	**7.9**	**8.5**	**9.2**	**1.2**
Total Energy Consumption							
Liquids	4.7	4.5	4.4	4.5	4.7	4.8	0.1
Natural gas	3.0	3.3	3.5	3.8	4.1	4.4	1.4
Coal	1.5	1.1	1.0	1.1	1.1	1.2	-0.8
Nuclear	1.0	1.3	1.4	1.5	1.6	1.7	1.9
Renewables	4.2	4.5	5.0	5.4	5.8	6.1	1.4
Total	**14.3**	**14.6**	**15.4**	**16.3**	**17.2**	**18.2**	**0.9**

[a]Fuel inputs used in the production of electricity and heat at central-station generators.

Sources: **2007:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, "Balances of OECD and Non-OECD Statistics" (2009), web site www.iea.org (subscription site). **Projections:** EIA, World Energy Projection System Plus (2010).

Table F5. Delivered energy consumption in Mexico by end-use sector and fuel, 2007-2035
(Quadrillion Btu)

Sector/Fuel	2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
Residential							
Liquids	0.3	0.3	0.4	0.4	0.4	0.4	1.3
Natural gas	0.0	0.0	0.1	0.1	0.1	0.1	2.9
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.2	0.3	0.3	0.4	0.4	0.5	3.8
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**0.5**	**0.7**	**0.7**	**0.8**	**0.9**	**1.0**	**2.5**
Commercial							
Liquids	0.1	0.1	0.1	0.1	0.1	0.1	1.6
Natural gas	0.0	0.0	0.0	0.0	0.0	0.0	2.3
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	5.1
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**0.2**	**0.2**	**0.3**	**0.3**	**0.4**	**0.4**	**3.8**
Industrial							
Liquids	0.9	0.9	0.9	1.0	1.1	1.3	1.1
Natural gas	1.5	1.4	1.7	2.0	2.3	2.6	2.0
Coal	0.0	0.0	0.0	0.0	0.0	0.0	1.7
Electricity	0.4	0.4	0.5	0.6	0.7	0.9	2.7
Renewables	0.1	0.1	0.1	0.1	0.2	0.2	2.3
Total	**3.0**	**2.9**	**3.2**	**3.8**	**4.3**	**5.0**	**1.9**
Transportation							
Liquids	2.1	2.2	2.4	2.7	3.0	3.3	1.6
Natural gas	0.1	0.1	0.1	0.1	0.1	0.1	3.3
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	2.4
Total	**2.2**	**2.2**	**2.5**	**2.8**	**3.1**	**3.4**	**1.6**
All End-Use Sectors							
Liquids	3.5	3.5	3.8	4.1	4.6	5.1	1.4
Natural gas	1.6	1.5	1.8	2.2	2.5	2.9	2.1
Coal	0.0	0.0	0.0	0.0	0.0	0.0	1.7
Electricity	0.7	0.8	1.0	1.2	1.5	1.7	3.4
Renewables	0.1	0.1	0.1	0.1	0.2	0.2	2.3
Delivered Energy	**5.9**	**6.0**	**6.7**	**7.7**	**8.7**	**9.9**	**1.9**
Electricity-Related Losses	1.8	2.1	2.3	2.7	3.1	3.6	2.4
Total	**7.7**	**8.1**	**9.0**	**10.4**	**11.8**	**13.5**	**2.0**
Electric Power[a]							
Liquids	0.7	0.6	0.6	0.6	0.5	0.5	-0.9
Natural gas	0.9	1.1	1.5	2.0	2.5	3.0	4.2
Coal	0.4	0.3	0.3	0.4	0.4	0.6	1.7
Nuclear	0.1	0.1	0.1	0.1	0.2	0.2	2.3
Renewables	0.4	0.7	0.7	0.9	1.0	1.1	3.2
Total	**2.5**	**2.9**	**3.3**	**3.9**	**4.5**	**5.3**	**2.7**
Total Energy Consumption							
Liquids	4.1	4.2	4.4	4.7	5.1	5.6	1.1
Natural gas	2.5	2.7	3.3	4.2	4.9	5.8	3.0
Coal	0.4	0.4	0.4	0.4	0.4	0.6	1.7
Nuclear	0.1	0.1	0.1	0.1	0.2	0.2	2.3
Renewables	0.5	0.8	0.8	1.0	1.1	1.3	3.1
Total	**7.7**	**8.1**	**9.0**	**10.4**	**11.8**	**13.5**	**2.0**

[a]Fuel inputs used in the production of electricity and heat at central-station generators.

Sources: **2007:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, "Balances of OECD and Non-OECD Statistics" (2009), web site www.iea.org (subscription site). **Projections:** EIA, World Energy Projection System Plus (2010).

Table F6. Delivered energy consumption in OECD Europe by end-use sector and fuel, 2007-2035
(Quadrillion Btu)

Sector/Fuel	2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
Residential							
Liquids	1.9	1.9	1.8	1.7	1.7	1.6	-0.5
Natural gas	5.2	5.7	5.8	5.7	5.5	5.4	0.1
Coal	0.5	0.5	0.5	0.4	0.4	0.4	-1.3
Electricity	3.0	3.6	3.9	4.1	4.2	4.4	1.3
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**10.7**	**11.7**	**11.9**	**12.0**	**11.8**	**11.8**	**0.4**
Commercial							
Liquids	0.7	0.7	0.6	0.6	0.6	0.6	-0.8
Natural gas	1.8	2.1	2.1	2.1	1.9	1.9	0.1
Coal	0.1	0.1	0.1	0.1	0.1	0.1	-1.2
Electricity	2.9	3.5	3.7	4.0	4.2	4.4	1.5
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**5.5**	**6.3**	**6.5**	**6.7**	**6.8**	**6.9**	**0.8**
Industrial							
Liquids	9.7	7.4	7.0	7.2	7.5	7.8	-0.8
Natural gas	6.6	7.2	7.3	7.3	6.8	6.6	0.0
Coal	3.6	2.5	2.4	2.4	2.4	2.3	-1.6
Electricity	4.6	4.3	4.6	4.9	5.2	5.6	0.7
Renewables	1.5	1.4	1.5	1.6	1.7	1.9	0.7
Total	**26.1**	**22.7**	**22.9**	**23.4**	**23.7**	**24.1**	**-0.3**
Transportation							
Liquids	18.4	18.2	17.5	17.5	17.5	17.6	-0.2
Natural gas	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.3	0.3	0.3	0.3	0.3	0.3	0.1
Total	**18.8**	**18.6**	**17.9**	**17.8**	**17.9**	**17.9**	**-0.2**
All End-Use Sectors							
Liquids	30.8	28.2	27.0	27.0	27.3	27.6	-0.4
Natural gas	13.7	15.1	15.3	15.2	14.4	14.0	0.1
Coal	4.2	3.1	3.0	2.9	2.8	2.7	-1.6
Electricity	10.8	11.6	12.4	13.2	13.9	14.6	1.1
Renewables	1.5	1.4	1.5	1.6	1.7	1.9	0.7
Delivered Energy	**61.0**	**59.3**	**59.1**	**59.9**	**60.2**	**60.8**	**0.0**
Electricity-Related Losses	21.3	22.7	23.9	25.1	26.3	27.4	0.9
Total	**82.3**	**82.0**	**83.0**	**85.0**	**86.5**	**88.2**	**0.2**
Electric Power[a]							
Liquids	0.9	0.8	0.8	0.7	0.7	0.7	-1.0
Natural gas	6.1	5.7	6.4	7.0	7.8	8.6	1.2
Coal	9.0	8.5	8.2	8.0	7.9	8.3	-0.3
Nuclear	9.1	9.7	10.0	10.5	10.9	11.2	0.8
Renewables	7.1	9.6	10.9	12.2	12.8	13.2	2.2
Total	**32.1**	**34.3**	**36.3**	**38.3**	**40.2**	**42.0**	**1.0**
Total Energy Consumption							
Liquids	31.6	29.0	27.7	27.7	28.0	28.3	-0.4
Natural gas	19.8	20.8	21.7	22.1	22.2	22.6	0.5
Coal	13.2	11.5	11.2	10.9	10.8	11.0	-0.6
Nuclear	9.1	9.7	10.0	10.5	10.9	11.2	0.8
Renewables	8.7	11.0	12.4	13.8	14.5	15.1	2.0
Total	**82.3**	**82.0**	**83.0**	**85.0**	**86.5**	**88.2**	**0.2**

[a]Fuel inputs used in the production of electricity and heat at central-station generators.
Sources: **2007:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, "Balances of OECD and Non-OECD Statistics" (2009), web site www.iea.org (subscription site). **Projections:** EIA, World Energy Projection System Plus (2010).

Table F7. Delivered energy consumption in Japan by end-use sector and fuel, 2007-2035
(Quadrillion Btu)

Sector/Fuel	2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
Residential							
Liquids	0.6	0.5	0.5	0.5	0.5	0.5	-0.9
Natural gas	0.4	0.4	0.4	0.4	0.4	0.4	0.0
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	1.1	1.1	1.1	1.2	1.2	1.2	0.5
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**2.1**	**2.1**	**2.1**	**2.1**	**2.1**	**2.1**	**0.0**
Commercial							
Liquids	0.6	0.5	0.5	0.5	0.5	0.5	-0.8
Natural gas	0.7	0.8	0.8	0.8	0.7	0.7	-0.1
Coal	0.0	0.0	0.0	0.0	0.0	0.0	-0.9
Electricity	1.3	1.4	1.4	1.5	1.6	1.6	0.7
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**2.7**	**2.7**	**2.8**	**2.8**	**2.8**	**2.8**	**0.2**
Industrial							
Liquids	4.1	3.2	3.3	3.4	3.3	3.3	-0.8
Natural gas	0.5	0.6	0.6	0.6	0.6	0.5	0.4
Coal	2.1	1.6	1.6	1.5	1.4	1.4	-1.5
Electricity	1.0	0.9	1.0	1.0	1.1	1.1	0.4
Renewables	0.3	0.3	0.3	0.3	0.3	0.3	-0.1
Total	**8.0**	**6.5**	**6.8**	**6.8**	**6.7**	**6.6**	**-0.7**
Transportation							
Liquids	4.0	3.5	3.6	3.6	3.5	3.3	-0.6
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	-0.2
Total	**4.0**	**3.6**	**3.7**	**3.6**	**3.5**	**3.4**	**-0.6**
All End-Use Sectors							
Liquids	9.3	7.7	8.0	8.0	7.8	7.6	-0.7
Natural gas	1.6	1.8	1.9	1.8	1.7	1.6	0.1
Coal	2.1	1.6	1.6	1.5	1.5	1.4	-1.5
Electricity	3.4	3.5	3.6	3.8	3.9	4.0	0.6
Renewables	0.3	0.3	0.3	0.3	0.3	0.3	-0.1
Delivered Energy	**16.7**	**14.9**	**15.3**	**15.3**	**15.1**	**14.9**	**-0.4**
Electricity-Related Losses	6.1	6.2	6.5	6.8	7.0	7.3	0.6
Total	**22.8**	**21.1**	**21.9**	**22.1**	**22.1**	**22.2**	**-0.1**
Electric Power[a]							
Liquids	0.8	0.8	0.7	0.7	0.6	0.6	-1.0
Natural gas	2.3	2.2	2.2	2.5	2.6	2.6	0.4
Coal	2.8	2.6	2.5	2.4	2.4	2.4	-0.5
Nuclear	2.5	3.2	3.5	3.7	4.0	4.3	1.9
Renewables	1.0	1.0	1.3	1.3	1.3	1.4	1.1
Total	**9.5**	**9.7**	**10.2**	**10.5**	**10.9**	**11.3**	**0.6**
Total Energy Consumption							
Liquids	10.1	8.4	8.7	8.6	8.4	8.2	-0.7
Natural gas	3.9	4.0	4.1	4.2	4.2	4.2	0.2
Coal	4.9	4.2	4.1	3.9	3.8	3.8	-0.9
Nuclear	2.5	3.2	3.5	3.7	4.0	4.3	1.9
Renewables	1.3	1.3	1.5	1.6	1.6	1.7	0.8
Total	**22.8**	**21.1**	**21.9**	**22.1**	**22.1**	**22.2**	**-0.1**

[a]Fuel inputs used in the production of electricity and heat at central-station generators.

Sources: **2007:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, "Balances of OECD and Non-OECD Statistics" (2009), web site www.iea.org (subscription site). **Projections:** EIA, World Energy Projection System Plus (2010).

Table F8. Delivered energy consumption in South Korea by end-use sector and fuel, 2007-2035
(Quadrillion Btu)

Sector/Fuel	2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
Residential							
Liquids	0.1	0.1	0.1	0.1	0.1	0.1	-0.4
Natural gas	0.4	0.5	0.5	0.5	0.5	0.5	0.5
Coal	0.0	0.0	0.0	0.0	0.0	0.0	-2.2
Electricity	0.2	0.2	0.3	0.3	0.3	0.3	2.1
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**0.8**	**0.8**	**0.9**	**0.9**	**0.9**	**0.9**	**0.8**
Commercial							
Liquids	0.2	0.2	0.1	0.1	0.1	0.1	-0.2
Natural gas	0.2	0.2	0.2	0.2	0.2	0.2	1.4
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.4	0.5	0.6	0.7	0.7	0.8	2.4
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**0.7**	**0.9**	**0.9**	**1.0**	**1.1**	**1.2**	**1.8**
Industrial							
Liquids	2.4	2.4	2.6	2.8	3.1	3.3	1.3
Natural gas	0.3	0.4	0.4	0.4	0.3	0.3	1.0
Coal	0.8	0.7	0.8	0.9	0.9	0.9	0.7
Electricity	0.7	0.7	0.9	1.0	1.1	1.2	1.9
Renewables	0.1	0.1	0.1	0.1	0.1	0.1	1.7
Total	**4.2**	**4.3**	**4.7**	**5.1**	**5.5**	**5.9**	**1.3**
Transportation							
Liquids	1.7	2.0	2.1	2.3	2.4	2.5	1.3
Natural gas	0.0	0.0	0.0	0.0	0.0	0.0	1.0
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	1.2
Total	**1.8**	**2.0**	**2.2**	**2.3**	**2.4**	**2.5**	**1.3**
All End-Use Sectors							
Liquids	4.4	4.6	5.0	5.3	5.7	6.1	1.2
Natural gas	0.8	1.0	1.1	1.1	1.1	1.1	0.9
Coal	0.8	0.8	0.8	0.9	0.9	1.0	0.6
Electricity	1.3	1.5	1.7	1.9	2.1	2.4	2.1
Renewables	0.1	0.1	0.1	0.1	0.1	0.1	1.7
Delivered Energy	**7.4**	**8.0**	**8.6**	**9.3**	**9.9**	**10.6**	**1.3**
Electricity-Related Losses	2.3	2.6	3.0	3.4	3.8	4.3	2.2
Total	**9.7**	**10.6**	**11.7**	**12.7**	**13.8**	**14.9**	**1.5**
Electric Power[a]							
Liquids	0.2	0.2	0.2	0.2	0.2	0.2	-1.0
Natural gas	0.5	0.6	0.7	0.9	1.0	1.0	2.1
Coal	1.5	1.4	1.5	1.8	2.1	2.7	2.0
Nuclear	1.3	1.8	2.2	2.4	2.6	2.7	2.5
Renewables	0.0	0.1	0.1	0.1	0.1	0.2	4.6
Total	**3.6**	**4.1**	**4.7**	**5.3**	**6.0**	**6.7**	**2.2**
Total Energy Consumption							
Liquids	4.6	4.8	5.1	5.5	5.9	6.2	1.1
Natural gas	1.4	1.6	1.8	2.0	2.0	2.0	1.4
Coal	2.3	2.2	2.3	2.7	3.1	3.6	1.6
Nuclear	1.3	1.8	2.2	2.4	2.6	2.7	2.5
Renewables	0.1	0.2	0.2	0.2	0.3	0.3	3.1
Total	**9.7**	**10.6**	**11.7**	**12.7**	**13.8**	**14.9**	**1.5**

[a]Fuel inputs used in the production of electricity and heat at central-station generators.

Sources: **2007:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, "Balances of OECD and Non-OECD Statistics" (2009), web site www.iea.org (subscription site). **Projections:** EIA, World Energy Projection System Plus (2010).

Table F9. Delivered energy consumption in Australia/New Zealand by end-use sector and fuel, 2007-2035
(Quadrillion Btu)

Sector/Fuel	2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
Residential							
Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.5
Natural gas	0.1	0.2	0.2	0.2	0.2	0.2	1.6
Coal	0.0	0.0	0.0	0.0	0.0	0.0	-0.9
Electricity	0.3	0.3	0.3	0.3	0.3	0.4	1.1
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**0.4**	**0.5**	**0.5**	**0.5**	**0.6**	**0.6**	**1.3**
Commercial							
Liquids	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
Natural gas	0.0	0.1	0.1	0.1	0.1	0.1	0.6
Coal	0.0	0.0	0.0	0.0	0.0	0.0	-0.4
Electricity	0.2	0.3	0.3	0.3	0.3	0.3	1.7
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**0.3**	**0.3**	**0.4**	**0.4**	**0.4**	**0.4**	**1.3**
Industrial							
Liquids	0.6	0.5	0.5	0.5	0.5	0.5	-0.3
Natural gas	0.8	1.0	1.0	1.1	1.2	1.3	1.6
Coal	0.3	0.3	0.3	0.3	0.4	0.4	1.1
Electricity	0.4	0.4	0.5	0.5	0.5	0.5	0.6
Renewables	0.2	0.2	0.2	0.2	0.2	0.2	0.9
Total	**2.3**	**2.5**	**2.6**	**2.6**	**2.8**	**3.0**	**0.9**
Transportation							
Liquids	1.6	1.7	1.7	1.7	1.8	1.9	0.6
Natural gas	0.0	0.0	0.0	0.0	0.1	0.1	4.6
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	**1.6**	**1.8**	**1.8**	**1.8**	**1.9**	**2.0**	**0.7**
All End-Use Sectors							
Liquids	2.2	2.3	2.3	2.3	2.4	2.5	0.4
Natural gas	1.0	1.3	1.3	1.4	1.5	1.6	1.6
Coal	0.3	0.3	0.3	0.4	0.4	0.4	1.1
Electricity	0.9	1.0	1.1	1.1	1.2	1.2	1.0
Renewables	0.2	0.2	0.2	0.2	0.2	0.2	0.9
Delivered Energy	**4.6**	**5.1**	**5.2**	**5.4**	**5.6**	**5.9**	**0.9**
Electricity-Related Losses	2.6	2.9	3.0	3.1	3.2	3.3	0.9
Total	**7.2**	**8.0**	**8.2**	**8.5**	**8.9**	**9.2**	**0.9**
Electric Power[a]							
Liquids	0.0	0.0	0.0	0.0	0.0	0.0	-1.0
Natural gas	0.4	0.4	0.5	0.6	0.6	0.6	1.9
Coal	2.6	2.5	2.5	2.5	2.6	2.6	0.0
Nuclear	0.0	0.0	0.0	0.0	0.0	0.0	—
Renewables	0.5	1.0	1.1	1.2	1.2	1.3	3.4
Total	**3.4**	**3.9**	**4.1**	**4.3**	**4.4**	**4.5**	**0.9**
Total Energy Consumption							
Liquids	2.2	2.3	2.3	2.3	2.4	2.5	0.4
Natural gas	1.4	1.7	1.8	2.0	2.1	2.2	1.7
Coal	2.9	2.8	2.8	2.9	2.9	3.0	0.2
Nuclear	0.0	0.0	0.0	0.0	0.0	0.0	—
Renewables	0.7	1.2	1.3	1.4	1.5	1.5	2.8
Total	**7.2**	**8.0**	**8.2**	**8.5**	**8.9**	**9.2**	**0.9**

[a]Fuel inputs used in the production of electricity and heat at central-station generators.

Sources: **2007:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, "Balances of OECD and Non-OECD Statistics" (2009), web site www.iea.org (subscription site). **Projections:** EIA, World Energy Projection System Plus (2010).

Table F10. Total Non-OECD delivered energy consumption by end-use sector and fuel, 2007-2035
(Quadrillion Btu)

Sector/Fuel	2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
Residential							
Liquids	5.4	6.0	5.9	6.1	6.2	6.3	0.5
Natural gas	8.8	10.9	11.8	12.3	12.8	13.6	1.6
Coal	3.2	3.3	3.4	3.4	3.4	3.3	0.1
Electricity	5.8	8.3	10.1	12.0	13.8	15.7	3.6
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**23.2**	**28.5**	**31.2**	**33.8**	**36.2**	**38.9**	**1.9**
Commercial							
Liquids	1.8	1.8	1.8	1.8	1.9	1.9	0.2
Natural gas	1.6	2.0	2.2	2.4	2.5	2.6	1.8
Coal	0.6	0.7	0.7	0.8	0.8	0.9	1.1
Electricity	3.5	4.9	6.1	7.5	9.0	10.4	3.9
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**7.5**	**9.5**	**10.9**	**12.5**	**14.1**	**15.8**	**2.7**
Industrial							
Liquids	27.8	26.9	28.6	31.7	35.2	38.4	1.2
Natural gas	23.9	33.6	37.6	39.1	39.7	41.7	2.0
Coal	34.4	36.2	41.0	45.0	48.3	50.9	1.4
Electricity	16.2	20.2	24.6	29.4	34.3	39.7	3.2
Renewables	8.7	9.3	10.4	11.6	12.8	14.2	1.8
Total	**111.1**	**126.1**	**142.2**	**156.8**	**170.4**	**184.9**	**1.8**
Transportation							
Liquids	34.9	46.3	51.8	58.3	65.6	73.2	2.7
Natural gas	2.4	2.7	2.9	3.1	3.3	3.5	1.3
Coal	0.1	0.2	0.1	0.0	0.0	0.0	—
Electricity	0.5	0.6	0.6	0.7	0.8	0.8	1.5
Total	**38.1**	**49.7**	**55.4**	**62.2**	**69.6**	**77.5**	**2.6**
All End-Use Sectors							
Liquids	70.0	81.0	88.1	98.0	108.8	119.8	1.9
Natural gas	36.8	49.2	54.4	56.9	58.3	61.4	1.9
Coal	38.4	40.3	45.3	49.2	52.5	55.1	1.3
Electricity	26.0	34.0	41.5	49.5	57.8	66.6	3.4
Renewables	8.7	9.3	10.4	11.6	12.8	14.2	1.8
Delivered Energy	**179.9**	**213.8**	**239.8**	**265.2**	**290.3**	**317.1**	**2.0**
Electricity-Related Losses	69.6	83.7	96.6	110.3	124.8	140.9	2.6
Total	**249.5**	**297.5**	**336.3**	**375.5**	**415.2**	**458.0**	**2.2**
Electric Power[a]							
Liquids	6.8	6.3	6.0	5.7	5.6	6.1	-0.4
Natural gas	19.7	23.4	27.3	30.7	32.9	33.8	1.9
Coal	46.2	54.2	62.2	73.1	86.7	102.9	2.9
Nuclear	4.5	7.5	10.9	13.7	15.4	17.5	4.9
Renewables	18.4	26.3	31.6	36.5	42.1	47.2	3.4
Total	**95.6**	**117.7**	**138.1**	**159.8**	**182.7**	**207.5**	**2.8**
Total Energy Consumption							
Liquids	76.8	87.3	94.1	103.7	114.4	125.9	1.8
Natural gas	56.5	72.6	81.7	87.7	91.2	95.2	1.9
Coal	84.6	94.6	107.6	122.4	139.2	157.9	2.3
Nuclear	4.5	7.5	10.9	13.7	15.4	17.5	4.9
Renewables	27.1	35.6	42.0	48.1	55.0	61.4	3.0
Total	**249.5**	**297.5**	**336.3**	**375.5**	**415.2**	**458.0**	**2.2**

[a]Fuel inputs used in the production of electricity and heat at central-station generators.

Sources: **2007:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, “Balances of OECD and Non-OECD Statistics” (2009), web site www.iea.org (subscription site). **Projections:** EIA, World Energy Projection System Plus (2010).

Table F11. Delivered energy consumption in Russia by end-use sector and fuel, 2007-2035
(Quadrillion Btu)

Sector/Fuel	2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
Residential							
Liquids	0.4	0.4	0.4	0.4	0.4	0.4	0.0
Natural gas	3.1	3.1	3.1	3.2	3.3	3.4	0.4
Coal	0.2	0.2	0.2	0.2	0.2	0.2	-1.2
Electricity	0.4	0.5	0.6	0.6	0.7	0.8	2.6
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**4.1**	**4.2**	**4.3**	**4.5**	**4.6**	**4.8**	**0.5**
Commercial							
Liquids	0.1	0.1	0.1	0.1	0.1	0.1	-1.3
Natural gas	0.7	0.7	0.7	0.8	0.8	0.8	0.6
Coal	0.1	0.1	0.1	0.1	0.1	0.1	-1.0
Electricity	0.4	0.5	0.6	0.7	0.8	0.9	2.5
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**1.4**	**1.5**	**1.5**	**1.7**	**1.8**	**1.9**	**1.2**
Industrial							
Liquids	2.6	2.3	2.3	2.4	2.5	2.6	0.1
Natural gas	5.4	5.3	5.4	5.4	5.3	5.3	-0.1
Coal	1.0	0.8	0.9	0.9	1.0	1.0	0.1
Electricity	1.7	1.8	1.9	2.1	2.3	2.4	1.2
Renewables	0.1	0.1	0.1	0.1	0.1	0.1	1.7
Total	**10.8**	**10.3**	**10.6**	**11.0**	**11.2**	**11.5**	**0.2**
Transportation							
Liquids	2.3	2.4	2.4	2.2	2.2	2.3	0.0
Natural gas	1.7	1.8	1.9	2.0	2.2	2.3	1.1
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.3	0.3	0.3	0.3	0.3	0.3	0.5
Total	**4.3**	**4.5**	**4.6**	**4.6**	**4.7**	**4.9**	**0.5**
All End-Use Sectors							
Liquids	5.4	5.3	5.2	5.2	5.2	5.5	0.0
Natural gas	10.8	10.9	11.1	11.4	11.5	11.8	0.3
Coal	1.4	1.2	1.2	1.2	1.3	1.3	-0.2
Electricity	2.9	3.1	3.4	3.7	4.1	4.5	1.6
Renewables	0.1	0.1	0.1	0.1	0.1	0.1	1.7
Delivered Energy	**20.5**	**20.5**	**21.0**	**21.7**	**22.2**	**23.2**	**0.4**
Electricity-Related Losses	9.9	10.2	10.6	11.2	11.6	12.3	0.8
Total	**30.5**	**30.7**	**31.6**	**32.8**	**33.9**	**35.5**	**0.5**
Electric Power[a]							
Liquids	0.4	0.4	0.3	0.3	0.3	0.3	-0.8
Natural gas	6.1	6.0	6.0	5.9	6.0	6.0	-0.1
Coal	2.9	2.9	2.9	2.9	3.3	4.0	1.1
Nuclear	1.6	2.1	2.8	3.5	3.7	3.9	3.1
Renewables	1.8	1.9	2.1	2.2	2.4	2.7	1.5
Total	**12.8**	**13.3**	**14.0**	**14.9**	**15.7**	**16.8**	**1.0**
Total Energy Consumption							
Liquids	5.8	5.6	5.5	5.5	5.5	5.8	0.0
Natural gas	16.9	16.8	17.1	17.4	17.5	17.8	0.2
Coal	4.3	4.1	4.1	4.2	4.6	5.3	0.8
Nuclear	1.6	2.1	2.8	3.5	3.7	3.9	3.1
Renewables	1.9	2.0	2.2	2.4	2.6	2.8	1.5
Total	**30.5**	**30.7**	**31.6**	**32.8**	**33.9**	**35.5**	**0.5**

[a]Fuel inputs used in the production of electricity and heat at central-station generators.

Sources: **2007:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, “Balances of OECD and Non-OECD Statistics” (2009), web site www.iea.org (subscription site). **Projections:** EIA, World Energy Projection System Plus (2010).

Table F12. Delivered energy consumption in Other Non-OECD Europe and Eurasia by end-use sector and fuel, 2007-2035
(Quadrillion Btu)

Sector/Fuel	2007	Projections					Average annual percent change, 2007-2035
		2015	2020	2025	2030	2035	
Residential							
Liquids	0.2	0.2	0.2	0.2	0.2	0.2	0.1
Natural gas	2.6	2.8	2.8	2.8	2.7	2.7	0.1
Coal	0.1	0.1	0.1	0.1	0.1	0.1	-1.6
Electricity	0.4	0.5	0.5	0.6	0.6	0.7	1.5
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**3.4**	**3.6**	**3.7**	**3.7**	**3.7**	**3.7**	**0.3**
Commercial							
Liquids	0.1	0.1	0.0	0.0	0.0	0.0	-0.6
Natural gas	0.4	0.4	0.4	0.4	0.4	0.4	0.2
Coal	0.0	0.0	0.0	0.0	0.0	0.0	-0.4
Electricity	0.2	0.3	0.3	0.4	0.4	0.5	2.4
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**0.7**	**0.8**	**0.8**	**0.9**	**0.9**	**0.9**	**1.0**
Industrial							
Liquids	1.6	1.3	1.2	1.3	1.4	1.4	-0.5
Natural gas	3.8	4.4	4.6	4.7	4.6	4.6	0.7
Coal	2.1	1.6	1.6	1.5	1.5	1.4	-1.5
Electricity	1.1	1.2	1.3	1.4	1.6	1.7	1.6
Renewables	0.1	0.1	0.1	0.1	0.1	0.1	1.4
Total	**8.7**	**8.6**	**8.8**	**9.0**	**9.1**	**9.3**	**0.2**
Transportation							
Liquids	2.3	2.5	2.7	2.9	3.1	3.2	1.2
Natural gas	0.3	0.3	0.3	0.3	0.3	0.4	0.6
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	-0.3
Total	**2.7**	**2.9**	**3.1**	**3.3**	**3.5**	**3.6**	**1.1**
All End-Use Sectors							
Liquids	4.2	4.1	4.2	4.4	4.7	4.9	0.6
Natural gas	7.0	8.0	8.2	8.3	8.1	8.1	0.5
Coal	2.3	1.8	1.7	1.7	1.6	1.5	-1.5
Electricity	1.9	2.0	2.2	2.4	2.7	2.9	1.6
Renewables	0.1	0.1	0.1	0.1	0.1	0.1	1.4
Delivered Energy	**15.4**	**15.9**	**16.4**	**16.9**	**17.2**	**17.5**	**0.5**
Electricity-Related Losses	5.6	5.8	6.1	6.4	6.7	7.2	0.9
Total	**21.0**	**21.7**	**22.5**	**23.3**	**23.9**	**24.7**	**0.6**
Electric Power[a]							
Liquids	0.4	0.4	0.3	0.3	0.3	0.3	-0.9
Natural gas	2.4	2.5	2.7	3.0	3.1	3.2	1.0
Coal	2.1	2.1	2.1	2.1	2.3	2.6	0.7
Nuclear	1.4	1.6	1.8	2.0	2.1	2.4	2.0
Renewables	1.1	1.3	1.3	1.4	1.5	1.6	1.3
Total	**7.4**	**7.8**	**8.3**	**8.8**	**9.4**	**10.1**	**1.1**
Total Energy Consumption							
Liquids	4.6	4.4	4.5	4.7	5.0	5.2	0.5
Natural gas	9.4	10.4	10.9	11.3	11.2	11.3	0.6
Coal	4.4	3.9	3.8	3.8	3.9	4.1	-0.2
Nuclear	1.4	1.6	1.8	2.0	2.1	2.4	2.0
Renewables	1.2	1.4	1.4	1.5	1.6	1.7	1.3
Total	**21.0**	**21.7**	**22.5**	**23.3**	**23.9**	**24.7**	**0.6**

[a]Fuel inputs used in the production of electricity and heat at central-station generators.

Sources: **2007:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, “Balances of OECD and Non-OECD Statistics” (2009), web site www.iea.org (subscription site). **Projections:** EIA, World Energy Projection System Plus (2010).

Table F13. Delivered energy consumption in China by end-use sector and fuel, 2007-2035
(Quadrillion Btu)

Sector/Fuel	2007	Projections					Average annual percent change, 2007-2035
		2015	2020	2025	2030	2035	
Residential							
Liquids	0.9	1.0	1.0	1.0	0.9	0.9	-0.2
Natural gas	0.6	1.3	1.8	2.3	2.9	3.4	6.4
Coal	2.5	2.6	2.7	2.7	2.6	2.5	0.0
Electricity	1.2	2.4	3.1	3.9	4.7	5.4	5.4
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**5.3**	**7.3**	**8.6**	**9.9**	**11.1**	**12.2**	**3.0**
Commercial							
Liquids	1.0	1.0	0.9	0.9	0.9	0.8	-0.6
Natural gas	0.2	0.3	0.4	0.6	0.7	0.8	6.0
Coal	0.3	0.3	0.3	0.3	0.3	0.3	0.1
Electricity	0.5	0.9	1.2	1.7	2.1	2.6	6.2
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**1.9**	**2.5**	**2.9**	**3.4**	**4.0**	**4.5**	**3.2**
Industrial							
Liquids	7.0	7.5	8.3	9.4	10.3	11.2	1.7
Natural gas	1.4	2.8	3.5	4.0	4.5	4.7	4.5
Coal	24.1	26.5	30.1	33.2	35.6	37.4	1.6
Electricity	7.9	11.1	14.3	17.8	21.4	25.1	4.2
Renewables	0.2	0.3	0.3	0.4	0.5	0.6	3.6
Total	**40.5**	**48.3**	**56.6**	**64.8**	**72.3**	**78.9**	**2.4**
Transportation							
Liquids	6.1	10.4	13.0	16.0	18.7	21.2	4.5
Natural gas	0.0	0.0	0.0	0.0	0.0	0.0	9.6
Coal	0.1	0.2	0.1	0.0	0.0	0.0	—
Electricity	0.1	0.1	0.2	0.2	0.2	0.3	3.6
Total	**6.3**	**10.7**	**13.3**	**16.2**	**19.0**	**21.5**	**4.5**
All End-Use Sectors							
Liquids	15.0	19.9	23.2	27.2	30.9	34.2	3.0
Natural gas	2.1	4.4	5.7	6.9	8.1	9.0	5.3
Coal	27.1	29.6	33.2	36.2	38.5	40.2	1.4
Electricity	9.7	14.6	18.9	23.6	28.4	33.3	4.5
Renewables	0.2	0.3	0.3	0.4	0.5	0.6	3.6
Delivered Energy	**54.0**	**68.8**	**81.4**	**94.3**	**106.4**	**117.2**	**2.8**
Electricity-Related Losses	24.0	32.6	40.0	48.1	56.3	64.7	3.6
Total	**78.0**	**101.4**	**121.4**	**142.4**	**162.7**	**181.9**	**3.1**
Electric Power[a]							
Liquids	0.5	0.5	0.5	0.5	0.5	0.5	-0.5
Natural gas	0.5	0.7	0.9	1.0	1.1	1.2	3.1
Coal	27.7	35.6	43.2	52.3	62.0	72.2	3.5
Nuclear	0.6	1.9	3.5	4.5	5.3	6.2	8.5
Renewables	4.3	8.4	10.9	13.4	15.9	18.0	5.2
Total	**33.7**	**47.1**	**58.9**	**71.6**	**84.7**	**98.0**	**3.9**
Total Energy Consumption							
Liquids	15.5	20.4	23.7	27.7	31.4	34.6	2.9
Natural gas	2.6	5.1	6.6	7.9	9.1	10.1	5.0
Coal	54.8	65.2	76.4	88.5	100.5	112.4	2.6
Nuclear	0.6	1.9	3.5	4.5	5.3	6.2	8.5
Renewables	4.5	8.7	11.2	13.8	16.4	18.5	5.2
Total	**78.0**	**101.4**	**121.4**	**142.4**	**162.7**	**181.9**	**3.1**

[a]Fuel inputs used in the production of electricity and heat at central-station generators.

Sources: **2007:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, "Balances of OECD and Non-OECD Statistics" (2009), web site www.iea.org (subscription site). **Projections:** EIA, World Energy Projection System Plus (2010).

Table F14. Delivered energy consumption in India by end-use sector and fuel, 2007-2035
(Quadrillion Btu)

Sector/Fuel	2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
Residential							
Liquids	0.9	1.0	1.0	1.0	1.0	1.0	0.2
Natural gas	0.0	0.0	0.1	0.1	0.1	0.1	3.4
Coal	0.1	0.2	0.2	0.2	0.2	0.3	2.2
Electricity	0.5	0.8	1.1	1.3	1.6	1.9	5.1
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**1.6**	**2.0**	**2.3**	**2.6**	**2.9**	**3.2**	**2.6**
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	0.0	—
Coal	0.2	0.2	0.2	0.3	0.3	0.3	2.8
Electricity	0.2	0.3	0.4	0.5	0.6	0.8	5.5
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**0.3**	**0.5**	**0.6**	**0.8**	**0.9**	**1.1**	**4.4**
Industrial							
Liquids	3.0	2.8	3.1	3.4	3.6	3.9	1.0
Natural gas	0.9	2.1	2.5	2.6	2.6	2.6	4.0
Coal	3.3	3.5	4.3	4.6	5.0	5.3	1.7
Electricity	1.3	1.3	1.6	1.8	2.0	2.3	2.2
Renewables	1.2	1.2	1.5	1.6	1.8	2.0	1.9
Total	**9.6**	**11.0**	**12.9**	**14.0**	**15.1**	**16.2**	**1.9**
Transportation							
Liquids	1.8	2.7	3.1	3.6	4.1	4.6	3.5
Natural gas	0.1	0.1	0.1	0.1	0.1	0.1	2.1
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	2.7
Total	**1.9**	**2.8**	**3.3**	**3.7**	**4.2**	**4.8**	**3.4**
All End-Use Sectors							
Liquids	5.6	6.4	7.2	7.9	8.7	9.5	1.9
Natural gas	0.9	2.2	2.6	2.8	2.8	2.8	3.9
Coal	3.6	3.9	4.7	5.1	5.6	5.9	1.8
Electricity	1.9	2.5	3.1	3.7	4.3	5.0	3.5
Renewables	1.2	1.2	1.5	1.6	1.8	2.0	1.9
Delivered Energy	**13.3**	**16.3**	**19.1**	**21.1**	**23.1**	**25.2**	**2.3**
Electricity-Related Losses	7.0	8.0	9.0	10.0	11.0	12.4	2.1
Total	**20.3**	**24.3**	**28.2**	**31.1**	**34.1**	**37.6**	**2.2**
Electric Power[a]							
Liquids	0.2	0.2	0.2	0.2	0.2	0.2	-1.0
Natural gas	0.6	1.0	1.5	1.7	1.8	1.8	4.3
Coal	6.6	6.6	6.8	7.3	8.2	9.5	1.3
Nuclear	0.2	0.7	1.3	1.7	1.9	2.1	9.0
Renewables	1.3	2.0	2.5	2.8	3.3	3.8	3.8
Total	**8.9**	**10.5**	**12.2**	**13.7**	**15.3**	**17.4**	**2.4**
Total Energy Consumption							
Liquids	5.9	6.6	7.4	8.1	8.8	9.6	1.8
Natural gas	1.5	3.2	4.1	4.5	4.6	4.6	4.1
Coal	10.2	10.5	11.5	12.4	13.7	15.5	1.5
Nuclear	0.2	0.7	1.3	1.7	1.9	2.1	9.0
Renewables	2.5	3.2	4.0	4.5	5.1	5.8	3.0
Total	**20.3**	**24.3**	**28.2**	**31.1**	**34.1**	**37.6**	**2.2**

[a]Fuel inputs used in the production of electricity and heat at central-station generators.

Sources: **2007:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, “Balances of OECD and Non-OECD Statistics” (2009), web site www.iea.org (subscription site). **Projections:** EIA, World Energy Projection System Plus (2010).

Table F15. Delivered energy consumption in Other Non-OECD Asia by end-use sector and fuel, 2007-2035
(Quadrillion Btu)

Sector/Fuel	2007	Projections					Average annual percent change, 2007-2035
		2015	2020	2025	2030	2035	
Residential							
Liquids	0.7	0.8	0.8	0.8	0.9	0.9	1.0
Natural gas	0.3	0.5	0.6	0.6	0.7	0.8	3.5
Coal	0.0	0.0	0.0	0.0	0.0	0.0	0.5
Electricity	0.9	1.2	1.4	1.6	1.9	2.2	3.2
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**2.0**	**2.5**	**2.8**	**3.2**	**3.5**	**4.0**	**2.6**
Commercial							
Liquids	0.2	0.2	0.3	0.3	0.3	0.3	1.4
Natural gas	0.1	0.1	0.1	0.1	0.1	0.1	2.2
Coal	0.0	0.0	0.0	0.0	0.0	0.0	2.8
Electricity	0.8	1.0	1.2	1.5	1.8	2.2	3.8
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**1.1**	**1.3**	**1.6**	**1.9**	**2.2**	**2.6**	**3.3**
Industrial							
Liquids	4.1	3.7	4.0	4.6	5.3	6.1	1.4
Natural gas	3.1	4.4	4.9	5.3	5.7	6.5	2.7
Coal	2.3	2.1	2.4	2.7	3.0	3.3	1.3
Electricity	1.4	1.6	1.9	2.3	2.7	3.3	3.1
Renewables	1.4	1.5	1.7	1.9	2.2	2.6	2.2
Total	**12.3**	**13.2**	**14.9**	**16.8**	**19.0**	**21.8**	**2.1**
Transportation							
Liquids	7.1	8.8	9.8	11.1	12.5	14.0	2.5
Natural gas	0.1	0.1	0.0	0.0	0.0	0.0	-5.8
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	1.0
Total	**7.2**	**8.8**	**9.8**	**11.1**	**12.5**	**14.0**	**2.4**
All End-Use Sectors							
Liquids	12.1	13.5	14.9	16.8	19.0	21.4	2.0
Natural gas	3.5	5.0	5.6	6.0	6.6	7.4	2.7
Coal	2.3	2.2	2.4	2.7	3.1	3.4	1.3
Electricity	3.1	3.8	4.5	5.4	6.4	7.6	3.3
Renewables	1.4	1.5	1.7	1.9	2.2	2.6	2.2
Delivered Energy	**22.5**	**25.9**	**29.1**	**32.9**	**37.3**	**42.4**	**2.3**
Electricity-Related Losses	6.3	7.8	9.1	10.7	12.9	15.4	3.2
Total	**28.8**	**33.7**	**38.2**	**43.5**	**50.2**	**57.8**	**2.5**
Electric Power[a]							
Liquids	1.0	1.0	0.9	0.9	0.8	0.9	-0.7
Natural gas	3.1	3.8	4.7	5.5	5.9	6.1	2.4
Coal	3.1	3.3	3.6	4.6	6.5	9.1	3.9
Nuclear	0.4	0.6	0.9	1.1	1.3	1.4	4.7
Renewables	1.7	2.9	3.5	4.0	4.8	5.6	4.3
Total	**9.4**	**11.6**	**13.6**	**16.0**	**19.3**	**23.1**	**3.3**
Total Energy Consumption							
Liquids	13.2	14.4	15.8	17.7	19.8	22.2	1.9
Natural gas	6.7	8.8	10.3	11.6	12.5	13.5	2.6
Coal	5.4	5.5	6.0	7.3	9.6	12.4	3.0
Nuclear	0.4	0.6	0.9	1.1	1.3	1.4	4.7
Renewables	3.1	4.3	5.2	5.9	7.0	8.2	3.5
Total	**28.8**	**33.7**	**38.2**	**43.5**	**50.2**	**57.8**	**2.5**

[a]Fuel inputs used in the production of electricity and heat at central-station generators.

Sources: **2007:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, “Balances of OECD and Non-OECD Statistics” (2009), web site www.iea.org (subscription site). **Projections:** EIA, World Energy Projection System Plus (2010).

Table F16. Delivered energy consumption in the Middle East by end-use sector and fuel, 2007-2035
(Quadrillion Btu)

Sector/Fuel	2007	Projections					Average annual percent change, 2007-2035
		2015	2020	2025	2030	2035	
Residential							
Liquids	0.8	0.9	0.9	0.9	1.0	1.0	0.7
Natural gas	1.5	2.3	2.3	2.2	2.0	2.0	0.9
Coal	0.0	0.0	0.0	0.0	0.0	0.0	-2.4
Electricity	0.9	1.2	1.3	1.5	1.7	1.9	2.5
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**3.3**	**4.4**	**4.6**	**4.6**	**4.7**	**4.9**	**1.4**
Commercial							
Liquids	0.2	0.2	0.2	0.3	0.3	0.3	1.9
Natural gas	0.2	0.4	0.4	0.4	0.3	0.3	1.9
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.5	0.7	0.8	1.0	1.1	1.3	3.2
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**0.9**	**1.3**	**1.4**	**1.6**	**1.7**	**1.9**	**2.7**
Industrial							
Liquids	3.9	3.7	4.1	4.7	5.5	6.2	1.6
Natural gas	5.3	9.0	10.3	10.4	10.4	10.9	2.6
Coal	0.0	0.0	0.0	0.0	0.0	0.0	1.1
Electricity	0.6	0.6	0.7	0.8	0.8	0.9	1.7
Renewables	0.0	0.0	0.1	0.1	0.1	0.1	0.6
Total	**9.9**	**13.4**	**15.2**	**16.0**	**16.8**	**18.1**	**2.2**
Transportation							
Liquids	5.8	7.8	8.7	9.6	10.8	12.5	2.8
Natural gas	0.0	0.0	0.0	0.0	0.0	0.1	1.0
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	—
Total	**5.8**	**7.8**	**8.7**	**9.7**	**10.9**	**12.5**	**2.8**
All End-Use Sectors							
Liquids	10.7	12.7	13.9	15.6	17.6	20.0	2.3
Natural gas	7.1	11.7	13.1	13.1	12.8	13.3	2.3
Coal	0.0	0.0	0.0	0.0	0.0	0.0	1.1
Electricity	2.0	2.5	2.8	3.2	3.6	4.0	2.5
Renewables	0.0	0.0	0.1	0.1	0.1	0.1	0.6
Delivered Energy	**19.9**	**26.9**	**29.9**	**31.9**	**34.1**	**37.4**	**2.3**
Electricity-Related Losses	5.2	0.0	0.0	0.0	0.0	0.0	—
Total	**25.1**	**32.9**	**36.5**	**39.1**	**41.8**	**45.7**	**2.2**
Electric Power[a]							
Liquids	2.6	2.4	2.2	2.1	2.1	2.7	0.3
Natural gas	4.1	5.3	6.2	7.2	7.9	8.2	2.5
Coal	0.3	0.3	0.3	0.3	0.3	0.3	-0.4
Nuclear	0.0	0.1	0.2	0.3	0.4	0.5	—
Renewables	0.2	0.4	0.4	0.5	0.5	0.6	3.4
Total	**7.2**	**8.4**	**9.4**	**10.4**	**11.3**	**12.3**	**1.9**
Total Energy Consumption							
Liquids	13.3	15.0	16.1	17.7	19.7	22.7	1.9
Natural gas	11.2	17.0	19.3	20.2	20.7	21.5	2.4
Coal	0.4	0.4	0.3	0.3	0.3	0.4	-0.2
Nuclear	0.0	0.1	0.2	0.3	0.4	0.5	—
Renewables	0.3	0.4	0.5	0.5	0.6	0.6	3.1
Total	**25.1**	**32.9**	**36.5**	**39.1**	**41.8**	**45.7**	**2.2**

[a]Fuel inputs used in the production of electricity and heat at central-station generators.

Sources: **2007:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, "Balances of OECD and Non-OECD Statistics" (2009), web site www.iea.org (subscription site). **Projections:** EIA, World Energy Projection System Plus (2010).

Table F17. Delivered energy consumption in Africa by end-use sector and fuel, 2007-2035
(Quadrillion Btu)

Sector/Fuel	2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
Residential							
Liquids	0.8	0.9	0.9	0.9	1.0	1.0	1.1
Natural gas	0.2	0.3	0.4	0.4	0.4	0.5	3.1
Coal	0.1	0.1	0.2	0.2	0.2	0.2	2.3
Electricity	0.5	0.7	0.8	0.9	1.1	1.2	2.9
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**1.6**	**2.0**	**2.2**	**2.4**	**2.7**	**2.9**	**2.1**
Commercial							
Liquids	0.1	0.1	0.1	0.1	0.1	0.1	1.3
Natural gas	0.0	0.0	0.0	0.0	0.0	0.0	4.1
Coal	0.1	0.1	0.1	0.1	0.1	0.1	2.0
Electricity	0.3	0.3	0.4	0.5	0.6	0.7	3.6
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**3.0**
Industrial							
Liquids	1.5	1.4	1.3	1.4	1.5	1.6	0.2
Natural gas	1.4	2.3	2.5	2.7	2.6	2.8	2.5
Coal	1.2	1.1	1.2	1.2	1.3	1.3	0.4
Electricity	1.0	1.1	1.3	1.5	1.6	1.8	2.3
Renewables	2.7	2.9	3.1	3.4	3.6	3.8	1.2
Total	**7.7**	**8.8**	**9.4**	**10.1**	**10.6**	**11.3**	**1.4**
Transportation							
Liquids	3.4	4.3	4.5	5.0	5.6	6.2	2.2
Natural gas	0.1	0.1	0.1	0.1	0.1	0.1	2.1
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	2.8
Total	**3.5**	**4.4**	**4.6**	**5.1**	**5.7**	**6.3**	**2.2**
All End-Use Sectors							
Liquids	5.7	6.6	6.8	7.4	8.1	8.9	1.6
Natural gas	1.7	2.7	3.0	3.2	3.1	3.4	2.6
Coal	1.3	1.3	1.4	1.5	1.6	1.6	0.7
Electricity	1.8	2.2	2.5	2.9	3.3	3.7	2.7
Renewables	2.7	2.9	3.1	3.4	3.6	3.8	1.2
Delivered Energy	**13.2**	**15.7**	**16.8**	**18.4**	**19.7**	**21.4**	**1.7**
Electricity-Related Losses	4.6	5.2	5.6	6.2	6.8	7.6	1.8
Total	**17.8**	**20.8**	**22.5**	**24.6**	**26.5**	**29.0**	**1.8**
Electric Power[a]							
Liquids	0.7	0.6	0.6	0.6	0.5	0.5	-1.0
Natural gas	1.7	2.4	3.1	3.7	3.9	4.0	3.2
Coal	2.9	2.9	3.0	3.2	3.7	4.6	1.6
Nuclear	0.1	0.2	0.2	0.2	0.2	0.3	3.6
Renewables	1.0	1.3	1.4	1.5	1.7	1.9	2.4
Total	**6.4**	**7.3**	**8.2**	**9.2**	**10.1**	**11.3**	**2.1**
Total Energy Consumption							
Liquids	6.4	7.2	7.4	8.0	8.7	9.4	1.4
Natural gas	3.3	5.1	6.1	6.9	7.1	7.4	2.9
Coal	4.2	4.2	4.3	4.7	5.3	6.2	1.4
Nuclear	0.1	0.2	0.2	0.2	0.2	0.3	3.6
Renewables	3.7	4.2	4.5	4.9	5.3	5.8	1.6
Total	**17.8**	**20.8**	**22.5**	**24.6**	**26.5**	**29.0**	**1.8**

[a]Fuel inputs used in the production of electricity and heat at central-station generators.

Sources: **2007:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, “Balances of OECD and Non-OECD Statistics” (2009), web site www.iea.org (subscription site). **Projections:** EIA, World Energy Projection System Plus (2010).

Table F18. Delivered energy consumption in Brazil by end-use sector and fuel, 2007-2035
(Quadrillion Btu)

Sector/Fuel	2007	Projections					Average annual percent change, 2007-2035
		2015	2020	2025	2030	2035	
Residential							
Liquids	0.3	0.3	0.3	0.4	0.4	0.4	1.5
Natural gas	0.0	0.0	0.0	0.0	0.0	0.0	6.4
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.3	0.5	0.6	0.7	0.8	0.9	3.4
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**0.6**	**0.8**	**0.9**	**1.1**	**1.2**	**1.3**	**2.8**
Commercial							
Liquids	0.0	0.1	0.1	0.1	0.1	0.1	1.6
Natural gas	0.0	0.0	0.0	0.0	0.0	0.0	4.1
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.3	0.5	0.7	0.8	1.0	1.0	3.9
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**0.4**	**0.6**	**0.8**	**0.9**	**1.1**	**1.1**	**3.7**
Industrial							
Liquids	1.8	1.9	2.1	2.4	2.8	3.2	2.1
Natural gas	0.4	0.5	0.6	0.6	0.6	0.7	1.6
Coal	0.4	0.4	0.5	0.7	0.9	1.1	3.6
Electricity	0.7	0.7	0.8	1.0	1.1	1.2	2.2
Renewables	2.3	2.5	2.8	3.1	3.5	3.9	1.8
Total	**5.6**	**6.1**	**6.8**	**7.8**	**8.8**	**10.1**	**2.1**
Transportation							
Liquids	2.7	3.4	3.6	3.9	4.2	4.4	1.8
Natural gas	0.1	0.1	0.1	0.1	0.2	0.2	3.3
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	2.2
Total	**2.8**	**3.5**	**3.7**	**4.0**	**4.4**	**4.6**	**1.8**
All End-Use Sectors							
Liquids	4.8	5.7	6.1	6.7	7.4	8.0	1.9
Natural gas	0.5	0.7	0.8	0.8	0.9	1.0	2.1
Coal	0.4	0.4	0.5	0.7	0.9	1.1	3.6
Electricity	1.4	1.8	2.1	2.5	2.8	3.1	3.0
Renewables	2.3	2.5	2.8	3.1	3.5	3.9	1.8
Delivered Energy	**9.4**	**11.0**	**12.3**	**13.8**	**15.5**	**17.1**	**2.2**
Electricity-Related Losses	2.9	3.8	4.6	5.5	6.4	7.2	3.3
Total	**12.3**	**14.9**	**16.9**	**19.3**	**21.9**	**24.3**	**2.4**
Electric Power[a]							
Liquids	0.1	0.1	0.1	0.1	0.1	0.1	-1.0
Natural gas	0.2	0.4	0.8	1.0	1.3	1.4	7.4
Coal	0.1	0.1	0.1	0.1	0.1	0.1	2.1
Nuclear	0.1	0.2	0.2	0.3	0.3	0.4	4.4
Renewables	3.8	4.8	5.6	6.6	7.6	8.3	2.8
Total	**4.3**	**5.6**	**6.7**	**8.0**	**9.3**	**10.3**	**3.2**
Total Energy Consumption							
Liquids	4.8	5.8	6.2	6.7	7.5	8.1	1.9
Natural gas	0.7	1.1	1.5	1.8	2.1	2.4	4.3
Coal	0.5	0.5	0.6	0.8	1.0	1.2	3.4
Nuclear	0.1	0.2	0.2	0.3	0.3	0.4	4.4
Renewables	6.2	7.3	8.4	9.7	11.0	12.2	2.4
Total	**12.3**	**14.9**	**16.9**	**19.3**	**21.9**	**24.3**	**2.4**

[a]Fuel inputs used in the production of electricity and heat at central-station generators.

Sources: **2007:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, "Balances of OECD and Non-OECD Statistics" (2009), web site www.iea.org (subscription site). **Projections:** EIA, World Energy Projection System Plus (2010).

Table F19. Delivered energy consumption in Other Central and South America by end-use sector and fuel, 2007-2035
(Quadrillion Btu)

Sector/Fuel	2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
Residential							
Liquids	0.4	0.5	0.5	0.5	0.5	0.5	0.8
Natural gas	0.5	0.6	0.7	0.7	0.6	0.7	1.5
Coal	0.0	0.0	0.0	0.0	0.0	0.0	0.6
Electricity	0.5	0.6	0.6	0.7	0.7	0.8	1.6
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**1.4**	**1.7**	**1.8**	**1.8**	**1.9**	**2.0**	**1.3**
Commercial							
Liquids	0.1	0.1	0.1	0.1	0.1	0.1	1.0
Natural gas	0.1	0.1	0.1	0.1	0.1	0.1	0.0
Coal	0.0	0.0	0.0	0.0	0.0	0.0	—
Electricity	0.3	0.4	0.4	0.5	0.6	0.6	2.0
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	—
Total	**0.5**	**0.6**	**0.6**	**0.7**	**0.7**	**0.8**	**1.6**
Industrial							
Liquids	2.4	2.2	2.1	2.2	2.2	2.1	-0.4
Natural gas	2.4	2.7	3.3	3.3	3.4	3.6	1.5
Coal	0.0	0.0	0.0	0.1	0.1	0.1	1.0
Electricity	0.7	0.7	0.8	0.8	0.9	0.9	1.3
Renewables	0.6	0.7	0.8	0.9	0.9	1.0	1.7
Total	**6.1**	**6.4**	**7.0**	**7.2**	**7.4**	**7.7**	**0.9**
Transportation							
Liquids	3.5	4.0	4.0	4.2	4.5	4.8	1.1
Natural gas	0.2	0.2	0.3	0.3	0.3	0.4	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	2.5
Total	**3.7**	**4.3**	**4.3**	**4.5**	**4.8**	**5.2**	**1.2**
All End-Use Sectors							
Liquids	6.4	6.8	6.7	6.9	7.2	7.5	0.6
Natural gas	3.1	3.7	4.4	4.4	4.4	4.8	1.6
Coal	0.0	0.0	0.0	0.1	0.1	0.1	1.0
Electricity	1.5	1.7	1.9	2.0	2.2	2.3	1.6
Renewables	0.6	0.7	0.8	0.9	0.9	1.0	1.7
Delivered Energy	**11.6**	**12.9**	**13.7**	**14.2**	**14.9**	**15.7**	**1.1**
Electricity-Related Losses	4.0	0.0	0.0	0.0	0.0	0.0	—
Total	**15.7**	**17.2**	**18.6**	**19.3**	**20.3**	**21.4**	**1.1**
Electric Power[a]							
Liquids	0.9	0.9	0.8	0.8	0.7	0.7	-1.0
Natural gas	1.1	1.2	1.5	1.8	1.9	1.9	2.1
Coal	0.4	0.4	0.4	0.4	0.4	0.4	0.0
Nuclear	0.1	0.1	0.1	0.1	0.1	0.2	3.9
Renewables	3.0	3.5	3.8	4.1	4.5	4.8	1.7
Total	**5.5**	**6.1**	**6.7**	**7.1**	**7.6**	**8.1**	**1.4**
Total Energy Consumption							
Liquids	7.3	7.6	7.5	7.7	8.0	8.2	0.4
Natural gas	4.2	4.9	5.9	6.2	6.3	6.7	1.7
Coal	0.5	0.4	0.4	0.4	0.4	0.5	0.1
Nuclear	0.1	0.1	0.1	0.1	0.1	0.2	3.9
Renewables	3.6	4.2	4.6	5.0	5.4	5.8	1.7
Total	**15.7**	**17.2**	**18.6**	**19.3**	**20.3**	**21.4**	**1.1**

[a]Fuel inputs used in the production of electricity and heat at central-station generators.

Sources: **2007:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international; and International Energy Agency, “Balances of OECD and Non-OECD Statistics” (2009), web site www.iea.org (subscription site). **Projections:** EIA, World Energy Projection System Plus (2010).

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Appendix G

Projections of Liquid Fuels and Other Petroleum Production in Five Cases:

- Reference
- High Oil Price
- Low Oil Price
- High Economic Growth
- Low Economic Growth

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Table G1. World total liquids production by region and country, Reference case, 2006-2035
(Million barrels per day)

Region/Country	History (estimates) 2006	2007	2008	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OPEC[a]	**34.7**	**34.4**	**35.6**	**37.4**	**38.8**	**41.2**	**43.9**	**47.0**	**1.1**
Middle East	**23.6**	**23.1**	**24.2**	**25.2**	**26.4**	**28.5**	**31.3**	**34.3**	**1.4**
Iran	4.1	4.0	4.2	3.9	3.7	3.6	3.6	3.7	-0.3
Iraq	2.0	2.1	2.4	2.6	3.1	3.9	5.1	6.1	3.9
Kuwait	2.7	2.6	2.7	2.9	3.0	3.2	3.6	3.9	1.4
Qatar	1.1	1.1	1.2	1.8	2.1	2.3	2.5	2.5	2.8
Saudi Arabia	10.7	10.2	10.7	10.7	11.2	12.1	13.3	15.1	1.4
United Arab Emirates	2.9	2.9	3.0	3.4	3.4	3.4	3.2	3.1	0.2
North Africa	**3.9**	**4.0**	**4.1**	**4.4**	**4.1**	**4.3**	**4.5**	**4.6**	**0.5**
Algeria	2.1	2.2	2.2	2.6	2.8	2.9	3.0	3.0	1.2
Libya	1.8	1.8	1.9	1.7	1.4	1.4	1.5	1.6	-0.5
West Africa	3.9	4.1	4.2	5.1	5.4	5.5	5.3	5.1	0.8
Angola	1.4	1.8	2.0	2.4	2.5	2.5	2.3	2.1	0.6
Nigeria	2.4	2.4	2.2	2.8	2.9	3.1	3.0	3.0	0.9
South America	3.3	3.2	3.1	2.7	2.8	2.8	2.8	2.8	-0.4
Ecuador	0.5	0.5	0.5	0.4	0.4	0.4	0.5	0.5	-0.4
Venezuela	2.7	2.7	2.6	2.3	2.4	2.4	2.4	2.4	-0.4
Non-OPEC	**50.0**	**50.4**	**49.9**	**51.3**	**53.3**	**56.5**	**60.0**	**63.6**	**0.8**
OECD	**21.7**	**21.6**	**20.9**	**20.5**	**20.6**	**20.9**	**21.8**	**23.3**	**0.3**
OECD North America	**15.3**	**15.4**	**15.0**	**16.2**	**16.9**	**17.3**	**18.3**	**19.8**	**0.9**
United States	8.3	8.5	8.4	9.9	10.6	10.8	10.9	11.4	1.1
Canada	3.3	3.4	3.4	4.2	4.6	5.2	5.9	6.8	2.5
Mexico	3.7	3.5	3.2	2.1	1.6	1.4	1.5	1.6	-2.8
OECD Europe	**5.6**	**5.4**	**5.2**	**3.5**	**3.1**	**2.9**	**2.9**	**2.9**	**-2.3**
OECD Asia	**0.7**	**0.8**	**0.8**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**-0.5**
Japan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.2
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3
Australia and New Zealand	0.6	0.6	0.7	0.6	0.5	0.5	0.5	0.5	-0.6
Non-OECD	**28.3**	**28.8**	**29.0**	**30.8**	**32.7**	**35.5**	**38.2**	**40.3**	**1.2**
Non-OECD Europe and Eurasia	**12.3**	**12.8**	**12.7**	**13.1**	**13.8**	**15.0**	**16.4**	**17.6**	**1.2**
Russia	9.7	9.9	9.8	9.5	9.8	10.6	11.8	12.8	0.9
Caspian Area	2.3	2.6	2.6	3.4	3.8	4.2	4.5	4.6	2.1
Other	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	-1.4
Non-OECD Asia	**7.9**	**7.8**	**7.8**	**7.4**	**7.4**	**7.8**	**7.9**	**7.9**	**0.0**
China	4.0	4.1	4.0	3.8	4.0	4.5	4.7	4.8	0.6
India	0.9	0.9	0.9	1.0	1.0	1.1	1.1	1.2	1.0
Other	3.0	2.9	2.9	2.5	2.4	2.2	2.1	2.0	-1.3
Middle East (Non-OPEC)	**1.6**	**1.5**	**1.5**	**1.6**	**1.5**	**1.4**	**1.4**	**1.3**	**-0.5**
Africa	2.5	2.6	2.6	2.9	3.2	3.4	3.5	3.6	1.1
Central and South America	**4.0**	**4.1**	**4.3**	**5.9**	**7.0**	**7.9**	**8.9**	**9.8**	**3.2**
Brazil	2.1	2.3	2.4	3.7	4.8	5.5	6.3	7.2	4.2
Other	1.8	1.8	1.9	2.2	2.2	2.4	2.6	2.7	1.4
Total World	**84.7**	**84.8**	**85.5**	**88.7**	**92.1**	**97.6**	**103.9**	**110.6**	**1.0**
OPEC Share of World Production	41%	41%	42%	42%	42%	42%	42%	42%	
Persian Gulf Share of World Production	28%	27%	28%	28%	29%	29%	30%	31%	

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-12).
Note: Conventional liquids include crude oil and lease condensates, natural gas plant liquids, and refinery gains.
Sources: **History:** U.S. Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2010).

Table G2. World conventional liquids production by region and country, Reference case, 2006-2035
(Million barrels per day)

Region/Country	History (estimates) 2006	2007	2008	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OPEC[a]	**34.1**	**33.8**	**35.0**	**36.4**	**37.5**	**39.7**	**42.3**	**45.3**	**1.0**
Middle East	**23.6**	**23.1**	**24.2**	**25.0**	**26.2**	**28.2**	**31.0**	**34.1**	**1.4**
Iran	4.1	4.0	4.2	3.9	3.7	3.6	3.6	3.7	-0.3
Iraq	2.0	2.1	2.4	2.6	3.1	3.9	5.1	6.1	3.9
Kuwait	2.7	2.6	2.7	2.9	3.0	3.2	3.6	3.9	1.4
Qatar	1.1	1.1	1.2	1.6	1.9	2.0	2.2	2.2	2.5
Saudi Arabia	10.7	10.2	10.7	10.7	11.2	12.1	13.3	15.1	1.4
United Arab Emirates	2.9	2.9	3.0	3.4	3.4	3.4	3.2	3.1	0.2
North Africa	**3.9**	**4.0**	**4.1**	**4.4**	**4.1**	**4.3**	**4.5**	**4.6**	**0.5**
Algeria	2.1	2.2	2.2	2.6	2.8	2.9	3.0	3.0	1.2
Libya	1.8	1.8	1.9	1.7	1.4	1.4	1.5	1.6	-0.5
West Africa	**3.9**	**4.1**	**4.2**	**5.1**	**5.4**	**5.5**	**5.3**	**5.1**	**0.8**
Angola	1.4	1.8	2.0	2.4	2.5	2.5	2.3	2.1	0.6
Nigeria	2.4	2.4	2.2	2.7	2.9	3.0	3.0	3.0	0.9
South America	**2.7**	**2.6**	**2.5**	**1.9**	**1.8**	**1.7**	**1.5**	**1.4**	**-2.1**
Ecuador	0.5	0.5	0.5	0.4	0.4	0.4	0.5	0.5	-0.4
Venezuela	2.1	2.1	2.0	1.5	1.3	1.2	1.1	1.0	-2.7
Non-OPEC	**47.7**	**47.7**	**46.6**	**46.2**	**47.0**	**48.8**	**50.8**	**52.5**	**0.3**
OECD	**20.0**	**19.6**	**18.5**	**16.8**	**16.2**	**15.7**	**15.6**	**15.5**	**-0.8**
OECD North America	**13.8**	**13.6**	**12.8**	**12.7**	**12.7**	**12.3**	**12.4**	**12.3**	**-0.4**
United States	8.0	8.0	7.8	8.9	9.4	9.3	9.4	9.2	0.5
Canada	2.1	2.1	1.8	1.8	1.7	1.7	1.6	1.6	-0.9
Mexico	3.7	3.5	3.2	2.1	1.6	1.3	1.4	1.5	-2.9
OECD Europe	**5.5**	**5.2**	**5.0**	**3.3**	**2.8**	**2.7**	**2.6**	**2.6**	**-2.5**
Denmark	0.3	0.3	0.3	0.2	0.1	0.1	0.1	0.1	-3.9
Norway	2.8	2.6	2.5	1.8	1.5	1.4	1.3	1.3	-2.3
United Kngdom	1.7	1.7	1.6	0.8	0.6	0.6	0.6	0.6	-3.5
Other	0.7	0.7	0.6	0.5	0.5	0.5	0.5	0.5	-0.8
OECD Asia	**0.7**	**0.8**	**0.8**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**-0.5**
Japan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.2
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
Australia and New Zealand	0.6	0.6	0.7	0.6	0.5	0.5	0.5	0.5	-0.6

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-12).

Table G2. World conventional liquids production by region and country, Reference case, 2006-2035 (continued)
(Million barrels per day)

Region/Country	History (estimates) 2006	2007	2008	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
Non-OECD	**27.7**	**28.1**	**28.1**	**29.4**	**30.9**	**33.1**	**35.1**	**36.9**	**1.0**
Non-OECD Europe and Eurasia	**12.3**	**12.8**	**12.7**	**13.1**	**13.8**	**15.0**	**16.4**	**17.6**	**1.2**
Russia	**9.7**	**9.9**	**9.8**	**9.5**	**9.8**	**10.6**	**11.8**	**12.8**	**0.9**
Caspian Area	**2.3**	**2.6**	**2.6**	**3.4**	**3.8**	**4.2**	**4.5**	**4.6**	**2.1**
Azerbaijan	0.6	0.8	0.9	1.2	1.3	1.2	1.2	1.1	0.8
Kazakhstan	1.4	1.4	1.4	1.9	2.3	2.6	2.9	3.1	2.8
Turkmenistan	0.2	0.2	0.2	0.2	0.2	0.3	0.4	0.4	2.6
Uzbekistan	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	-3.3
Other	**0.3**	**0.3**	**0.3**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**-1.6**
Non-OECD Asia	**7.7**	**7.7**	**7.7**	**7.2**	**7.1**	**7.2**	**7.0**	**6.7**	**-0.5**
China	3.9	3.9	4.0	3.8	3.8	4.1	4.0	3.8	-0.1
India	0.9	0.9	0.9	1.0	0.9	1.0	1.0	1.0	0.6
Brunei	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	-2.4
Malaysia	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.6	-0.7
Thailand	0.3	0.3	0.4	0.4	0.4	0.4	0.3	0.3	-0.2
Vietnam	0.4	0.4	0.3	0.4	0.3	0.3	0.3	0.2	-1.3
Other	1.4	1.3	1.3	1.0	0.9	0.8	0.7	0.7	-2.1
Middle East (Non-OPEC)	**1.6**	**1.5**	**1.5**	**1.6**	**1.5**	**1.4**	**1.4**	**1.3**	**-0.5**
Oman	0.7	0.7	0.8	0.9	0.8	0.8	0.8	0.8	0.2
Syria	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	-1.8
Yemen	0.4	0.3	0.3	0.2	0.2	0.2	0.1	0.1	-2.9
Other	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	4.0
Africa	**2.4**	**2.4**	**2.4**	**2.7**	**2.8**	**3.0**	**3.1**	**3.2**	**1.0**
Chad	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-3.4
Congo (Brazzaville)	0.2	0.2	0.2	0.3	0.3	0.2	0.2	0.2	0.0
Egypt	0.7	0.7	0.6	0.5	0.6	0.7	0.7	0.7	0.1
Equatorial Guniea	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	-0.3
Gabon	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	-1.4
Sao Tome and Principe	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	—
Sudan	0.4	0.5	0.5	0.5	0.6	0.7	0.8	0.9	2.4
Other	0.3	0.3	0.3	0.7	0.7	0.8	0.8	0.8	3.3
Central and South America	**3.7**	**3.7**	**3.8**	**4.9**	**5.7**	**6.4**	**7.3**	**8.1**	**2.8**
Brazil	1.9	1.9	1.9	2.8	3.6	4.1	4.7	5.5	3.8
Argentina	0.8	0.8	0.8	0.6	0.6	0.6	0.5	0.5	-1.4
Colombia	0.5	0.5	0.6	0.8	0.7	0.7	0.7	0.6	0.6
Peru	0.1	0.1	0.1	0.2	0.3	0.3	0.4	0.4	4.2
Trinidad and Tobago	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.0
Other	0.2	0.2	0.2	0.2	0.3	0.5	0.8	0.8	5.6
Total World	**81.8**	**81.4**	**81.6**	**82.6**	**84.5**	**88.5**	**93.1**	**97.7**	**0.7**
OPEC Share of World Production	42%	41%	43%	44%	44%	45%	45%	46%	
Persian Gulf Share of World Production	29%	28%	30%	30%	31%	32%	33%	35%	

Note: Conventional liquids include crude oil and lease condensate, natural gas plant liquids, and refinery gain.
Sources: **History:** U.S. Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2010).

Table G3. World unconventional liquids production by region and country, Reference case, 2006-2035
(Million barrels per day)

Region/Country	History (estimates)			Projections					Average annual percent change, 2007-2035
	2006	2007	2008	2015	2020	2025	2030	2035	
OPEC[a]	**0.6**	**0.6**	**0.7**	**1.0**	**1.3**	**1.4**	**1.6**	**1.7**	**3.8**
Biofuels	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Extra-Heavy Oil (Venezuela)	0.6	0.6	0.7	0.8	1.1	1.2	1.3	1.4	3.1
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	0.2	0.2	0.3	0.3	0.3	15.4
Non-OPEC	**2.3**	**2.8**	**3.3**	**5.1**	**6.3**	**7.7**	**9.2**	**11.2**	**5.1**
OECD	**1.7**	**2.0**	**2.4**	**3.7**	**4.4**	**5.2**	**6.2**	**7.8**	**4.9**
Biofuels	0.5	0.6	0.9	1.3	1.4	1.5	1.6	1.9	4.0
Oil Sands/Bitumen (Canada)	1.2	1.4	1.5	2.4	2.9	3.5	4.2	5.2	4.8
Extra-Heavy Oil (Mexico)	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	9.8
Coal-to-Liquids	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.2	21.3
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	0.1	0.1	0.4	—
Non-OECD	**0.6**	**0.7**	**0.9**	**1.4**	**1.9**	**2.4**	**3.0**	**3.4**	**5.6**
Biofuels	0.4	0.5	0.6	1.1	1.4	1.7	2.0	2.1	5.1
Extra-Heavy Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Coal-to-Liquids	0.1	0.2	0.2	0.2	0.4	0.7	0.9	1.1	7.2
Gas-to-Liquids	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	2.3
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
World									
Biofuels	0.9	1.2	1.5	2.4	2.8	3.2	3.5	4.1	4.6
Oil Sands/Bitumen	1.2	1.4	1.5	2.4	2.9	3.5	4.2	5.2	4.8
Extra-Heavy Oil	0.6	0.6	0.7	0.8	1.1	1.2	1.4	1.5	3.3
Coal-to-Liquids	0.1	0.2	0.2	0.3	0.5	0.8	1.1	1.4	7.9
Gas-to-Liquids	0.0	0.1	0.1	0.3	0.3	0.3	0.4	0.4	7.3
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.4	15.6
World Total	**2.9**	**3.4**	**3.9**	**6.1**	**7.6**	**9.1**	**10.8**	**12.9**	**4.9**
Selected Country Highlights									
Biofuels									
Brazil	0.3	0.3	0.5	0.9	1.1	1.4	1.5	1.7	5.9
China	0.1	0.2	0.0	0.0	0.1	0.1	0.2	0.3	1.7
India	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.6
United States	0.3	0.5	0.7	1.0	1.1	1.2	1.2	1.6	4.6
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	0.1	0.3	0.5	0.7	—
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	0.1	0.1	0.1	—
South Africa	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	2.0
United States	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.2	—
Gas-to-Liquids									
Qatar	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.2	14.9
South Africa	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	1.0

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-12).

Sources: **History:** U.S. Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2010).

Table G4. World total liquids production by region and country, High Oil Price case, 2006-2035
(Million barrels per day)

Region/Country	History (estimates) 2006	2007	2008	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OPEC[a]	**34.7**	**34.4**	**35.6**	**32.0**	**30.6**	**31.1**	**31.7**	**33.0**	**-0.1**
Middle East	**23.6**	**23.1**	**24.2**	**21.8**	**21.3**	**22.0**	**23.0**	**24.6**	**0.2**
Iran	4.1	4.0	4.2	3.3	2.9	2.7	2.6	2.6	-1.6
Iraq	2.0	2.1	2.4	2.4	2.5	2.8	3.6	4.2	2.5
Kuwait	2.7	2.6	2.7	2.4	2.3	2.4	2.6	2.7	0.1
Qatar	1.1	1.1	1.2	1.6	1.7	1.8	1.9	1.9	1.9
Saudi Arabia	10.7	10.2	10.7	9.3	9.2	9.6	10.0	11.0	0.3
United Arab Emirates	2.9	2.9	3.0	3.0	2.7	2.6	2.3	2.2	-1.0
North Africa	**3.9**	**4.0**	**4.1**	**3.8**	**3.3**	**3.3**	**3.3**	**3.4**	**-0.6**
Algeria	2.1	2.2	2.2	2.3	2.3	2.3	2.3	2.2	0.1
Libya	1.8	1.8	1.9	1.5	1.1	1.0	1.1	1.1	-1.7
West Africa	**3.9**	**4.1**	**4.2**	**4.3**	**4.2**	**4.1**	**3.7**	**3.5**	**-0.5**
Angola	1.4	1.8	2.0	2.0	1.9	1.9	1.6	1.5	-0.6
Nigeria	2.4	2.4	2.2	2.3	2.2	2.2	2.1	2.1	-0.5
South America	**3.3**	**3.2**	**3.1**	**2.1**	**1.8**	**1.7**	**1.6**	**1.5**	**-2.7**
Ecuador	0.5	0.5	0.5	0.3	0.3	0.3	0.3	0.3	-1.7
Venezuela	2.7	2.7	2.6	1.8	1.5	1.4	1.3	1.2	-2.9
Non-OPEC	**50.0**	**50.4**	**49.9**	**51.4**	**51.5**	**54.6**	**58.8**	**62.5**	**0.8**
OECD	**21.7**	**21.6**	**20.9**	**22.1**	**23.4**	**25.0**	**26.6**	**27.8**	**0.9**
OECD North America	**15.3**	**15.4**	**15.0**	**17.7**	**19.7**	**21.5**	**23.2**	**24.3**	**1.6**
United States	8.3	8.5	8.4	10.3	11.7	13.0	14.1	14.6	1.9
Canada	3.3	3.4	3.4	5.5	6.7	7.4	8.0	8.6	3.3
Mexico	3.7	3.5	3.2	1.9	1.3	1.0	1.1	1.2	-3.8
OECD Europe	**5.6**	**5.4**	**5.2**	**3.7**	**3.0**	**2.9**	**2.8**	**2.8**	**-2.3**
OECD Asia	**0.7**	**0.8**	**0.8**	**0.7**	**0.7**	**0.6**	**0.6**	**0.7**	**-0.7**
Japan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-1.0
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
Australia and New Zealand	0.6	0.6	0.7	0.6	0.5	0.5	0.5	0.5	-0.6
Non-OECD	**28.3**	**28.8**	**29.0**	**29.3**	**28.2**	**29.7**	**32.1**	**34.7**	**0.7**
Non-OECD Europe and Eurasia	**12.3**	**12.8**	**12.7**	**11.2**	**10.0**	**10.2**	**11.0**	**12.0**	**-0.2**
Russia	9.7	9.9	9.8	8.1	7.0	7.2	7.8	8.6	-0.5
Caspian Area	2.3	2.6	2.6	2.9	2.8	2.9	3.0	3.1	0.7
Other	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	-1.4
Non-OECD Asia	**7.9**	**7.8**	**7.8**	**7.8**	**7.4**	**7.9**	**8.6**	**9.2**	**0.6**
China	4.0	4.1	4.0	4.1	4.0	4.7	5.4	6.1	1.4
India	0.9	0.9	0.9	1.1	1.0	1.1	1.1	1.1	0.9
Other	3.0	2.9	2.9	2.7	2.4	2.2	2.1	2.0	-1.2
Middle East (Non-OPEC)	**1.6**	**1.5**	**1.5**	**1.7**	**1.5**	**1.4**	**1.3**	**1.4**	**-0.4**
Africa	**2.5**	**2.6**	**2.6**	**3.1**	**3.2**	**3.3**	**3.5**	**3.7**	**1.2**
Central and South America	**4.0**	**4.1**	**4.3**	**5.6**	**6.1**	**6.8**	**7.6**	**8.4**	**2.6**
Brazil	2.1	2.3	2.4	3.3	3.9	4.4	5.0	5.7	3.3
Other	1.8	1.8	1.9	2.3	2.2	2.3	2.6	2.7	1.5
Total World	**84.7**	**84.8**	**85.5**	**83.4**	**82.1**	**85.7**	**90.4**	**95.5**	**0.4**
OPEC Share of World Production	41%	41%	42%	38%	37%	36%	35%	35%	
Persian Gulf Share of World Production	28%	27%	28%	26%	26%	26%	25%	26%	

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-12).

Sources: **History:** U.S. Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2010).

Table G5. World conventional liquids production by region and country, High Oil Price case, 2006-2035
(Million barrels per day)

Region/Country	History (estimates) 2006	2007	2008	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OPEC[a]	**34.1**	**33.8**	**35.0**	**31.4**	**30.0**	**30.5**	**31.0**	**32.4**	**-0.2**
Middle East	**23.6**	**23.1**	**24.2**	**21.7**	**21.1**	**21.8**	**22.8**	**24.4**	**0.2**
Iran	4.1	4.0	4.2	3.3	2.9	2.7	2.6	2.6	-1.6
Iraq	2.0	2.1	2.4	2.4	2.5	2.8	3.6	4.2	2.5
Kuwait	2.7	2.6	2.7	2.4	2.3	2.4	2.6	2.7	0.1
Qatar	1.1	1.1	1.2	1.4	1.5	1.6	1.7	1.7	1.5
Saudi Arabia	10.7	10.2	10.7	9.3	9.2	9.6	10.0	11.0	0.3
United Arab Emirates	2.9	2.9	3.0	3.0	2.7	2.6	2.3	2.2	-1.0
North Africa	**3.9**	**4.0**	**4.1**	**3.8**	**3.3**	**3.3**	**3.3**	**3.4**	**-0.6**
Algeria	2.1	2.2	2.2	2.3	2.3	2.3	2.3	2.2	0.1
Libya	1.8	1.8	1.9	1.5	1.1	1.0	1.1	1.1	-1.7
West Africa	**3.9**	**4.1**	**4.2**	**4.3**	**4.1**	**4.1**	**3.7**	**3.5**	**-0.6**
Angola	1.4	1.8	2.0	2.0	1.9	1.9	1.6	1.5	-0.6
Nigeria	2.4	2.4	2.2	2.3	2.2	2.2	2.1	2.0	-0.5
South America	**2.7**	**2.6**	**2.5**	**1.7**	**1.4**	**1.3**	**1.2**	**1.1**	**-3.1**
Ecuador	0.5	0.5	0.5	0.3	0.3	0.3	0.3	0.3	-1.7
Venezuela	2.1	2.1	2.0	1.3	1.1	1.0	0.9	0.8	-3.5
Non-OPEC	**47.7**	**47.7**	**46.6**	**45.0**	**42.3**	**42.5**	**43.8**	**45.2**	**-0.2**
OECD	**20.0**	**19.6**	**18.5**	**17.0**	**16.3**	**15.9**	**15.7**	**15.5**	**-0.8**
OECD North America	**13.8**	**13.6**	**12.8**	**12.8**	**12.8**	**12.7**	**12.6**	**12.3**	**-0.3**
United States	8.0	8.0	7.8	9.1	9.9	10.0	9.9	9.6	0.7
Canada	2.1	2.1	1.8	1.9	1.7	1.7	1.6	1.6	-0.9
Mexico	3.7	3.5	3.2	1.8	1.2	1.0	1.0	1.1	-4.1
OECD Europe	**5.5**	**5.2**	**5.0**	**3.5**	**2.8**	**2.6**	**2.5**	**2.5**	**-2.6**
Denmark	0.3	0.3	0.3	0.2	0.1	0.1	0.1	0.1	-3.8
Norway	2.8	2.6	2.5	1.9	1.5	1.4	1.3	1.3	-2.3
United Kngdom	1.7	1.7	1.6	0.9	0.6	0.6	0.6	0.6	-3.5
Other	0.7	0.7	0.6	0.5	0.5	0.5	0.5	0.5	-1.3
OECD Asia	**0.7**	**0.8**	**0.8**	**0.7**	**0.7**	**0.6**	**0.6**	**0.6**	**-0.7**
Japan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-1.0
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5
Australia and New Zealand	0.6	0.6	0.7	0.6	0.5	0.5	0.5	0.5	-0.7

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-12).

Table G5. World conventional liquids production by region and country, High Oil Price case, 2006-2035 (continued)
(Million barrels per day)

Region/Country	History (estimates) 2006	2007	2008	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
Non-OECD	**27.7**	**28.1**	**28.1**	**28.0**	**26.1**	**26.6**	**28.1**	**29.7**	**0.2**
Non-OECD Europe and Eurasia	**12.3**	**12.8**	**12.7**	**11.2**	**10.0**	**10.2**	**11.0**	**12.0**	**-0.2**
Russia	**9.7**	**9.9**	**9.8**	**8.1**	**7.0**	**7.2**	**7.8**	**8.6**	**-0.5**
Caspian Area	**2.3**	**2.6**	**2.6**	**2.9**	**2.8**	**2.9**	**3.0**	**3.1**	**0.7**
Azerbaijan	0.6	0.8	0.9	1.0	0.9	0.8	0.8	0.7	-0.7
Kazakhstan	1.4	1.4	1.4	1.7	1.7	1.8	2.0	2.2	1.5
Turkmenistan	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	1.2
Uzbekistan	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	-4.5
Other	**0.3**	**0.3**	**0.3**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**-1.6**
Non-OECD Asia	**7.7**	**7.7**	**7.7**	**7.6**	**7.0**	**7.0**	**6.8**	**6.7**	**-0.5**
China	3.9	3.9	4.0	4.0	3.8	4.0	3.9	3.8	-0.1
India	0.9	0.9	0.9	1.0	0.9	0.9	1.0	1.0	0.4
Brunei	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	-2.3
Malaysia	0.7	0.7	0.7	0.7	0.6	0.6	0.6	0.6	-0.7
Thailand	0.3	0.3	0.4	0.4	0.4	0.3	0.3	0.3	-0.3
Vietnam	0.4	0.4	0.3	0.4	0.3	0.3	0.3	0.2	-1.2
Other	1.4	1.3	1.3	1.0	0.9	0.8	0.7	0.7	-2.1
Middle East (Non-OPEC)	**1.6**	**1.5**	**1.5**	**1.7**	**1.5**	**1.4**	**1.3**	**1.4**	**-0.4**
Oman	0.7	0.7	0.8	0.9	0.8	0.8	0.8	0.8	0.3
Syria	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	-1.7
Yemen	0.4	0.3	0.3	0.2	0.2	0.2	0.1	0.1	-2.8
Other	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	4.0
Africa	**2.4**	**2.4**	**2.4**	**2.9**	**2.8**	**3.0**	**3.1**	**3.3**	**1.1**
Chad	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-3.3
Congo (Brazzaville)	0.2	0.2	0.2	0.3	0.3	0.2	0.2	0.2	0.0
Egypt	0.7	0.7	0.6	0.6	0.6	0.7	0.7	0.7	0.2
Equatorial Guniea	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.4	-0.2
Gabon	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	-1.3
Sao Tome and Principe	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	—
Sudan	0.4	0.5	0.5	0.6	0.6	0.6	0.8	0.9	2.5
Other	0.3	0.3	0.3	0.7	0.7	0.8	0.8	0.8	3.3
Central and South America	**3.7**	**3.7**	**3.8**	**4.6**	**4.7**	**5.1**	**5.7**	**6.4**	**2.0**
Brazil	1.9	1.9	1.9	2.4	2.6	2.8	3.2	3.8	2.4
Argentina	0.8	0.8	0.8	0.7	0.6	0.5	0.5	0.5	-1.4
Colombia	0.5	0.5	0.6	0.8	0.7	0.7	0.7	0.7	0.7
Peru	0.1	0.1	0.1	0.3	0.3	0.3	0.3	0.4	4.3
Trinidad and Tobago	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.0
Other	0.2	0.2	0.2	0.2	0.3	0.5	0.7	0.8	5.7
Total World	**81.8**	**81.5**	**81.6**	**76.4**	**72.3**	**73.0**	**74.8**	**77.6**	**-0.2**
OPEC Share of World Production	42%	41%	43%	41%	41%	42%	41%	42%	
Persian Gulf Share of World Production	29%	28%	30%	28%	29%	30%	30%	31%	

Note: Conventional liquids include crude oil and lease condensate, natural gas plant liquids, and refinery gain.
Sources: **History:** U.S. Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2010).

Table G6. World unconventional liquids production by region and country, High Oil Price case, 2006-2035
(Million barrels per day)

Region/Country	History (estimates)			Projections					Average annual percent change, 2007-2035
	2006	2007	2008	2015	2020	2025	2030	2035	
OPEC[a]	**0.6**	**0.6**	**0.7**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.2**
Biofuels	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Extra-Heavy Oil (Venezuela)	0.6	0.6	0.7	0.4	0.4	0.4	0.4	0.4	-1.4
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	0.2	0.2	0.2	0.2	0.2	14.8
Non-OPEC	**2.3**	**2.8**	**3.3**	**6.4**	**9.2**	**12.1**	**15.0**	**17.3**	**6.8**
OECD	**1.7**	**2.0**	**2.4**	**5.0**	**7.1**	**9.1**	**10.9**	**12.3**	**6.7**
Biofuels	0.5	0.6	0.9	1.3	1.7	2.5	3.2	3.5	6.3
Oil Sands/Bitumen (Canada)	1.2	1.4	1.5	3.6	4.9	5.6	6.3	6.9	5.9
Extra-Heavy Oil (Mexico)	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	10.7
Coal-to-Liquids	0.0	0.0	0.0	0.1	0.3	0.6	0.8	0.9	27.6
Gas-to-Liquids	0.0	0.0	0.0	0.0	0.1	0.2	0.4	0.5	—
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.4	—
Non-OECD	**0.6**	**0.7**	**0.9**	**1.4**	**2.1**	**3.0**	**4.1**	**5.0**	**7.0**
Biofuels	0.4	0.5	0.6	1.1	1.6	2.0	2.3	2.5	5.6
Extra-Heavy Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Coal-to-Liquids	0.1	0.2	0.2	0.2	0.5	0.9	1.6	2.4	10.2
Gas-to-Liquids	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	3.3
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
World									
Biofuels	0.9	1.2	1.5	2.4	3.3	4.5	5.5	6.0	6.0
Oil Sands/Bitumen	1.2	1.4	1.5	3.6	4.9	5.6	6.3	6.9	5.9
Extra-Heavy Oil	0.6	0.6	0.7	0.5	0.5	0.5	0.5	0.5	-0.7
Coal-to-Liquids	0.1	0.2	0.2	0.3	0.7	1.5	2.4	3.3	11.4
Gas-to-Liquids	0.0	0.1	0.1	0.2	0.4	0.5	0.7	0.8	10.6
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.4	15.6
World Total	**2.9**	**3.4**	**3.9**	**7.0**	**9.8**	**12.7**	**15.6**	**17.9**	**6.2**
Selected Country Highlights									
Biofuels									
Brazil	0.3	0.3	0.5	0.9	1.3	1.6	1.8	1.9	6.4
China	0.1	0.2	0.0	0.0	0.1	0.2	0.3	0.3	2.2
India	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	9.1
United States	0.3	0.5	0.7	1.1	1.4	2.2	2.8	3.1	7.1
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	0.2	0.5	1.2	2.0	—
Germany	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
India	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	—
South Africa	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	2.1
United States	0.0	0.0	0.0	0.1	0.3	0.6	0.8	0.9	—
Gas-to-Liquids									
Qatar	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	14.2
South Africa	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	1.1

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-12).

Sources: **History:** U.S. Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2010).

Table G7. World total liquids production by region and country, Low Oil Price case, 2006-2035
(Million barrels per day)

Region/Country	History (estimates) 2006	2007	2008	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OPEC[a]	**34.7**	**34.4**	**35.6**	**43.2**	**47.3**	**51.9**	**56.6**	**61.5**	**2.1**
Middle East	**23.6**	**23.1**	**24.2**	**28.6**	**31.5**	**35.0**	**39.0**	**42.9**	**2.2**
Iran	4.1	4.0	4.2	4.7	4.8	5.0	5.1	5.3	1.0
Iraq	2.0	2.1	2.4	2.9	3.7	4.7	6.3	7.6	4.7
Kuwait	2.7	2.6	2.7	3.5	3.9	4.5	5.2	5.6	2.8
Qatar	1.1	1.1	1.2	2.0	2.4	2.7	3.0	3.1	3.7
Saudi Arabia	10.7	10.2	10.7	11.5	12.5	13.6	14.9	16.8	1.8
United Arab Emirates	2.9	2.9	3.0	4.1	4.3	4.5	4.4	4.4	1.4
North Africa	**3.9**	**4.0**	**4.1**	**5.1**	**5.2**	**5.6**	**6.1**	**6.4**	**1.7**
Algeria	2.1	2.2	2.2	3.1	3.4	3.8	4.0	4.2	2.3
Libya	1.8	1.8	1.9	2.1	1.7	1.8	2.1	2.3	0.8
West Africa	**3.9**	**4.1**	**4.2**	**5.7**	**6.2**	**6.6**	**6.5**	**6.6**	**1.7**
Angola	1.4	1.8	2.0	2.7	2.9	3.1	2.8	2.6	1.4
Nigeria	2.4	2.4	2.2	3.0	3.3	3.5	3.7	4.0	1.9
South America	**3.3**	**3.2**	**3.1**	**3.8**	**4.5**	**4.7**	**5.1**	**5.5**	**2.0**
Ecuador	0.5	0.5	0.5	0.5	0.6	0.6	0.7	0.7	1.0
Venezuela	2.7	2.7	2.6	3.3	3.9	4.1	4.4	4.9	2.2
Non-OPEC	**50.0**	**50.4**	**49.9**	**51.0**	**52.9**	**54.9**	**57.9**	**61.2**	**0.7**
OECD	**21.7**	**21.6**	**20.9**	**20.1**	**19.5**	**18.8**	**18.7**	**18.9**	**-0.5**
OECD North America	**15.3**	**15.4**	**15.0**	**15.9**	**15.8**	**15.4**	**15.4**	**15.7**	**0.1**
United States	8.3	8.5	8.4	9.7	9.9	9.6	9.3	9.1	0.2
Canada	3.3	3.4	3.4	4.0	4.1	4.4	4.6	4.8	1.2
Mexico	3.7	3.5	3.2	2.2	1.7	1.5	1.6	1.8	-2.3
OECD Europe	**5.6**	**5.4**	**5.2**	**3.5**	**3.0**	**2.7**	**2.6**	**2.6**	**-2.6**
OECD Asia	**0.7**	**0.8**	**0.8**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**-0.6**
Japan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
Australia and New Zealand	0.6	0.6	0.7	0.6	0.5	0.5	0.5	0.5	-0.9
Non-OECD	**28.3**	**28.8**	**29.0**	**30.9**	**33.4**	**36.1**	**39.2**	**42.3**	**1.4**
Non-OECD Europe and Eurasia	**12.3**	**12.8**	**12.7**	**13.7**	**15.2**	**17.0**	**19.2**	**21.4**	**1.9**
Russia	9.7	9.9	9.8	10.0	10.8	12.1	13.9	15.7	1.7
Caspian Area	2.3	2.6	2.6	3.6	4.2	4.7	5.1	5.5	2.7
Other	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	-1.8
Non-OECD Asia	**7.9**	**7.8**	**7.8**	**7.3**	**7.2**	**7.2**	**6.9**	**6.6**	**-0.6**
China	4.0	4.1	4.0	3.8	3.9	4.1	4.0	3.8	-0.2
India	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	0.6
Other	3.0	2.9	2.9	2.5	2.3	2.1	1.9	1.8	-1.7
Middle East (Non-OPEC)	**1.6**	**1.5**	**1.5**	**1.6**	**1.4**	**1.3**	**1.2**	**1.2**	**-0.9**
Africa	**2.5**	**2.6**	**2.6**	**2.8**	**3.0**	**3.0**	**3.0**	**2.9**	**0.4**
Central and South America	**4.0**	**4.1**	**4.3**	**5.5**	**6.7**	**7.5**	**8.8**	**10.1**	**3.3**
Brazil	2.1	2.3	2.4	3.3	4.6	5.3	6.4	7.7	4.5
Other	1.8	1.8	1.9	2.1	2.1	2.2	2.4	2.4	1.0
Total World	**84.7**	**84.8**	**85.5**	**94.2**	**100.2**	**106.8**	**114.6**	**122.7**	**1.3**
OPEC Share of World Production	41%	41%	42%	46%	47%	49%	49%	50%	
Persian Gulf Share of World Production	28%	27%	28%	30%	31%	33%	34%	35%	

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-12).
Sources: **History:** U.S. Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2010).

Table G8. World conventional liquids production by region and country, Low Oil Price case, 2006-2035
(Million barrels per day)

Region/Country	History (estimates)			Projections					Average annual percent change, 2007-2035
	2006	2007	2008	2015	2020	2025	2030	2035	
OPEC[a]	**34.1**	**33.8**	**35.0**	**41.5**	**44.9**	**49.1**	**53.3**	**57.6**	**1.9**
Middle East	**23.6**	**23.1**	**24.2**	**28.4**	**31.3**	**34.8**	**38.8**	**42.7**	**2.2**
Iran	4.1	4.0	4.2	4.7	4.8	5.0	5.1	5.3	1.0
Iraq	2.0	2.1	2.4	2.9	3.7	4.7	6.3	7.6	4.7
Kuwait	2.7	2.6	2.7	3.5	3.9	4.5	5.2	5.6	2.8
Qatar	1.1	1.1	1.2	1.9	2.2	2.5	2.8	2.9	3.5
Saudi Arabia	10.7	10.2	10.7	11.5	12.5	13.6	14.9	16.8	1.8
United Arab Emirates	2.9	2.9	3.0	4.1	4.3	4.5	4.4	4.4	1.4
North Africa	**3.9**	**4.0**	**4.1**	**5.1**	**5.2**	**5.6**	**6.1**	**6.4**	**1.7**
Algeria	2.1	2.2	2.2	3.1	3.4	3.8	4.0	4.2	2.3
Libya	1.8	1.8	1.9	2.1	1.7	1.8	2.1	2.3	0.8
West Africa	**3.9**	**4.1**	**4.2**	**5.6**	**6.2**	**6.6**	**6.5**	**6.6**	**1.7**
Angola	1.4	1.8	2.0	2.7	2.9	3.1	2.8	2.6	1.4
Nigeria	2.4	2.4	2.2	2.9	3.2	3.5	3.7	4.0	1.9
South America	**2.7**	**2.6**	**2.5**	**2.3**	**2.2**	**2.1**	**2.0**	**1.9**	**-1.2**
Ecuador	0.5	0.5	0.5	0.5	0.6	0.6	0.7	0.7	1.0
Venezuela	2.1	2.1	2.0	1.8	1.6	1.5	1.3	1.2	-2.0
Non-OPEC	**47.7**	**47.7**	**46.6**	**47.0**	**48.2**	**49.7**	**52.0**	**54.6**	**0.5**
OECD	**20.0**	**19.6**	**18.5**	**16.7**	**15.7**	**14.6**	**14.2**	**14.1**	**-1.2**
OECD North America	**13.8**	**13.6**	**12.8**	**12.6**	**12.2**	**11.3**	**11.0**	**11.0**	**-0.7**
United States	8.0	8.0	7.8	8.6	8.7	8.2	7.9	7.7	-0.2
Canada	2.1	2.1	1.8	1.8	1.7	1.6	1.6	1.5	-1.0
Mexico	3.7	3.5	3.2	2.2	1.7	1.4	1.6	1.8	-2.3
OECD Europe	**5.5**	**5.2**	**5.0**	**3.4**	**2.8**	**2.6**	**2.5**	**2.4**	**-2.7**
Denmark	0.3	0.3	0.3	0.2	0.1	0.1	0.1	0.1	-4.3
Norway	2.8	2.6	2.5	1.8	1.5	1.4	1.3	1.2	-2.7
United Kngdom	1.7	1.7	1.6	0.8	0.6	0.6	0.6	0.6	-3.8
Other	0.7	0.7	0.6	0.6	0.5	0.5	0.5	0.6	-0.6
OECD Asia	**0.7**	**0.8**	**0.8**	**0.7**	**0.7**	**0.7**	**0.7**	**0.6**	**-0.7**
Japan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1
Australia and New Zealand	0.6	0.6	0.7	0.6	0.5	0.5	0.5	0.5	-0.9

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-12).

Table G8. World conventional liquids production by region and country, Low Oil Price case, 2006-2035 (continued)
(Million barrels per day)

Region/Country	History (estimates) 2006	2007	2008	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
Non-OECD	**27.7**	**28.1**	**28.1**	**30.3**	**32.5**	**35.1**	**37.8**	**40.5**	**1.3**
Non-OECD Europe and Eurasia	**12.3**	**12.8**	**12.7**	**13.7**	**15.2**	**17.0**	**19.2**	**21.4**	**1.9**
Russia	**9.7**	**9.9**	**9.8**	**10.0**	**10.8**	**12.1**	**13.9**	**15.7**	**1.7**
Caspian Area	**2.3**	**2.6**	**2.6**	**3.6**	**4.2**	**4.7**	**5.1**	**5.5**	**2.7**
Azerbaijan	0.6	0.8	0.9	1.3	1.4	1.4	1.4	1.3	1.6
Kazakhstan	1.4	1.4	1.4	2.0	2.5	3.0	3.4	3.7	3.5
Turkmenistan	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	2.2
Uzbekistan	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	-3.6
Other	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	-1.9
Non-OECD Asia	**7.7**	**7.7**	**7.7**	**7.3**	**7.0**	**6.9**	**6.5**	**6.2**	**-0.8**
China	3.9	3.9	4.0	3.8	3.8	3.9	3.7	3.4	-0.5
India	0.9	0.9	0.9	1.0	0.9	0.9	0.9	1.0	0.4
Brunei	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	-2.8
Malaysia	0.7	0.7	0.7	0.6	0.6	0.6	0.5	0.5	-1.1
Thailand	0.3	0.3	0.4	0.4	0.4	0.3	0.3	0.3	-0.5
Vietnam	0.4	0.4	0.3	0.4	0.3	0.3	0.3	0.2	-1.6
Other	1.4	1.3	1.3	1.0	0.9	0.8	0.7	0.6	-2.5
Middle East (Non-OPEC)	**1.6**	**1.5**	**1.5**	**1.6**	**1.4**	**1.3**	**1.2**	**1.2**	**-0.9**
Oman	0.7	0.7	0.8	0.9	0.8	0.7	0.7	0.7	-0.2
Syria	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.2	-2.2
Yemen	0.4	0.3	0.3	0.2	0.2	0.2	0.1	0.1	-3.3
Other	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	3.6
Africa	**2.4**	**2.4**	**2.4**	**2.7**	**2.8**	**2.9**	**2.9**	**2.8**	**0.6**
Chad	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.0	-3.9
Congo (Brazzaville)	0.2	0.2	0.2	0.3	0.3	0.2	0.2	0.2	-0.5
Egypt	0.7	0.7	0.6	0.5	0.6	0.7	0.7	0.6	-0.4
Equatorial Guniea	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	-0.7
Gabon	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	-1.9
Sao Tome and Principe	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	—
Sudan	0.4	0.5	0.5	0.5	0.6	0.6	0.7	0.8	2.0
Other	0.3	0.3	0.3	0.7	0.7	0.7	0.7	0.7	2.8
Central and South America	**3.7**	**3.7**	**3.8**	**5.1**	**6.1**	**6.9**	**7.9**	**9.0**	**3.2**
Brazil	1.9	1.9	1.9	3.0	4.0	4.7	5.5	6.7	4.5
Argentina	0.8	0.8	0.8	0.6	0.6	0.5	0.5	0.5	-1.7
Colombia	0.5	0.5	0.6	0.8	0.7	0.7	0.6	0.6	0.2
Peru	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.3	3.9
Trinidad and Tobago	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.8
Other	0.2	0.2	0.2	0.2	0.3	0.5	0.7	0.7	5.2
Total World	**81.8**	**81.5**	**81.6**	**88.6**	**93.1**	**98.8**	**105.3**	**112.2**	**1.2**
OPEC Share of World Production	42%	41%	43%	47%	48%	50%	51%	51%	
Persian Gulf Share of World Production	29%	28%	30%	32%	34%	35%	37%	38%	

Note: Conventional liquids include crude oil and lease condensate, natural gas plant liquids, and refinery gain.
Sources: **History:** U.S. Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2010).

Table G9. World unconventional liquids production by region and country, Low Oil Price case, 2006-2035
(Million barrels per day)

Region/Country	History (estimates) 2006	2007	2008	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OPEC[a]	**0.6**	**0.6**	**0.7**	**1.6**	**2.5**	**2.8**	**3.3**	**3.9**	**6.9**
Biofuels	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Extra-Heavy Oil (Venezuela)	0.6	0.6	0.7	1.5	2.3	2.6	3.1	3.7	6.7
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	0.2	0.2	0.2	0.2	0.2	14.3
Non-OPEC	**2.3**	**2.8**	**3.3**	**4.0**	**4.7**	**5.2**	**6.0**	**6.6**	**3.2**
OECD	**1.7**	**2.0**	**2.4**	**3.4**	**3.8**	**4.2**	**4.5**	**4.9**	**3.2**
Biofuels	0.5	0.6	0.9	1.2	1.3	1.4	1.5	1.6	3.2
Oil Sands/Bitumen (Canada)	1.2	1.4	1.5	2.2	2.4	2.7	3.0	3.2	3.1
Extra-Heavy Oil (Mexico)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
Coal-to-Liquids	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	15.5
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	**0.6**	**0.7**	**0.9**	**0.6**	**0.9**	**1.0**	**1.4**	**1.7**	**3.1**
Biofuels	0.4	0.5	0.6	0.5	0.7	0.7	1.1	1.4	3.4
Extra-Heavy Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Coal-to-Liquids	0.1	0.2	0.2	0.1	0.2	0.3	0.3	0.3	2.6
Gas-to-Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.2
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.8
World									
Biofuels	0.9	1.2	1.5	1.6	2.0	2.2	2.6	2.9	3.3
Oil Sands/Bitumen	1.2	1.4	1.5	2.2	2.4	2.7	3.0	3.2	3.1
Extra-Heavy Oil	0.6	0.6	0.7	1.5	2.3	2.6	3.1	3.7	6.7
Coal-to-Liquids	0.1	0.2	0.2	0.2	0.2	0.3	0.4	0.4	3.2
Gas-to-Liquids	0.0	0.1	0.1	0.2	0.2	0.2	0.3	0.2	5.8
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.8
World Total	**2.9**	**3.4**	**3.9**	**5.6**	**7.2**	**8.0**	**9.3**	**10.5**	**4.1**
Selected Country Highlights									
Biofuels									
Brazil	0.3	0.3	0.5	0.4	0.6	0.6	0.8	1.1	4.2
China	0.1	0.2	0.0	0.0	0.0	0.1	0.1	0.2	0.1
India	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.9
United States	0.3	0.5	0.7	1.1	1.2	1.3	1.3	1.3	3.9
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	0.2	0.2	—
Germany	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-4.0
India	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
South Africa	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	-2.4
United States	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	—
Gas-to-Liquids									
Qatar	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	13.7
South Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.4

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-12).

Sources: **History:** U.S. Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2010).

Table G10. World total liquids production by region and country, High Economic Growth case, 2006-2035
(Million barrels per day)

Region/Country	History (estimates) 2006	2007	2008	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OPEC[a]	**34.7**	**34.4**	**35.6**	**38.2**	**40.6**	**44.0**	**48.0**	**52.2**	**1.4**
Middle East	**23.6**	**23.1**	**24.2**	**25.7**	**27.6**	**30.4**	**34.2**	**38.1**	**1.7**
Iran	4.1	4.0	4.2	4.0	3.9	3.9	4.0	4.2	0.0
Iraq	2.0	2.1	2.4	2.7	3.2	4.2	5.7	7.1	4.1
Kuwait	2.7	2.6	2.7	2.9	3.1	3.5	4.1	4.4	1.8
Qatar	1.1	1.1	1.2	1.8	2.1	2.4	2.7	2.7	3.1
Saudi Arabia	10.7	10.2	10.7	10.8	11.6	12.7	14.2	16.2	1.5
United Arab Emirates	2.9	2.9	3.0	3.5	3.5	3.6	3.5	3.5	0.5
North Africa	**3.9**	**4.0**	**4.1**	**4.5**	**4.4**	**4.6**	**4.9**	**5.2**	**0.9**
Algeria	2.1	2.2	2.2	2.7	2.9	3.1	3.3	3.4	1.7
Libya	1.8	1.8	1.9	1.8	1.4	1.5	1.6	1.8	-0.1
West Africa	**3.9**	**4.1**	**4.2**	**5.3**	**5.7**	**6.1**	**6.0**	**5.9**	**1.3**
Angola	1.4	1.8	2.0	2.4	2.6	2.7	2.5	2.4	0.7
Nigeria	2.4	2.4	2.2	2.8	3.1	3.3	3.4	3.5	1.8
South America	**3.3**	**3.2**	**3.1**	**2.8**	**2.9**	**2.9**	**2.9**	**2.9**	**-0.3**
Ecuador	0.5	0.5	0.5	0.4	0.4	0.5	0.5	0.5	0.2
Venezuela	2.7	2.7	2.6	2.4	2.5	2.4	2.4	2.4	-0.3
Non-OPEC	**50.0**	**50.4**	**49.9**	**52.5**	**55.8**	**60.5**	**66.0**	**71.2**	**1.3**
OECD	**21.7**	**21.6**	**20.9**	**20.8**	**21.1**	**21.9**	**23.4**	**25.5**	**0.7**
OECD North America	**15.3**	**15.4**	**15.0**	**16.4**	**17.2**	**18.0**	**19.6**	**21.5**	**1.4**
United States	8.3	8.5	8.4	10.1	10.8	11.3	12.0	12.8	1.6
Canada	3.3	3.4	3.4	4.2	4.6	5.3	6.0	6.9	2.7
Mexico	3.7	3.5	3.2	2.2	1.7	1.5	1.6	1.8	-2.1
OECD Europe	**5.6**	**5.4**	**5.2**	**3.6**	**3.2**	**3.1**	**3.1**	**3.2**	**-1.8**
OECD Asia	**0.7**	**0.8**	**0.8**	**0.7**	**0.7**	**0.7**	**0.7**	**0.8**	**-0.2**
Japan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.2
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
Australia and New Zealand	0.6	0.6	0.7	0.6	0.6	0.6	0.6	0.6	-0.3
Non-OECD	**28.3**	**28.8**	**29.0**	**31.7**	**34.7**	**38.6**	**42.5**	**45.8**	**1.7**
Non-OECD Europe and Eurasia	**12.3**	**12.8**	**12.7**	**13.5**	**14.6**	**16.4**	**18.4**	**20.1**	**1.7**
Russia	9.7	9.9	9.8	9.8	10.4	11.6	13.2	14.7	1.5
Caspian Area	2.3	2.6	2.6	3.5	4.1	4.6	5.0	5.2	2.7
Other	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	-1.0
Non-OECD Asia	**7.9**	**7.8**	**7.8**	**7.6**	**7.8**	**8.5**	**8.8**	**9.0**	**0.5**
China	4.0	4.1	4.0	4.0	4.3	4.9	5.3	5.4	1.1
India	0.9	0.9	0.9	1.0	1.0	1.2	1.2	1.3	1.2
Other	3.0	2.9	2.9	2.6	2.5	2.4	2.3	2.3	-0.9
Middle East (Non-OPEC)	**1.6**	**1.5**	**1.5**	**1.6**	**1.5**	**1.6**	**1.5**	**1.5**	**0.0**
Africa	**2.5**	**2.6**	**2.6**	**3.0**	**3.4**	**3.7**	**4.0**	**4.1**	**1.7**
Central and South America	**4.0**	**4.1**	**4.3**	**6.1**	**7.3**	**8.5**	**9.8**	**11.0**	**3.5**
Brazil	2.1	2.3	2.4	3.8	5.0	5.9	6.8	7.9	4.5
Other	1.8	1.8	1.9	2.2	2.3	2.6	3.0	3.0	1.8
Total World	**84.7**	**84.8**	**85.5**	**90.8**	**96.4**	**104.5**	**113.9**	**123.4**	**1.4**
OPEC Share of World Production	41%	41%	42%	42%	42%	42%	42%	42%	
Persian Gulf Share of World Production	28%	27%	28%	28%	29%	29%	30%	31%	

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-12).
Sources: **History:** U.S. Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2010).

Table G11. World conventional liquids production by region and country, High Economic Growth case, 2006-2035
(Million barrels per day)

Region/Country	History (estimates)			Projections					Average annual percent change, 2007-2035
	2006	2007	2008	2015	2020	2025	2030	2035	
OPEC[a]	**34.1**	**33.8**	**35.0**	**37.2**	**39.3**	**42.6**	**46.5**	**50.5**	**1.4**
Middle East	**23.6**	**23.1**	**24.2**	**25.6**	**27.4**	**30.2**	**33.9**	**37.9**	**1.7**
Iran	4.1	4.0	4.2	4.0	3.9	3.9	4.0	4.2	0.0
Iraq	2.0	2.1	2.4	2.7	3.2	4.2	5.7	7.1	4.1
Kuwait	2.7	2.6	2.7	2.9	3.1	3.5	4.1	4.4	1.8
Qatar	1.1	1.1	1.2	1.7	1.9	2.2	2.4	2.5	2.7
Saudi Arabia	10.7	10.2	10.7	10.8	11.6	12.7	14.2	16.2	1.5
United Arab Emirates	2.9	2.9	3.0	3.5	3.5	3.6	3.5	3.5	0.5
North Africa	**3.9**	**4.0**	**4.1**	**4.5**	**4.4**	**4.6**	**4.9**	**5.2**	**0.9**
Algeria	2.1	2.2	2.2	2.7	2.9	3.1	3.3	3.4	1.7
Libya	1.8	1.8	1.9	1.8	1.4	1.5	1.6	1.8	-0.1
West Africa	**3.9**	**4.1**	**4.2**	**5.2**	**5.7**	**6.0**	**5.9**	**5.9**	**1.3**
Angola	1.4	1.8	2.0	2.4	2.6	2.7	2.5	2.4	0.7
Nigeria	2.4	2.4	2.2	2.8	3.1	3.3	3.4	3.4	1.7
South America	**2.7**	**2.6**	**2.5**	**2.0**	**1.9**	**1.8**	**1.7**	**1.6**	**-1.7**
Ecuador	0.5	0.5	0.5	0.4	0.4	0.5	0.5	0.5	0.2
Venezuela	2.1	2.1	2.0	1.6	1.4	1.3	1.2	1.0	-2.4
Non-OPEC	**47.7**	**47.7**	**46.6**	**47.3**	**49.4**	**52.4**	**55.9**	**58.8**	**0.9**
OECD	**20.0**	**19.6**	**18.5**	**17.0**	**16.6**	**16.3**	**16.4**	**16.5**	**-0.4**
OECD North America	**13.8**	**13.6**	**12.8**	**12.9**	**12.9**	**12.7**	**12.9**	**12.9**	**0.0**
United States	8.0	8.0	7.8	8.9	9.5	9.6	9.7	9.5	0.8
Canada	2.1	2.1	1.8	1.8	1.7	1.7	1.7	1.6	-0.4
Mexico	3.7	3.5	3.2	2.2	1.7	1.4	1.5	1.7	-2.3
OECD Europe	**5.5**	**5.2**	**5.0**	**3.4**	**3.0**	**2.9**	**2.9**	**2.9**	**-2.0**
Denmark	0.3	0.3	0.3	0.2	0.1	0.1	0.1	0.1	-3.1
Norway	2.8	2.6	2.5	1.9	1.6	1.6	1.5	1.5	-1.8
United Kngdom	1.7	1.7	1.6	0.9	0.7	0.7	0.7	0.7	-3.0
Other	0.7	0.7	0.6	0.5	0.5	0.5	0.5	0.6	-0.3
OECD Asia	**0.7**	**0.8**	**0.8**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**-0.3**
Japan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.2
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
Australia and New Zealand	0.6	0.6	0.7	0.6	0.6	0.6	0.6	0.6	-0.3

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-12).

Table G11. World conventional liquids production by region and country, High Economic Growth case, 2006-2035 (continued)
(Million barrels per day)

Region/Country	History (estimates) 2006	2007	2008	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
Non-OECD	**27.7**	**28.1**	**28.1**	**30.3**	**32.8**	**36.1**	**39.4**	**42.3**	**1.5**
Non-OECD Europe and Eurasia	**12.3**	**12.8**	**12.7**	**13.5**	**14.6**	**16.4**	**18.4**	**20.1**	**1.7**
Russia	**9.7**	**9.9**	**9.8**	**9.8**	**10.4**	**11.6**	**13.2**	**14.7**	**1.5**
Caspian Area	**2.3**	**2.6**	**2.6**	**3.5**	**4.1**	**4.6**	**5.0**	**5.2**	**2.7**
Azerbaijan	0.6	0.8	0.9	1.3	1.4	1.4	1.3	1.2	1.3
Kazakhstan	1.4	1.4	1.4	2.0	2.4	2.8	3.2	3.5	3.4
Turkmenistan	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.4	3.1
Uzbekistan	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	-2.3
Other	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	-1.1
Non-OECD Asia	**7.7**	**7.7**	**7.7**	**7.4**	**7.5**	**7.9**	**7.8**	**7.7**	**0.0**
China	3.9	3.9	4.0	3.9	4.1	4.5	4.5	4.4	0.3
India	0.9	0.9	0.9	1.0	1.0	1.0	1.1	1.1	0.9
Brunei	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	-1.5
Malaysia	0.7	0.7	0.7	0.7	0.7	0.6	0.6	0.6	-0.4
Thailand	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.0
Vietnam	0.4	0.4	0.3	0.4	0.4	0.3	0.3	0.3	-0.4
Other	1.4	1.3	1.3	1.0	0.9	0.9	0.8	0.8	-1.8
Middle East (Non-OPEC)	**1.6**	**1.5**	**1.5**	**1.6**	**1.5**	**1.6**	**1.5**	**1.5**	**0.0**
Oman	0.7	0.7	0.8	0.9	0.8	0.9	0.9	0.9	0.6
Syria	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	-1.3
Yemen	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2	-2.2
Other	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	4.7
Africa	**2.4**	**2.4**	**2.4**	**2.8**	**3.0**	**3.3**	**3.6**	**3.7**	**1.7**
Chad	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-2.5
Congo (Brazzaville)	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.2	0.1
Egypt	0.7	0.7	0.6	0.5	0.7	0.8	0.8	0.8	0.8
Equatorial Guniea	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Gabon	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	-1.0
Sao Tome and Principe	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	—
Sudan	0.4	0.5	0.5	0.6	0.6	0.7	0.9	1.1	3.0
Other	0.3	0.3	0.3	0.7	0.8	0.9	0.9	0.9	4.1
Central and South America	**3.7**	**3.7**	**3.8**	**5.0**	**6.1**	**7.0**	**8.1**	**9.2**	**3.4**
Brazil	1.9	1.9	1.9	2.9	3.8	4.5	5.3	6.2	4.4
Argentina	0.8	0.8	0.8	0.7	0.6	0.6	0.6	0.6	-0.9
Colombia	0.5	0.5	0.6	0.8	0.8	0.8	0.8	0.8	0.9
Peru	0.1	0.1	0.1	0.2	0.3	0.3	0.4	0.4	4.8
Trinidad and Tobago	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.3
Other	0.2	0.2	0.2	0.2	0.3	0.5	0.9	1.0	6.6
Total World	**81.8**	**81.5**	**81.6**	**84.6**	**88.7**	**95.0**	**102.3**	**109.3**	**1.1**
OPEC Share of World Production	42%	41%	43%	44%	44%	45%	45%	46%	
Persian Gulf Share of World Production	29%	28%	30%	30%	31%	32%	33%	35%	

Note: Conventional liquids include crude oil and lease condensate, natural gas plant liquids, and refinery gain.
Sources: **History:** U.S. Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2010).

Table G12. World unconventional liquids production by region and country, High Economic Growth case, 2006-2035
(Million barrels per day)

Region/Country	History (estimates)			Projections					Average annual percent change, 2007-2035
	2006	2007	2008	2015	2020	2025	2030	2035	
OPEC[a]	**0.6**	**0.6**	**0.7**	**1.0**	**1.3**	**1.4**	**1.5**	**1.7**	**3.5**
Biofuels	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Extra-Heavy Oil (Venezuela)	0.6	0.6	0.7	0.8	1.1	1.1	1.2	1.4	2.8
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	0.2	0.2	0.3	0.3	0.3	16.1
Non-OPEC	**2.3**	**2.8**	**3.3**	**5.2**	**6.4**	**8.1**	**10.1**	**12.5**	**5.1**
OECD	**1.7**	**2.0**	**2.4**	**3.8**	**4.5**	**5.6**	**7.0**	**9.0**	**5.0**
Biofuels	0.5	0.6	0.9	1.3	1.4	1.8	2.3	3.0	4.7
Oil Sands/Bitumen (Canada)	1.2	1.4	1.5	2.4	2.9	3.5	4.3	5.3	4.7
Extra-Heavy Oil (Mexico)	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	8.9
Coal-to-Liquids	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.3	22.9
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	0.1	0.1	0.4	—
Non-OECD	**0.6**	**0.7**	**0.9**	**1.4**	**1.9**	**2.5**	**3.1**	**3.5**	**5.3**
Biofuels	0.4	0.5	0.6	1.2	1.4	1.8	2.0	2.2	4.6
Extra-Heavy Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Coal-to-Liquids	0.1	0.2	0.2	0.2	0.4	0.7	1.0	1.2	7.7
Gas-to-Liquids	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	3.5
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
World									
Biofuels	0.9	1.2	1.5	2.5	2.9	3.5	4.3	5.2	4.7
Oil Sands/Bitumen	1.2	1.4	1.5	2.4	2.9	3.5	4.3	5.3	4.7
Extra-Heavy Oil	0.6	0.6	0.7	0.8	1.1	1.2	1.3	1.4	3.0
Coal-to-Liquids	0.1	0.2	0.2	0.3	0.5	0.8	1.2	1.4	8.4
Gas-to-Liquids	0.0	0.1	0.1	0.3	0.3	0.4	0.4	0.4	8.0
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.4	16.3
World Total	**2.9**	**3.4**	**3.9**	**6.2**	**7.7**	**9.5**	**11.6**	**14.1**	**4.9**
Selected Country Highlights									
Biofuels									
Brazil	0.3	0.3	0.5	0.9	1.2	1.4	1.6	1.7	4.8
China	0.1	0.2	0.0	0.0	0.1	0.2	0.2	0.3	7.4
India	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
United States	0.3	0.5	0.7	1.0	1.2	1.5	1.9	2.7	5.3
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	0.1	0.3	0.6	0.8	27.9
Germany	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
India	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	—
South Africa	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	2.2
United States	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.3	—
Gas-to-Liquids									
Qatar	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.2	15.5
South Africa	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	1.2

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-12).
Sources: **History:** U.S. Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2010).

Table G13. World total liquids production by region and country, Low Economic Growth case, 2006-2035
(Million barrels per day)

Region/Country	History (estimates) 2006	2007	2008	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OPEC[a]	**34.7**	**34.4**	**35.6**	**36.6**	**37.0**	**38.3**	**39.8**	**41.7**	**0.6**
Middle East	**23.6**	**23.1**	**24.2**	**24.7**	**25.2**	**26.6**	**28.4**	**30.5**	**0.9**
Iran	4.1	4.0	4.2	3.8	3.5	3.3	3.2	3.1	-1.1
Iraq	2.0	2.1	2.4	2.5	2.9	3.5	4.5	5.2	2.9
Kuwait	2.7	2.6	2.7	2.8	2.8	3.0	3.2	3.3	0.7
Qatar	1.1	1.1	1.2	1.8	2.0	2.2	2.3	2.2	2.3
Saudi Arabia	10.7	10.2	10.7	10.5	10.9	11.5	12.5	14.1	1.0
United Arab Emirates	2.9	2.9	3.0	3.3	3.2	3.1	2.8	2.7	-0.5
North Africa	**3.9**	**4.0**	**4.1**	**4.3**	**3.9**	**4.0**	**4.0**	**4.0**	**0.0**
Algeria	2.1	2.2	2.2	2.6	2.6	2.7	2.7	2.6	0.7
Libya	1.8	1.8	1.9	1.7	1.3	1.3	1.3	1.4	-1.1
West Africa	**3.9**	**4.1**	**4.2**	**5.0**	**5.1**	**5.0**	**4.6**	**4.3**	**0.1**
Angola	1.4	1.8	2.0	2.3	2.3	2.3	2.0	1.8	-0.4
Nigeria	2.4	2.4	2.2	2.7	2.7	2.8	2.6	2.5	0.6
South America	**3.3**	**3.2**	**3.1**	**2.7**	**2.8**	**2.8**	**2.8**	**2.8**	**-0.4**
Ecuador	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	-1.0
Venezuela	2.7	2.7	2.6	2.3	2.4	2.4	2.4	2.4	-0.3
Non-OPEC	**50.0**	**50.4**	**49.9**	**50.2**	**51.1**	**53.0**	**55.2**	**57.1**	**0.5**
OECD	**21.7**	**21.6**	**20.9**	**20.2**	**20.2**	**20.3**	**21.2**	**22.4**	**0.3**
OECD North America	**15.3**	**15.4**	**15.0**	**16.0**	**16.6**	**16.9**	**18.0**	**19.3**	**0.9**
United States	8.3	8.5	8.4	9.9	10.6	10.6	10.9	11.3	1.1
Canada	3.3	3.4	3.4	4.1	4.5	5.1	5.8	6.6	2.5
Mexico	3.7	3.5	3.2	2.1	1.6	1.3	1.3	1.4	-3.0
OECD Europe	**5.6**	**5.4**	**5.2**	**3.5**	**2.9**	**2.7**	**2.6**	**2.5**	**-2.6**
OECD Asia	**0.7**	**0.8**	**0.8**	**0.7**	**0.7**	**0.6**	**0.6**	**0.6**	**-1.0**
Japan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.2
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
Australia and New Zealand	0.6	0.6	0.7	0.5	0.5	0.5	0.5	0.5	-1.3
Non-OECD	**28.3**	**28.8**	**29.0**	**30.0**	**30.9**	**32.7**	**33.9**	**34.7**	**0.7**
Non-OECD Europe and Eurasia	**12.3**	**12.8**	**12.7**	**12.8**	**13.0**	**13.8**	**14.5**	**15.1**	**0.6**
Russia	9.7	9.9	9.8	9.2	9.2	9.7	10.4	10.9	0.4
Caspian Area	2.3	2.6	2.6	3.3	3.6	3.9	4.0	3.9	1.6
Other	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	-2.0
Non-OECD Asia	**7.9**	**7.8**	**7.8**	**7.1**	**6.9**	**7.2**	**7.1**	**6.9**	**-0.5**
China	4.0	4.1	4.0	3.7	3.7	4.1	4.2	4.1	0.1
India	0.9	0.9	0.9	1.0	0.9	1.0	1.0	1.0	0.5
Other	3.0	2.9	2.9	2.4	2.2	2.1	1.9	1.7	-1.9
Middle East (Non-OPEC)	**1.6**	**1.5**	**1.5**	**1.5**	**1.4**	**1.3**	**1.2**	**1.1**	**-1.3**
Africa	**2.5**	**2.6**	**2.6**	**2.8**	**3.0**	**3.1**	**3.1**	**3.0**	**0.6**
Central and South America	**4.0**	**4.1**	**4.3**	**5.8**	**6.6**	**7.4**	**8.1**	**8.7**	**2.6**
Brazil	2.1	2.3	2.4	3.7	4.6	5.2	5.7	6.4	3.7
Other	1.8	1.8	1.9	2.1	2.1	2.2	2.3	2.3	0.7
Total World	**84.7**	**84.8**	**85.5**	**86.9**	**88.0**	**91.3**	**94.9**	**98.8**	**0.5**
OPEC Share of World Production	41%	41%	42%	42%	42%	42%	42%	42%	
Persian Gulf Share of World Production	28%	27%	28%	28%	29%	29%	30%	31%	

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-12).
Sources: **History:** U.S. Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2010).

Table G14. World conventional liquids production by region and country, Low Economic Growth case, 2006-2035
(Million barrels per day)

Region/Country	History (estimates)			Projections					Average annual percent change, 2007-2035
	2006	2007	2008	2015	2020	2025	2030	2035	
OPEC[a]	**34.1**	**33.8**	**35.0**	**35.6**	**35.6**	**36.8**	**38.1**	**39.8**	**0.5**
Middle East	**23.6**	**23.1**	**24.2**	**24.5**	**25.0**	**26.3**	**28.1**	**30.3**	**0.8**
Iran	4.1	4.0	4.2	3.8	3.5	3.3	3.2	3.1	-1.1
Iraq	2.0	2.1	2.4	2.5	2.9	3.5	4.5	5.2	2.9
Kuwait	2.7	2.6	2.7	2.8	2.8	3.0	3.2	3.3	0.7
Qatar	1.1	1.1	1.2	1.6	1.8	1.9	2.0	2.0	1.9
Saudi Arabia	10.7	10.2	10.7	10.5	10.9	11.5	12.5	14.1	1.0
United Arab Emirates	2.9	2.9	3.0	3.3	3.2	3.1	2.8	2.7	-0.5
North Africa	**3.9**	**4.0**	**4.1**	**4.3**	**3.9**	**4.0**	**4.0**	**4.0**	**0.0**
Algeria	2.1	2.2	2.2	2.6	2.6	2.7	2.7	2.6	0.7
Libya	1.8	1.8	1.9	1.7	1.3	1.3	1.3	1.4	-1.1
West Africa	**3.9**	**4.1**	**4.2**	**4.9**	**5.0**	**5.0**	**4.6**	**4.3**	**0.1**
Angola	1.4	1.8	2.0	2.3	2.3	2.3	2.0	1.8	-0.4
Nigeria	2.4	2.4	2.2	2.7	2.7	2.7	2.6	2.5	0.5
South America	**2.7**	**2.6**	**2.5**	**1.9**	**1.7**	**1.6**	**1.4**	**1.3**	**-2.5**
Ecuador	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	-1.0
Venezuela	2.1	2.1	2.0	1.5	1.3	1.2	1.0	0.9	-3.0
Non-OPEC	**47.7**	**47.7**	**46.6**	**45.1**	**44.7**	**45.3**	**45.9**	**46.0**	**0.0**
OECD	**20.0**	**19.6**	**18.5**	**16.5**	**15.7**	**15.0**	**14.9**	**14.6**	**-0.9**
OECD North America	**13.8**	**13.6**	**12.8**	**12.6**	**12.4**	**11.9**	**12.0**	**11.8**	**-0.3**
United States	8.0	8.0	7.8	8.8	9.2	9.1	9.2	8.9	0.5
Canada	2.1	2.1	1.8	1.7	1.6	1.6	1.6	1.5	-0.7
Mexico	3.7	3.5	3.2	2.1	1.5	1.2	1.3	1.3	-3.2
OECD Europe	**5.5**	**5.2**	**5.0**	**3.2**	**2.7**	**2.5**	**2.3**	**2.3**	**-2.9**
Denmark	0.3	0.3	0.3	0.2	0.1	0.1	0.1	0.1	-4.4
Norway	2.8	2.6	2.5	1.8	1.5	1.3	1.2	1.1	-2.8
United Kngdom	1.7	1.7	1.6	0.8	0.6	0.6	0.6	0.5	-4.0
Other	0.7	0.7	0.6	0.5	0.5	0.5	0.5	0.5	-0.7
OECD Asia	**0.7**	**0.8**	**0.8**	**0.7**	**0.6**	**0.6**	**0.6**	**0.6**	**-1.1**
Japan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.2
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7
Australia and New Zealand	0.6	0.6	0.7	0.5	0.5	0.5	0.5	0.5	-1.3

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-12).

Table G14. World conventional liquids production by region and country, Low Economic Growth case, 2006-2035 (continued)
(Million barrels per day)

Region/Country	History (estimates) 2006	2007	2008	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
Non-OECD	**27.7**	**28.1**	**28.1**	**28.6**	**29.0**	**30.2**	**31.0**	**31.4**	**0.4**
Non-OECD Europe and Eurasia	**12.3**	**12.8**	**12.7**	**12.8**	**13.0**	**13.8**	**14.5**	**15.1**	**0.6**
Russia	**9.7**	**9.9**	**9.8**	**9.2**	**9.2**	**9.7**	**10.4**	**10.9**	**0.4**
Caspian Area	**2.3**	**2.6**	**2.6**	**3.3**	**3.6**	**3.9**	**4.0**	**3.9**	**1.6**
Azerbaijan	0.6	0.8	0.9	1.2	1.2	1.1	1.0	0.9	0.1
Kazakhstan	1.4	1.4	1.4	1.9	2.2	2.4	2.6	2.7	2.4
Turkmenistan	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	1.9
Uzbekistan	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	-3.3
Other	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	-2.2
Non-OECD Asia	**7.7**	**7.7**	**7.7**	**7.0**	**6.6**	**6.6**	**6.1**	**5.7**	**-1.1**
China	3.9	3.9	4.0	3.6	3.6	3.7	3.4	3.1	-0.9
India	0.9	0.9	0.9	1.0	0.9	0.9	0.9	0.9	0.1
Brunei	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	-2.7
Malaysia	0.7	0.7	0.7	0.6	0.6	0.5	0.5	0.5	-1.5
Thailand	0.3	0.3	0.4	0.4	0.4	0.3	0.3	0.3	-0.8
Vietnam	0.4	0.4	0.3	0.4	0.3	0.3	0.2	0.2	-1.5
Other	1.4	1.3	1.3	0.9	0.8	0.7	0.6	0.6	-2.9
Middle East (Non-OPEC)	**1.6**	**1.5**	**1.5**	**1.5**	**1.4**	**1.3**	**1.2**	**1.1**	**-1.3**
Oman	0.7	0.7	0.8	0.8	0.7	0.7	0.7	0.6	-0.8
Syria	0.4	0.4	0.4	0.4	0.3	0.3	0.2	0.2	-2.4
Yemen	0.4	0.3	0.3	0.2	0.2	0.1	0.1	0.1	-3.5
Other	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	3.5
Africa	**2.4**	**2.4**	**2.4**	**2.6**	**2.6**	**2.7**	**2.7**	**2.6**	**0.3**
Chad	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.0	-3.8
Congo (Brazzaville)	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.2	-1.2
Egypt	0.7	0.7	0.6	0.5	0.6	0.6	0.6	0.6	-0.5
Equatorial Guniea	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	-0.8
Gabon	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	-2.3
Sao Tome and Principe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Sudan	0.4	0.5	0.5	0.5	0.5	0.6	0.7	0.7	1.6
Other	0.3	0.3	0.3	0.7	0.7	0.7	0.7	0.6	2.7
Central and South America	**3.7**	**3.7**	**3.8**	**4.8**	**5.4**	**5.9**	**6.5**	**6.9**	**2.3**
Brazil	1.9	1.9	1.9	2.8	3.4	3.8	4.2	4.8	3.4
Argentina	0.8	0.8	0.8	0.6	0.5	0.5	0.5	0.5	-1.9
Colombia	0.5	0.5	0.6	0.8	0.7	0.6	0.6	0.5	-0.5
Peru	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.3	3.7
Trinidad and Tobago	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.7
Other	0.2	0.2	0.2	0.2	0.3	0.4	0.6	0.7	5.2
Total World	**81.8**	**81.5**	**81.6**	**80.7**	**80.4**	**82.1**	**84.1**	**85.8**	**0.2**
OPEC Share of World Production	42%	41%	43%	44%	44%	45%	45%	46%	
Persian Gulf Share of World Production	29%	28%	30%	30%	31%	32%	33%	35%	

Note: Conventional liquids include crude oil and lease condensate, natural gas plant liquids, and refinery gain.
Sources: **History:** U.S. Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2010).

Table G15. World unconventional liquids production by region and country, Low Economic Growth case, 2006-2035
(Million barrels per day)

Region/Country	History (estimates) 2006	2007	2008	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OPEC[a]	**0.6**	**0.6**	**0.7**	**1.0**	**1.4**	**1.5**	**1.6**	**1.8**	**3.9**
Biofuels	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Extra-Heavy Oil (Venezuela)	0.6	0.6	0.7	0.8	1.1	1.2	1.4	1.6	3.3
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	0.2	0.2	0.3	0.3	0.3	16.1
Non-OPEC	**2.3**	**2.8**	**3.3**	**5.1**	**6.3**	**7.7**	**9.2**	**11.1**	**4.7**
OECD	**1.7**	**2.0**	**2.4**	**3.7**	**4.4**	**5.2**	**6.3**	**7.8**	**4.5**
Biofuels	0.5	0.6	0.9	1.3	1.5	1.6	1.7	2.1	3.3
Oil Sands/Bitumen (Canada)	1.2	1.4	1.5	2.3	2.8	3.4	4.2	5.1	4.6
Extra-Heavy Oil (Mexico)	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	8.5
Coal-to-Liquids	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.2	22.3
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	0.1	0.1	0.4	—
Non-OECD	**0.6**	**0.7**	**0.9**	**1.4**	**1.9**	**2.4**	**3.0**	**3.3**	**5.1**
Biofuels	0.4	0.5	0.6	1.1	1.4	1.7	2.0	2.1	4.5
Extra-Heavy Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Coal-to-Liquids	0.1	0.2	0.2	0.2	0.4	0.6	0.9	1.1	7.3
Gas-to-Liquids	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	3.3
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
World									
Biofuels	0.9	1.2	1.5	2.4	2.9	3.3	3.7	4.2	3.8
Oil Sands/Bitumen	1.2	1.4	1.5	2.3	2.8	3.4	4.2	5.1	4.6
Extra-Heavy Oil	0.6	0.6	0.7	0.8	1.2	1.3	1.4	1.6	3.4
Coal-to-Liquids	0.1	0.2	0.2	0.3	0.5	0.8	1.1	1.3	8.0
Gas-to-Liquids	0.0	0.1	0.1	0.3	0.3	0.4	0.4	0.4	7.9
Shale Oil	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.4	16.3
World Total	**2.9**	**3.4**	**3.9**	**6.1**	**7.7**	**9.2**	**10.9**	**13.0**	**4.5**
Selected Country Highlights									
Biofuels									
Brazil	0.3	0.3	0.5	0.9	1.1	1.3	1.5	1.6	4.7
China	0.1	0.2	0.0	0.0	0.1	0.1	0.2	0.2	7.3
India	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2
United States	0.3	0.5	0.7	1.0	1.2	1.3	1.4	1.7	3.7
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	0.1	0.3	0.5	0.7	27.3
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	0.1	0.1	0.1	—
South Africa	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	2.0
United States	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.2	—
Gas-to-Liquids									
Qatar	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.2	15.5
South Africa	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	1.0

[a]OPEC = Organization of the Petroleum Exporting Countries (OPEC-12).

Sources: **History:** U.S. Energy Information Administration (EIA), Office of Energy Markets and End Use. **Projections:** EIA, Generate World Oil Balance Model (2010).

Appendix H

Reference Case Projections for Electricity Capacity and Generation by Fuel

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Table H1. World total installed generating capacity by region and country, 2007-2035
(Gigawatts)

Region/Country	History	Projections					Average annual percent change, 2007-2035
	2007	2015	2020	2025	2030	2035	
OECD							
OECD North America	**1,176**	**1,266**	**1,290**	**1,340**	**1,410**	**1,491**	**0.9**
United States[a]	995	1,069	1,082	1,114	1,162	1,216	0.7
Canada	125	136	138	146	158	171	1.1
Mexico	56	62	70	80	91	104	2.2
OECD Europe	**836**	**874**	**928**	**972**	**1,004**	**1,034**	**0.8**
OECD Asia	**415**	**391**	**401**	**413**	**425**	**437**	**0.2**
Japan	279	247	247	248	250	250	-0.4
South Korea	73	75	83	92	101	111	1.5
Australia/New Zealand	63	69	71	73	74	76	0.7
Total OECD	**2,427**	**2,532**	**2,620**	**2,725**	**2,840**	**2,962**	**0.7**
Non-OECD							
Non-OECD Europe and Eurasia	**404**	**410**	**429**	**448**	**470**	**498**	**0.7**
Russia	221	228	239	251	265	282	0.9
Other	183	183	190	197	205	215	0.6
Non-OECD Asia	**1,089**	**1,471**	**1,766**	**2,080**	**2,360**	**2,700**	**3.3**
China	716	1,021	1,242	1,486	1,686	1,924	3.6
India	159	198	234	264	297	339	2.7
Other Non-OECD Asia	215	252	290	330	377	437	2.6
Middle East	**153**	**174**	**190**	**206**	**221**	**239**	**1.6**
Africa	**117**	**139**	**155**	**173**	**191**	**212**	**2.1**
Central and South America	**238**	**279**	**310**	**339**	**372**	**398**	**1.9**
Brazil	100	125	146	168	191	209	2.7
Other Central and South America	137	154	163	172	180	189	1.1
Total Non-OECD	2,002	2,473	2,850	3,248	3,613	4,047	2.5
Total World	**4,428**	**5,005**	**5,470**	**5,973**	**6,453**	**7,009**	**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:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table H2. World installed liquids-fired generating capacity by region and country, 2007-2035
(Gigawatts)

Region/Country	History 2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OECD							
OECD North America	**138**	**111**	**106**	**105**	**104**	**103**	**-1.0**
United States[a]	117	92	88	88	88	87	-1.1
Canada	5	5	5	4	4	4	-1.0
Mexico	15	14	13	12	12	11	-0.9
OECD Europe	**54**	**50**	**48**	**45**	**43**	**41**	**-1.0**
OECD Asia	**66**	**61**	**58**	**55**	**52**	**50**	**-1.0**
Japan	58	54	51	48	46	44	-1.0
South Korea	7	6	6	5	5	5	-1.0
Australia/New Zealand	1	1	1	1	1	1	-1.0
Total OECD	**258**	**222**	**212**	**206**	**200**	**194**	**-1.0**
Non-OECD							
Non-OECD Europe and Eurasia	**29**	**27**	**26**	**25**	**24**	**23**	**-0.9**
Russia	9	8	8	7	7	7	-0.8
Other	20	19	18	17	16	15	-1.0
Non-OECD Asia	**64**	**59**	**56**	**54**	**52**	**51**	**-0.8**
China	22	21	20	19	19	18	-0.7
India	6	6	6	5	5	5	-1.0
Other Non-OECD Asia	35	33	31	30	28	28	-0.8
Middle East	**45**	**42**	**40**	**38**	**38**	**49**	**0.3**
Africa	**11**	**10**	**9**	**9**	**8**	**8**	**-1.0**
Central and South America	**30**	**28**	**26**	**25**	**24**	**23**	**-1.0**
Brazil	3	3	3	3	3	3	-1.0
Other Central and South America	27	25	23	22	21	20	-1.0
Total Non-OECD	**179**	**165**	**157**	**150**	**145**	**153**	**-0.6**
Total World	**436**	**387**	**369**	**355**	**345**	**346**	**-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:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table H3. World installed natural-gas-fired generating capacity by region and country, 2007-2035
(Gigawatts)

Region/Country	History 2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OECD							
OECD North America	**358**	**380**	**391**	**424**	**469**	**514**	**1.3**
United States[a]	330	349	354	375	409	443	1.1
Canada	8	8	7	10	12	14	1.9
Mexico	19	23	30	39	48	57	4.0
OECD Europe	**175**	**164**	**174**	**181**	**195**	**206**	**0.6**
OECD Asia	**107**	**103**	**106**	**112**	**114**	**113**	**0.2**
Japan	74	68	68	71	72	71	-0.1
South Korea	20	21	23	25	26	26	0.9
Australia/New Zealand	13	14	15	16	16	16	0.7
Total OECD	**640**	**647**	**671**	**717**	**777**	**834**	**1.0**
Non-OECD							
Non-OECD Europe and Eurasia	**145**	**146**	**150**	**155**	**160**	**161**	**0.4**
Russia	98	97	98	98	99	100	0.1
Other	47	48	53	57	60	61	1.0
Non-OECD Asia	**135**	**157**	**185**	**206**	**216**	**221**	**1.8**
China	36	39	42	44	46	50	1.1
India	20	28	37	41	42	43	2.8
Other Non-OECD Asia	78	90	106	121	127	129	1.8
Middle East	**94**	**112**	**126**	**142**	**154**	**158**	**1.9**
Africa	**40**	**54**	**66**	**77**	**81**	**82**	**2.6**
Central and South America	**51**	**58**	**68**	**77**	**84**	**88**	**2.0**
Brazil	9	13	19	23	28	32	4.5
Other Central and South America	42	44	49	54	56	57	1.1
Total Non-OECD	**464**	**526**	**596**	**656**	**695**	**711**	**1.5**
Total World	**1,103**	**1,172**	**1,266**	**1,374**	**1,472**	**1,545**	**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:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table H4. World installed coal-fired generating capacity by region and country, 2007-2035
(Gigawatts)

Region/Country	History 2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OECD							
OECD North America	**340**	**345**	**346**	**347**	**352**	**363**	**0.2**
United States[a]	313	325	326	327	330	337	0.3
Canada	21	14	14	14	15	16	-0.8
Mexico	7	6	6	6	7	10	1.4
OECD Europe	**200**	**189**	**182**	**176**	**174**	**177**	**-0.4**
OECD Asia	**99**	**95**	**94**	**98**	**104**	**113**	**0.5**
Japan	45	42	41	40	39	39	-0.5
South Korea	23	22	23	27	33	41	2.1
Australia/New Zealand	31	30	31	31	32	33	0.3
Total OECD	**639**	**629**	**622**	**621**	**630**	**653**	**0.1**
Non-OECD							
Non-OECD Europe and Eurasia	**98**	**97**	**95**	**96**	**103**	**118**	**0.7**
Russia	44	44	44	44	50	61	1.1
Other	54	52	51	51	53	57	0.2
Non-OECD Asia	**630**	**764**	**896**	**1,072**	**1,277**	**1,509**	**3.2**
China	496	625	750	901	1,062	1,233	3.3
India	84	86	89	98	113	135	1.7
Other Non-OECD Asia	50	53	57	72	102	141	3.8
Middle East	**6**	**5**	**5**	**5**	**5**	**5**	**-0.4**
Africa	**41**	**41**	**43**	**47**	**56**	**70**	**1.9**
Central and South America	**10**	**10**	**9**	**9**	**9**	**11**	**0.1**
Brazil	2	2	2	2	2	3	0.8
Other Central and South America	8	8	7	7	7	8	-0.1
Total Non-OECD	**786**	**916**	**1,049**	**1,228**	**1,450**	**1,713**	**2.8**
Total World	**1,425**	**1,545**	**1,671**	**1,849**	**2,080**	**2,366**	**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 U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table H5. World installed nuclear generating capacity by region and country, 2007-2035
(Gigawatts)

Region/Country	History 2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OECD							
OECD North America	**115**	**121**	**129**	**130**	**132**	**136**	**0.6**
United States[a]	101	105	111	111	111	113	0.4
Canada	13	15	17	18	19	21	1.6
Mexico	1	1	1	1	2	2	2.0
OECD Europe	**131**	**130**	**133**	**137**	**142**	**144**	**0.3**
OECD Asia	**67**	**74**	**82**	**85**	**90**	**94**	**1.2**
Japan	49	52	55	56	59	61	0.8
South Korea	18	22	27	29	31	33	2.2
Australia/New Zealand	0	0	0	0	0	0	—
Total OECD	**313**	**325**	**344**	**353**	**364**	**374**	**0.6**
Non-OECD							
Non-OECD Europe and Eurasia	**43**	**49**	**60**	**70**	**74**	**79**	**2.2**
Russia	23	28	36	44	46	48	2.6
Other	19	20	23	26	28	31	1.7
Non-OECD Asia	**19**	**42**	**72**	**91**	**105**	**120**	**6.9**
China	9	25	44	56	65	75	7.9
India	4	9	16	21	24	27	6.9
Other Non-OECD Asia	6	8	12	14	16	18	4.4
Middle East	**0**	**1**	**3**	**4**	**6**	**7**	**—**
Africa	**2**	**2**	**2**	**3**	**3**	**4**	**3.0**
Central and South America	**3**	**4**	**5**	**6**	**6**	**8**	**3.6**
Brazil	2	3	3	4	4	5	3.6
Other Central and South America	1	1	2	2	2	3	3.7
Total Non-OECD	**66**	**98**	**141**	**174**	**194**	**219**	**4.4**
Total World	**380**	**423**	**485**	**527**	**558**	**593**	**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 U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table H6. World installed hydroelectric generating capacity by region and country, 2007-2035
(Gigawatts)

Region/Country	History	Projections					Average annual percent change, 2007-2035
	2007	2015	2020	2025	2030	2035	
OECD							
OECD North America	**164**	**169**	**172**	**177**	**184**	**191**	**0.5**
United States[a]	78	77	77	77	77	78	0.0
Canada	73	78	79	83	89	96	1.0
Mexico	13	14	15	17	17	17	0.9
OECD Europe	**147**	**155**	**162**	**169**	**177**	**180**	**0.7**
OECD Asia	**37**	**38**	**38**	**38**	**39**	**40**	**0.3**
Japan	22	23	23	23	24	24	0.4
South Korea	2	2	2	2	2	2	0.1
Australia/New Zealand	13	13	13	13	14	14	0.2
Total OECD	**348**	**362**	**371**	**385**	**399**	**411**	**0.6**
Non-OECD							
Non-OECD Europe and Eurasia	**87**	**91**	**96**	**101**	**107**	**114**	**1.0**
Russia	46	49	53	57	61	66	1.3
Other	41	42	43	44	46	49	0.6
Non-OECD Asia	**220**	**373**	**442**	**498**	**519**	**573**	**3.5**
China	145	256	298	339	342	368	3.4
India	35	54	67	74	85	98	3.7
Other Non-OECD Asia	40	63	77	85	93	107	3.6
Middle East	**9**	**13**	**14**	**15**	**17**	**18**	**2.4**
Africa	**22**	**29**	**31**	**33**	**37**	**42**	**2.4**
Central and South America	**136**	**169**	**191**	**212**	**237**	**256**	**2.3**
Brazil	77	96	111	127	145	157	2.6
Other Central and South America	59	74	80	85	92	99	1.9
Total Non-OECD	**474**	**675**	**774**	**860**	**917**	**1,003**	**2.7**
Total World	**822**	**1,037**	**1,145**	**1,244**	**1,316**	**1,414**	**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:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table H7. World installed wind-powered generating capacity by region and country, 2007-2035
(Gigawatts)

Region/Country	History	Projections					Average annual percent change, 2007-2035
	2007	2015	2020	2025	2030	2035	
OECD							
OECD North America	**18**	**80**	**81**	**83**	**85**	**90**	**5.9**
United States[a]	16	64	64	66	66	69	5.3
Canada	2	14	15	15	16	17	8.3
Mexico	0	2	2	2	3	3	13.7
OECD Europe	**57**	**127**	**170**	**200**	**210**	**219**	**4.9**
OECD Asia	**3**	**11**	**12**	**12**	**13**	**14**	**5.4**
Japan	2	3	3	3	3	3	2.0
South Korea	0	1	2	2	3	4	11.2
Australia/New Zealand	2	7	7	7	8	8	5.9
Total OECD	**78**	**218**	**263**	**296**	**308**	**323**	**5.2**
Non-OECD							
Non-OECD Europe and Eurasia	**0**	**1**	**1**	**1**	**1**	**2**	**5.8**
Russia	0	0	0	0	0	0	0.0
Other	0	1	1	1	1	2	6.0
Non-OECD Asia	**14**	**52**	**77**	**105**	**131**	**154**	**8.9**
China	6	39	63	86	110	130	11.7
India	8	11	13	16	18	20	3.5
Other Non-OECD Asia	0	1	2	3	3	4	9.4
Middle East	**0**	**1**	**1**	**1**	**1**	**1**	**8.1**
Africa	**0**	**2**	**2**	**2**	**3**	**3**	**6.6**
Central and South America	**0**	**3**	**3**	**3**	**4**	**4**	**8.2**
Brazil	0	2	2	2	2	3	8.6
Other Central and South America	0	1	1	1	1	1	7.4
Total Non-OECD	**15**	**59**	**85**	**113**	**140**	**163**	**8.8**
Total World	**93**	**277**	**347**	**409**	**448**	**486**	**6.1**

[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 U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.oiaf/aeo; and World Energy Projection System Plus (2010).

Table H8. World Installed geothermal generating capacity by region and country, 2007-2035
(Gigawatts)

Region/Country	History 2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OECD							
OECD North America	**3**	**4**	**5**	**5**	**5**	**6**	**2.1**
United States[a]	2	3	3	3	4	4	1.8
Canada	0	0	0	0	0	0	—
Mexico	1	1	1	2	2	2	2.9
OECD Europe	**1**	**2**	**2**	**2**	**2**	**2**	**1.7**
OECD Asia	**1**	**2**	**2**	**2**	**3**	**3**	**3.8**
Japan	1	1	1	1	1	1	0.3
South Korea	0	0	0	0	0	0	—
Australia/New Zealand	0	1	2	2	2	2	5.8
Total OECD	**5**	**8**	**8**	**9**	**10**	**11**	**2.4**
Non-OECD							
Non-OECD Europe and Eurasia	**0**	**0**	**0**	**0**	**0**	**0**	**5.3**
Russia	0	0	0	0	0	0	4.8
Other	0	0	0	0	0	0	—
Non-OECD Asia	**3**	**5**	**6**	**6**	**8**	**9**	**4.2**
China	0	0	0	0	0	0	—
India	0	0	0	0	0	0	—
Other Non-OECD Asia	3	5	5	6	8	9	4.1
Middle East	**0**	**0**	**0**	**0**	**0**	**0**	**—**
Africa	**0**	**0**	**0**	**0**	**0**	**0**	**4.2**
Central and South America	**0**	**1**	**1**	**1**	**1**	**1**	**2.9**
Brazil	0	0	0	0	0	0	—
Other Central and South America	0	1	1	1	1	1	2.9
Total Non-OECD	**4**	**6**	**7**	**8**	**10**	**11**	**4.1**
Total World	**9**	**14**	**15**	**17**	**20**	**22**	**3.2**

[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 U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table H9. World installed solar generating capacity by region and country, 2007-2035
(Gigawatts)

Region/Country	History	Projections					Average annual percent change, 2007-2035
	2007	2015	2020	2025	2030	2035	
OECD							
OECD North America	**1**	**1**	**1**	**1**	**1**	**2**	**3.5**
United States[a]	1	1	1	1	1	1	3.3
Canada	0	0	0	0	0	0	0.0
Mexico	0	0	0	0	0	0	7.9
OECD Europe	**5**	**31**	**33**	**34**	**35**	**37**	**7.6**
OECD Asia	**2**	**6**	**7**	**7**	**7**	**8**	**4.8**
Japan	2	4	5	5	5	5	3.7
South Korea	0	1	1	1	1	1	10.3
Australia/New Zealand	0	1	1	1	1	1	17.5
Total OECD	**7**	**39**	**41**	**42**	**44**	**46**	**6.7**
Non-OECD							
Non-OECD Europe and Eurasia	**0**	**0**	**0**	**0**	**0**	**0**	**—**
Russia	0	0	0	0	0	0	—
Other	0	0	0	0	0	0	—
Non-OECD Asia	**0**	**5**	**9**	**11**	**12**	**13**	**20.0**
China	0	4	6	6	6	6	16.9
India	0	1	3	5	6	7	—
Other Non-OECD Asia	0	0	0	0	0	0	—
Middle East	**0**	**1**	**1**	**2**	**2**	**2**	**—**
Africa	**0**	**1**	**1**	**2**	**2**	**3**	**22.2**
Central and South America	**0**	**0**	**0**	**0**	**0**	**0**	**0.0**
Brazil	0	0	0	0	0	0	—
Other Central and South America	0	0	0	0	0	0	0.0
Total Non-OECD	**0**	**6**	**12**	**15**	**16**	**18**	**19.9**
Total World	**8**	**45**	**53**	**57**	**60**	**64**	**7.9**

[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 U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table H10. World installed other renewable generating capacity by region and country, 2007-2035
(Gigawatts)

Region/Country	History	Projections					Average annual percent change, 2007-2035
	2007	2015	2020	2025	2030	2035	
OECD							
OECD North America	**7**	**11**	**11**	**12**	**14**	**19**	**3.4**
United States[a]	6	9	9	10	12	17	4.0
Canada	2	2	2	2	2	2	0.5
Mexico	0	0	0	0	1	1	2.6
OECD Europe	**25**	**26**	**26**	**27**	**27**	**28**	**0.4**
OECD Asia	**3**	**3**	**3**	**3**	**3**	**3**	**0.4**
Japan	2	2	2	2	2	2	0.6
South Korea	0	0	0	0	0	0	0.2
Australia/New Zealand	1	1	1	1	1	1	0.3
Total OECD	**35**	**40**	**40**	**41**	**44**	**50**	**1.3**
Non-OECD							
Non-OECD Europe and Eurasia	**0**	**0**	**0**	**0**	**0**	**0**	**—**
Russia	0	0	0	0	0	0	—
Other	0	0	0	0	0	0	—
Non-OECD Asia	**2**	**15**	**24**	**38**	**39**	**49**	**11.7**
China	1	12	21	34	36	45	15.4
India	1	3	3	3	4	4	3.8
Other Non-OECD Asia	0	0	0	0	0	0	—
Middle East	**0**	**0**	**0**	**0**	**0**	**0**	**—**
Africa	**0**	**0**	**0**	**0**	**0**	**0**	**—**
Central and South America	**7**	**7**	**7**	**7**	**7**	**8**	**0.5**
Brazil	6	6	6	7	7	7	0.4
Other Central and South America	0	0	0	0	0	0	3.5
Total Non-OECD	**9**	**22**	**30**	**45**	**47**	**57**	**6.9**
Total World	**44**	**62**	**70**	**85**	**91**	**107**	**3.2**

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

Notes: In this table, “other renewable” includes biomass, waste, and tidal/wave/ocean. Totals may not equal sum of components due to independent rounding.

Sources: **History:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table H11. World total net electricity generation from central producers by region and country, 2007-2035
(Billion kilowatthours)

Region/Country	History 2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OECD							
OECD North America	**5,003**	**5,179**	**5,532**	**5,903**	**6,303**	**6,690**	**1.0**
United States[a]	4,139	4,257	4,502	4,747	5,010	5,236	0.8
Canada	621	634	686	742	801	868	1.2
Mexico	244	288	344	415	492	586	3.2
OECD Europe	**3,399**	**3,651**	**3,904**	**4,156**	**4,380**	**4,596**	**1.1**
OECD Asia	**1,747**	**1,843**	**1,976**	**2,097**	**2,215**	**2,336**	**1.0**
Japan	1,063	1,074	1,125	1,164	1,201	1,236	0.5
South Korea	402	449	514	580	650	723	2.1
Australia/New Zealand	282	320	337	352	364	377	1.0
Total OECD	**10,149**	**10,673**	**11,413**	**12,156**	**12,898**	**13,621**	**1.1**
Non-OECD							
Non-OECD Europe and Eurasia	**1,592**	**1,727**	**1,887**	**2,058**	**2,233**	**2,450**	**1.6**
Russia	959	1,038	1,134	1,236	1,344	1,477	1.6
Other	633	689	753	822	889	973	1.5
Non-OECD Asia	**4,779**	**6,789**	**8,607**	**10,554**	**12,605**	**14,790**	**4.1**
China	3,041	4,611	5,981	7,476	9,014	10,555	4.5
India	762	964	1,166	1,343	1,531	1,778	3.1
Other Non-OECD Asia	976	1,215	1,460	1,735	2,060	2,458	3.4
Middle East	**674**	**826**	**950**	**1,074**	**1,191**	**1,330**	**2.5**
Africa	**581**	**711**	**821**	**947**	**1,061**	**1,202**	**2.6**
Central and South America	**1,009**	**1,174**	**1,339**	**1,499**	**1,660**	**1,798**	**2.1**
Brazil	439	554	660	776	898	993	3.0
Other Central and South America	570	620	678	723	762	805	1.2
Total Non-OECD	**8,634**	**11,226**	**13,604**	**16,132**	**18,751**	**21,570**	**3.3**
Total World	**18,783**	**21,899**	**25,017**	**28,288**	**31,649**	**35,191**	**2.3**

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

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

Sources: **History:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table H12. World net liquids-fired electricity generation from central producers by region and country, 2007-2035
(Billion kilowatthours)

Region/Country	History 2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OECD							
OECD North America	**145**	**119**	**117**	**114**	**112**	**110**	**-1.0**
United States[a]	65	46	47	48	48	49	-1.0
Canada	17	16	15	14	14	13	-1.0
Mexico	63	58	55	52	50	48	-0.9
OECD Europe	**70**	**65**	**62**	**59**	**56**	**53**	**-1.0**
OECD Asia	**110**	**102**	**97**	**92**	**87**	**83**	**-1.0**
Japan	89	82	78	75	71	67	-1.0
South Korea	20	18	17	17	16	15	-1.0
Australia/New Zealand	1	1	1	1	1	1	-1.0
Total OECD	**326**	**286**	**275**	**265**	**255**	**247**	**-1.0**
Non-OECD							
Non-OECD Europe and Eurasia	**57**	**53**	**51**	**48**	**47**	**46**	**-0.8**
Russia	28	26	25	23	24	23	-0.6
Other	29	27	26	25	24	22	-0.9
Non-OECD Asia	**171**	**161**	**153**	**146**	**143**	**145**	**-0.6**
China	52	51	48	46	48	46	-0.4
India	21	19	18	17	17	16	-1.0
Other Non-OECD Asia	98	91	86	82	78	83	-0.6
Middle East	**238**	**220**	**209**	**199**	**201**	**283**	**0.6**
Africa	**62**	**57**	**54**	**52**	**49**	**47**	**-1.0**
Central and South America	**90**	**83**	**79**	**75**	**71**	**68**	**-1.0**
Brazil	6	5	5	5	5	4	-1.0
Other Central and South America	84	78	74	70	67	64	-1.0
Total Non-OECD	**617**	**574**	**546**	**519**	**512**	**588**	**-0.2**
Total World	**943**	**860**	**821**	**784**	**767**	**835**	**-0.4**

[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 U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table H13. World net natural-gas-fired electricity generation from central producers by region and country, 2007-2035
(Billion kilowatthours)

Region/Country	History 2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OECD							
OECD North America	**1,010**	**833**	**961**	**1,147**	**1,371**	**1,534**	**1.5**
United States[a]	897	690	767	871	1,015	1,093	0.7
Canada	24	22	21	40	57	71	4.0
Mexico	90	121	173	236	300	369	5.2
OECD Europe	**747**	**707**	**794**	**867**	**983**	**1,082**	**1.3**
OECD Asia	**399**	**398**	**434**	**497**	**520**	**528**	**1.0**
Japan	295	272	282	315	327	332	0.4
South Korea	69	79	95	116	124	126	2.2
Australia/New Zealand	36	46	58	67	69	70	2.4
Total OECD	**2,156**	**1,937**	**2,190**	**2,511**	**2,874**	**3,144**	**1.4**
Non-OECD							
Non-OECD Europe and Eurasia	**568**	**609**	**663**	**714**	**767**	**794**	**1.2**
Russia	385	404	420	433	457	472	0.7
Other	183	206	243	282	310	322	2.0
Non-OECD Asia	**458**	**642**	**851**	**1,010**	**1,085**	**1,122**	**3.2**
China	66	90	110	124	133	143	2.8
India	47	111	175	210	222	228	5.8
Other Non-OECD Asia	346	441	566	676	730	751	2.8
Middle East	**382**	**529**	**643**	**764**	**862**	**901**	**3.1**
Africa	**143**	**253**	**344**	**424**	**460**	**471**	**4.4**
Central and South America	**154**	**202**	**276**	**335**	**386**	**416**	**3.6**
Brazil	26	56	94	123	160	182	7.2
Other Central and South America	128	146	182	212	226	234	2.2
Total Non-OECD	**1,705**	**2,235**	**2,777**	**3,247**	**3,561**	**3,705**	**2.8**
Total World	**3,861**	**4,172**	**4,967**	**5,758**	**6,434**	**6,849**	**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:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table H14. World net coal-fired electricity generation from central producers by region and country, 2007-2035
(Billion kilowatthours)

Region/Country	History 2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OECD							
OECD North America	**2,177**	**2,160**	**2,212**	**2,269**	**2,343**	**2,469**	**0.5**
United States[a]	2,017	2,037	2,093	2,147	2,210	2,305	0.5
Canada	115	80	77	80	87	97	-0.6
Mexico	45	42	42	43	47	68	1.5
OECD Europe	**992**	**937**	**908**	**882**	**878**	**915**	**-0.3**
OECD Asia	**700**	**671**	**667**	**691**	**732**	**797**	**0.5**
Japan	328	307	296	287	282	282	-0.5
South Korea	173	167	171	200	241	296	1.9
Australia/New Zealand	199	197	199	203	209	219	0.3
Total OECD	**3,868**	**3,767**	**3,786**	**3,842**	**3,954**	**4,181**	**0.3**
Non-OECD							
Non-OECD Europe and Eurasia	**403**	**408**	**409**	**422**	**487**	**599**	**1.4**
Russia	221	227	228	234	278	355	1.7
Other	182	181	182	188	209	244	1.1
Non-OECD Asia	**3,301**	**4,306**	**5,276**	**6,545**	**8,021**	**9,684**	**3.9**
China	2,422	3,388	4,306	5,401	6,567	7,795	4.3
India	542	557	582	648	752	911	1.9
Other Non-OECD Asia	337	361	387	495	702	977	3.9
Middle East	**32**	**30**	**29**	**28**	**28**	**29**	**-0.3**
Africa	**264**	**263**	**275**	**304**	**367**	**468**	**2.1**
Central and South America	**56**	**53**	**51**	**49**	**51**	**61**	**0.3**
Brazil	6	6	6	6	7	12	2.5
Other Central and South America	50	47	45	43	44	49	0.0
Total Non-OECD	**4,055**	**5,059**	**6,040**	**7,348**	**8,954**	**10,841**	**3.6**
Total World	**7,923**	**8,826**	**9,826**	**11,190**	**12,908**	**15,022**	**2.3**

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

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

Sources: **History:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table H15. World net nuclear electricity generation from central producers by region and country, 2007-2035
(Billion kilowatthours)

Region/Country	History 2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OECD							
OECD North America	**905**	**958**	**1,020**	**1,031**	**1,046**	**1,074**	**0.6**
United States[a]	806	834	883	886	886	898	0.4
Canada	89	113	127	134	142	158	2.1
Mexico	10	11	11	11	18	18	2.2
OECD Europe	**879**	**935**	**967**	**1,011**	**1,055**	**1,084**	**0.8**
OECD Asia	**386**	**486**	**560**	**591**	**641**	**683**	**2.1**
Japan	251	311	342	358	388	417	1.8
South Korea	136	175	218	233	254	266	2.4
Australia/New Zealand	0	0	0	0	0	0	—
Total OECD	**2,171**	**2,379**	**2,548**	**2,634**	**2,742**	**2,841**	**1.0**
Non-OECD							
Non-OECD Europe and Eurasia	**273**	**342**	**425**	**512**	**545**	**588**	**2.8**
Russia	148	197	258	324	345	364	3.3
Other	125	145	167	188	200	224	2.1
Non-OECD Asia	**119**	**312**	**543**	**698**	**814**	**942**	**7.7**
China	63	186	335	437	512	598	8.4
India	16	66	119	156	179	203	9.5
Other Non-OECD Asia	41	61	89	105	123	141	4.5
Middle East	**0**	**6**	**20**	**29**	**39**	**49**	**—**
Africa	**12**	**15**	**15**	**21**	**21**	**31**	**3.5**
Central and South America	**19**	**28**	**34**	**43**	**43**	**62**	**4.3**
Brazil	12	18	22	31	31	41	4.4
Other Central and South America	7	10	12	12	12	21	4.2
Total Non-OECD	**423**	**704**	**1,038**	**1,303**	**1,462**	**1,672**	**5.0**
Total World	**2,593**	**3,083**	**3,586**	**3,937**	**4,204**	**4,514**	**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:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table H16. World net hydroelectric generation from central producers by region and country, 2007-2035
(Billion kilowatthours)

Region/Country	History	Projections					Average annual percent change, 2007-2035
	2007	2015	2020	2025	2030	2035	
OECD							
OECD North America	**639**	**723**	**758**	**785**	**804**	**823**	**0.9**
United States[a]	248	300	300	302	302	303	0.7
Canada	365	383	413	432	451	469	0.9
Mexico	27	40	45	51	51	51	2.3
OECD Europe	**493**	**540**	**568**	**609**	**641**	**656**	**1.0**
OECD Asia	**114**	**121**	**134**	**136**	**140**	**144**	**0.8**
Japan	73	76	89	91	94	97	1.0
South Korea	4	4	4	4	4	4	0.5
Australia/New Zealand	38	41	41	41	42	43	0.5
Total OECD	**1,246**	**1,384**	**1,460**	**1,530**	**1,585**	**1,624**	**0.9**
Non-OECD							
Non-OECD Europe and Eurasia	**289**	**307**	**331**	**353**	**379**	**413**	**1.3**
Russia	175	181	201	218	236	257	1.4
Other	113	126	131	135	142	156	1.1
Non-OECD Asia	**684**	**1,079**	**1,352**	**1,574**	**1,809**	**2,016**	**3.9**
China	430	686	846	1,006	1,167	1,262	3.9
India	123	173	223	247	287	333	3.6
Other Non-OECD Asia	131	220	283	321	355	421	4.3
Middle East	**22**	**37**	**43**	**49**	**54**	**60**	**3.6**
Africa	**97**	**112**	**120**	**130**	**147**	**166**	**1.9**
Central and South America	**660**	**770**	**860**	**955**	**1,061**	**1,140**	**2.0**
Brazil	370	446	511	588	667	723	2.4
Other Central and South America	290	323	349	367	394	417	1.3
Total Non-OECD	**1,753**	**2,305**	**2,706**	**3,061**	**3,449**	**3,795**	**2.8**
Total World	**2,999**	**3,689**	**4,166**	**4,591**	**5,034**	**5,418**	**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:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table H17. World net wind-powered electricity generation from central producers by region and country, 2007-2035
(Billion kilowatthours)

Region/Country	History	Projections					Average annual percent change, 2007-2035
	2007	2015	2020	2025	2030	2035	
OECD							
OECD North America	**38**	**215**	**229**	**244**	**256**	**277**	**7.4**
United States[a]	35	198	199	204	207	218	6.8
Canada	3	12	24	33	41	49	10.7
Mexico	0	5	6	7	8	10	13.9
OECD Europe	**100**	**284**	**411**	**527**	**555**	**582**	**6.5**
OECD Asia	**6**	**25**	**31**	**33**	**35**	**39**	**6.8**
Japan	2	3	6	6	6	6	3.2
South Korea	0	3	5	7	8	11	13.1
Australia/New Zealand	3	20	21	21	21	22	6.9
Total OECD	**144**	**525**	**671**	**803**	**846**	**898**	**6.8**
Non-OECD							
Non-OECD Europe and Eurasia	**0**	**4**	**4**	**4**	**4**	**4**	**8.9**
Russia	0	0	0	0	0	0	0.0
Other	0	4	4	4	4	4	9.0
Non-OECD Asia	**18**	**139**	**212**	**292**	**366**	**433**	**12.0**
China	6	114	181	248	316	374	15.6
India	11	22	26	36	41	48	5.4
Other Non-OECD Asia	0	3	5	8	9	11	11.9
Middle East	**0**	**1**	**1**	**2**	**2**	**2**	**10.0**
Africa	**1**	**6**	**6**	**6**	**7**	**8**	**7.4**
Central and South America	**1**	**8**	**8**	**8**	**9**	**10**	**8.8**
Brazil	1	4	4	5	6	6	9.0
Other Central and South America	0	3	3	3	4	4	8.5
Total Non-OECD	**21**	**157**	**231**	**312**	**388**	**457**	**11.7**
Total World	**165**	**682**	**902**	**1,115**	**1,234**	**1,355**	**7.8**

[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 U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table H18. World net geothermal electricity generation from central producers by region and country, 2007-2035
(Billion kilowatthours)

Region/Country	History	Projections					Average annual percent change, 2007-2035
	2007	2015	2020	2025	2030	2035	
OECD							
OECD North America	**22**	**32**	**33**	**35**	**40**	**45**	**2.6**
United States[a]	15	24	24	24	26	28	2.4
Canada	0	0	0	0	0	0	—
Mexico	7	9	9	12	14	16	3.1
OECD Europe	**9**	**13**	**13**	**14**	**14**	**15**	**1.8**
OECD Asia	**6**	**12**	**15**	**18**	**20**	**20**	**4.3**
Japan	3	3	3	3	3	3	0.3
South Korea	0	0	0	0	0	0	—
Australia/New Zealand	3	9	12	15	16	17	6.0
Total OECD	**37**	**57**	**61**	**66**	**73**	**80**	**2.8**
Non-OECD							
Non-OECD Europe and Eurasia	**0**	**2**	**2**	**2**	**2**	**3**	**6.2**
Russia	0	2	2	2	2	2	5.7
Other	0	0	0	0	0	0	—
Non-OECD Asia	**16**	**32**	**36**	**41**	**56**	**66**	**5.1**
China	0	0	0	0	0	0	—
India	0	1	1	1	1	2	—
Other Non-OECD Asia	16	31	35	40	54	65	5.0
Middle East	**0**	**0**	**0**	**0**	**1**	**1**	**—**
Africa	**1**	**2**	**2**	**3**	**3**	**3**	**4.5**
Central and South America	**3**	**4**	**6**	**6**	**7**	**7**	**3.4**
Brazil	0	0	0	0	0	0	—
Other Central and South America	3	4	6	6	7	7	3.4
Total Non-OECD	**21**	**41**	**47**	**52**	**68**	**80**	**5.0**
Total World	**57**	**98**	**108**	**119**	**142**	**160**	**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 U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table H19. World net solar electricity generation from central producers by region and country, 2007-2035
(Billion kilowatthours)

Region/Country	History 2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OECD							
OECD North America	**1**	**16**	**19**	**20**	**22**	**25**	**10.9**
United States[a]	1	15	19	19	21	25	11.0
Canada	0	0	0	0	0	0	0.7
Mexico	0	0	0	0	0	0	13.8
OECD Europe	**4**	**64**	**72**	**75**	**79**	**83**	**11.3**
OECD Asia	**0**	**5**	**13**	**13**	**13**	**14**	**19.2**
Japan	0	0	8	8	8	8	27.2
South Korea	0	3	3	3	3	3	13.8
Australia/New Zealand	0	2	2	2	2	2	21.3
Total OECD	**6**	**85**	**104**	**107**	**114**	**122**	**11.6**
Non-OECD							
Non-OECD Europe and Eurasia	**0**	**0**	**0**	**0**	**0**	**0**	**—**
Russia	0	0	0	0	0	0	—
Other	0	0	0	0	0	0	—
Non-OECD Asia	**0**	**7**	**16**	**23**	**29**	**32**	**21.1**
China	0	5	8	11	14	16	19.3
India	0	2	7	12	14	16	27.1
Other Non-OECD Asia	0	0	0	0	0	0	1.5
Middle East	**0**	**2**	**4**	**4**	**5**	**5**	**—**
Africa	**0**	**1**	**3**	**5**	**6**	**7**	**21.4**
Central and South America	**0**	**0**	**0**	**0**	**0**	**0**	**—**
Brazil	0	0	0	0	0	0	—
Other Central and South America	0	0	0	0	0	0	—
Total Non-OECD	**0**	**10**	**23**	**33**	**39**	**44**	**21.7**
Total World	**6**	**95**	**126**	**140**	**153**	**165**	**12.7**

[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 U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table H20. World net other renewable electricity generation from central producers by region and country, 2007-2035
(Billion kilowatthours)

Region/Country	History 2007	Projections 2015	2020	2025	2030	2035	Average annual percent change, 2007-2035
OECD							
OECD North America	**65**	**123**	**183**	**258**	**310**	**332**	**6.0**
United States[a]	55	112	172	246	296	318	6.5
Canada	8	8	9	9	9	10	0.6
Mexico	3	3	3	3	4	5	2.4
OECD Europe	**104**	**106**	**109**	**113**	**119**	**125**	**0.7**
OECD Asia	**25**	**24**	**26**	**26**	**27**	**28**	**0.3**
Japan	22	20	22	22	23	24	0.3
South Korea	1	1	1	1	1	1	0.3
Australia/New Zealand	3	3	3	3	3	3	0.7
Total OECD	**195**	**253**	**318**	**398**	**456**	**485**	**3.3**
Non-OECD							
Non-OECD Europe and Eurasia	**2**	**2**	**2**	**3**	**3**	**3**	**0.9**
Russia	2	2	2	2	2	3	1.0
Other	0	0	0	0	0	0	0.6
Non-OECD Asia	**12**	**112**	**167**	**224**	**282**	**351**	**13.0**
China	2	91	146	201	256	321	19.5
India	2	14	14	15	18	20	8.9
Other Non-OECD Asia	8	8	8	8	9	10	1.1
Middle East	**0**	**0**	**0**	**0**	**0**	**0**	**—**
Africa	**1**	**1**	**1**	**1**	**1**	**1**	**2.6**
Central and South America	**26**	**26**	**26**	**28**	**31**	**34**	**0.9**
Brazil	18	18	18	19	22	24	1.0
Other Central and South America	8	8	8	8	9	10	0.6
Total Non-OECD	**40**	**141**	**196**	**255**	**317**	**389**	**8.4**
Total World	**235**	**394**	**515**	**653**	**773**	**874**	**4.8**

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

Notes: In this table, “other renewable” includes biomass, waste, and tidal/wave/ocean. Totals may not equal sum of components due to independent rounding.

Sources: **History:** Derived from U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Appendix I

Projections of Natural Gas Production in Five Cases:

- Reference
- High Economic Growth
- Low Economic Growth
- High Oil Price
- Low Price

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Table I1. World total natural gas production by region, Reference case, 2007-2035
(Trillion cubic feet)

Region/Country	History 2007	History 2008	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD								
OECD North America	**27.4**	**28.2**	**26.9**	**27.7**	**29.3**	**31.0**	**32.2**	**0.6**
United States[a]	19.2	20.3	19.4	20.1	21.4	22.5	23.4	0.7
Canada	6.3	6.0	5.6	5.5	5.8	6.4	6.7	0.2
Mexico	1.8	1.8	1.9	2.1	2.1	2.1	2.1	0.5
OECD Europe	**10.2**	**10.7**	**9.6**	**9.0**	**8.6**	**8.3**	**8.0**	**-0.9**
North Europe	9.8	10.3	9.1	8.5	8.1	7.8	7.5	-1.0
South Europe	0.3	0.3	0.4	0.4	0.4	0.4	0.4	1.0
Southwest Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Turkey	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
OECD Asia	**1.9**	**2.0**	**3.7**	**3.9**	**4.0**	**4.2**	**4.6**	**3.2**
Japan	0.2	0.2	0.1	0.1	0.1	0.1	0.1	-2.4
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2
Australia/New Zealand	1.7	1.7	3.5	3.7	3.9	4.1	4.5	3.5
Total OECD	**39.5**	**40.8**	**40.2**	**40.5**	**41.9**	**43.5**	**44.8**	**0.4**
Non-OECD								
Non-OECD Europe and Eurasia	**30.4**	**31.2**	**32.1**	**33.8**	**34.9**	**35.9**	**36.8**	**0.7**
Russia	23.1	23.4	23.0	24.3	25.3	26.5	27.3	0.6
Central Asia	6.1	6.6	7.8	8.1	8.2	8.1	8.2	1.0
Non-OECD Europe	1.2	1.2	1.4	1.4	1.4	1.4	1.4	0.4
Non-OECD Asia	**12.0**	**12.6**	**15.8**	**17.1**	**18.4**	**19.8**	**20.9**	**2.0**
China	2.4	2.7	2.9	3.0	3.4	4.5	5.6	3.0
India	1.1	1.1	2.7	3.0	3.2	3.3	3.3	4.0
LNG exporters	4.9	5.0	6.6	7.3	7.6	7.6	7.5	1.6
Developed Asia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Southeast Asia	2.3	2.4	2.3	2.3	2.4	2.5	2.5	0.4
Northwest Asia	1.3	1.3	1.3	1.5	1.7	1.9	2.0	1.6
Middle East	**12.6**	**13.5**	**20.9**	**24.6**	**26.6**	**27.8**	**28.4**	**2.9**
Arabian producers	3.5	3.5	3.7	4.0	4.3	4.3	4.1	0.6
Iran	4.0	4.1	6.4	8.0	8.7	9.0	8.7	2.9
Iraq	0.1	0.1	0.2	0.5	0.7	0.8	1.1	11.6
Qatar	2.2	2.7	6.4	7.4	8.2	9.2	9.5	5.3
Saudi Arabia	2.6	2.8	4.1	4.5	4.5	4.5	4.8	2.2
Other Middle East	0.3	0.3	0.2	0.2	0.2	0.1	0.1	-2.8
Africa	**6.8**	**7.2**	**11.3**	**12.7**	**13.8**	**14.1**	**14.0**	**2.6**
North Africa	5.3	5.4	8.2	9.0	9.7	9.9	9.8	2.2
West Africa	1.3	1.5	2.9	3.5	3.8	4.0	4.0	4.0
South Africa	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.5
Other Africa	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.1
Central and South America	**5.2**	**5.3**	**6.6**	**8.7**	**9.4**	**10.0**	**10.5**	**2.5**
Brazil	0.3	0.4	1.0	1.5	1.8	2.2	2.5	7.4
Northern producers	2.6	2.6	3.2	4.5	4.8	5.0	4.9	2.3
Other South America	2.2	2.2	2.3	2.6	2.6	2.7	2.9	0.9
Central America and Caribbean	0.0	0.0	0.1	0.1	0.1	0.1	0.1	6.1
Total Non-OECD	**67.0**	**69.7**	**86.8**	**97.0**	**103.0**	**107.7**	**110.6**	**1.8**
Total World	**106.6**	**110.5**	**126.9**	**137.5**	**144.8**	**151.1**	**155.4**	**1.4**
Discrepancy[b]	1.9	0.7	-2.3	-1.1	0.1	-0.9	0.9	

[a]Includes the 50 States and the District of Columbia. Production includes supplemental production, less any forecast discrepancy.
[b]Balancing item. Differences between global production and consumption totals result from rounding and different conversion factors derived from heat contents of regionally consumed and produced natural gas.
Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and International Natural Gas Model (2010).

Table I2. World tight gas, shale gas, and coalbed methane production by region, Reference case, 2007-2035
(Trillion cubic feet)

Region/Country	History 2007	History 2008	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD								
OECD North America	**5.0**	**5.6**	**8.0**	**8.9**	**9.8**	**11.4**	**12.7**	**3.4**
United States[a]	3.1	3.5	5.7	6.4	6.7	7.3	7.9	3.5
Canada	2.0	2.1	2.3	2.4	2.9	3.7	4.2	2.8
Mexico	0.0	0.0	0.0	0.1	0.2	0.4	0.6	—
OECD Europe	**0.0**	**0.0**	**0.0**	**0.0**	**0.3**	**0.6**	**0.9**	**—**
North Europe	0.0	0.0	0.0	0.0	0.3	0.6	0.8	—
South Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.1	—
Southwest Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Turkey	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
OECD Asia	**0.1**	**0.1**	**0.1**	**0.2**	**0.3**	**0.5**	**1.1**	**9.5**
Japan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Australia/New Zealand	0.1	0.1	0.1	0.2	0.3	0.5	1.1	9.5
Total OECD	**5.1**	**5.7**	**8.2**	**9.1**	**10.4**	**12.6**	**14.6**	**3.8**
Non-OECD								
Non-OECD Europe and Eurasia	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**0.3**	**1.1**	**—**
Russia	0.0	0.0	0.0	0.0	0.0	0.1	0.4	—
Central Asia	0.0	0.0	0.0	0.0	0.0	0.1	0.5	—
Non-OECD Europe	0.0	0.0	0.0	0.0	0.1	0.1	0.2	—
Non-OECD Asia	**0.2**	**0.2**	**0.3**	**0.5**	**1.4**	**3.1**	**4.8**	**12.0**
China	0.2	0.2	0.3	0.3	0.8	2.0	3.1	10.3
India	0.0	0.0	0.0	0.0	0.1	0.2	0.3	—
LNG exporters	0.0	0.0	0.0	0.0	0.0	0.1	0.2	—
Developed Asia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Southeast Asia	0.0	0.0	0.0	0.0	0.0	0.1	0.2	—
Northwest Asia	0.0	0.0	0.0	0.2	0.5	0.7	0.9	—
Middle East	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**—**
Arabian producers	0.0	0.0	0.0	0.0	0.0	0.0	0.1	—
Iran	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Iraq	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Qatar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Saudi Arabia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Middle East	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Africa	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**—**
North Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
West Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
South Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Central and South America	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.5**	**1.2**	**—**
Brazil	0.0	0.0	0.0	0.0	0.0	0.2	0.5	—
Northern producers	0.0	0.0	0.0	0.0	0.0	0.0	0.2	—
Other South America	0.0	0.0	0.0	0.0	0.0	0.3	0.5	—
Central America and Caribbean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Total Non-OECD	**0.2**	**0.2**	**0.4**	**0.6**	**1.5**	**4.0**	**7.3**	**13.7**
Total World	**5.3**	**5.9**	**8.6**	**9.7**	**12.0**	**16.5**	**21.9**	**5.2**

[a]Includes the 50 States and the District of Columbia. U.S. tight gas is reported in the “other natural gas” table that follows.

Sources: **History:** *United States:* U.S. Energy Information Administration (EIA), Natural Gas Navigator, “Unconventional Dry Natural Gas Production” (as of November 2009), web site www.eia.gov/dnav/ng/ng_prod_top.asp. *Other countries:* EIA, Office of Integrated Analysis and Forecasting, internal estimates. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and International Natural Gas Model (2010).

Table I3. World other natural gas production by region, Reference case, 2007-2035
(Trillion cubic feet)

Region/Country	History 2007	History 2008	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD								
OECD North America	**22.4**	**22.6**	**18.9**	**18.8**	**19.4**	**19.6**	**19.5**	**-0.5**
United States[a]	16.2	16.8	13.6	13.7	14.7	15.1	15.5	-0.2
Canada	4.4	3.9	3.3	3.0	2.9	2.7	2.5	-2.0
Mexico	1.8	1.8	1.9	2.1	1.9	1.7	1.5	-0.6
OECD Europe	**10.2**	**10.7**	**9.5**	**8.9**	**8.3**	**7.7**	**7.1**	**-1.3**
North Europe	9.8	10.3	9.1	8.5	7.9	7.3	6.7	-1.4
South Europe	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4
Southwest Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Turkey	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
OECD Asia	**1.8**	**1.8**	**3.5**	**3.7**	**3.7**	**3.7**	**3.5**	**2.3**
Japan	0.2	0.2	0.1	0.1	0.1	0.1	0.1	-2.5
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2
Australia/New Zealand	1.6	1.6	3.4	3.6	3.6	3.5	3.4	2.7
Total OECD	**34.4**	**35.1**	**32.0**	**31.4**	**31.5**	**30.9**	**30.2**	**-0.5**
Non-OECD								
Non-OECD Europe and Eurasia	**30.4**	**31.2**	**32.1**	**33.8**	**34.8**	**35.6**	**35.7**	**0.6**
Russia	23.1	23.4	23.0	24.3	25.3	26.3	26.8	0.5
Central Asia	6.1	6.6	7.8	8.1	8.2	8.0	7.7	0.8
Non-OECD Europe	1.2	1.2	1.4	1.4	1.3	1.3	1.2	-0.1
Non-OECD Asia	**11.8**	**12.4**	**15.5**	**16.6**	**17.0**	**16.7**	**16.2**	**1.1**
China	2.2	2.5	2.6	2.7	2.7	2.6	2.5	0.3
India	1.1	1.1	2.7	3.0	3.1	3.1	2.9	3.6
LNG exporters	4.9	5.0	6.6	7.3	7.6	7.6	7.4	1.5
Developed Asia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Southeast Asia	2.3	2.4	2.3	2.3	2.4	2.3	2.3	0.0
Northwest Asia	1.3	1.3	1.3	1.3	1.2	1.2	1.1	-0.6
Middle East	**12.6**	**13.5**	**20.9**	**24.6**	**26.5**	**27.8**	**28.2**	**2.9**
Arabian producers	3.5	3.5	3.7	4.0	4.3	4.2	4.0	0.5
Iran	4.0	4.1	6.4	8.0	8.7	9.0	8.7	2.9
Iraq	0.1	0.1	0.2	0.5	0.7	0.7	1.1	11.6
Qatar	2.2	2.7	6.4	7.4	8.2	9.2	9.5	5.3
Saudi Arabia	2.6	2.8	4.1	4.5	4.5	4.5	4.8	2.2
Other Middle East	0.3	0.3	0.2	0.2	0.2	0.1	0.1	-3.2
Africa	**6.8**	**7.2**	**11.3**	**12.7**	**13.8**	**14.1**	**13.9**	**2.6**
North Africa	5.3	5.4	8.2	9.0	9.7	9.9	9.8	2.2
West Africa	1.3	1.5	2.9	3.5	3.8	4.0	4.0	3.9
South Africa	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-1.1
Other Africa	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.1
Central and South America	**5.2**	**5.3**	**6.6**	**8.7**	**9.3**	**9.5**	**9.2**	**2.1**
Brazil	0.3	0.4	1.0	1.5	1.8	2.0	2.0	6.5
Northern producers	2.6	2.6	3.2	4.5	4.8	5.0	4.8	2.2
Other South America	2.2	2.2	2.3	2.6	2.5	2.5	2.3	0.2
Central America and Caribbean	0.0	0.0	0.1	0.1	0.1	0.1	0.1	5.9
Total Non-OECD	**66.8**	**69.5**	**86.4**	**96.4**	**101.4**	**103.7**	**103.3**	**1.6**
Total World	**101.3**	**104.6**	**118.4**	**127.8**	**132.9**	**134.6**	**133.5**	**1.0**

[a]Includes the 50 States and the District of Columbia. Production includes supplemental production, less any forecast discrepancy.

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and International Natural Gas Model (2010).

Table I4. World net natural gas trade by region, Reference case, 2007-2035
(Trillion cubic feet)

Region/Country	History 2007	History 2008	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD								
OECD North America	**0.9**	**0.4**	**0.5**	**1.5**	**2.0**	**2.1**	**2.6**	**3.9**
United States[a]	3.8	3.0	2.4	2.6	2.2	1.8	1.5	-3.3
Canada	-3.4	-3.1	-2.4	-2.1	-2.0	-2.2	-2.2	-1.5
Mexico	0.5	0.5	0.6	1.0	1.8	2.5	3.4	6.8
OECD Europe	**9.0**	**8.9**	**10.7**	**12.2**	**12.9**	**13.5**	**14.1**	**1.6**
North Europe	3.5	3.3	5.1	6.2	6.8	7.2	7.5	2.8
South Europe	2.8	2.8	2.9	3.0	3.1	3.3	3.3	0.6
Southwest Europe	1.4	1.5	1.5	1.6	1.6	1.7	1.7	0.8
Turkey	1.3	1.3	1.2	1.3	1.4	1.4	1.5	0.6
OECD Asia	**4.4**	**4.2**	**3.3**	**3.5**	**3.7**	**3.7**	**3.4**	**-0.9**
Japan	3.5	3.4	3.7	3.8	4.0	4.0	3.9	0.4
South Korea	1.2	1.2	1.5	1.7	1.8	1.8	1.8	1.5
Australia/New Zealand	-0.4	-0.4	-1.8	-1.9	-2.0	-2.1	-2.4	6.6
Total OECD	**14.2**	**13.4**	**14.6**	**17.2**	**18.7**	**19.4**	**20.0**	**1.2**
Non-OECD								
Non-OECD Europe and Eurasia	**-4.5**	**-5.0**	**-5.2**	**-6.1**	**-6.6**	**-7.3**	**-8.3**	**2.2**
Russia	-6.3	-6.6	-6.2	-7.2	-8.0	-8.9	-9.7	1.5
Central Asia	-2.0	-2.3	-3.0	-3.2	-3.1	-3.0	-3.3	1.8
Non-OECD Europe	3.7	3.8	4.0	4.3	4.4	4.6	4.6	0.7
Non-OECD Asia	**-1.5**	**-1.3**	**0.9**	**3.4**	**5.0**	**6.0**	**6.5**	**—**
China	0.0	0.0	2.1	3.3	4.2	4.3	4.2	17.7
India	0.4	0.4	0.4	1.0	1.2	1.3	1.2	4.5
LNG exporters	-2.6	-2.6	-3.0	-3.0	-2.9	-2.6	-2.1	-0.8
Developed Asia	0.8	0.8	1.0	1.2	1.4	1.6	1.6	2.6
Other Southeast Asia	0.0	0.0	0.4	0.8	1.2	1.4	1.6	23.1
Northwest Asia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Middle East	**-1.9**	**-1.9**	**-4.5**	**-6.2**	**-7.5**	**-7.7**	**-8.0**	**5.2**
Arabian producers	-0.5	0.0	-0.2	-0.1	-0.1	0.3	0.3	—
Iran	0.0	0.1	-0.3	-1.4	-1.9	-1.9	-1.7	—
Iraq	0.0	0.0	0.0	-0.3	-0.5	-0.5	-0.8	—
Qatar	-1.5	-2.0	-4.2	-4.8	-5.6	-6.2	-6.4	5.2
Saudi Arabia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Middle East	0.1	0.1	0.3	0.4	0.5	0.6	0.6	7.5
Africa	**-3.8**	**-3.9**	**-6.5**	**-7.1**	**-7.5**	**-7.5**	**-7.2**	**2.4**
North Africa	-2.9	-3.0	-5.2	-5.8	-6.1	-6.1	-5.8	2.5
West Africa	-0.8	-0.9	-1.5	-2.0	-2.2	-2.2	-2.2	3.6
South Africa	0.1	0.1	0.1	0.7	0.8	0.8	0.8	7.7
Other Africa	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	—
Central and South America	**-0.6**	**-0.5**	**-1.0**	**-1.7**	**-2.0**	**-2.0**	**-1.8**	**3.9**
Brazil	0.4	0.4	0.0	-0.1	-0.1	-0.1	-0.2	—
Northern producers	-0.7	-0.6	-1.0	-1.7	-2.0	-2.0	-1.8	3.7
Other South America	-0.4	-0.4	0.0	0.2	0.2	0.2	0.2	—
Central America and Caribbean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Total Non-OECD	**-12.3**	**-12.7**	**-16.4**	**-17.7**	**-18.6**	**-18.6**	**-18.9**	**1.5**
Total World	**1.9**	**0.8**	**-1.8**	**-0.5**	**0.0**	**0.8**	**1.1**	**—**

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and International Natural Gas Model (2010).

Table I5. World total natural gas production by region, High Economic Growth case, 2007-2035
(Trillion cubic feet)

Region/Country	History 2007	History 2008	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD								
OECD North America	**27.4**	**28.2**	**27.4**	**28.4**	**31.0**	**32.9**	**33.9**	**0.8**
United States[a]	19.2	20.3	19.6	20.5	22.6	24.0	24.7	0.9
Canada	6.3	6.0	5.6	5.7	6.3	6.8	7.1	0.4
Mexico	1.8	1.8	2.1	2.1	2.1	2.1	2.1	0.5
OECD Europe	**10.2**	**10.7**	**9.7**	**9.0**	**8.7**	**8.4**	**8.0**	**-0.9**
North Europe	9.8	10.3	9.2	8.6	8.2	7.9	7.5	-0.9
South Europe	0.3	0.3	0.4	0.4	0.4	0.5	0.5	1.0
Southwest Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Turkey	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
OECD Asia	**1.9**	**2.0**	**3.7**	**3.9**	**4.1**	**4.4**	**5.4**	**3.7**
Japan	0.2	0.2	0.1	0.1	0.1	0.1	0.1	-2.4
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2
Australia/New Zealand	1.7	1.7	3.5	3.8	4.0	4.2	5.3	4.1
Total OECD	**39.5**	**40.8**	**40.8**	**41.3**	**43.8**	**45.7**	**47.3**	**0.6**
Non-OECD								
Non-OECD Europe and Eurasia	**30.4**	**31.2**	**32.2**	**33.9**	**35.2**	**36.3**	**37.4**	**0.7**
Russia	23.1	23.4	22.9	24.3	25.5	26.7	27.7	0.7
Central Asia	6.1	6.6	7.8	8.2	8.2	8.2	8.3	1.1
Non-OECD Europe	1.2	1.2	1.4	1.4	1.4	1.4	1.4	0.4
Non-OECD Asia	**12.0**	**12.6**	**15.9**	**17.3**	**18.6**	**20.0**	**21.3**	**2.1**
China	2.4	2.7	2.9	3.0	3.6	4.7	5.8	3.1
India	1.1	1.1	2.7	3.0	3.2	3.3	3.3	4.0
LNG exporters	4.9	5.0	6.6	7.3	7.6	7.6	7.6	1.6
Developed Asia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Southeast Asia	2.3	2.4	2.3	2.4	2.4	2.5	2.5	0.4
Northwest Asia	1.3	1.3	1.4	1.6	1.9	2.0	2.1	1.7
Middle East	**12.6**	**13.5**	**20.9**	**25.0**	**27.8**	**28.9**	**31.1**	**3.3**
Arabian producers	3.5	3.5	3.8	4.4	4.4	4.2	4.2	0.6
Iran	4.0	4.1	6.3	8.0	9.1	9.7	10.6	3.6
Iraq	0.1	0.1	0.2	0.5	0.7	0.8	1.2	11.7
Qatar	2.2	2.7	6.3	7.2	8.3	9.2	9.6	5.3
Saudi Arabia	2.6	2.8	4.1	4.7	5.0	4.9	5.4	2.6
Other Middle East	0.3	0.3	0.2	0.2	0.2	0.1	0.1	-2.5
Africa	**6.8**	**7.2**	**11.3**	**12.9**	**13.9**	**14.2**	**14.2**	**2.6**
North Africa	5.3	5.4	8.1	9.1	9.9	10.0	9.9	2.3
West Africa	1.3	1.5	3.0	3.5	3.9	4.0	4.1	4.0
South Africa	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.4
Other Africa	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Central and South America	**5.2**	**5.3**	**6.9**	**9.3**	**10.0**	**10.5**	**11.3**	**2.8**
Brazil	0.3	0.4	1.2	1.7	2.0	2.5	3.0	7.9
Northern producers	2.6	2.6	3.3	4.9	5.1	5.0	5.1	2.5
Other South America	2.2	2.2	2.4	2.6	2.7	2.9	3.1	1.1
Central America and Caribbean	0.0	0.0	0.1	0.1	0.1	0.1	0.1	6.6
Total Non-OECD	**67.0**	**69.7**	**87.2**	**98.3**	**105.5**	**109.9**	**115.2**	**2.0**
Total World	**106.6**	**110.5**	**128.0**	**139.6**	**149.3**	**155.6**	**162.5**	**1.5**
Discrepancy[b]	1.9	0.7	-1.9	-0.1	1.3	1.5	2.6	

[a]Includes the 50 States and the District of Columbia. Production includes supplemental production, less any forecast discrepancy.
[b]Balancing item. Differences between global production and consumption totals result from rounding and different conversion factors derived from heat contents of regionally consumed and produced natural gas.
Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HM2010.D020310A, web site www.eia.gov/oiaf/aeo; and International Natural Gas Model (2010).

Table I6. World tight gas, shale gas, and coalbed methane production by region, High Economic Growth case, 2007-2035
(Trillion cubic feet)

Region/Country	History 2007	History 2008	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD								
OECD North America	**5.0**	**5.6**	**8.2**	**9.3**	**10.8**	**12.5**	**13.6**	**3.6**
United States[a]	3.1	3.5	5.8	6.6	7.2	8.0	8.5	3.7
Canada	2.0	2.1	2.3	2.6	3.3	4.0	4.5	3.0
Mexico	0.0	0.0	0.0	0.1	0.3	0.5	0.6	—
OECD Europe	**0.0**	**0.0**	**0.1**	**0.1**	**0.4**	**0.7**	**0.9**	**—**
North Europe	0.0	0.0	0.1	0.1	0.4	0.6	0.8	—
South Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.1	—
Southwest Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Turkey	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
OECD Asia	**0.1**	**0.1**	**0.1**	**0.2**	**0.4**	**0.7**	**1.8**	**11.6**
Japan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Australia/New Zealand	0.1	0.1	0.1	0.2	0.3	0.7	1.8	11.6
Total OECD	**5.1**	**5.7**	**8.4**	**9.6**	**11.5**	**13.8**	**16.4**	**4.2**
Non-OECD								
Non-OECD Europe and Eurasia	**0.0**	**0.0**	**0.1**	**0.1**	**0.2**	**0.5**	**1.6**	**—**
Russia	0.0	0.0	0.0	0.0	0.1	0.2	0.8	—
Central Asia	0.0	0.0	0.0	0.0	0.0	0.2	0.6	—
Non-OECD Europe	0.0	0.0	0.0	0.0	0.1	0.1	0.2	—
Non-OECD Asia	**0.2**	**0.2**	**0.5**	**0.7**	**1.7**	**3.3**	**5.1**	**12.3**
China	0.2	0.2	0.3	0.3	0.9	2.1	3.3	10.6
India	0.0	0.0	0.0	0.0	0.1	0.2	0.3	—
LNG exporters	0.0	0.0	0.0	0.0	0.0	0.1	0.2	—
Developed Asia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Southeast Asia	0.0	0.0	0.0	0.0	0.1	0.1	0.3	—
Northwest Asia	0.0	0.0	0.1	0.4	0.6	0.8	1.0	—
Middle East	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.2**	**—**
Arabian producers	0.0	0.0	0.0	0.0	0.0	0.0	0.1	—
Iran	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Iraq	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Qatar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Saudi Arabia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Middle East	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Africa	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.2**	**—**
North Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.1	—
West Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.1	—
South Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Central and South America	**0.0**	**0.0**	**0.0**	**0.0**	**0.3**	**1.0**	**2.1**	**—**
Brazil	0.0	0.0	0.0	0.0	0.1	0.5	0.9	—
Northern producers	0.0	0.0	0.0	0.0	0.0	0.0	0.4	—
Other South America	0.0	0.0	0.0	0.0	0.2	0.5	0.7	—
Central America and Caribbean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Total Non-OECD	**0.2**	**0.2**	**0.6**	**0.8**	**2.2**	**4.8**	**9.1**	**14.6**
Total World	**5.3**	**5.9**	**8.9**	**10.4**	**13.8**	**18.7**	**25.4**	**5.8**

[a]Includes the 50 States and the District of Columbia. U.S. tight gas is reported in the "other natural gas" table that follows.

Sources: **History:** *United States:* U.S. Energy Information Administration (EIA), Natural Gas Navigator, "Unconventional Dry Natural Gas Production" (as of November 2009), web site www.eia.gov/dnav/ng/ng_prod_top.asp. *Other countries:* EIA, Office of Integrated Analysis and Forecasting, internal estimates. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HM2010.D020310A, web site www.eia.gov/oiaf/aeo; and International Natural Gas Model (2010).

Table I7. World other natural gas production by region, High Economic Growth case, 2007-2035
(Trillion cubic feet)

Region/Country	History 2007	History 2008	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD								
OECD North America	**22.4**	**22.6**	**19.3**	**19.0**	**20.3**	**20.5**	**20.3**	**-0.3**
United States[a]	16.2	16.8	13.8	14.0	15.5	16.0	16.2	0.0
Canada	4.4	3.9	3.3	3.1	3.0	2.8	2.6	-1.8
Mexico	1.8	1.8	2.1	2.0	1.8	1.7	1.5	-0.7
OECD Europe	**10.2**	**10.7**	**9.5**	**8.9**	**8.3**	**7.7**	**7.1**	**-1.3**
North Europe	9.8	10.3	9.1	8.5	7.9	7.3	6.7	-1.4
South Europe	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4
Southwest Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Turkey	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
OECD Asia	**1.8**	**1.8**	**3.6**	**3.7**	**3.8**	**3.7**	**3.5**	**2.4**
Japan	0.2	0.2	0.1	0.1	0.1	0.1	0.1	-2.5
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2
Australia/New Zealand	1.6	1.6	3.4	3.6	3.6	3.5	3.4	2.7
Total OECD	**22.4**	**22.6**	**19.3**	**19.0**	**20.3**	**20.5**	**20.3**	**-0.3**
Non-OECD								
Non-OECD Europe and Eurasia	**30.4**	**31.2**	**32.1**	**33.8**	**35.0**	**35.8**	**35.8**	**0.6**
Russia	23.1	23.4	22.9	24.3	25.5	26.5	26.9	0.6
Central Asia	6.1	6.6	7.8	8.1	8.2	8.0	7.7	0.8
Non-OECD Europe	1.2	1.2	1.4	1.4	1.3	1.3	1.2	-0.1
Non-OECD Asia	**11.8**	**12.4**	**15.5**	**16.6**	**16.9**	**16.7**	**16.2**	**1.1**
China	2.2	2.5	2.6	2.7	2.7	2.6	2.5	0.3
India	1.1	1.1	2.7	3.0	3.1	3.1	3.0	3.6
LNG exporters	4.9	5.0	6.6	7.3	7.6	7.5	7.4	1.5
Developed Asia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Southeast Asia	2.3	2.4	2.3	2.4	2.4	2.3	2.3	0.0
Northwest Asia	1.3	1.3	1.3	1.3	1.2	1.2	1.1	-0.6
Middle East	**12.6**	**13.5**	**20.9**	**25.0**	**27.7**	**28.9**	**30.9**	**3.3**
Arabian producers	3.5	3.5	3.8	4.4	4.4	4.2	4.0	0.5
Iran	4.0	4.1	6.3	8.0	9.1	9.7	10.6	3.6
Iraq	0.1	0.1	0.2	0.5	0.7	0.8	1.1	11.7
Qatar	2.2	2.7	6.3	7.2	8.3	9.2	9.6	5.3
Saudi Arabia	2.6	2.8	4.1	4.7	5.0	4.9	5.4	2.6
Other Middle East	0.3	0.3	0.2	0.2	0.2	0.1	0.1	-2.9
Africa	**6.8**	**7.2**	**11.3**	**12.8**	**13.9**	**14.1**	**14.0**	**2.6**
North Africa	5.3	5.4	8.1	9.1	9.9	10.0	9.8	2.3
West Africa	1.3	1.5	3.0	3.5	3.9	4.0	4.0	3.9
South Africa	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-1.1
Other Africa	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Central and South America	**5.2**	**5.3**	**6.9**	**9.3**	**9.7**	**9.6**	**9.2**	**2.1**
Brazil	0.3	0.4	1.2	1.7	1.9	2.0	2.0	6.5
Northern producers	2.6	2.6	3.3	4.9	5.1	5.0	4.8	2.2
Other South America	2.2	2.2	2.4	2.6	2.6	2.5	2.3	0.2
Central America and Caribbean	0.0	0.0	0.1	0.1	0.1	0.1	0.1	5.9
Total Non-OECD	**66.8**	**69.5**	**86.6**	**97.5**	**103.2**	**105.1**	**106.1**	**1.7**
Total World	**101.3**	**104.6**	**119.0**	**129.2**	**135.5**	**136.9**	**137.1**	**1.1**

[a]Includes the 50 States and the District of Columbia. Production includes supplemental production, less any forecast discrepancy.

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HM2010.D020310A, web site www.eia.gov/oiaf/aeo; and International Natural Gas Model (2010).

Table I8. World net natural gas trade by region, High Economic Growth case, 2007-2035
(Trillion cubic feet)

Region/Country	History 2007	History 2008	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD								
OECD North America	**0.9**	**0.4**	**0.6**	**1.7**	**2.2**	**2.5**	**3.4**	**5.0**
United States[a]	3.8	3.0	2.5	2.8	2.6	2.3	2.2	-1.9
Canada	-3.4	-3.1	-2.4	-2.2	-2.3	-2.5	-2.4	-1.3
Mexico	0.5	0.5	0.6	1.1	1.9	2.7	3.6	7.1
OECD Europe	**9.0**	**8.9**	**10.6**	**12.5**	**13.6**	**14.3**	**15.2**	**1.9**
North Europe	3.5	3.3	5.1	6.3	7.1	7.6	8.1	3.1
South Europe	2.8	2.8	2.9	3.1	3.3	3.5	3.6	0.9
Southwest Europe	1.4	1.5	1.5	1.6	1.7	1.8	1.8	1.0
Turkey	1.3	1.3	1.2	1.4	1.5	1.5	1.6	1.0
OECD Asia	**4.4**	**4.2**	**3.3**	**3.6**	**3.9**	**3.9**	**3.1**	**-1.2**
Japan	3.5	3.4	3.7	3.9	4.2	4.3	4.3	0.7
South Korea	1.2	1.2	1.5	1.6	1.8	1.8	1.8	1.4
Australia/New Zealand	-0.4	-0.4	-1.8	-2.0	-2.0	-2.2	-3.0	7.5
Total OECD	**14.2**	**13.4**	**14.6**	**17.8**	**19.7**	**20.8**	**21.7**	**1.5**
Non-OECD								
Non-OECD Europe and Eurasia	**-4.5**	**-5.0**	**-5.2**	**-6.2**	**-6.8**	**-7.6**	**-8.5**	**2.3**
Russia	-6.3	-6.6	-6.1	-7.2	-8.1	-9.1	-9.9	1.6
Central Asia	-2.0	-2.3	-3.1	-3.2	-3.1	-3.1	-3.1	1.7
Non-OECD Europe	3.7	3.8	4.0	4.2	4.4	4.5	4.5	0.7
Non-OECD Asia	**-1.5**	**-1.3**	**1.0**	**3.2**	**4.7**	**5.6**	**6.5**	**—**
China	0.0	0.0	2.0	3.2	3.9	4.1	4.1	17.6
India	0.4	0.4	0.4	0.9	1.0	1.1	1.1	4.1
LNG exporters	-2.6	-2.6	-2.9	-3.0	-2.9	-2.6	-2.0	-1.0
Developed Asia	0.8	0.8	1.0	1.2	1.4	1.5	1.5	2.5
Other Southeast Asia	0.0	0.0	0.4	0.9	1.2	1.4	1.6	23.1
Northwest Asia	0.0	0.0	0.0	0.0	0.0	0.1	0.2	—
Middle East	**-1.9**	**-1.9**	**-4.4**	**-6.2**	**-7.8**	**-8.5**	**-9.2**	**5.7**
Arabian producers	-0.5	0.0	-0.3	-0.4	0.0	0.3	0.7	—
Iran	0.0	0.1	-0.3	-1.4	-2.3	-2.8	-3.3	—
Iraq	0.0	0.0	0.0	-0.3	-0.5	-0.5	-0.8	—
Qatar	-1.5	-2.0	-4.1	-4.6	-5.6	-6.1	-6.4	5.2
Saudi Arabia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Middle East	0.1	0.1	0.3	0.5	0.6	0.6	0.7	7.8
Africa	**-3.8**	**-3.9**	**-6.5**	**-7.1**	**-7.5**	**-7.6**	**-7.3**	**2.4**
North Africa	-2.9	-3.0	-5.1	-5.8	-6.2	-6.3	-5.9	2.5
West Africa	-0.8	-0.9	-1.5	-2.0	-2.1	-2.2	-2.2	3.6
South Africa	0.1	0.1	0.1	0.7	0.8	0.8	0.7	7.3
Other Africa	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	—
Central and South America	**-0.6**	**-0.5**	**-1.0**	**-1.7**	**-1.7**	**-1.5**	**-1.4**	**3.0**
Brazil	0.4	0.4	0.0	0.0	0.0	-0.1	-0.2	—
Northern producers	-0.7	-0.6	-1.0	-1.9	-2.0	-1.9	-1.7	3.4
Other South America	-0.4	-0.4	0.0	0.3	0.3	0.4	0.5	—
Central America and Caribbean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Total Non-OECD	**-12.3**	**-12.7**	**-16.2**	**-18.0**	**-19.1**	**-19.8**	**-19.9**	**1.7**
Total World	**1.9**	**0.8**	**-1.6**	**-0.2**	**0.6**	**1.0**	**1.8**	**—**

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HM2010.D020310A, web site www.eia.gov/oiaf/aeo; and International Natural Gas Model (2010).

Table I9. World total natural gas production by region, Low Economic Growth case, 2007-2035
(Trillion cubic feet)

Region/Country	History 2007	History 2008	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD								
OECD North America	**27.4**	**28.2**	**27.0**	**26.9**	**27.4**	**29.0**	**30.2**	**0.3**
United States[a]	19.2	20.3	19.2	19.5	19.9	21.0	21.8	0.4
Canada	6.3	6.0	5.6	5.4	5.6	6.0	6.5	0.1
Mexico	1.8	1.8	2.2	2.0	2.0	2.0	1.9	0.2
OECD Europe	**10.2**	**10.7**	**9.6**	**9.0**	**8.4**	**7.7**	**7.4**	**-1.1**
North Europe	9.8	10.3	9.2	8.6	7.9	7.3	7.0	-1.2
South Europe	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.6
Southwest Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Turkey	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
OECD Asia	**1.9**	**2.0**	**3.6**	**3.8**	**3.9**	**4.0**	**4.1**	**2.7**
Japan	0.2	0.2	0.1	0.1	0.1	0.1	0.1	-2.4
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2
Australia/New Zealand	1.7	1.7	3.5	3.7	3.7	3.8	4.0	3.0
Total OECD	**39.5**	**40.8**	**40.2**	**39.7**	**39.7**	**40.7**	**41.7**	**0.2**
Non-OECD								
Non-OECD Europe and Eurasia	**30.4**	**31.2**	**32.1**	**33.7**	**34.4**	**35.2**	**35.4**	**0.5**
Russia	23.1	23.4	22.9	24.1	24.9	25.9	26.4	0.5
Central Asia	6.1	6.6	7.8	8.2	8.2	8.0	7.7	0.8
Non-OECD Europe	1.2	1.2	1.4	1.4	1.3	1.3	1.2	0.0
Non-OECD Asia	**12.0**	**12.6**	**15.6**	**16.9**	**17.5**	**17.8**	**18.3**	**1.5**
China	2.4	2.7	2.9	3.0	2.9	3.0	3.6	1.4
India	1.1	1.1	2.7	2.9	3.0	3.1	3.0	3.7
LNG exporters	4.9	5.0	6.4	7.1	7.5	7.5	7.3	1.5
Developed Asia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Southeast Asia	2.3	2.4	2.3	2.3	2.3	2.3	2.3	0.1
Northwest Asia	1.3	1.3	1.4	1.6	1.8	1.9	2.0	1.6
Middle East	**12.6**	**13.5**	**20.4**	**23.7**	**26.6**	**27.8**	**29.8**	**3.1**
Arabian producers	3.5	3.5	3.7	4.3	4.4	4.2	4.0	0.5
Iran	4.0	4.1	6.1	7.8	8.9	9.5	10.5	3.6
Iraq	0.1	0.1	0.2	0.5	0.7	0.8	1.1	11.6
Qatar	2.2	2.7	6.2	6.5	7.9	8.7	9.4	5.3
Saudi Arabia	2.6	2.8	4.1	4.4	4.5	4.5	4.6	2.1
Other Middle East	0.3	0.3	0.2	0.2	0.2	0.1	0.1	-2.7
Africa	**6.8**	**7.2**	**11.0**	**12.3**	**13.0**	**13.3**	**13.5**	**2.5**
North Africa	5.3	5.4	7.9	8.7	9.0	9.2	9.4	2.1
West Africa	1.3	1.5	2.9	3.5	3.8	3.9	3.9	3.9
South Africa	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.9
Other Africa	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.2
Central and South America	**5.2**	**5.3**	**6.6**	**8.1**	**9.1**	**9.2**	**9.2**	**2.0**
Brazil	0.3	0.4	1.0	1.3	1.6	1.8	2.0	6.4
Northern producers	2.6	2.6	3.1	4.2	4.9	4.9	4.7	2.2
Other South America	2.2	2.2	2.3	2.5	2.5	2.4	2.4	0.2
Central America and Caribbean	0.0	0.0	0.1	0.1	0.1	0.1	0.1	6.1
Total Non-OECD	**67.0**	**69.7**	**85.7**	**94.7**	**100.6**	**103.4**	**106.2**	**1.7**
Total World	**106.6**	**110.5**	**126.0**	**134.4**	**140.2**	**144.1**	**147.9**	**1.2**
Discrepancy[b]	1.9	0.7	-2.7	-1.8	-1.6	-1.7	-0.7	

[a]Includes the 50 States and the District of Columbia. Production includes supplemental production, less any forecast discrepancy.
[b]Balancing item. Differences between global production and consumption totals result from rounding and different conversion factors derived from heat contents of regionally consumed and produced natural gas.

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LM2010.D011110A, web site www.eia.gov/oiaf/aeo; and International Natural Gas Model (2010).

Table I10. World tight gas, shale gas, and coalbed methane production by region, Low Economic Growth case, 2007-2035
(Trillion cubic feet)

Region/Country	History		Projections					Average annual percent change, 2007-2035
	2007	2008	2015	2020	2025	2030	2035	
OECD								
OECD North America	**5.0**	**5.6**	**8.1**	**8.8**	**9.9**	**10.5**	**11.8**	**3.1**
United States[a]	3.1	3.5	5.8	6.4	7.0	6.9	7.4	3.2
Canada	2.0	2.1	2.3	2.4	2.8	3.4	4.0	2.6
Mexico	0.0	0.0	0.0	0.0	0.1	0.3	0.4	—
OECD Europe	**0.0**	**0.0**	**0.1**	**0.1**	**0.1**	**0.1**	**0.3**	**—**
North Europe	0.0	0.0	0.1	0.1	0.1	0.1	0.3	—
South Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Southwest Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Turkey	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
OECD Asia	**0.1**	**0.1**	**0.1**	**0.1**	**0.2**	**0.3**	**0.6**	**7.0**
Japan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Australia/New Zealand	0.1	0.1	0.1	0.1	0.2	0.3	0.6	7.0
Total OECD	**5.1**	**5.7**	**8.3**	**9.0**	**10.1**	**10.9**	**12.6**	**3.3**
Non-OECD								
Non-OECD Europe and Eurasia	**0.0**	**0.0**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**—**
Russia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Central Asia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Non-OECD Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Non-OECD Asia	**0.2**	**0.2**	**0.4**	**0.6**	**0.8**	**1.2**	**2.2**	**9.0**
China	0.2	0.2	0.3	0.3	0.3	0.4	1.1	6.3
India	0.0	0.0	0.0	0.0	0.0	0.1	0.1	—
LNG exporters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Developed Asia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Southeast Asia	0.0	0.0	0.0	0.0	0.0	0.0	0.1	—
Northwest Asia	0.0	0.0	0.0	0.3	0.5	0.7	0.9	—
Middle East	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**—**
Arabian producers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Iran	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Iraq	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Qatar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Saudi Arabia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Middle East	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Africa	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**—**
North Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
West Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
South Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Central and South America	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**—**
Brazil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Northern producers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other South America	0.0	0.0	0.0	0.0	0.0	0.0	0.1	—
Central America and Caribbean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Total Non-OECD	**0.2**	**0.2**	**0.5**	**0.7**	**0.9**	**1.3**	**2.4**	**9.3**
Total World	**5.3**	**5.9**	**8.8**	**9.7**	**11.0**	**12.1**	**15.0**	**3.8**

[a]Includes the 50 States and the District of Columbia. U.S. tight gas is reported in the "other natural gas" table that follows.

Sources: **History:** *United States:* U.S. Energy Information Administration (EIA), Natural Gas Navigator, "Unconventional Dry Natural Gas Production" (as of November 2009), web site www.eia.gov/dnav/ng/ng_prod_top.asp. *Other countries:* EIA, Office of Integrated Analysis and Forecasting, internal estimates. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LM2010.D011110A, web site www.eia.gov/oiaf/aeo; and International Natural Gas Model (2010).

Table I11. World other natural gas production by region, Low Economic Growth case, 2007-2035
(Trillion cubic feet)

Region/Country	History		Projections					Average annual percent change, 2007-2035
	2007	2008	2015	2020	2025	2030	2035	
OECD								
OECD North America	**22.4**	**22.6**	**18.9**	**18.1**	**17.6**	**18.5**	**18.4**	**-0.7**
United States[a]	16.2	16.8	13.4	13.1	12.9	14.2	14.4	-0.4
Canada	4.4	3.9	3.3	3.0	2.8	2.6	2.5	-2.0
Mexico	1.8	1.8	2.2	2.0	1.8	1.7	1.5	-0.7
OECD Europe	**10.2**	**10.7**	**9.5**	**8.9**	**8.3**	**7.7**	**7.1**	**-1.3**
North Europe	9.8	10.3	9.1	8.5	7.9	7.3	6.7	-1.4
South Europe	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4
Southwest Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Turkey	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
OECD Asia	**1.8**	**1.8**	**3.5**	**3.7**	**3.7**	**3.7**	**3.5**	**2.3**
Japan	0.2	0.2	0.1	0.1	0.1	0.1	0.1	-2.5
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2
Australia/New Zealand	1.6	1.6	3.3	3.5	3.6	3.5	3.4	2.6
Total OECD	**34.4**	**35.1**	**31.9**	**30.8**	**29.6**	**29.8**	**29.1**	**-0.6**
Non-OECD								
Non-OECD Europe and Eurasia	**30.4**	**31.2**	**32.1**	**33.6**	**34.4**	**35.2**	**35.3**	**0.5**
Russia	23.1	23.4	22.9	24.1	24.9	25.9	26.4	0.5
Central Asia	6.1	6.6	7.8	8.1	8.2	8.0	7.7	0.8
Non-OECD Europe	1.2	1.2	1.4	1.4	1.3	1.3	1.2	-0.1
Non-OECD Asia	**11.8**	**12.4**	**15.2**	**16.3**	**16.7**	**16.6**	**16.1**	**1.1**
China	2.2	2.5	2.6	2.7	2.7	2.6	2.5	0.3
India	1.1	1.1	2.6	2.9	3.0	3.0	2.9	3.5
LNG exporters	4.9	5.0	6.4	7.1	7.5	7.5	7.3	1.5
Developed Asia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Southeast Asia	2.3	2.4	2.3	2.3	2.3	2.3	2.3	0.0
Northwest Asia	1.3	1.3	1.3	1.3	1.2	1.2	1.1	-0.6
Middle East	**12.6**	**13.5**	**20.4**	**23.7**	**26.5**	**27.8**	**29.7**	**3.1**
Arabian producers	3.5	3.5	3.7	4.3	4.3	4.2	4.0	0.5
Iran	4.0	4.1	6.1	7.8	8.9	9.5	10.5	3.6
Iraq	0.1	0.1	0.2	0.5	0.7	0.7	1.1	11.5
Qatar	2.2	2.7	6.2	6.5	7.9	8.7	9.4	5.3
Saudi Arabia	2.6	2.8	4.1	4.4	4.5	4.5	4.6	2.1
Other Middle East	0.3	0.3	0.2	0.2	0.2	0.1	0.1	-2.8
Africa	**6.8**	**7.2**	**11.0**	**12.3**	**13.0**	**13.3**	**13.5**	**2.5**
North Africa	5.3	5.4	7.9	8.7	9.0	9.2	9.4	2.1
West Africa	1.3	1.5	2.9	3.5	3.8	3.9	3.9	3.9
South Africa	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-1.1
Other Africa	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.2
Central and South America	**5.2**	**5.3**	**6.6**	**8.1**	**9.1**	**9.2**	**9.1**	**2.0**
Brazil	0.3	0.4	1.0	1.3	1.6	1.8	1.9	6.3
Northern producers	2.6	2.6	3.1	4.2	4.9	4.9	4.7	2.2
Other South America	2.2	2.2	2.3	2.5	2.5	2.4	2.3	0.1
Central America and Caribbean	0.0	0.0	0.1	0.1	0.1	0.1	0.1	5.9
Total Non-OECD	**66.8**	**69.5**	**85.2**	**94.0**	**99.6**	**102.1**	**103.8**	**1.6**
Total World	**101.3**	**104.6**	**117.2**	**124.8**	**129.2**	**132.0**	**132.8**	**1.0**

[a]Includes the 50 States and the District of Columbia. Production includes supplemental production, less any forecast discrepancy.

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LM2010.D011110A, web site www.eia.gov/oiaf/aeo; and International Natural Gas Model (2010).

Table I12. World net natural gas trade by region, Low Economic Growth case, 2007-2035
(Trillion cubic feet)

Region/Country	History 2007	History 2008	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD								
OECD North America	**0.9**	**0.4**	**0.4**	**1.2**	**1.7**	**1.3**	**1.4**	**1.8**
United States[a]	3.8	3.0	2.3	2.3	2.0	1.3	0.9	-5.0
Canada	-3.4	-3.1	-2.4	-2.1	-2.1	-2.3	-2.6	-1.0
Mexico	0.5	0.5	0.5	1.0	1.7	2.4	3.2	6.6
OECD Europe	**9.0**	**8.9**	**10.5**	**11.3**	**11.9**	**12.3**	**12.7**	**1.2**
North Europe	3.5	3.3	4.9	5.7	6.3	6.6	6.9	2.4
South Europe	2.8	2.8	2.8	2.9	2.9	2.9	3.0	0.2
Southwest Europe	1.4	1.5	1.5	1.5	1.5	1.5	1.5	0.3
Turkey	1.3	1.3	1.2	1.2	1.3	1.3	1.3	0.2
OECD Asia	**4.4**	**4.2**	**3.2**	**3.2**	**3.3**	**3.2**	**3.2**	**-1.1**
Japan	3.5	3.4	3.7	3.6	3.6	3.5	3.4	-0.1
South Korea	1.2	1.2	1.4	1.5	1.7	1.7	1.7	1.3
Australia/New Zealand	-0.4	-0.4	-1.8	-2.0	-2.0	-2.0	-2.0	5.9
Total OECD	**14.2**	**13.4**	**14.1**	**15.7**	**16.9**	**16.9**	**17.3**	**0.7**
Non-OECD								
Non-OECD Europe and Eurasia	**-4.5**	**-5.0**	**-5.4**	**-6.6**	**-7.0**	**-8.0**	**-7.9**	**2.0**
Russia	-6.3	-6.6	-6.2	-7.4	-8.1	-9.1	-9.4	1.4
Central Asia	-2.0	-2.3	-3.1	-3.3	-3.3	-3.2	-2.9	1.4
Non-OECD Europe	3.7	3.8	4.0	4.2	4.3	4.3	4.4	0.5
Non-OECD Asia	**-1.5**	**-1.3**	**1.0**	**3.2**	**5.3**	**7.1**	**8.3**	**—**
China	0.0	0.0	2.0	3.3	4.6	5.7	5.8	19.1
India	0.4	0.4	0.4	0.9	1.3	1.3	1.4	5.0
LNG exporters	-2.6	-2.6	-2.8	-3.0	-3.0	-2.8	-2.2	-0.6
Developed Asia	0.8	0.8	1.0	1.1	1.3	1.4	1.5	2.5
Other Southeast Asia	0.0	0.0	0.4	0.8	1.1	1.4	1.6	23.2
Northwest Asia	0.0	0.0	0.0	0.0	0.0	0.0	0.1	—
Middle East	**-1.9**	**-1.9**	**-4.4**	**-5.7**	**-8.0**	**-9.1**	**-10.2**	**6.2**
Arabian producers	-0.5	0.0	-0.4	-0.7	-0.4	-0.2	0.2	—
Iran	0.0	0.1	-0.3	-1.3	-2.3	-3.1	-3.8	—
Iraq	0.0	0.0	0.0	-0.3	-0.5	-0.5	-0.8	—
Qatar	-1.5	-2.0	-4.0	-3.9	-5.3	-5.8	-6.4	5.2
Saudi Arabia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Middle East	0.1	0.1	0.3	0.4	0.5	0.6	0.6	7.4
Africa	**-3.8**	**-3.9**	**-6.3**	**-6.8**	**-6.8**	**-6.9**	**-6.8**	**2.2**
North Africa	-2.9	-3.0	-5.0	-5.6	-5.5	-5.5	-5.5	2.3
West Africa	-0.8	-0.9	-1.5	-1.9	-2.1	-2.2	-2.2	3.5
South Africa	0.1	0.1	0.1	0.7	0.8	0.8	0.9	8.0
Other Africa	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	—
Central and South America	**-0.6**	**-0.5**	**-1.2**	**-1.7**	**-2.5**	**-2.5**	**-2.1**	**4.5**
Brazil	0.4	0.4	-0.1	-0.1	-0.2	-0.2	-0.1	—
Northern producers	-0.7	-0.6	-1.0	-1.7	-2.4	-2.4	-2.1	4.1
Other South America	-0.4	-0.4	-0.1	0.1	0.1	0.1	0.1	—
Central America and Caribbean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Total Non-OECD	**-12.3**	**-12.7**	**-16.3**	**-17.6**	**-18.9**	**-19.3**	**-18.8**	**1.5**
Total World	**1.9**	**0.8**	**-2.3**	**-1.9**	**-2.0**	**-2.4**	**-1.4**	**—**

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LM2010.D011110A, web site www.eia.gov/oiaf/aeo; and International Natural Gas Model (2010).

Table I13. World total natural gas production by region, High Oil Price case, 2007-2035
(Trillion cubic feet)

Region/Country	History		Projections					Average annual percent change, 2007-2035
	2007	2008	2015	2020	2025	2030	2035	
OECD								
OECD North America	**27.4**	**28.2**	**26.8**	**28.5**	**30.9**	**32.9**	**34.4**	**0.8**
United States[a]	19.2	20.3	18.9	20.5	22.5	24.0	25.1	1.0
Canada	6.3	6.0	5.7	5.9	6.4	6.9	7.3	0.5
Mexico	1.8	1.8	2.1	2.0	2.0	2.0	2.1	0.4
OECD Europe	**10.2**	**10.7**	**9.6**	**9.0**	**8.4**	**8.1**	**7.8**	**-0.9**
North Europe	9.8	10.3	9.2	8.6	8.0	7.6	7.4	-1.0
South Europe	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.9
Southwest Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Turkey	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
OECD Asia	**1.9**	**2.0**	**3.8**	**4.0**	**4.1**	**4.2**	**4.8**	**3.3**
Japan	0.2	0.2	0.1	0.1	0.1	0.1	0.1	-2.4
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2
Australia/New Zealand	1.7	1.7	3.6	3.8	3.9	4.1	4.7	3.6
Total OECD	**39.5**	**40.8**	**40.3**	**41.5**	**43.3**	**45.2**	**47.1**	**0.6**
Non-OECD								
Non-OECD Europe and Eurasia	**30.4**	**31.2**	**32.2**	**34.0**	**35.5**	**36.3**	**36.9**	**0.7**
Russia	23.1	23.4	23.0	24.4	25.9	26.9	27.5	0.6
Central Asia	6.1	6.6	7.8	8.2	8.2	8.0	8.0	1.0
Non-OECD Europe	1.2	1.2	1.4	1.4	1.4	1.3	1.3	0.3
Non-OECD Asia	**12.0**	**12.6**	**15.9**	**17.3**	**18.3**	**19.5**	**20.8**	**2.0**
China	2.4	2.7	2.9	3.0	3.2	4.2	5.4	2.8
India	1.1	1.1	2.6	3.0	3.2	3.2	3.3	3.9
LNG exporters	4.9	5.0	6.6	7.3	7.6	7.6	7.5	1.6
Developed Asia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Southeast Asia	2.3	2.4	2.3	2.3	2.4	2.4	2.5	0.3
Northwest Asia	1.3	1.3	1.4	1.7	1.9	2.0	2.1	1.7
Middle East	**12.6**	**13.5**	**20.9**	**24.9**	**27.4**	**29.0**	**31.0**	**3.3**
Arabian producers	3.5	3.5	4.0	4.5	4.5	4.3	4.1	0.6
Iran	4.0	4.1	6.5	8.2	9.4	9.8	10.7	3.6
Iraq	0.1	0.1	0.2	0.5	0.7	0.8	1.1	11.7
Qatar	2.2	2.7	6.0	7.0	7.8	8.9	9.5	5.3
Saudi Arabia	2.6	2.8	4.0	4.5	4.9	5.1	5.4	2.6
Other Middle East	0.3	0.3	0.2	0.2	0.2	0.1	0.1	-2.6
Africa	**6.8**	**7.2**	**11.7**	**13.7**	**14.4**	**14.5**	**14.2**	**2.7**
North Africa	5.3	5.4	8.5	9.8	10.2	10.2	9.9	2.3
West Africa	1.3	1.5	3.0	3.6	3.9	4.0	4.0	4.0
South Africa	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.6
Other Africa	0.1	0.1	0.1	0.2	0.2	0.2	0.2	1.7
Central and South America	**5.2**	**5.3**	**6.8**	**8.8**	**9.8**	**10.3**	**10.9**	**2.7**
Brazil	0.3	0.4	1.1	1.6	1.9	2.2	2.8	7.7
Northern producers	2.6	2.6	3.1	4.4	5.2	5.2	5.1	2.5
Other South America	2.2	2.2	2.4	2.6	2.6	2.7	2.9	1.0
Central America and Caribbean	0.0	0.0	0.1	0.1	0.1	0.1	0.1	6.1
Total Non-OECD	**67.0**	**69.7**	**87.4**	**98.6**	**105.3**	**109.5**	**113.8**	**1.9**
Total World	**106.6**	**110.5**	**127.7**	**140.1**	**148.6**	**154.7**	**160.9**	**1.5**
Discrepancy[b]	1.9	0.7	-2.9	-1.9	-0.5	0.1	1.1	

[a]Includes the 50 States and the District of Columbia. Production includes supplemental production, less any forecast discrepancy.
[b]Balancing item. Differences between global production and consumption totals result from rounding and different conversion factors derived from heat contents of regionally consumed and produced natural gas.

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HP2010.D011910A, web site www.eia.gov/oiaf/aeo; and International Natural Gas Model (2010).

Table I14. World tight gas, shale gas, and coalbed methane production by region, High Oil Price case, 2007-2035
(Trillion cubic feet)

Region/Country	History 2007	History 2008	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD								
OECD North America	**5.0**	**5.6**	**8.0**	**9.0**	**10.1**	**11.5**	**12.9**	**3.4**
United States[a]	3.1	3.5	5.6	6.1	6.5	7.1	7.8	3.4
Canada	2.0	2.1	2.4	2.8	3.4	4.0	4.6	3.1
Mexico	0.0	0.0	0.0	0.1	0.2	0.4	0.6	—
OECD Europe	**0.0**	**0.0**	**0.1**	**0.1**	**0.1**	**0.4**	**0.7**	**—**
North Europe	0.0	0.0	0.1	0.1	0.1	0.4	0.7	—
South Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.1	—
Southwest Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Turkey	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
OECD Asia	**0.1**	**0.1**	**0.1**	**0.1**	**0.3**	**0.5**	**1.2**	**10.1**
Japan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Australia/New Zealand	0.1	0.1	0.1	0.1	0.3	0.5	1.2	10.1
Total OECD	**5.1**	**5.7**	**8.2**	**9.2**	**10.5**	**12.4**	**14.9**	**3.9**
Non-OECD								
Non-OECD Europe and Eurasia	**0.0**	**0.0**	**0.1**	**0.0**	**0.0**	**0.1**	**0.8**	**—**
Russia	0.0	0.0	0.0	0.0	0.0	0.0	0.3	—
Central Asia	0.0	0.0	0.0	0.0	0.0	0.0	0.3	—
Non-OECD Europe	0.0	0.0	0.0	0.0	0.0	0.1	0.1	—
Non-OECD Asia	**0.2**	**0.2**	**0.4**	**0.7**	**1.3**	**2.8**	**4.6**	**11.8**
China	0.2	0.2	0.3	0.3	0.6	1.6	2.9	10.0
India	0.0	0.0	0.0	0.0	0.1	0.2	0.3	—
LNG exporters	0.0	0.0	0.0	0.0	0.0	0.1	0.2	—
Developed Asia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Southeast Asia	0.0	0.0	0.0	0.0	0.0	0.1	0.2	—
Northwest Asia	0.0	0.0	0.1	0.4	0.6	0.8	1.0	—
Middle East	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**—**
Arabian producers	0.0	0.0	0.0	0.0	0.0	0.0	0.1	—
Iran	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Iraq	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Qatar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Saudi Arabia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Middle East	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Africa	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**—**
North Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
West Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.1	—
South Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Central and South America	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.5**	**1.6**	**—**
Brazil	0.0	0.0	0.0	0.0	0.0	0.2	0.7	—
Northern producers	0.0	0.0	0.0	0.0	0.0	0.0	0.2	—
Other South America	0.0	0.0	0.0	0.0	0.0	0.3	0.6	—
Central America and Caribbean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Total Non-OECD	**0.2**	**0.2**	**0.5**	**0.8**	**1.4**	**3.4**	**7.2**	**13.6**
Total World	**5.3**	**5.9**	**8.7**	**10.0**	**11.9**	**15.8**	**22.0**	**5.2**

[a]Includes the 50 States and the District of Columbia. U.S. tight gas is reported in the "other natural gas" table that follows.

Sources: **History:** *United States:* U.S. Energy Information Administration (EIA), Natural Gas Navigator, "Unconventional Dry Natural Gas Production" (as of November 2009), web site www.eia.gov/dnav/ng/ng_prod_top.asp. *Other countries:* EIA, Office of Integrated Analysis and Forecasting, internal estimates. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HP2010.D011910A, web site www.eia.gov/oiaf/aeo; and International Natural Gas Model (2010).

Table I15. World other natural gas production by region, High Oil Price case, 2007-2035
(Trillion cubic feet)

Region/Country	History 2007	History 2008	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD								
OECD North America	**22.4**	**22.6**	**18.8**	**19.5**	**20.8**	**21.4**	**21.5**	**-0.1**
United States[a]	16.2	16.8	13.3	14.4	15.9	16.9	17.3	0.2
Canada	4.4	3.9	3.4	3.2	3.0	2.8	2.7	-1.7
Mexico	1.8	1.8	2.1	2.0	1.8	1.7	1.5	-0.7
OECD Europe	**10.2**	**10.7**	**9.5**	**8.9**	**8.3**	**7.7**	**7.1**	**-1.3**
North Europe	9.8	10.3	9.1	8.5	7.9	7.3	6.7	-1.4
South Europe	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4
Southwest Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Turkey	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
OECD Asia	**1.8**	**1.8**	**3.7**	**3.8**	**3.8**	**3.7**	**3.5**	**2.4**
Japan	0.2	0.2	0.1	0.1	0.1	0.1	0.1	-2.5
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2
Australia/New Zealand	1.6	1.6	3.5	3.7	3.7	3.6	3.4	2.7
Total OECD	**34.4**	**35.1**	**32.0**	**32.3**	**32.9**	**32.8**	**32.2**	**-0.2**
Non-OECD								
Non-OECD Europe and Eurasia	**30.4**	**31.2**	**32.1**	**33.9**	**35.4**	**36.2**	**36.1**	**0.6**
Russia	23.1	23.4	23.0	24.4	25.9	26.9	27.2	0.6
Central Asia	6.1	6.6	7.8	8.1	8.2	8.0	7.7	0.8
Non-OECD Europe	1.2	1.2	1.4	1.4	1.3	1.3	1.2	-0.1
Non-OECD Asia	**11.8**	**12.4**	**15.5**	**16.6**	**17.0**	**16.7**	**16.2**	**1.1**
China	2.2	2.5	2.6	2.7	2.7	2.6	2.5	0.3
India	1.1	1.1	2.6	3.0	3.1	3.1	3.0	3.6
LNG exporters	4.9	5.0	6.6	7.3	7.6	7.6	7.4	1.5
Developed Asia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Southeast Asia	2.3	2.4	2.3	2.3	2.4	2.3	2.3	0.0
Northwest Asia	1.3	1.3	1.3	1.3	1.2	1.2	1.1	-0.6
Middle East	**12.6**	**13.5**	**20.9**	**24.9**	**27.3**	**28.9**	**30.9**	**3.3**
Arabian producers	3.5	3.5	4.0	4.5	4.4	4.3	4.0	0.5
Iran	4.0	4.1	6.5	8.2	9.4	9.8	10.7	3.6
Iraq	0.1	0.1	0.2	0.5	0.7	0.8	1.1	11.6
Qatar	2.2	2.7	6.0	7.0	7.8	8.9	9.5	5.3
Saudi Arabia	2.6	2.8	4.0	4.5	4.9	5.1	5.4	2.6
Other Middle East	0.3	0.3	0.2	0.2	0.2	0.1	0.1	-2.9
Africa	**6.8**	**7.2**	**11.7**	**13.6**	**14.4**	**14.5**	**14.1**	**2.6**
North Africa	5.3	5.4	8.5	9.8	10.2	10.2	9.9	2.3
West Africa	1.3	1.5	3.0	3.6	3.9	4.0	4.0	4.0
South Africa	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-1.1
Other Africa	0.1	0.1	0.1	0.2	0.2	0.2	0.2	1.7
Central and South America	**5.2**	**5.3**	**6.8**	**8.8**	**9.8**	**9.8**	**9.4**	**2.1**
Brazil	0.3	0.4	1.1	1.6	1.9	2.0	2.0	6.5
Northern producers	2.6	2.6	3.1	4.4	5.2	5.2	4.9	2.3
Other South America	2.2	2.2	2.4	2.6	2.6	2.5	2.3	0.2
Central America and Caribbean	0.0	0.0	0.1	0.1	0.1	0.1	0.1	5.9
Total Non-OECD	**66.8**	**69.5**	**86.9**	**97.8**	**103.9**	**106.1**	**106.6**	**1.7**
Total World	**101.3**	**104.6**	**118.9**	**130.1**	**136.8**	**138.8**	**138.8**	**1.1**

[a]Includes the 50 States and the District of Columbia. Production includes supplemental production, less any forecast discrepancy.

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HP2010.D011910A, web site www.eia.gov/oiaf/aeo; and International Natural Gas Model (2010).

Table I16. World net natural gas trade by region, High Oil Price case, 2007-2035
(Trillion cubic feet)

Region/Country	History 2007	History 2008	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD								
OECD North America	**0.9**	**0.4**	**0.4**	**1.0**	**1.3**	**1.6**	**2.0**	**3.0**
United States[a]	3.8	3.0	2.3	2.1	1.5	1.3	0.9	-4.8
Canada	-3.4	-3.1	-2.4	-2.3	-2.4	-2.6	-2.7	-0.9
Mexico	0.5	0.5	0.6	1.3	2.2	3.0	3.7	7.2
OECD Europe	**9.0**	**8.9**	**10.9**	**12.4**	**13.6**	**14.1**	**14.6**	**1.8**
North Europe	3.5	3.3	5.3	6.4	7.3	7.5	7.8	2.9
South Europe	2.8	2.8	2.9	3.1	3.2	3.3	3.4	0.7
Southwest Europe	1.4	1.5	1.5	1.6	1.7	1.7	1.8	0.8
Turkey	1.3	1.3	1.2	1.3	1.4	1.5	1.5	0.7
OECD Asia	**4.4**	**4.2**	**3.2**	**3.6**	**3.9**	**3.9**	**3.5**	**-0.8**
Japan	3.5	3.4	3.7	4.1	4.3	4.3	4.3	0.7
South Korea	1.2	1.2	1.5	1.6	1.7	1.7	1.7	1.3
Australia/New Zealand	-0.4	-0.4	-2.0	-2.1	-2.1	-2.1	-2.5	6.8
Total OECD	**14.2**	**13.4**	**14.4**	**17.0**	**18.8**	**19.6**	**20.1**	**1.2**
Non-OECD								
Non-OECD Europe and Eurasia	**-4.5**	**-5.0**	**-5.3**	**-6.7**	**-7.7**	**-8.6**	**-9.0**	**2.5**
Russia	-6.3	-6.6	-6.3	-7.6	-8.9	-9.8	-10.2	1.7
Central Asia	-2.0	-2.3	-3.1	-3.3	-3.2	-3.1	-3.1	1.7
Non-OECD Europe	3.7	3.8	4.1	4.2	4.4	4.4	4.4	0.6
Non-OECD Asia	**-1.5**	**-1.3**	**1.1**	**3.5**	**5.5**	**6.6**	**7.2**	**—**
China	0.0	0.0	2.1	3.4	4.5	4.8	4.6	18.1
India	0.4	0.4	0.5	1.0	1.2	1.2	1.2	4.5
LNG exporters	-2.6	-2.6	-3.0	-3.0	-2.9	-2.5	-2.0	-1.0
Developed Asia	0.8	0.8	1.0	1.2	1.4	1.5	1.5	2.5
Other Southeast Asia	0.0	0.0	0.5	0.9	1.3	1.5	1.7	23.3
Northwest Asia	0.0	0.0	0.0	0.0	0.0	0.1	0.2	—
Middle East	**-1.9**	**-1.9**	**-4.5**	**-6.1**	**-7.4**	**-8.2**	**-8.9**	**5.6**
Arabian producers	-0.5	0.0	-0.6	-0.5	-0.1	0.3	0.8	—
Iran	0.0	0.1	-0.4	-1.3	-2.3	-2.9	-3.3	—
Iraq	0.0	0.0	0.0	-0.3	-0.5	-0.5	-0.8	—
Qatar	-1.5	-2.0	-3.9	-4.4	-5.1	-5.8	-6.4	5.2
Saudi Arabia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Middle East	0.1	0.1	0.3	0.5	0.6	0.7	0.7	8.0
Africa	**-3.8**	**-3.9**	**-6.9**	**-8.0**	**-8.0**	**-7.9**	**-7.4**	**2.4**
North Africa	-2.9	-3.0	-5.5	-6.5	-6.6	-6.5	-6.0	2.6
West Africa	-0.8	-0.9	-1.5	-2.1	-2.2	-2.3	-2.2	3.6
South Africa	0.1	0.1	0.1	0.7	0.8	0.8	0.9	8.1
Other Africa	-0.1	-0.1	0.0	-0.1	-0.1	-0.1	-0.1	—
Central and South America	**-0.6**	**-0.5**	**-1.2**	**-1.8**	**-2.3**	**-2.0**	**-1.8**	**4.0**
Brazil	0.4	0.4	-0.1	-0.1	-0.1	0.0	-0.2	—
Northern producers	-0.7	-0.6	-1.0	-1.8	-2.4	-2.3	-2.0	3.9
Other South America	-0.4	-0.4	-0.1	0.2	0.2	0.2	0.3	—
Central America and Caribbean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Total Non-OECD	**-12.3**	**-12.7**	**-16.9**	**-19.0**	**-19.9**	**-20.2**	**-19.9**	**1.7**
Total World	**1.9**	**0.8**	**-2.5**	**-2.0**	**-1.2**	**-0.6**	**0.2**	**—**

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run HP2010.D011910A, web site www.eia.gov/oiaf/aeo; and International Natural Gas Model (2010).

Table I17. World total natural gas production by region, Low Oil Price case, 2007-2035
(Trillion cubic feet)

Region/Country	History		Projections					Average annual percent change, 2007-2035
	2007	2008	2015	2020	2025	2030	2035	
OECD								
OECD North America	**27.4**	**28.2**	**27.5**	**28.0**	**28.6**	**30.8**	**32.5**	**0.6**
United States[a]	19.2	20.3	19.9	20.6	21.0	22.8	24.0	0.8
Canada	6.3	6.0	5.4	5.3	5.5	5.9	6.4	0.0
Mexico	1.8	1.8	2.1	2.1	2.1	2.1	2.1	0.4
OECD Europe	**10.2**	**10.7**	**9.7**	**9.1**	**8.7**	**8.3**	**7.9**	**-0.9**
North Europe	9.8	10.3	9.2	8.6	8.2	7.8	7.4	-1.0
South Europe	0.3	0.3	0.4	0.4	0.4	0.5	0.4	1.0
Southwest Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Turkey	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
OECD Asia	**1.9**	**2.0**	**3.6**	**3.8**	**4.0**	**4.1**	**4.3**	**2.9**
Japan	0.2	0.2	0.1	0.1	0.1	0.1	0.1	-2.4
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2
Australia/New Zealand	1.7	1.7	3.4	3.7	3.8	4.0	4.2	3.2
Total OECD	**39.5**	**40.8**	**40.7**	**40.9**	**41.3**	**43.2**	**44.7**	**0.4**
Non-OECD								
Non-OECD Europe and Eurasia	**30.4**	**31.2**	**32.1**	**33.7**	**34.5**	**35.3**	**35.6**	**0.6**
Russia	23.1	23.4	22.9	24.1	24.9	25.9	26.5	0.5
Central Asia	6.1	6.6	7.8	8.2	8.2	8.0	7.7	0.9
Non-OECD Europe	1.2	1.2	1.4	1.4	1.4	1.4	1.3	0.3
Non-OECD Asia	**12.0**	**12.6**	**15.5**	**16.9**	**18.2**	**19.2**	**20.1**	**1.9**
China	2.4	2.7	2.9	3.0	3.4	4.1	5.0	2.6
India	1.1	1.1	2.7	3.0	3.2	3.2	3.2	3.9
LNG exporters	4.9	5.0	6.3	7.0	7.4	7.4	7.4	1.5
Developed Asia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Southeast Asia	2.3	2.4	2.3	2.3	2.4	2.4	2.5	0.3
Northwest Asia	1.3	1.3	1.4	1.6	1.8	2.0	2.1	1.6
Middle East	**12.6**	**13.5**	**20.4**	**24.5**	**26.1**	**27.4**	**29.5**	**3.1**
Arabian producers	3.5	3.5	3.4	3.9	4.0	4.0	3.9	0.4
Iran	4.0	4.1	5.6	6.7	7.7	8.7	10.1	3.4
Iraq	0.1	0.1	0.2	0.5	0.7	0.8	1.1	11.6
Qatar	2.2	2.7	6.6	8.5	8.7	9.2	9.4	5.3
Saudi Arabia	2.6	2.8	4.4	4.7	4.9	4.6	4.8	2.2
Other Middle East	0.3	0.3	0.2	0.2	0.2	0.1	0.1	-2.8
Africa	**6.8**	**7.2**	**10.3**	**11.6**	**12.5**	**12.8**	**13.1**	**2.4**
North Africa	5.3	5.4	7.6	8.3	8.8	8.8	9.1	2.0
West Africa	1.3	1.5	2.5	3.0	3.5	3.7	3.8	3.8
South Africa	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.7
Other Africa	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Central and South America	**5.2**	**5.3**	**6.9**	**9.0**	**9.2**	**9.7**	**10.2**	**2.4**
Brazil	0.3	0.4	1.1	1.6	1.9	2.2	2.6	7.4
Northern producers	2.6	2.6	3.4	4.7	4.6	4.6	4.6	2.1
Other South America	2.2	2.2	2.3	2.6	2.6	2.8	2.9	1.0
Central America and Caribbean	0.0	0.0	0.1	0.1	0.1	0.1	0.1	6.3
Total Non-OECD	**67.0**	**69.7**	**85.2**	**95.7**	**100.4**	**104.4**	**108.5**	**1.7**
Total World	**106.6**	**110.5**	**126.0**	**136.6**	**141.7**	**147.6**	**153.3**	**1.3**
Discrepancy[b]	1.9	0.7	-1.0	0.0	2.3	1.5	1.2	

[a]Includes the 50 States and the District of Columbia. Production includes supplemental production, less any forecast discrepancy.
[b]Balancing item. Differences between global production and consumption totals result from rounding and different conversion factors derived from heat contents of regionally consumed and produced natural gas.

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LP2010.D011910A, web site www.eia.gov/oiaf/aeo; and International Natural Gas Model (2010).

Table I18. World tight gas, shale gas, and coalbed methane production by region, Low Oil Price case, 2007-2035
(Trillion cubic feet)

Region/Country	History		Projections					Average annual percent change, 2007-2035
	2007	2008	2015	2020	2025	2030	2035	
OECD								
OECD North America	**5.0**	**5.6**	**8.2**	**9.3**	**10.6**	**11.9**	**13.4**	**3.6**
United States[a]	3.1	3.5	6.0	6.9	7.6	8.2	8.9	3.9
Canada	2.0	2.1	2.2	2.3	2.7	3.3	3.9	2.5
Mexico	0.0	0.0	0.0	0.1	0.3	0.4	0.6	—
OECD Europe	**0.0**	**0.0**	**0.1**	**0.2**	**0.4**	**0.6**	**0.8**	**—**
North Europe	0.0	0.0	0.1	0.1	0.4	0.5	0.7	—
South Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.1	—
Southwest Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Turkey	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
OECD Asia	**0.1**	**0.1**	**0.1**	**0.2**	**0.3**	**0.5**	**0.8**	**8.3**
Japan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Australia/New Zealand	0.1	0.1	0.1	0.2	0.3	0.5	0.8	8.3
Total OECD	**5.1**	**5.7**	**8.5**	**9.6**	**11.3**	**13.0**	**15.0**	**3.9**
Non-OECD								
Non-OECD Europe and Eurasia	**0.0**	**0.0**	**0.1**	**0.1**	**0.1**	**0.1**	**0.3**	**—**
Russia	0.0	0.0	0.0	0.0	0.0	0.0	0.1	—
Central Asia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Non-OECD Europe	0.0	0.0	0.0	0.0	0.1	0.1	0.1	—
Non-OECD Asia	**0.2**	**0.2**	**0.4**	**0.7**	**1.4**	**2.6**	**4.0**	**11.3**
China	0.2	0.2	0.4	0.4	0.7	1.6	2.6	9.5
India	0.0	0.0	0.0	0.0	0.1	0.2	0.3	—
LNG exporters	0.0	0.0	0.0	0.0	0.0	0.0	0.1	—
Developed Asia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Southeast Asia	0.0	0.0	0.0	0.0	0.0	0.1	0.2	—
Northwest Asia	0.0	0.0	0.1	0.3	0.6	0.8	0.9	—
Middle East	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**—**
Arabian producers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Iran	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Iraq	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Qatar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Saudi Arabia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Middle East	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Africa	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**—**
North Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
West Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
South Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Africa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Central and South America	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**0.6**	**1.2**	**—**
Brazil	0.0	0.0	0.0	0.0	0.0	0.2	0.6	—
Northern producers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other South America	0.0	0.0	0.0	0.0	0.1	0.3	0.6	—
Central America and Caribbean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Total Non-OECD	**0.2**	**0.2**	**0.5**	**0.8**	**1.7**	**3.3**	**5.5**	**12.6**
Total World	**5.3**	**5.9**	**9.0**	**10.4**	**13.0**	**16.3**	**20.5**	**4.9**

[a]Includes the 50 States and the District of Columbia. U.S. tight gas is reported in the “other natural gas” table that follows.

Sources: **History:** *United States:* U.S. Energy Information Administration (EIA), Natural Gas Navigator, “Unconventional Dry Natural Gas Production” (as of November 2009), web site www.eia.gov/dnav/ng/ng_prod_top.asp. *Other countries:* EIA, Office of Integrated Analysis and Forecasting, internal estimates. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LP2010.D011910A, web site www.eia.gov/oiaf/aeo; and International Natural Gas Model (2010).

Table I19. World other natural gas production by region, Low Oil Price case, 2007-2035
(Trillion cubic feet)

Region/Country	History		Projections					Average annual percent change, 2007-2035
	2007	2008	2015	2020	2025	2030	2035	
OECD								
OECD North America	**22.4**	**22.6**	**19.2**	**18.6**	**18.0**	**18.9**	**19.1**	**-0.6**
United States[a]	16.2	16.8	13.9	13.7	13.4	14.6	15.2	-0.2
Canada	4.4	3.9	3.2	3.0	2.8	2.6	2.4	-2.1
Mexico	1.8	1.8	2.1	2.0	1.8	1.7	1.5	-0.7
OECD Europe	**10.2**	**10.7**	**9.5**	**8.9**	**8.3**	**7.7**	**7.1**	**-1.3**
North Europe	9.8	10.3	9.1	8.5	7.9	7.3	6.7	-1.4
South Europe	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4
Southwest Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Turkey	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
OECD Asia	**1.8**	**1.8**	**3.4**	**3.7**	**3.7**	**3.7**	**3.5**	**2.3**
Japan	0.2	0.2	0.1	0.1	0.1	0.1	0.1	-2.5
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2
Australia/New Zealand	1.6	1.6	3.3	3.5	3.6	3.5	3.4	2.6
Total OECD	**34.4**	**35.1**	**32.2**	**31.2**	**30.0**	**30.2**	**29.8**	**-0.5**
Non-OECD								
Non-OECD Europe and Eurasia	**30.4**	**31.2**	**32.0**	**33.6**	**34.4**	**35.2**	**35.4**	**0.5**
Russia	23.1	23.4	22.9	24.1	24.8	25.9	26.4	0.5
Central Asia	6.1	6.6	7.8	8.1	8.2	8.0	7.7	0.8
Non-OECD Europe	1.2	1.2	1.4	1.4	1.3	1.3	1.2	-0.1
Non-OECD Asia	**11.8**	**12.4**	**15.1**	**16.3**	**16.7**	**16.6**	**16.1**	**1.1**
China	2.2	2.5	2.6	2.7	2.7	2.6	2.5	0.3
India	1.1	1.1	2.6	3.0	3.1	3.1	3.0	3.6
LNG exporters	4.9	5.0	6.3	7.0	7.4	7.4	7.3	1.5
Developed Asia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Southeast Asia	2.3	2.4	2.3	2.3	2.3	2.3	2.3	0.0
Northwest Asia	1.3	1.3	1.3	1.3	1.2	1.2	1.1	-0.6
Middle East	**12.6**	**13.5**	**20.4**	**24.5**	**26.1**	**27.3**	**29.4**	**3.1**
Arabian producers	3.5	3.5	3.4	3.9	4.0	4.0	3.9	0.4
Iran	4.0	4.1	5.6	6.7	7.7	8.7	10.1	3.4
Iraq	0.1	0.1	0.2	0.5	0.7	0.7	1.1	11.6
Qatar	2.2	2.7	6.6	8.5	8.7	9.2	9.4	5.3
Saudi Arabia	2.6	2.8	4.4	4.7	4.9	4.6	4.8	2.2
Other Middle East	0.3	0.3	0.2	0.2	0.2	0.1	0.1	-2.9
Africa	**6.8**	**7.2**	**10.3**	**11.6**	**12.5**	**12.7**	**13.1**	**2.4**
North Africa	5.3	5.4	7.6	8.3	8.8	8.8	9.1	2.0
West Africa	1.3	1.5	2.5	3.0	3.5	3.7	3.8	3.8
South Africa	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-1.1
Other Africa	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Central and South America	**5.2**	**5.3**	**6.9**	**8.9**	**9.0**	**9.1**	**9.0**	**2.0**
Brazil	0.3	0.4	1.1	1.6	1.8	2.0	2.0	6.5
Northern producers	2.6	2.6	3.4	4.7	4.6	4.6	4.5	2.0
Other South America	2.2	2.2	2.3	2.6	2.5	2.5	2.3	0.1
Central America and Caribbean	0.0	0.0	0.1	0.1	0.1	0.1	0.1	5.9
Total Non-OECD	**66.8**	**69.5**	**84.7**	**94.9**	**98.7**	**101.1**	**103.0**	**1.6**
Total World	**101.3**	**104.6**	**116.9**	**126.1**	**128.7**	**131.3**	**132.8**	**1.0**

[a]Includes the 50 States and the District of Columbia. Production includes supplemental production, less any forecast discrepancy.

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LP2010.D011910A, web site www.eia.gov/oiaf/aeo; and International Natural Gas Model (2010).

Table I20. World net natural gas trade by region, Low Oil Price case, 2007-2035
(Trillion cubic feet)

Region/Country	History		Projections					Average annual percent change, 2007-2035
	2007	2008	2015	2020	2025	2030	2035	
OECD								
OECD North America	**0.9**	**0.4**	**0.9**	**1.7**	**2.4**	**2.3**	**2.4**	**3.7**
United States[a]	3.8	3.0	2.6	2.7	2.6	2.0	1.4	-3.4
Canada	-3.4	-3.1	-2.3	-2.0	-1.9	-2.1	-2.2	-1.5
Mexico	0.5	0.5	0.6	1.0	1.7	2.4	3.2	6.7
OECD Europe	**9.0**	**8.9**	**10.2**	**11.7**	**12.4**	**12.9**	**13.5**	**1.5**
North Europe	3.5	3.3	4.7	5.8	6.4	6.7	7.1	2.6
South Europe	2.8	2.8	2.8	3.0	3.1	3.2	3.2	0.5
Southwest Europe	1.4	1.5	1.5	1.5	1.6	1.6	1.6	0.5
Turkey	1.3	1.3	1.2	1.3	1.4	1.4	1.5	0.6
OECD Asia	**4.4**	**4.2**	**3.4**	**3.5**	**3.7**	**3.7**	**3.6**	**-0.7**
Japan	3.5	3.4	3.6	3.7	3.9	3.9	3.8	0.3
South Korea	1.2	1.2	1.5	1.6	1.7	1.8	1.8	1.4
Australia/New Zealand	-0.4	-0.4	-1.7	-1.9	-2.0	-2.0	-2.1	6.1
Total OECD	**14.2**	**13.4**	**14.5**	**16.8**	**18.5**	**18.9**	**19.5**	**1.1**
Non-OECD								
Non-OECD Europe and Eurasia	**-4.5**	**-5.0**	**-5.4**	**-6.4**	**-6.8**	**-7.4**	**-7.5**	**1.8**
Russia	-6.3	-6.6	-6.2	-7.2	-7.8	-8.6	-9.0	1.3
Central Asia	-2.0	-2.3	-3.1	-3.3	-3.2	-3.1	-2.9	1.4
Non-OECD Europe	3.7	3.8	3.9	4.1	4.2	4.3	4.3	0.5
Non-OECD Asia	**-1.5**	**-1.3**	**0.9**	**3.0**	**4.5**	**5.5**	**6.3**	**—**
China	0.0	0.0	1.8	3.0	3.8	4.2	4.1	17.7
India	0.4	0.4	0.4	0.9	1.1	1.2	1.2	4.6
LNG exporters	-2.6	-2.6	-2.8	-3.0	-3.0	-2.8	-2.4	-0.4
Developed Asia	0.8	0.8	1.0	1.2	1.3	1.5	1.6	2.6
Other Southeast Asia	0.0	0.0	0.4	0.9	1.2	1.4	1.6	23.1
Northwest Asia	0.0	0.0	0.0	0.0	0.0	0.0	0.1	—
Middle East	**-1.9**	**-1.9**	**-4.4**	**-6.1**	**-7.2**	**-8.3**	**-9.7**	**6.0**
Arabian producers	-0.5	0.0	-0.1	0.1	0.1	0.1	0.3	—
Iran	0.0	0.1	-0.3	-0.6	-1.4	-2.2	-3.4	—
Iraq	0.0	0.0	0.0	-0.3	-0.5	-0.5	-0.8	—
Qatar	-1.5	-2.0	-4.4	-5.8	-6.0	-6.2	-6.4	5.2
Saudi Arabia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Other Middle East	0.1	0.1	0.4	0.4	0.5	0.6	0.6	7.4
Africa	**-3.8**	**-3.9**	**-5.4**	**-5.8**	**-6.0**	**-6.0**	**-6.2**	**1.8**
North Africa	-2.9	-3.0	-4.4	-4.8	-4.8	-4.7	-4.9	1.8
West Africa	-0.8	-0.9	-1.2	-1.6	-1.9	-2.1	-2.1	3.4
South Africa	0.1	0.1	0.1	0.6	0.7	0.7	0.7	7.3
Other Africa	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	—
Central and South America	**-0.6**	**-0.5**	**-1.0**	**-1.6**	**-1.6**	**-1.5**	**-1.3**	**2.6**
Brazil	0.4	0.4	0.0	0.0	-0.1	-0.1	-0.2	—
Northern producers	-0.7	-0.6	-1.0	-1.7	-1.7	-1.7	-1.4	2.8
Other South America	-0.4	-0.4	0.0	0.2	0.3	0.3	0.4	—
Central America and Caribbean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Total Non-OECD	**-12.3**	**-12.7**	**-15.3**	**-16.9**	**-17.1**	**-17.8**	**-18.4**	**1.4**
Total World	**1.9**	**0.8**	**-0.9**	**0.0**	**1.4**	**1.0**	**1.1**	**—**

Sources: **History:** U.S. Energy Information Administration (EIA), International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run LP2010.D011910A, web site www.eia.gov/oiaf/aeo; and International Natural Gas Model (2010).

Appendix J

Kaya Identity Factor Projections:

- Population
- GDP per capita
- Energy intensity
- Carbon dioxide intensity

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Table J1. World population by region, Reference case, 2005-2035
(Millions)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**432**	**436**	**441**	**477**	**500**	**523**	**546**	**569**	**0.9**
United States[a]	297	300	302	327	343	359	375	391	0.9
Canada	32	33	33	36	38	40	42	43	1.0
Mexico	103	104	105	114	120	125	130	135	0.9
OECD Europe	**535**	**538**	**541**	**558**	**565**	**571**	**575**	**577**	**0.2**
OECD Asia	**200**	**200**	**201**	**203**	**202**	**201**	**199**	**196**	**-0.1**
Japan	128	128	128	126	124	122	119	116	-0.3
South Korea	48	48	48	49	49	49	49	48	0.0
Australia/New Zealand	25	25	25	27	28	30	31	32	0.8
Total OECD	**1,167**	**1,175**	**1,183**	**1,238**	**1,267**	**1,294**	**1,319**	**1,342**	**0.5**
Non-OECD									
Non-OECD Europe and Eurasia	**341**	**341**	**340**	**338**	**336**	**333**	**329**	**324**	**-0.2**
Russia	143	143	142	138	135	132	129	125	-0.4
Other	198	198	198	200	200	201	200	198	0.0
Non-OECD Asia	**3,446**	**3,486**	**3,525**	**3,841**	**4,021**	**4,175**	**4,299**	**4,398**	**0.8**
China	1,308	1,314	1,321	1,386	1,421	1,443	1,452	1,452	0.3
India	1,131	1,148	1,165	1,294	1,367	1,431	1,485	1,528	1.0
Other Non-OECD Asia	1,008	1,024	1,039	1,160	1,233	1,300	1,363	1,418	1.1
Middle East	**191**	**195**	**199**	**231**	**251**	**270**	**288**	**305**	**1.5**
Africa	**902**	**919**	**939**	**1,098**	**1,197**	**1,297**	**1,395**	**1,494**	**1.7**
Central and South America	**451**	**458**	**464**	**511**	**538**	**563**	**586**	**606**	**1.0**
Brazil	187	190	192	210	220	229	236	243	0.8
Other Central and South America	265	268	272	301	318	334	349	363	1.0
Total Non-OECD	**5,332**	**5,398**	**5,467**	**6,018**	**6,343**	**6,638**	**6,897**	**7,127**	**1.0**
Total World	**6,498**	**6,573**	**6,650**	**7,256**	**7,610**	**7,932**	**8,217**	**8,469**	**0.9**

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

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

Sources: **United States:** U.S. Energy Information Administration (EIA), *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo. **Other Countries:** IHS Global Insight, *World Overview* (Lexington, MA, various issues).

Table J2. World gross domestic product (GDP) per capita by region expressed in purchasing power parity, Reference case, 2005-2035
(2005 dollars per person)

Region/Country	History 2005	History 2006	History 2007	Projections 2015	Projections 2020	Projections 2025	Projections 2030	Projections 2035	Average annual percent change, 2007-2035
OECD									
OECD North America	**34,472**	**35,145**	**35,554**	**37,910**	**42,032**	**46,007**	**50,260**	**54,766**	**1.6**
United States[a]	41,866	42,621	43,076	45,981	50,873	55,354	59,987	64,700	1.5
Canada	36,238	36,895	37,423	40,126	42,581	44,848	47,509	50,529	1.1
Mexico	12,577	13,069	13,351	14,183	16,598	19,545	23,064	27,289	2.6
OECD Europe	**26,030**	**26,779**	**27,427**	**29,050**	**31,923**	**34,812**	**37,882**	**41,234**	**1.5**
OECD Asia	**27,697**	**28,365**	**29,140**	**32,225**	**35,078**	**37,667**	**40,484**	**43,460**	**1.4**
Japan	30,309	30,926	31,629	33,689	35,708	37,174	38,687	40,125	0.9
South Korea	18,753	19,641	20,560	25,704	30,206	34,867	39,844	45,211	2.9
Australia/New Zealand	31,447	31,973	32,873	37,224	40,824	44,391	48,491	53,044	1.7
Total OECD	**29,440**	**30,156**	**30,745**	**32,984**	**36,416**	**39,780**	**43,396**	**47,292**	**1.5**
Non-OECD									
Non-OECD Europe and Eurasia	**8,722**	**9,441**	**10,227**	**12,418**	**14,719**	**17,202**	**19,943**	**22,978**	**2.9**
Russia	11,893	12,867	13,967	17,022	20,317	24,193	28,600	33,671	3.2
Other	6,432	6,979	7,552	9,237	10,933	12,595	14,364	16,220	2.8
Non-OECD Asia	**3,452**	**3,733**	**4,063**	**6,263**	**7,917**	**9,655**	**11,482**	**13,419**	**4.4**
China	4,136	4,591	5,162	9,185	12,211	15,556	19,003	22,558	5.4
India	2,158	2,331	2,506	3,745	4,639	5,473	6,418	7,497	4.0
Other Non-OECD Asia	4,016	4,203	4,413	5,581	6,602	7,712	8,984	10,443	3.1
Middle East	**10,403**	**11,013**	**11,368**	**13,289**	**14,904**	**16,561**	**18,531**	**20,763**	**2.2**
Africa	**2,617**	**2,715**	**2,811**	**3,316**	**3,679**	**4,026**	**4,373**	**4,748**	**1.9**
Central and South America	**8,001**	**8,347**	**8,757**	**10,453**	**11,827**	**13,342**	**15,053**	**16,998**	**2.4**
Brazil	8,209	8,413	8,761	11,186	13,080	15,318	17,972	21,117	3.2
Other Central and South America	7,854	8,300	8,755	9,942	10,961	11,990	13,077	14,242	1.8
Total Non-OECD	**4,282**	**4,574**	**4,897**	**6,697**	**8,085**	**9,529**	**11,045**	**12,654**	**3.4**
Total World	**8,798**	**9,146**	**9,494**	**11,180**	**12,802**	**14,465**	**16,240**	**18,144**	**2.3**

[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 non-OECD Europe and Eurasia (excluding Russia), China, India, Africa, and Central and South America (excluding Brazil) were adjusted, based on the analyst's judgment.

Sources: **History:** IHS Global Insight, *World Overview* (Lexington, MA, various issues). **Projections:** IHS Global Insight, *World Overview*, Third Quarter 2009 (Lexington, MA, November 2009); and U.S. Energy Information Administration (EIA), *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/ oiaf/aeo.

Table J3. World energy intensity by region, Reference case, 2005-2035
(Thousand Btu per 2005 dollar of GDP)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**8.2**	**7.9**	**7.9**	**6.9**	**6.2**	**5.6**	**5.1**	**4.7**	**-1.8**
United States[a]	8.1	7.8	7.8	6.8	6.0	5.5	4.9	4.5	-1.9
Canada	12.7	12.1	11.7	10.2	9.6	9.1	8.7	8.3	-1.2
Mexico	5.5	5.5	5.5	5.0	4.5	4.2	3.9	3.7	-1.4
OECD Europe	**5.9**	**5.8**	**5.5**	**5.1**	**4.6**	**4.3**	**4.0**	**3.7**	**-1.4**
OECD Asia	**7.0**	**6.9**	**6.8**	**6.1**	**5.9**	**5.7**	**5.6**	**5.4**	**-0.8**
Japan	6.0	5.9	5.6	4.9	4.9	4.9	4.8	4.7	-0.6
South Korea	10.4	10.0	9.9	8.4	7.8	7.4	7.0	6.8	-1.3
Australia/New Zealand	8.6	8.5	8.7	8.0	7.1	6.5	6.0	5.5	-1.6
Total OECD	**7.1**	**6.9**	**6.8**	**6.0**	**5.5**	**5.1**	**4.7**	**4.4**	**-1.5**
Non-OECD									
Non-OECD Europe and Eurasia	**16.9**	**15.9**	**14.8**	**12.5**	**11.0**	**9.8**	**8.8**	**8.1**	**-2.1**
Russia	17.4	16.6	15.4	13.1	11.5	10.3	9.2	8.4	-2.1
Other	16.2	14.9	14.0	11.8	10.3	9.2	8.3	7.7	-2.1
Non-OECD Asia	**9.5**	**9.2**	**8.9**	**6.6**	**5.9**	**5.4**	**5.0**	**4.7**	**-2.2**
China	12.7	12.1	11.4	8.0	7.0	6.3	5.9	5.6	-2.5
India	7.2	7.0	6.9	5.0	4.4	4.0	3.6	3.3	-2.6
Other Non-OECD Asia	6.6	6.5	6.3	5.2	4.7	4.3	4.1	3.9	-1.7
Middle East	**11.5**	**11.2**	**11.1**	**10.7**	**9.7**	**8.7**	**7.8**	**7.2**	**-1.5**
Africa	**7.3**	**6.9**	**6.8**	**5.7**	**5.1**	**4.7**	**4.3**	**4.1**	**-1.8**
Central and South America	**7.2**	**7.1**	**6.9**	**6.0**	**5.6**	**5.1**	**4.8**	**4.4**	**-1.6**
Brazil	7.3	7.3	7.3	6.3	5.9	5.5	5.2	4.7	-1.5
Other Central and South America	7.1	6.9	6.6	5.8	5.3	4.8	4.4	4.1	-1.6
Total Non-OECD	**10.0**	**9.7**	**9.3**	**7.4**	**6.6**	**5.9**	**5.4**	**5.1**	**-2.1**
Total World	**8.3**	**8.0**	**7.8**	**6.7**	**6.1**	**5.6**	**5.1**	**4.8**	**-1.7**

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

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

Sources: **History:** IHS Global Insight, *World Overview* (Lexington, MA, various issues). **Projections:** IHS Global Insight, *World Overview*, Third Quarter 2009 (Lexington, MA, November 2009); and U.S. Energy Information Administration, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Table J4. World carbon dioxide intensity of energy use by region, Reference case, 2005-2035
(Metric tons per billion Btu)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	**57.3**	**56.8**	**56.7**	**54.2**	**53.4**	**53.1**	**53.0**	**52.7**	**-0.3**
United States[a]	59.5	59.0	58.9	56.4	55.7	55.6	55.5	55.2	-0.2
Canada	42.3	41.0	40.9	37.8	36.0	35.6	35.5	35.2	-0.5
Mexico	57.9	57.3	57.7	56.0	55.5	54.8	54.4	54.8	-0.2
OECD Europe	**53.4**	**53.4**	**53.3**	**50.1**	**48.7**	**47.5**	**46.9**	**46.6**	**-0.5**
OECD Asia	**56.5**	**55.7**	**57.3**	**54.1**	**52.6**	**52.2**	**51.8**	**51.6**	**-0.4**
Japan	54.3	53.7	55.4	52.3	50.9	50.1	49.0	48.0	-0.5
South Korea	53.4	51.6	53.0	50.3	48.8	49.3	49.8	50.8	-0.2
Australia/New Zealand	68.2	68.0	68.8	63.8	62.8	62.1	61.7	61.5	-0.4
Total OECD	**55.8**	**55.4**	**55.7**	**52.8**	**51.7**	**51.2**	**50.8**	**50.6**	**-0.3**
Non-OECD									
Non-OECD Europe and Eurasia	**56.4**	**56.3**	**56.3**	**55.0**	**53.8**	**52.8**	**52.7**	**52.7**	**-0.2**
Russia	55.6	54.8	54.6	53.5	52.1	50.7	50.6	51.0	-0.2
Other	57.7	58.6	58.8	57.1	56.3	55.7	55.6	55.1	-0.2
Non-OECD Asia	**74.5**	**73.8**	**74.1**	**70.5**	**69.1**	**68.6**	**68.5**	**68.5**	**-0.3**
China	81.3	80.3	80.5	76.1	74.6	73.8	73.4	73.3	-0.3
India	67.9	68.5	69.0	64.5	62.2	61.3	61.0	61.0	-0.4
Other Non-OECD Asia	61.3	60.5	60.5	57.8	56.6	56.9	57.5	58.1	-0.1
Middle East	**61.1**	**60.4**	**60.4**	**59.0**	**58.5**	**58.5**	**58.7**	**58.9**	**-0.1**
Africa	**57.1**	**57.0**	**56.8**	**55.5**	**55.0**	**54.7**	**55.1**	**55.5**	**-0.1**
Central and South America	**42.0**	**41.8**	**41.7**	**40.8**	**39.7**	**38.8**	**38.3**	**37.9**	**-0.3**
Brazil	32.6	32.5	31.9	32.1	31.6	31.1	31.1	31.4	-0.1
Other Central and South America	49.1	48.9	49.5	48.3	47.1	46.6	45.9	45.4	-0.3
Total Non-OECD	**64.2**	**63.9**	**64.2**	**62.2**	**61.4**	**61.2**	**61.4**	**61.6**	**-0.1**
Total World	**59.9**	**59.6**	**60.0**	**58.0**	**57.3**	**57.1**	**57.2**	**57.4**	**-0.2**

[a]Includes the 50 States and the District of Columbia.
Notes: Totals may not equal sum of components due to independent rounding.
Sources: **History:** U.S. Energy Information Administration (EIA), derived from International Energy Statistics database (as of November 2009), web site www.eia.gov/emeu/international. **Projections:** EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, April 2010), AEO2010 National Energy Modeling System, run AEO2010R.D111809A, web site www.eia.gov/oiaf/aeo; and World Energy Projection System Plus (2010).

Appendix K

Comparisons With International Energy Agency and *IEO2009* Projections

Comparisons with IEA's *World Energy Outlook 2009*

The International Energy Agency (IEA) in its *World Energy Outlook 2009* provides projections comparable with those in *IEO2010*. In both reports, the latest historical year of data upon which the projections are based is 2007. Although the *IEO2010* projections now extend to 2035, IEA projections extend only to 2030. As a result, two time periods were chosen for comparison—2007 to 2015 and 2015 to 2030.

Before turning to a discussion of similarities and differences between the *IEO2010* and IEA projections, the divergent aims of the two publications should be recognized. The *IEO2010* Reference case is most directly comparable with the Reference Scenario *World Energy Outlook 2009*, Part A, "Global Energy Trends to 2030." EIA believes that a full understanding of energy trends under current laws and policies requires consideration of the uncertainties. For example, in the *IEO2010* Reference case, projected demand for liquid fuels in 2030 is 103.9 million barrels per day (including 3.5 million barrels per day of biofuels), compared with 107.9 million barrels per day of liquids in 2030 in the IEA Reference Scenario (including 2.7 million barrels per day of biofuels).

The IEA Reference Scenario has a world oil price trajectory similar to that in the *IEO2010* Reference case, but the IEA oil price projections for 2030 are about 7 percent lower than those in the *IEO2010* Reference case. In the *IEO2010* Low Oil Price case, in which the world oil price remains at about $51 per barrel through 2030 (all prices in 2008 dollars unless otherwise noted), world demand for liquids in 2030 is significantly higher, at 114.6 million barrels per day. In the *IEO2010* High Oil Price case, the world oil price rises steadily to $204 per barrel in 2030, and total world demand for liquids in 2030 is 90.4 million barrels per day.

EIA encourages users of its projections to consider how key energy market and economic uncertainties, as well as policy decisions, can affect future energy demand. As shown in *IEO2010*, alternative oil price assumptions also have significant impacts on the projected composition of liquids supply, because they affect the mix of unconventional and conventional oil sources and the composition of the unconventional component of supply. The alternative oil price cases included in IEA's *World Energy Outlook 2009* are released as sensitivity analyses that establish bounds on demand, rather than scenarios that consider the impacts of alternative price assumptions on the world's energy supply mix, as the *IEO2010* High and Low Oil Price cases do.

Most of the comparisons in this appendix focus on projections of energy demand in the *IEO2010* Reference case and the IEA Reference Scenario. There is one noteworthy difference between the two cases, regarding the natural gas market in North America and, in particular, the United States. In both the *IEO2010* Reference case and the *World Energy Outlook 2009* Reference Scenario, U.S. natural gas prices decline between 2008 and 2015; however, the decline is much steeper in *IEO2010*, and the price recovery thereafter is much slower. In the *IEO2010* Reference case, natural gas prices remain relatively flat from 2015 through 2025 (at about $6 per million Btu), before increasing modestly to $7.40 per million Btu in 2030. In the IEA Reference Scenario, the average U.S. price for imported natural gas falls to $7.30 per million Btu in 2015 and then rises steadily to $11.40 per million Btu in 2030.

Overall, the *IEO2010* Reference case and the IEA Reference Scenario provide similar outlooks for the future growth of U.S. demand for natural gas. In *IEO2010*, U.S. natural gas consumption grows by an average of 0.7 percent per year from 2007 to 2030, as compared with 0.5 percent per year in the IEA projection. From 2007 to 2015, U.S. natural gas consumption drops by an average of 0.7 percent per year in the *IEO2010* projection, as compared with 0.4 percent per year in the IEA projection. In the long term, the lower prices in *IEO2010* result in 0.8-percent average annual increases in U.S. gas consumption from 2015 to 2030, compared with increases averaging only 0.1 percent per year from 2015 to 2030 with IEA's higher price trajectory.

For the period from 2007 to 2015, the IEA Reference Scenario reflects growth in world energy consumption that more closely resembles that in the *IEO2010* High Economic Growth case than that in the Reference case. In the IEA Reference Scenario, world energy consumption increases by an average of 1.5 percent per year over the period, as compared with 1.4 percent per year in the *IEO2010* High Economic Growth case. In the *IEO2010* Reference case, world energy use increases by an average of 1.2 percent per year (Table K1).

The slower near-term growth in the *IEO2010* Reference case may reflect, in part, the different release dates for *IEO2010* and IEA's *World Energy Outlook 2009*. The *IEO2010* projections were prepared when preliminary assessments of the global recession were becoming available (specifically, as reflected in the near-term GDP estimates in IHS Global Insight's November 2009 release), whereas the *World Energy Outlook 2009* was released in November 2009, and its projections were formulated several months in advance of the report's release date. Thus, the IEA report may not have incorporated the full severity of the global recession and its impacts on world energy markets.

On a regional basis, both outlooks project almost no growth or a decline in energy demand among OECD nations. In the IEA projections, OECD energy consumption declines from 2007 to 2015 except in OECD Asia. By OECD region, the largest differences between the projections are for Europe and the United States. IEA projects a 0.3-percent average yearly decline in OECD Europe's energy consumption, compared with average declines of 0.1 percent in the *IEO2010* Reference case and 0.2 percent in the Low Economic Growth case. For the United States, IEA projects a 0.2-percent average yearly decline, whereas the *IEO2010* Reference case projects no decline (or increase) over the same period.

There is wider variation between the IEA and *IEO2010* reports in their near-term projections for non-OECD regions. For non-OECD nations as a group, the IEA projections more closely resemble—and sometimes exceed—those in the *IEO2010* High Economic Growth case rather than the *IEO2010* Reference case. On a regional basis, IEA projects growth rates that exceed the *IEO2010* projections for non-OECD Europe and Eurasia, China, and India. For each of those regions and countries, IEA projects higher growth rates than those in the *IEO2010* High Economic Growth case.

For two non-OECD regions—the Middle East and Africa—IEA projects much slower growth in energy demand from 2007 to 2015 than does the *IEO2010* Reference case. For the Middle East, IEA projects 3.2-percent average annual growth in energy consumption—the same as the rate in the *IEO2010* Low Economic Growth case—compared with 3.4 percent per year in the *IEO-2010* Reference case. Similarly, IEA projects a 1.6-percent average annual increase in Africa's energy use from 2007 to 2015, lower than the *IEO2010* projections of 2.0 percent per year in the Reference case and 1.8 percent per year in the Low Economic Growth case.

For the period from 2015 to 2030, the overall differences between the *IEO2010* and IEA projections narrow substantially, with worldwide energy demand growing by 1.6 percent per year in the *IEO2010* Reference case and 1.5 percent per year in the IEA Reference Scenario (Table K2). At the regional level, however, there are some substantial differences between the outlooks. For the OECD,

Table K1. Comparison of *IEO2010* and IEA world energy consumption growth rates by region, 2007-2015 (average annual percent growth)

Region	*IEO2010* Low Economic Growth	*IEO2010* Reference	*IEO2010* High Economic Growth	IEA Reference Scenario
OECD	**-0.2**	**0.0**	**0.3**	**-0.1**
North America	-0.2	0.1	0.4	-0.1
United States	-0.3	0.0	0.4	-0.2
Europe	-0.2	-0.1	0.1	-0.3
Asia	-0.2	0.0	0.2	0.2
Non-OECD	**2.0**	**2.2**	**2.4**	**2.7**
Europe and Eurasia	0.1	0.2	0.3	0.5
China	3.1	3.3	3.6	4.4
India	2.1	2.3	2.5	3.2
Other Non-OECD Asia	1.8	2.0	2.2	2.1
Middle East	3.2	3.4	3.6	3.2
Africa	1.8	2.0	2.2	1.6
Central and South America	1.5	1.7	2.0	1.7
Total World	**0.9**	**1.2**	**1.4**	**1.5**

Sources: ***IEO2010***: Energy Information Administration (EIA), World Energy Projection System Plus (2010). **IEA:** International Energy Agency, *World Energy Outlook 2009* (Paris, France, November 2009), pp. 621-657.

the largest difference between the two projections is for OECD Asia: average annual growth in OECD Asia's energy consumption from 2015 to 2030 in the IEA outlook (0.4 percent per year) is considerably lower than in the *IEO2010* Reference case (0.8 percent per year) and slightly lower than in the *IEO2010* Low Economic Growth case (0.5 percent per year).

In the projections for non-OECD energy consumption, the largest differences are for China, non-OECD Europe and Eurasia, the Middle East, and India. For China, IEA shows energy demand growth slowing to 2.1 percent per year from 2015 to 2030 (lower than in the *IEO2010* Low Economic Growth case), whereas the *IEO2010* Reference case shows a steady growth rate of 3.2 percent per year. In contrast, for non-OECD Europe and Eurasia, and especially for the Middle East and India, the IEA projections for energy demand growth from 2015 to 2030 are much higher than those in the *IEO2010* Reference case, exceeding those in the *IEO2010* High Economic Growth case. In the IEA Reference Scenario, energy demand growth in non-OECD Europe and Eurasia averages 1.0 percent per year from 2015 to 2030, as compared with 0.6 percent per year in the *IEO2010* Reference case; demand growth in the Middle East averages 2.6 percent per year, compared with 1.6 percent per year in the *IEO2010* Reference case; and demand growth in India averages 3.5 percent per year, as compared with 2.3 percent per year in the *IEO2010* Reference case. For each of the three, the IEA projections exceed those in the *IEO2010* High Economic Growth case.

The projections vary not only with respect to levels of energy demand but also with respect to the mix of primary energy inputs. In the 2007-2015 period, IEA expects much faster growth in the use of coal and slower growth in the use of natural gas, nuclear, and renewable energy sources than does *IEO2010* (Table K3). The IEA projection shows world coal consumption increasing by an annual average of 2.3 percent from 2007 to 2015, compared with only 0.6 percent in the *IEO2010* Reference case. *IEO2010* incorporates a substantial decline in coal use in the near term, particularly in the industrial sector, in large part because coal is widely used in the production of heavy commodities (such as, steel and pig iron), which were particularly hard hit in the recession. World coal use declines in the *IEO2010* Reference case by an estimated 3 percent annually from 2007 to 2009, strongly affecting the overall growth rate from 2007 through 2015. The IEA Reference Scenario, on the other hand, does not appear to incorporate a similar decline in worldwide coal consumption in its near-term outlook.

The IEA renewables projections were adjusted for this comparison by removing biofuels from the totals, but differences between the projections for consumption of renewables still exist, because IEA includes an estimate for traditional, nonmarketed biomass in its renewable energy projections, whereas the *IEO2010* projections do not attempt to estimate the use of nonmarketed renewable fuels (which, in fact, is not likely to expand significantly, because developing countries tend to move away from traditional fuels to commercial fuels as their energy

Table K2. Comparison of *IEO2010* and IEA world energy consumption growth rates by region, 2015-2030 (average annual percent growth)

Region	*IEO2010* Low Economic Growth	*IEO2010* Reference	*IEO2010* High Economic Growth	IEA Reference Scenario
OECD	**0.3**	**0.7**	**1.0**	**0.4**
North America	0.4	0.8	1.1	0.5
United States	0.2	0.6	0.9	0.3
Europe	0.1	0.4	0.6	0.4
Asia	0.5	0.8	1.1	0.4
Non-OECD	**1.9**	**2.2**	**2.6**	**2.1**
Europe and Eurasia	0.4	0.7	0.9	1.0
China	2.8	3.2	3.6	2.1
India	1.9	2.3	2.7	3.5
Other Non-OECD Asia	2.3	2.7	3.1	2.5
Middle East	1.3	1.6	2.0	2.6
Africa	1.2	1.6	2.0	1.3
Central and South America	1.4	1.8	2.3	1.7
Total World	**1.2**	**1.6**	**1.9**	**1.5**

Sources: ***IEO2010*:** Energy Information Administration (EIA), World Energy Projection System Plus (2010). **IEA:** International Energy Agency, *World Energy Outlook 2009* (Paris, France, November 2009), pp. 621-657.

infrastructures and standards of living increase). Still, consumption of traditional fuels in some developing countries is estimated to be quite large, with effects on total renewable energy use that would tend to mask any growth in the consumption of energy from marketed, commercial renewable sources—particularly, wind and other nonhydroelectric renewables.

Differences between the IEA and *IEO2010* projections for nuclear energy are explained in large part by different expectations for the OECD region, which accounted for 83 percent of the world's total nuclear power use in 2007. Although the IEA Reference Scenario projects more rapid growth for nuclear power in the OECD Asia region than is projected in the *IEO2010* Reference case, it also projects a decline in OECD Europe. In contrast, in the *IEO2010* Reference case, nuclear power use in OECD Europe rises by 0.8 percent per year through 2015. Because OECD Europe consumes more than twice as much nuclear electricity as OECD Asia, the 0.8-percent decline projected by IEA for OECD Europe offsets the projected increases for other OECD and non-OECD regions—including OECD Asia and non-OECD Asia (excluding India)—that are larger than those in the *IEO2010* Reference case.

Regional differences also explain the difference in expectations for world natural gas demand in the 2007 to 2015 period. In the *IEO2010* Reference case, natural gas use grows by 1.8 percent per year over the period, compared with 1.4 percent per year in the IEA Reference Scenario, which is below the comparable rate in the *IEO2010* Low Economic Growth case. Although the IEA Reference Scenario and the *IEO2010* Reference case have similar projections of natural gas demand for many regions of the world, *IEO2010* expects much stronger growth in demand in the key consuming regions of OECD Europe, non-OECD Europe and Eurasia, the Middle East, and Africa. Those regions currently account for more than one-half of the world's natural gas consumption, and so the higher increases in *IEO2010* result in different projections for natural gas demand growth worldwide.

For the period from 2015 to 2030, the most noticeable differences between the *IEO2010* Reference case and IEA projections are for natural gas, nuclear power, and renewable energy sources. Nuclear power and renewable energy projections in the IEA Reference Scenario fall significantly below those in the *IEO2010* Low Economic Growth case (Table K4). In the IEA projection, the average annual growth rate for world nuclear electricity

Table K3. Comparison of *IEO2010* and IEA world energy consumption growth rates by fuel, 2007-2015 (average annual percent growth)

Fuel	*IEO2010*			IEA Reference Scenario
	Low Economic Growth	Reference	High Economic Growth	
Liquids	0.1	0.3	0.6	0.5
Natural gas	1.6	1.8	1.9	1.4
Coal	0.4	0.6	0.8	2.3
Nuclear	2.1	2.2	2.2	1.7
Renewable/Other	3.0	3.4	3.8	2.0
Total	**0.9**	**1.2**	**1.4**	**1.5**

Note: In the IEA projections, Renewable/Other includes traditional biomass.
Sources: ***IEO2010*:** Energy Information Administration (EIA), World Energy Projection System Plus (2010). **IEA:** International Energy Agency, *World Energy Outlook 2009* (Paris, France, November 2009), pp. 621-657.

Table K4. Comparison of *IEO2010* and IEA world energy consumption growth rates by fuel, 2015-2030 (average annual percent growth)

Fuel	*IEO2010*			IEA Reference Scenario
	Low Economic Growth	Reference	High Economic Growth	
Liquids	0.6	1.1	1.5	1.2
Natural gas	1.0	1.3	1.5	1.6
Coal	1.5	1.9	2.5	1.6
Nuclear	2.1	2.1	2.1	1.1
Renewable/Other	2.3	2.4	2.6	1.7
Total	**1.2**	**1.6**	**1.9**	**1.5**

Note: In the IEA projections, Renewable/Other includes traditional biomass.
Sources: ***IEO2010*:** Energy Information Administration (EIA), World Energy Projection System Plus (2010). **IEA:** International Energy Agency, *World Energy Outlook 2009* (Paris, France, November 2009), pp. 621-657.

consumption slows from 1.7 percent in the 2007-2015 period to 1.1 percent in the 2015-2030 period; *IEO2010* projects average annual increases of 2.2 percent from 2007 to 2015 and 2.1 percent from 2015 to 2030. In the IEA Reference Scenario, renewable energy use increases by 2.0 percent per year over the 2007-2015 period and by 1.7 percent per year from 2015 to 2030; in the *IEO2010* Reference case, renewable energy use increases by 3.4 percent per year from 2007 to 2015 and 2.4 percent per year from 2015 to 2030.

In contrast to nuclear power and renewable energy sources, for world natural gas consumption the IEA Reference Scenario projects growth from 2015 to 2030 that is even stronger than that from 2007 to 2015 (1.6 percent vs. 1.4 percent per year). The 1.6-percent growth rate from 2015 to 2030 is higher than the corresponding rate in the *IEO2010* High Economic Growth case. In the *IEO2010* Reference case, natural gas demand is offset by projected increases in nuclear power, renewables, and coal for power generation. The slower projected growth rates in the IEA Reference Scenario, especially for nuclear power and renewables, are offset by increased demand for natural gas.

Comparisons With *IEO2009*

The *IEO2010* outlook for total energy consumption in 2015 is 20 quadrillion Btu (about 4 percent) lower than the outlook that was published in *IEO2009*. Because the global economic recession had a strong negative impact on energy demand in the near term, total marketed energy consumption in 2015 in the *IEO2010* Reference case is 532 quadrillion Btu, as compared with 552 quadrillion Btu in *IEO2009* (Table K5).[39]

OECD regions account for about one-half of the difference between the 2009 and 2010 outlooks, with *IEO2010* projections for 2015 about 9 quadrillion Btu lower than those in *IEO2009*. Within the OECD region, differences between the outlooks for 2015 are largest for Europe and Asia. For OECD Asia, the difference is attributable to Japan and South Korea—the nations of the region that were most strongly affected by the recession. In

Table K5. Comparison of *IEO2010* and *IEO2009* total world energy consumption, Reference case, 2015 and 2030 (quadrillion Btu)

Region	2015		2030		Change in *IEO2010*	
	IEO2010	*IEO2009*	*IEO2010*	*IEO2009*	2015	2030
OECD	**243**	**252**	**266**	**278**	**-9**	**-12**
North America	124	126	139	142	-2	-2
United States	102	103	111	114	-1	-2
Europe	81	85	83	92	-4	-9
Asia	39	42	44	45	-3	0
Japan	21	23	22	23	-2	-1
South Korea	11	12	14	13	-1	1
Australia/New Zealand	7	7	8	8	0	0
Non-OECD	**288**	**299**	**402**	**400**	**-11**	**2**
Europe and Eurasia	52	58	58	63	-5	-6
Russia	31	34	34	38	-4	-4
Other Non-OECD Europe and Eurasia	22	23	24	26	-2	-2
China	101	106	162	156	-5	6
India	23	23	32	32	0	0
Other Non-OECD Asia	32	34	48	51	-2	-4
Middle East	33	30	42	38	3	4
Africa	18	18	23	22	0	1
Central and South America	29	30	38	38	-1	0
Total World	**532**	**552**	**669**	**678**	**-20**	**-10**

Sources: ***IEO2010***: Energy Information Administration (EIA), World Energy Projection System Plus (2010). ***IEO2009***: EIA, *International Energy Outlook 2009*, DOE/EIA-0484(2009) (Washington, DC, May 2009), Table A1, p. 121.

[39] It is important to note that, for purposes of comparison, the *IEO2010* projections for 2015 and 2030 have been adjusted in Table K5 by removing industrial sector renewable energy use for all countries except the United States, because in *IEO* reports before 2010 that time series did not include renewables. The adjustment removes a total of 12 quadrillion Btu from world total energy consumption in 2015 in the *IEO2010* Reference case and a total of 18 quadrillion Btu in 2030. The *IEO* reports have always included U.S. historical data and projections related to industrial sector renewable energy consumption, as published in EIA's *Annual Energy Outlook* reports.

particular, recovery from the recession has been slower in Japan than in the other nations of OECD Asia. The recovery in OECD Europe has also been slow to take hold, lowering the near-term prospects for growth in energy demand.

The differences between the *IEO2010* and *IEO2009* projections for non-OECD countries account for about 11 quadrillion Btu of energy demand. For non-OECD countries, the differences between the projections for 2015 in *IEO2010* and *IEO2009* are largely divided between non-OECD Europe and Eurasia and non-OECD Asia. Lower growth in energy demand projected for those country groupings is offset in part by higher demand in the Middle East.

Almost one-half of the difference between this year's and last year's outlooks for non-OECD energy demand in 2015 is attributable to the countries of non-OECD Europe and Eurasia. Many of the countries in the region (in particular, Russia, the region's largest economy) experienced substantial declines in economic growth as a result of the collapse of world oil prices and the global recession. Non-OECD Europe and Eurasia as a whole experienced a 7.3-percent decline in GDP in 2009, when *IEO2009* expected GDP to increase by 3.6 percent that year. In addition, *IEO2010* expects GDP in the region to grow by only 1.9 percent in 2010 before resuming its pre-recession growth trend of between 3.5 and 4.5 percent per year. In contrast, in *IEO2009*, the region's growth was expected to return to its pre-recession rate in 2010. As a result of the strong downward revision in the economic growth rate for non-OECD Europe and Eurasia, the region's energy consumption in 2015 is 9 percent (5 quadrillion Btu) lower in the *IEO2010* Reference case than it was in *IEO2009*.

The near-term differences between the *IEO2010* and *IEO2009* projections lessen somewhat by 2030. *IEO2010* projects total world energy use in 2030 that is 10 quadrillion Btu (about 1 percent) lower than the *IEO2009* projection. For 2030, OECD Europe and non-OECD Europe and Eurasia are the regions with the largest downward revisions in *IEO2010* relative to last year's report. In contrast, the projections for total energy demand in China and in the Middle East are higher than those in last year's outlook.

Along with regional differences between the *IEO2010* and *IEO2009* projections, there are some differences in the projected mix of energy resources consumed (Table K6). The largest difference is in the 2015 projection for world coal consumption, which in the *IEO2010* Reference case is 12 quadrillion Btu lower than in last year's projection. In 2015, demand for every energy source except nuclear power is lower in *IEO2010* than in *IEO2009*, reflecting the impact of the recession on near-term demand. As noted above, coal use was disproportionately affected by the global recession, because coal is widely used in the production of heavy commodities, which were particularly hard hit in the recession. In contrast, the projections for nuclear power in *IEO2010* are about 9 percent higher on a Btu basis than those in *IEO2009*, and nuclear power use in 2030 is 4 quadrillion Btu (9 percent) higher in *IEO2010* than was projected in *IEO2009*.

Table K6. Comparison of *IEO2010* and *IEO2009* world energy consumption by fuel, Reference case, 2015 and 2030 (quadrillion Btu)

Fuel	2015		2030		Change in *IEO2010*	
	IEO2010	*IEO2009*	*IEO2010*	*IEO2009*	2015	2030
Liquids	179	183	210	216	-4	-6
Natural gas	129	131	156	158	-2	-2
Coal	139	151	186	190	-12	-5
Nuclear	32	32	44	40	0	4
Renewable/Other	52	55	73	74	-3	-1
Total	**532**	**552**	**669**	**678**	**-20**	**-10**

Sources: ***IEO2010*:** Energy Information Administration (EIA), World Energy Projection System Plus (2010). ***IEO2009*:** EIA, *International Energy Outlook 2009*, DOE/EIA-0484(2009) (Washington, DC, May 2009), Table A2, pp. 122-123.

Appendix L

Models Used To Generate the *IEO2010* Projections

The *IEO2010* projections of world energy consumption and supply were generated from EIA's World Energy Projections Plus (WEPS+) model. WEPS+ consists of a system of individual sectoral energy models, using an integrated iterative solution process that allows for convergence of consumption and prices to an equilibrium solution. It is used to build the Reference case energy projections, as well as alternative energy projections based on different assumptions for GDP growth and fossil fuel prices. It can also be used to perform other analyses.

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 2035.

The WEPS+ platform allows the various individual models to communicate with each other through a common, shared database and provides a comprehensive, central series of output reports for analysis. In the individual models, the detail also extends to the subsector level. In WEPS+, the end-use demand models (residential, commercial, industrial, and transportation) project consumption of the key primary energy sources: several petroleum products, other liquids, natural gas, coal, nuclear power, hydropower, wind, geothermal, and other renewable sources. These models also provide intermediate consumption projections for electricity in the end-use demand sectors.

The end-use model projections generally depend on retail supply prices, economic activity as represented by GDP (or gross output in the industrial sector), and population. The transformation models (power generation and district heat) satisfy electricity and heat requirements and also project consumption of primary energy sources at resulting price levels. The supply models (petroleum, natural gas, and coal) generate supply and wholesale price projections for the key supply sources corresponding to the primary consumption sources. The refinery model makes retail price projections for a variety of petroleum products corresponding to the world oil price. The main model in the WEPS+ system monitors the convergence sequence for all the models and projects energy-related carbon dioxide emissions from fossil fuels (including emissions from the use of petrochemical feedstocks but excluding flared natural gas) at the regional level.

Several model enhancements were implemented in this year's version of the WEPS+ model, including improvements to the modeling platform and improvements in the individual models:

- The residential and commercial demand models now use dynamic simulations with additional product detail, in which the projections are built up over the projection horizon based on changes in GDP, retail prices, consumption in the previous year, and a trend.
- There is a distinct district heat model, and the supply models now provide improved retail price feedback.
- The industrial model now includes consumption in eight industries using a stock/flow approach.
- The transportation sector model includes an extensive level of detail for modes and vehicle types.
- Last year, a new electric power generation model was added to WEPS+. It is a technology-based stock/flow model using a least-cost solution technique. The generation model has been expanded and enhanced for *IEO2010*.
- A new interface with the International Natural Gas Model (INGM) has also been incorporated into the WEPS+ model.

The new detailed regional industrial model incorporated into WEPS+ for *IEO2010* looks at industrial energy use in each of 8 industries in each of the 16 WEPS+ regions. The overall energy activity in each of the 8 industries is driven by regional forecasts of gross output for each industry from the macroeconomic model, which in turn are calibrated to the overall level of GDP in each region. The new model uses a stock/flow approach, looking at the energy intensity and fuel mix distinctions between industrial capacity that is existing (and retired over time) versus capacity that is newly built and added in each year.

WEPS+ now includes a detailed model of the world's transportation sector, which provides projections by the four transport modes: road, rail, water, and air. In addition, a variety of submodes are represented, such as light-duty vehicles and freight trucks. The model separates service demand (e.g., passenger-miles for cars, ton-miles for trucks) from service intensity (e.g., miles per gallon) and bases the service demand projections on economic and/or population growth and fuel prices.

The detailed regional power generation model that was new to WEPS+ last year has been significantly improved. It uses a stock/flow approach, keeping track of electricity generating capacity, generation, and consumption within remaining, new, and added vintages. The model is technology-based, with a wide variety of technologies for fossil fuels along with their characteristics, such as costs and heat rates. The slate of technologies has been updated and regionalized. The model solves for new capacity and generation in each year, based on the new generation requirements from the end-use demand models, after accounting for transmission and distribution losses. The solution technique is a least-cost market share, using levelized costs for each technology within various load segments based on the system load shape. The overall system load shape is built from sectoral load shapes fitted to annual loads from each of the demand models.

A new refinery model determines the regional retail prices for a variety of products by sector, based on the world oil price. The new refinery model uses the concept of marginal refineries in three international regions. The marginal refineries determine the refinery-gate (wholesale) prices for a variety of products, based on the price of crude oil entering the refinery. Wholesale prices for the WEPS+ regions are determined on the basis of transportation cost, and historical markups are then used to determine retail prices for each sector in each region.

The Reference case reflects the underlying relationships incorporated in the complete set of models interacting with each other in supply/demand relationships communicated through macroeconomic variables, prices, and consumption. The system of models is run iteratively to a point at which prices and consumption have converged to a reasonable equilibrium. Accumulated knowledge from the results of other complex models that focus on specific supply or demand issues and analysts' expert judgments also are taken into account and incorporated into the final projections. After the Reference case has been established, WEPS+ is used to run alternative cases that reflect different assumptions about future economic growth and energy prices. WEPS+ also can be used for other analyses, such as the effects of carbon prices.

The Generate World Oil Balance (GWOB) application is used to create a "bottom up" projection of world liquids supply—based on current production capacity, planned future additions to capacity, resource data, geopolitical factors, and oil prices—and to generate conventional crude oil production cases. The scenarios (Oil Price cases) are developed through an iterative process of examining demand levels at given prices and considering price and income sensitivity on both the demand and supply sides of the equation. Projections of conventional liquids production for 2009 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.

Ten 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, (9) ethanol, and (10) biodiesel. Biofuels are tracked on both a volume basis and an oil equivalent basis. All liquid fuels are reported in physical volumes, unless otherwise stated.

The *IEO2010* projections of global natural gas production and trade were generated from EIA's INGM, which estimates natural gas production, demand, and international trade for 60 detailed regions globally. It combines estimates of natural gas reserves, natural gas resources and resource extraction costs, energy demand, and transportation costs and capacity in order to estimate future production, consumption, and prices of natural gas.

INGM incorporates regional by-fuel energy consumption projections from the WEPS+ model, as well as more detailed U.S. projections from EIA's National Energy Modeling System (NEMS), which is used to generate U.S. energy projections for the *Annual Energy Outlook* (*AEO*). An iterative process between INGM and WEPS+ is used to balance world natural gas markets, with INGM providing supply curves to WEPS+ and receiving demand estimates developed by WEPS+. INGM uses regional natural gas demand estimates from NEMS for the United States rather than those computed as part of the WEPS+ output, so that the final output for the United States is consistent with projections that appear in the *AEO*.

INGM uses a linear program to simulate the global natural gas and LNG markets. The linear program combines multiple activities at different locations and optimizes them to determine a market equilibrium for each year of the simulation, while maximizing the cumulative discounted sum of producer and consumer surplus. Regions that currently show noncompetitive features or have internal constraints that will affect future markets are captured by limiting their ability to increase key asset capacities in the future. Restricting assets provides hard constraints on a region's ability to produce and export natural gas.

Appendix M

Regional Definitions

The six basic country groupings used in this report (Figure M1) are defined as follows:

- **OECD** (18 percent of the 2010 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.[40]

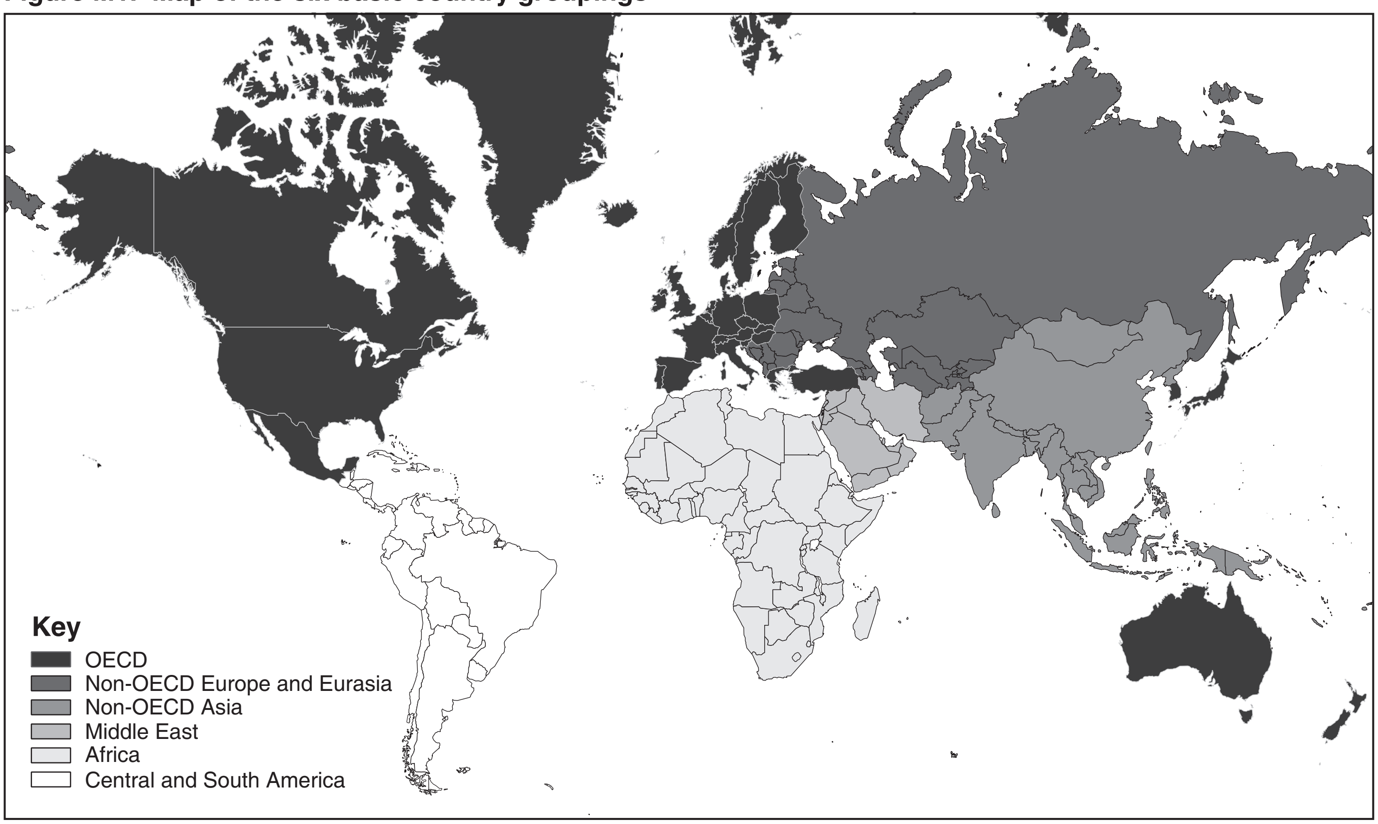
- **Non-OECD** (82 percent of the 2010 world population):

  - **Non-OECD Europe and Eurasia** (5 percent of the 2010 world population)—Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, 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 2010 world population)—Afghanistan, American Samoa, Bangladesh, Bhutan, Brunei, Cambodia (Kampuchea), China, Cook Islands, Fiji, French Polynesia, Guam, Hong Kong, India, Indonesia, Kiribati, Laos, Macau, Malaysia, Maldives, Mongolia, Myanmar (Burma), Nauru, Nepal, New Caledonia, Niue, North Korea, Pakistan, Papua New Guinea, Philippines, Samoa, Singapore, Solomon Islands, Sri Lanka, Taiwan, Thailand, Timor-Leste (East Timor), Tonga, U.S. Pacific Islands, Vanuatu, Vietnam, and Wake Islands.

  - **Middle East** (3 percent of the 2010 world population)—Bahrain, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, the United Arab Emirates, and Yemen.

Figure M1. Map of the six basic country groupings



Source: Energy Information Administration, Office of Integrated Analysis and Forecasting.

[40] For consistency, OECD includes all members of the organization as of March 1, 2010, throughout all the time series included in this report. Chile became a member on May 7, 2010, but its membership is not reflected in *IEO2010*.

- **Africa** (14 percent of the 2010 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, The Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, 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 2010 world population)—Antarctica, Antigua and Barbuda, Argentina, Aruba, The Bahamas, 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, 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:

- **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.
- **Organization of the Petroleum Exporting Countries (OPEC):** Algeria, Angola, Ecuador, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, the United Arab Emirates, and Venezuela.
- **Persian Gulf Countries:** Bahrain, Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates.
- **Arabian natural gas producers:** Bahrain, Kuwait, Oman, United Arab Emirates, and Yemen.
- **Non-OECD Developed Asia:** Hong Kong, Macau, Singapore, and Taiwan.
- **Non-OECD Asia LNG exporters:** Brunei, Indonesia, Malaysia, and Papua New Guinea.
- **Central and South America northern producers:** Colombia, Ecuador, Trinidad and Tobago, and Venezuela.