

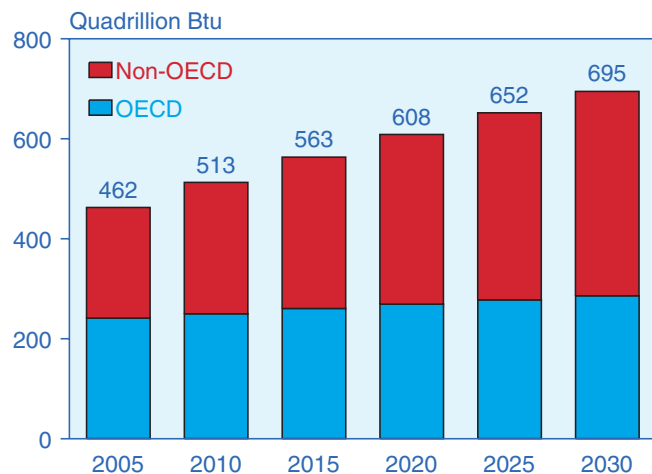
Highlights

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

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

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

Figure 1. World Marketed Energy Consumption, 2005-2030

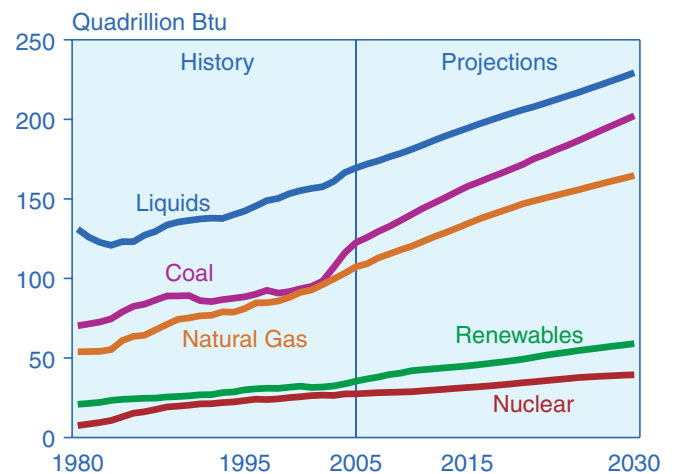


Sources: **2005:** Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, *World Energy Projections Plus* (2008).

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

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

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



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

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

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

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

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

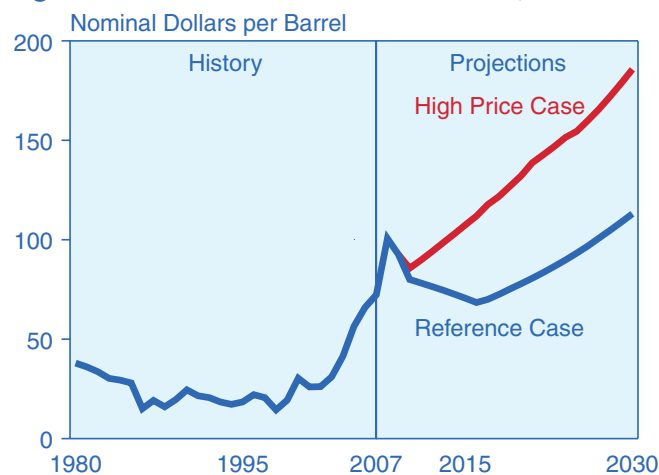
Liquids are expected to remain the world’s dominant energy source throughout the *IEO2008* reference case projection, given their importance in the transportation and industrial end-use sectors. World use of liquids and other petroleum grows from 83.6 million barrels oil equivalent per day in 2005 to 95.7 million barrels per day

in 2015 and 112.5 million barrels per day in 2030. The liquids share of world energy consumption declines through 2030, however, as other fuels replace liquids where possible. In most regions of the world, the role of liquid fuels outside the transportation sector continues to be eroded. Liquids remain the most important fuels for transportation, because there are few alternatives that can compete widely with liquid fuels. On a global basis, the transportation sector accounts for 74 percent of the total projected increase in liquids use from 2005 to 2030, with the industrial sector accounting for virtually all of the remainder.

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

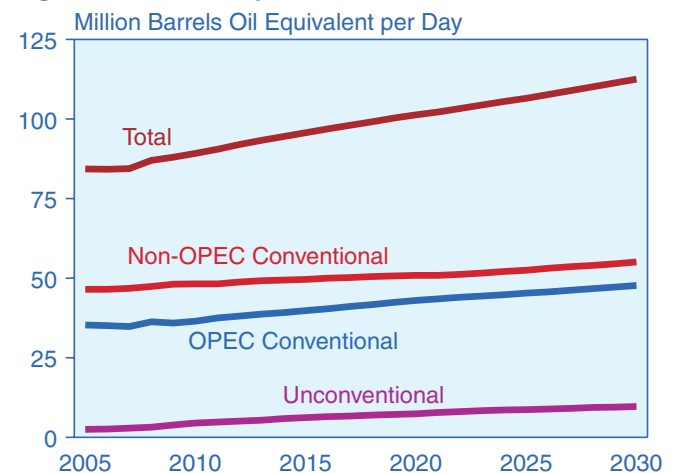
Unconventional resources (including oil sands, extra-heavy oil, biofuels, coal-to-liquids, and gas-to-liquids) from both OPEC and non-OPEC sources are expected to become increasingly competitive in the reference case. World production of unconventional resources, which totaled only 2.5 million barrels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

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



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

Figure 4. World Liquids Production, 2005-2030



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

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

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

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

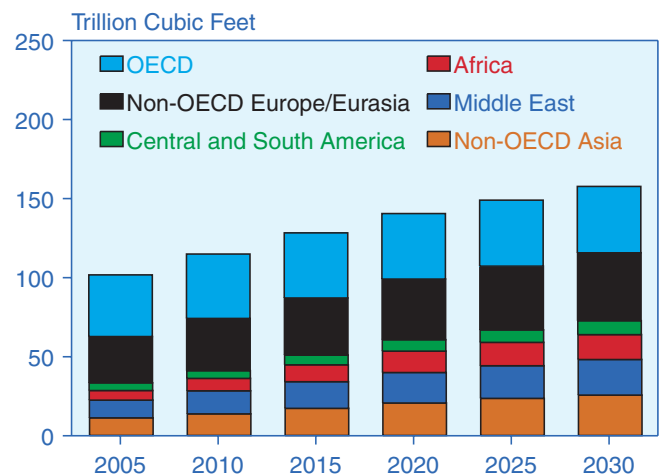
Much of the world's growing demand for natural gas is projected to be met by increased production from non-OECD nations. In the *IEO2008* reference case, non-OECD countries account for more than 90 percent of the world's total growth in production from 2005 to 2030 (Figure 5). A significant portion of the non-OECD production (excluding Russia and the other nations of Eurasia) is expected to be in the form of export projects—particularly liquefied natural gas (LNG) projects. The Middle East and Africa are at the forefront of the trend

toward LNG: natural gas production in the two regions combined increases by 21.0 trillion cubic feet between 2005 and 2030, but their combined demand for natural gas increases by only 9.9 trillion cubic feet. Significant increases in natural gas production are also projected for the countries of non-OECD Asia, but those supply increases are expected to be used largely for consumption within the region rather than for export.

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

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

Figure 5. World Natural Gas Production, 2005-2030



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

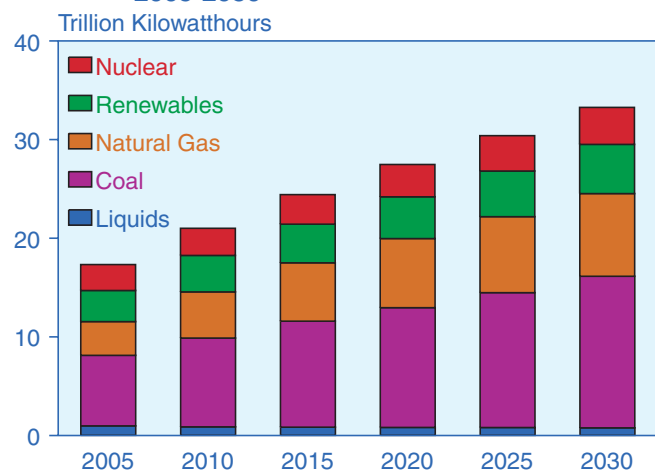
compared with a projected average increase of 1.3 percent per year for OECD electricity generation.

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

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

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

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



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

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

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

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

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

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

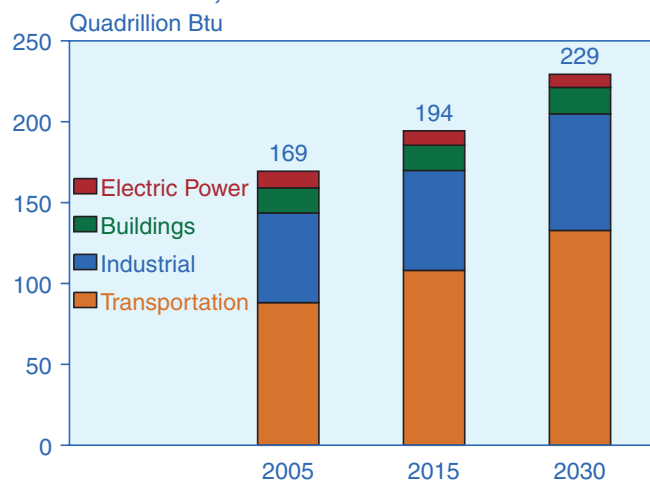
Over the next 25 years, world demand for liquid fuels and other petroleum is expected to increase more rapidly in the transportation sector than in any other end-use sector (Figure 7). The transportation share of total liquids consumption increases from 52 percent in 2005 to 58 percent in 2030 in the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

transportation systems in order to move products and raw materials to market, particularly in developing rural areas where economic growth often is achieved by increasing product exports.

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

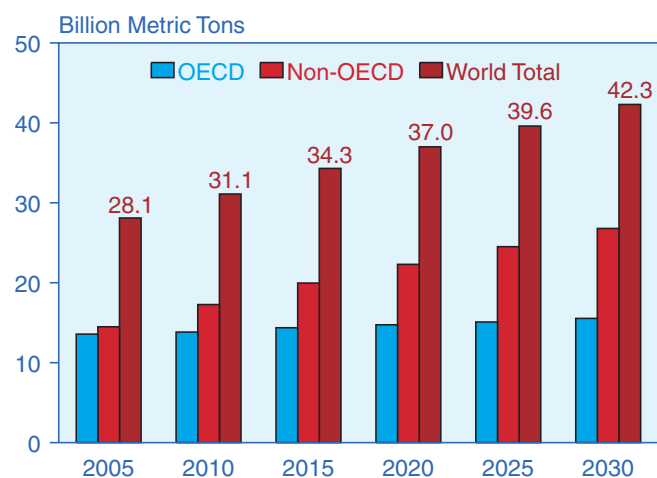
World energy-related carbon dioxide emissions continue to increase steadily in the *IEO2008* reference case, from 28.1 billion metric tons in 2005 to 34.3 billion metric tons in 2015 and 42.3 billion metric tons in 2030—an increase of 51 percent over the projection period. With strong economic growth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

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



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

Figure 8. World Carbon Dioxide Emissions, 2005-2030



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