

World Energy and Economic Outlook

The IEO2004 projections indicate continued growth in world energy use, including large increases for the developing economies of Asia. Energy resources are thought to be adequate to support the growth expected through 2025.

The *International Energy Outlook 2004 (IEO2004)* projects strong growth for worldwide energy demand over the 24-year projection period from 2001 to 2025. Total world consumption of marketed energy³ is expected to expand by 54 percent, from 404 quadrillion British thermal units (Btu) in 2001 to 623 quadrillion Btu in 2025 (Table 1 and Figure 12).

In the *IEO2004* mid-term outlook, developing nations of the world are largely expected to account for the increment in world energy consumption. In particular, energy demand in the emerging economies of developing Asia, which include China and India, is projected to more than double over the next quarter century. In the developing world as a whole, primary energy consumption is projected to grow at an average annual rate of 2.7 percent between 2001 and 2025 (Figure 13). In contrast, in the industrialized world—with its more mature energy-consuming nations—energy use is expected to grow at a much slower rate of 1.2 percent per year over the same period, and in the transitional economies of Eastern Europe and the former Soviet Union (EE/FSU) growth in energy demand is projected to average 1.5 percent per year.

This chapter begins with an overview of the *IEO2004* outlook for energy consumption by primary energy source. In addition, in order to give readers some perspective about the ways in which energy sources are

currently used and how energy use may evolve in the future, a discussion of trends in energy consumption in the residential, commercial, and industrial sectors is also presented. The chapter continues with the outlook for world carbon dioxide emissions resulting from the combustion of fossil fuels. The next section of the chapter discusses of the macroeconomic forecast in the context of recent economic developments in key nations of the industrialized world, the EE/FSU region, and the developing world.

As with any set of forecasts, there is uncertainty associated with the *IEO2004* energy projections. Consequently, the next section of the chapter looks at issues surrounding the forecast uncertainty, including a look at some of the elements that drive the *IEO2004* projections, which can result in a fair amount of variation in a forecast. Alternative assumptions about economic growth and their impacts on the *IEO2004* projections are considered, as well as the possible effects of future trends in energy intensity on the reference case projections.

Outlook for Primary Energy Consumption

The *IEO2004* reference case projects increased consumption of all primary energy sources over the 24-year forecast horizon (Figure 14 and Appendix A, Table A2). With fossil fuel prices projected to remain relatively low,

Table 1. World Energy Consumption and Carbon Dioxide Emissions by Region, 1990-2025

Region	Energy Consumption (Quadrillion Btu)				Carbon Dioxide Emissions (Million Metric Tons)			
	1990	2001	2010	2025	1990	2001	2010	2025
Industrialized Countries	182.8	211.5	236.3	281.4	10,462	11,634	12,938	15,643
EE/FSU	76.3	53.3	59.0	75.6	4,902	3,148	3,397	4,313
Developing Countries	89.3	139.2	175.5	265.9	6,200	9,118	11,379	17,168
Asia	52.5	85.0	110.6	173.4	3,994	6,012	7,647	11,801
Middle East	13.1	20.8	25.0	34.1	846	1,299	1,566	2,110
Africa	9.3	12.4	14.6	21.5	656	843	971	1,413
Central and South America	14.4	20.9	25.4	36.9	703	964	1,194	1,845
Total World	348.4	403.9	470.8	622.9	21,563	23,899	27,715	37,124

Sources: **1990 and 2001:** Energy Information Administration (EIA), *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/. **2010 and 2025:** EIA, System for the Analysis of Global Energy Markets (2004).

³Throughout this report, projections of energy consumption include only marketed (i.e., commercially traded) sources of energy.

the costs of generating energy from other fuels are not expected to become competitive; as a result, much of the increment in future energy demand in the reference case is projected to be supplied by oil, natural gas, and coal. It is possible, however, that as environmental programs or government policies—particularly those designed to limit or reduce greenhouse gas emissions, such as the Kyoto Protocol⁴—are implemented, the outlook could change, and non-fossil fuels (including nuclear power and renewable energy sources such as hydroelectricity, geothermal, biomass, solar, and wind power) could become more attractive. The *IEO2004* projections assume that government laws in place as of October 1, 2003, remain unchanged over the forecast horizon.

Oil is expected to remain the dominant energy fuel throughout the forecast period, with its share of total world energy consumption remaining unchanged at 39 percent through 2025. In the industrialized world, increases in oil use are projected primarily in the transportation sector, where there are currently no available fuels to compete significantly with oil products. The *IEO2004* reference case projects declining oil use for electricity generation, with other fuels (especially natural gas) expected to provide more favorable alternatives to oil-fired generation.

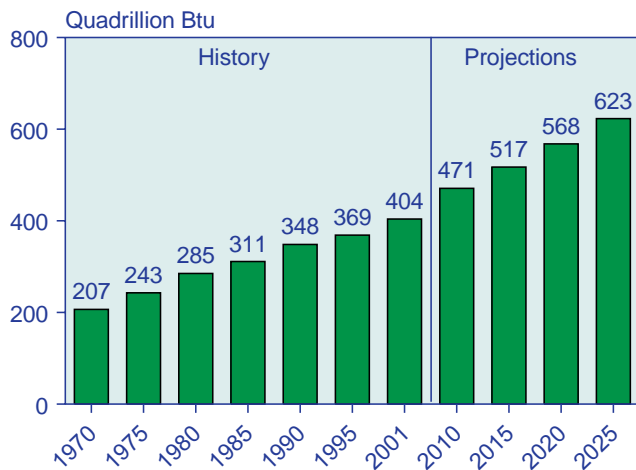
In the developing world, oil consumption is projected to increase for all end uses. In some countries where non-marketed fuels have been widely used in the past (such as fuel wood for cooking and home heating), diesel generators (as well as distributed generators, such as solar photovoltaics) are now sometimes being

used to dissuade rural populations from decimating surrounding forests and vegetation—most notably, in Sub-Saharan Africa, Central and South America, and Southeast Asia [1]. Because the infrastructure necessary to expand natural gas use has not been as widely established in the developing world as it has in the industrialized world, natural gas use is not expected to grow enough in the developing world to accommodate all of the increased demand for energy.

Natural gas is projected to be the fastest growing primary energy source worldwide, maintaining average growth of 2.2 percent annually over the 2001-2025 period. In comparison, 1.9-percent average annual growth rates are projected for oil and for renewables, 1.6-percent annual growth is projected for coal, and 0.6-percent annual growth is projected for nuclear power (on a Btu basis). Total world natural gas consumption is projected to rise from 90 trillion cubic feet in 2001 to 151 trillion cubic feet in 2025, as compared with the forecast of 176 trillion cubic feet in 2025 in EIA's *International Energy Outlook 2003* (Figure 15). The reduction is a result of a combination of factors, including slightly lower assumptions about worldwide economic growth in the forecast, a slower decline projected for nuclear power generation, which competes with natural gas in the electric power sector, and concerns about the long-term ability of natural gas producers to bring sufficient resources to market at prices competitive with those of other fossil fuels.

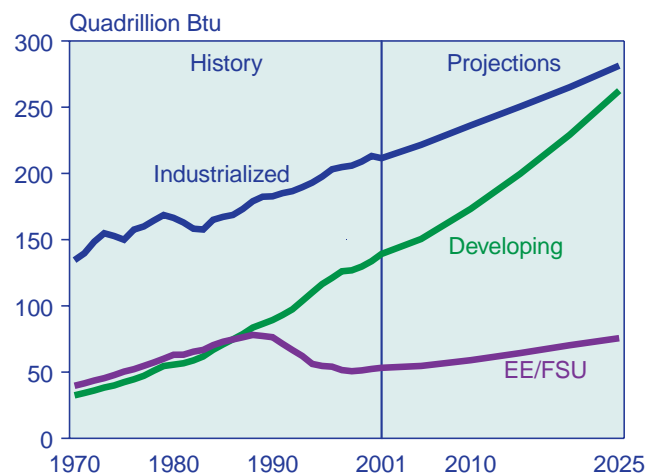
Natural gas is expected to remain an important supply source for new electric power generation in the forecast.

Figure 12. World Primary Energy Consumption, 1970-2025



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/. **Projections:** EIA, System for the Analysis of Global Energy Markets (2004).

Figure 13. World Energy Consumption by Region, 1970-2025



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/. **Projections:** EIA, System for the Analysis of Global Energy Markets (2004).

⁴In *IEO2004*, the Kyoto Protocol is assumed not to be enacted, because it had not been ratified by the required number of nations as of October 1, 2003. For further discussion of the Protocol, see the chapter on “Environmental Issues and World Energy Use.”

It is seen as the desired option for electric power, given its efficiency relative to other energy sources and the fact that it burns more cleanly than either coal or oil, making it a more attractive choice for countries interested in reducing greenhouse gas emissions. In the United States, the industrial sector is expected to remain the largest end-use consumer of natural gas, growing by 1.4 percent per year on average, from 7.3 trillion cubic feet in 2001 to 10.3 trillion cubic feet in 2025. In the electric power sector, natural gas use is projected to increase by 1.9 percent per year, from 5.4 trillion cubic feet to 8.4 trillion cubic feet.

Coal use worldwide is projected to increase by 2.3 billion short tons between 2001 and 2025. Substantial declines in coal use are projected for Western Europe and Eastern Europe, where natural gas is increasingly being used to fuel new growth in electric power generation and for other uses in the industrial and building sectors. In the developing world, however, larger increases in coal use are projected for China and India, where coal supplies are plentiful. Together, China and India account for 85 percent of the projected rise in coal use in the developing world and 70 percent of the total world increment in coal demand over the forecast period.

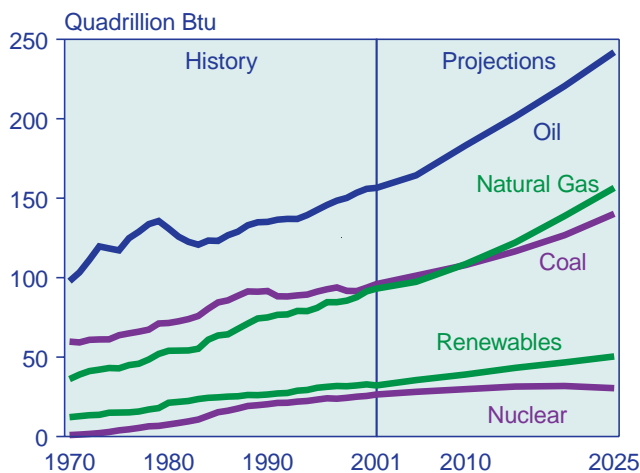
Electricity generation is expected to nearly double between 2001 and 2025, from 13,290 billion kilowatt-hours to 23,702 billion kilowatt-hours. Strongest growth is projected for the countries of the developing world, where net electricity consumption rises by 3.5 percent per year in the *IEO2004* reference case, compared with a projected average increase of 2.3 percent per year worldwide. Robust economic growth in many of the

developing nations is expected to boost demand for electricity to run newly purchased home appliances for air conditioning, cooking, space and water heating, and refrigeration. For the industrialized world and the transitional economies of the EE/FSU, where electricity markets are more mature, more modest annual growth rates of 1.5 and 2.0 percent, respectively, are projected.

As noted above, natural gas is expected to be the fuel of choice for much of the new electricity generation capacity built over the next two decades. The natural gas share of total energy used to generate electricity increases from 18 percent in 2001 to 25 percent in 2025, at the expense of oil and nuclear power, both of which are expected to lose market share of the world's electricity by 2025. The shares of hydroelectricity and other renewable energy resources, as well as that of coal use for electricity generation, are expected to remain fairly stable over the projection period.

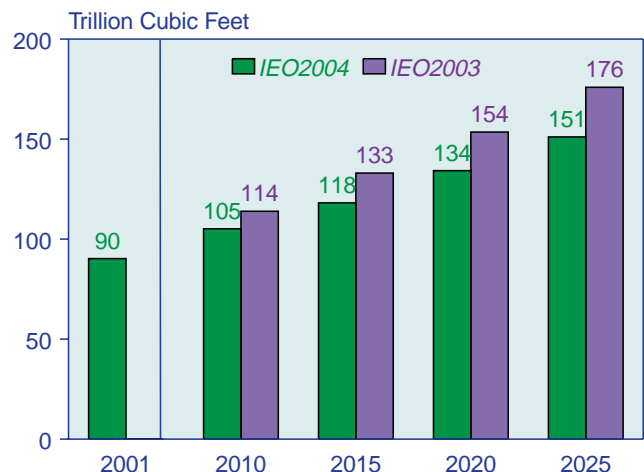
Worldwide, consumption of electricity generated from nuclear power is expected to increase from 2,521 billion kilowatt-hours in 2001 to 2,906 billion kilowatt-hours in 2025. The nuclear power forecast is somewhat higher than in last year's *IEO*. The prospects for nuclear power have been reassessed in light of the higher capacity utilization rates reported for many existing nuclear facilities and the expectation that fewer retirements of existing plants will occur than previously projected. Extensions of operating licenses (or the equivalent) for nuclear power plants are expected to be granted among the countries of the industrialized world and the EE/FSU, slowing the decline in nuclear generation. With higher

Figure 14. World Primary Energy Consumption by Energy Source, 1970-2025



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/. **Projections:** EIA, *System for the Analysis of Global Energy Markets* (2004).

Figure 15. World Natural Gas Consumption, 2001-2025



Sources: **2001:** Energy Information Administration (EIA), *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/. **IEO2003:** EIA, *International Energy Outlook 2003*, DOE/EIA-0484(2003) (Washington, DC, May 2003). **IEO2004:** EIA, *System for the Analysis of Global Energy Markets* (2004).

projections for natural gas prices in the United States than have been expected in earlier years, no U.S. nuclear power units are retired in the reference case.

The world nuclear generation forecast also reflects revised prospects for new construction of nuclear plants in several countries, in terms of both earlier completion dates and the number of new units that may be constructed. In the *IEO2004* reference case, world nuclear capacity is projected to rise from 353 gigawatts in 2001 to 407 gigawatts in 2015 before falling to 385 gigawatts in 2025 (Figure 16). In contrast, in last year's *IEO*, world nuclear capacity was projected to rise to 393 gigawatts in 2015 and then fall to 366 gigawatts in 2025.

The highest growth in nuclear generation is expected for the developing world, where consumption of electricity from nuclear power is projected to increase by 4.1 percent per year between 2001 and 2025. Developing Asia, in particular, is expected to see the largest increment in installed nuclear generating capacity over the forecast, accounting for 95 percent of the total increase in nuclear power capacity for the developing world. Of the 44 gigawatts of additional installed nuclear generating capacity projected for developing Asia, 19 gigawatts is projected for China, 15 gigawatts for South Korea, and 6 gigawatts for India.

Consumption of electricity from hydropower and other renewable energy sources is projected to grow by 1.9 percent annually in the *IEO2004* forecast. With fossil fuel prices projected to remain moderate in the reference case, renewable energy sources are not expected to be widely competitive, and the renewable share of total energy use is not expected to increase. Over the 2001-2025 forecast horizon, renewables maintain their share of total energy consumption at 8 percent. Moreover, despite the high rates of growth projected for alternative renewable energy sources—such as wind power in Western Europe and the United States—much of the growth in renewable energy sources is expected to result from large-scale hydroelectric power projects in the developing world, particularly among the nations of developing Asia. China, India, Malaysia, and Vietnam are already constructing or have plans to construct ambitious hydroelectric projects in the coming decades.

Energy End Use

One way of looking at the future of world energy markets is to consider trends in energy consumption at the end-use sector level. With the exception of the transportation sector, which is almost universally dominated by petroleum products (and is discussed separately in the chapter on “World Oil Markets”), the mix of energy use in the residential, commercial, and industrial sectors can vary widely from country to country, depending on a combination of regional factors, such as the availability

of energy resources, the level of economic development, and political and social factors. Regional trends in energy end use are discussed below.

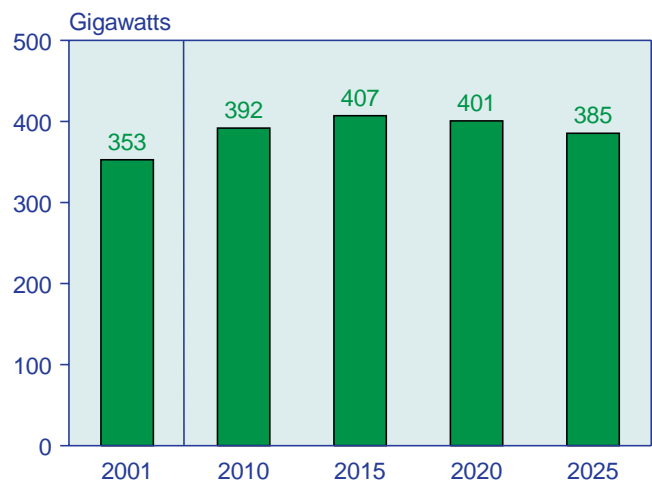
Residential Sector

Energy end use in the residential sector is defined as energy consumed by households, excluding transportation uses. The type and amount of energy used by households varies from country to country, depending on income levels, natural resources, and available energy infrastructure. In general, households in developed countries use more energy than those in transitional or developing nations, primarily as a result of the higher market saturation of energy-using appliances.

Industrialized World

Households in the developed nations of the industrialized world (North America, Western Europe, and Industrialized Asia) have much in common in terms of using energy. Space and water heating account for most of the energy used by households in the industrialized nations, the majority of which are located in the northern latitudes. Although the fuels used to heat both space and water vary from country to country, the recent trend has been toward natural gas and away from oil, coal, and biomass (wood and peat, for example) in most industrialized countries. That trend is expected to continue over the projection period, as natural gas distribution networks are built out in many of the developed nations that do not have complete coverage in terms of a natural gas grid. In some of the Scandinavian countries, where hydropower plays a key role in electricity production and taxes on fossil fuels are high, electricity is more widely used for home heating.

Figure 16. World Installed Nuclear Capacity, 2001-2025



Sources: **2001:** Energy Information Administration (EIA), *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/. **Projections:** EIA, *System for the Analysis of Global Energy Markets* (2004).

The technologies used for space and water heating also vary among the industrialized nations. In the United States, for example, central units are widely used to distribute hot water and air through ducts or pipes. Centralized systems tend to use more energy than do systems that heat individual rooms or that heat water inside a dishwasher, shower unit, or other appliance. In the United States, widespread use of air conditioning and the relatively large size of houses have contributed to the prevalence of central heating systems. In Western Europe and Japan, where houses on average are smaller, summer temperatures are more moderate, and energy costs are higher, there has been less reliance on central systems, although they are becoming more commonplace.

Increasingly, other appliances are becoming a bigger part of the energy picture in the developed world. In every industrialized nation, higher incomes have fueled demand for more and more electric appliances, such as home computers, home theater systems, and the like. As appliance standards for products such as refrigerators and clothes washers take hold in the developed nations, growth in electricity consumption is increasingly affected by the penetration of these more efficient appliances—a trend that is expected to continue in the industrialized countries as household incomes rise.

Eastern Europe and the Former Soviet Union

Since the collapse of the Socialist regimes in Eastern Europe, residential energy use, both per household and per capita, has declined in the region's transitional economies. The transition to market economies has had a significant impact on energy use, as energy price subsidies related to government-run energy service providers have waned. Consumers, reacting to higher market prices for energy, have reduced demand accordingly. At the same time, per capita incomes have declined, making energy less affordable.

As in the developed economies, space heating tends to be the most energy-intensive service for households in the transitional economies, where colder climates dictate that a substantial amount of energy be used for heating. In addition, the majority of homes in the EE/FSU countries are relatively energy-inefficient, with relatively high space heating intensities per square foot. The use of coal and wood for space heating tends to be more widespread in the transitional countries than in the developed nations.

The pace of the transition to fully operational market-based economies will determine how patterns of energy use change in the residential sector of the EE/FSU region in the coming decades. As household incomes rise, energy use in the transitional economies is expected to grow with the demand for energy-using appliances. Providing adequate and reliable supplies of

electricity to homes will require national investments in electricity production and distribution infrastructure as households begin to use electricity more intensively.

Developing World

Energy use in the developing nations (China, India, Central and South America, Africa, the Middle East, and Other Developing Asia) is projected to increase more rapidly than in other regions over the coming decades. Population growth and urbanization in populous China and India are expected to produce large increases in demand for residential energy services, and rising incomes and rural electrification efforts are generally expected to bolster demand for electricity-using appliances in most of the developing countries. Given the current low market saturation of such appliances, rapid growth in demand for electricity is projected over the forecast period as air conditioning, refrigeration, and laundry equipment become more commonplace. China's electricity supply system already is struggling to meet the demand of its customers, causing brownouts and curtailments. In South America, where air conditioning is more widely used, the electricity infrastructure is better established than in some of the other developing nations.

In most of the developing economies, energy use for space heating tends to be less important than it is in the industrialized nations, due in part to climate and dwelling size. In the poorest nations, available wood, wood waste, and other solid wastes are used for cooking, for water heating, and for space heating where it is needed. Traditional sources of free wood are becoming more scarce, however, as land development and population pressures deplete readily available supplies of forest products. As commercial markets for traditionally free fuels have developed, those who cannot afford the price of wood have turned to burning solid waste for cooking and other uses. Until household incomes in those areas increase, it is likely that the situation will continue as it is. Over time, however, as incomes rise and fuel distribution networks are established, switching to petroleum and natural gas is expected to displace some of the demand for traditional fuels.

Commercial Sector

The commercial sector—often referred to as the services sector or the services and institutional sector—consists of businesses, institutions, and organizations that provide services. The sector encompasses many different types of buildings and a wide range of activities and energy-related services. Examples of commercial sector facilities include schools, stores, correctional institutions, restaurants, hotels, hospitals, museums, office buildings, banks, and even stadiums that hold sporting events. Most commercial energy use occurs in buildings or structures, supplying services such as space heating,

water heating, lighting, cooking, and cooling. Energy consumed for services not associated with buildings, such as for traffic lights and city water and sewer services, is also categorized as commercial sector energy use.

Economic and population growth trends drive commercial sector activity and the resulting energy use. The need for services (health, education, financial, government) increases as populations increase. The degree to which these 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 commercial sector activities are offered and utilized. 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.

Industrialized World

With population growth in the industrialized world as a whole expected to continue slowing, the rate of increase in the region's commercial energy demand is also expected to slow. In addition, further efficiency improvements are also expected to moderate energy demand growth over time as energy-using equipment is replaced with newer, more efficient stock. Conversely, strong economic growth in industrial countries is expected to include continued growth in business activity, with its associated energy use, in areas such as retail and wholesale trade and business, financial, and leisure services.

Electricity demand growth in industrialized countries is becoming more dependent on advances in technology and the introduction of new electronic appliances and equipment. The continued saturation of space cooling in commercial buildings also contributes to increasing electricity use. Recently, natural gas has become the preferred heating fuel in many industrialized nations, displacing petroleum products and coal. In addition to the use of gas-fired systems in buildings, conversion of district heating plants to natural gas (for example, in eastern Germany) has played a role. Growth in commercial natural gas consumption is expected to continue but to slow over time in the industrialized countries; however, some individual countries may continue to see robust growth in commercial natural gas use as it replaces other fuels, such as liquefied petroleum gas (LPG).

Eastern Europe and the Former Soviet Union

Although the population of the EE/FSU region as a whole is projected to decline over the forecast period, increasing commercial activity and rising incomes are expected to lead to growth in the region's commercial

sector energy demand. The nations of Eastern Europe are expected to continue a general shift toward services and lighter industries as the transition to market economies continues, with tourism services expected to become increasingly important. As a result, the region's total energy consumption is expected to grow more slowly than its gross domestic product (GDP). Nevertheless, increased demand for commercial services is expected to contribute to continued growth in commercial energy use in absolute terms.

Electricity demand in the EE/FSU region is expected to grow rapidly as the transitional nations approach the requirements of market-based economies, including increased adoption of electronic equipment. Commercial natural gas demand is expected to grow more strongly in the transitional economies than in the industrialized nations as commercial activity increases. Natural gas is also expected to meet the heating needs of transitional countries to a greater extent than it has in the past, displacing coal and heating oil.

Developing World

The commercial sector typically represents a smaller share of energy consumption in developing countries than in industrialized and transitional nations; however, economic growth and commerce are expected to increase rapidly in the developing nations, fueling additional energy demand in the services sector. Faster population growth is also expected in the developing world than in the other regions, increasing the need for education, health care, and social services and the energy required to provide them.

Commercial electricity demand is expected to grow rapidly in developing countries as more clinics, schools, and businesses gain access to electricity. The projected increase in commercial electricity demand is compounded in nations with quickly growing economies, such as China, as they continue to shift away from heavy manufacturing toward services. Increasing commercial activity is expected to lead to growth in natural gas demand as well, with several developing countries focused on expanding the infrastructure necessary for delivery of this relatively clean fuel. Commercial sector oil consumption is expected to continue to increase more rapidly in areas where natural gas availability is limited.

Industrial Sector

Energy is consumed in the industrial sector by a diverse group of industries—including manufacturing, agriculture, mining, and construction—and for a wide range of activities, such as process and assembly uses, space conditioning, and lighting. Overall energy demand in the industrial sector varies across regions and countries of the world, based on the level and mix of economic activity, technological development, and population, among other factors.

Industrialized World

Industrialized countries accounted for one-half of all energy consumption in the industrial sector worldwide in 2001, and the United States accounted for one-half of the total in the industrialized countries. On the other hand, the industrialized countries use much less energy per dollar of GDP than do countries in the EE/FSU and developing regions. Reasons for the differences include more energy-efficient industrial operations and a mix of industrial output more heavily weighted toward non-energy-intensive sectors in the industrialized economies. For example, the United States has seen manufacturing's share of total value of output decline steadily over the past two decades, while that for the service sectors (included in the commercial sector) has increased. Additionally, within the U.S. manufacturing sector, a smaller share of output has been produced by the heavy, energy-intensive industries (such as steelmaking). These general trends are projected to continue. On a per capita basis, delivered energy consumption in the industrial sector is higher in the industrialized countries than in the EE/FSU or developing countries.

Similar developments are expected for the other industrialized nations as increasing international trade fosters a shift toward a less energy-intensive mix of industrial activity. For example, many of Japan's heavy industries are reducing their output as demand for energy-intensive materials increasingly is met by imports from China and other Asian countries. In Germany, a decline in industrial energy intensity in the early 1990s was largely the result of closures of heavy industries in the former East Germany after reunification. Much of Germany's inefficient, energy-intensive eastern capacity has already been shut down, but further improvements are projected as capital stock is replaced and modernized.

Eastern Europe and the Former Soviet Union

In 2001, in the aggregate, the transitional economies of the EE/FSU region had a higher ratio of industrial sector energy consumption to regional GDP than did either the industrialized or developing nations. The relatively high ratio is a result of three factors: the transition to market-based economies has been slow; a higher proportion of total output from the region is from the industrial sector than in the developed countries (the service sectors are less energy intensive than the manufacturing sectors); and much of the industrial sector's production is from inefficient Soviet-era facilities.

Abundant energy resources in the former Soviet Union, along with centralized decisionmaking led to the construction of energy-inefficient industrial capacity. As the transition to market economies progresses, and as inefficient capacity is replaced with modern facilities, the

intensity of energy use in the industrial sector is projected to decline more rapidly than in the industrialized countries. Because Russia has the world's largest natural gas reserves, this fuel source is likely to supply one-half of the industrial sector energy requirements in the region.

Developing World

Industrial energy consumption in the developing countries was nearly 40 percent of the worldwide industrial sector total in 2001, and their share is projected to increase to almost one-half of all industrial sector energy consumption by 2025 as a result of the more rapid economic growth expected in the region. The ratio of industrial sector energy consumption to GDP is projected to decline at approximately the same rate as in the industrialized countries.

China leads the developing countries in terms of both economic growth and industrial energy consumption. Two energy-intensive industries, iron and steel and chemicals, are projected to increase capacity, both to meet domestic needs and to supply international markets. As the standard of living in China rises, however, less energy-intensive light industries are projected to increase output even faster, in order to meet growing demand for consumer products.

Outlook for Carbon Dioxide Emissions

World carbon dioxide emissions are expected to increase from 23,899 million metric tons⁵ in 2001 to 37,124 million metric tons in 2025—growing by 1.9 percent per year—if world energy consumption reaches the levels projected in the *IEO2004* reference case (Figure 17). According to this projection, world carbon dioxide emissions in 2025 would exceed 1990 levels by 72 percent. Combustion of petroleum products contributes 5,733 million metric tons to the projected increase from 2001, coal 4,120 million metric tons, and natural gas the remaining 3,374 million metric tons. Although coal use is projected to grow at a slower rate than natural gas use over the projection period, coal is also a more carbon-intensive fuel than gas. As a result, the absolute increment in carbon dioxide emissions from coal combustion is larger than the increment in emissions from natural gas combustion.

Carbon dioxide emissions from energy use in the industrialized countries are expected to increase by 4,009 million metric tons, to 15,643 million metric tons in 2025, or by about 1.2 percent per year. Emissions from the combustion of petroleum products account for about 42 percent of the total increment expected for the industrialized world, natural gas 33 percent, and coal 24 percent.

⁵In keeping with current international practice, *IEO2004* presents data on carbon dioxide emissions in million metric tons carbon dioxide equivalent. The figures can be converted to carbon equivalent units by multiplying by 12/44.

By 2020, carbon dioxide emissions in the developing world (including China and India) are expected to surpass those in the industrialized countries, even though developing countries are projected to use less total energy than industrialized countries at that time (Figure 18). However, developing countries continue to account for less than one-half of global carbon dioxide emissions through the 2025 forecast horizon. Total emissions in developing nations are expected to increase from 9,118 million metric tons in 2001 to a total of 17,168 million metric tons in 2025, representing about 61 percent of the projected increase worldwide. The sizable rise in emissions projected for the developing nations results in part from their continued heavy reliance on coal, the most carbon-intensive of the fossil fuels. Coal is used extensively in the countries of developing Asia, which have the highest expected rates of economic growth and energy consumption growth in the forecast. Carbon dioxide emissions in developing Asia alone are projected to increase from 6,012 million metric tons in 2001 to 11,801 million metric tons in 2025.

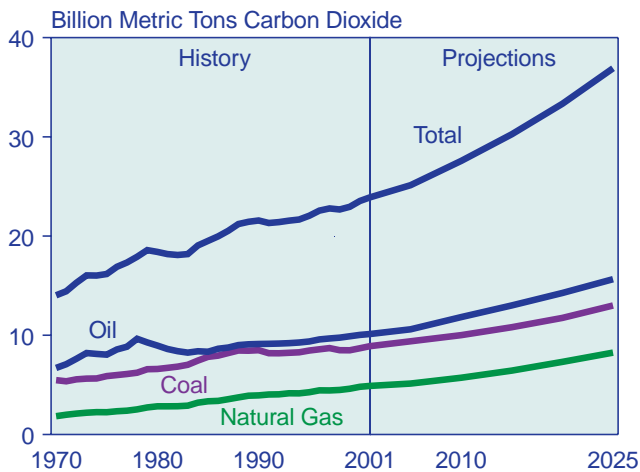
In the EE/FSU region, carbon dioxide emissions are not expected to return to their Soviet-era levels during the projection period. The *IEO2004* reference case projection reflects the expectation that coal use will not decline as precipitously as was projected in last year's *IEO*, particularly among the FSU countries. In fact, Russia's coal use is expected to increase slowly until 2015 before it begins

to decline. The FSU appears to be in the midst of sustained economic recovery after the political, social, and economic upheavals that followed the breakup of the Soviet Union in the early 1990s. Carbon dioxide emissions are not expected to increase as quickly as energy use because of gains in energy efficiency resulting from the replacement of old, inefficient capital stock, and because in many countries in the region, natural gas is expected to displace coal, particularly for new electricity generation capacity.

Worldwide, carbon dioxide emissions per person are projected to increase from about 4.1 metric tons in 1990 to 4.7 metric tons in 2025. Per capita emissions in the industrialized countries remain much higher than those in the rest of the world throughout the projection period, increasing from 11.8 to 12.9 metric tons per person between 1990 and 2010 and then to 14.7 metric tons per person in 2025 in the *IEO2004* reference case (Figure 19).

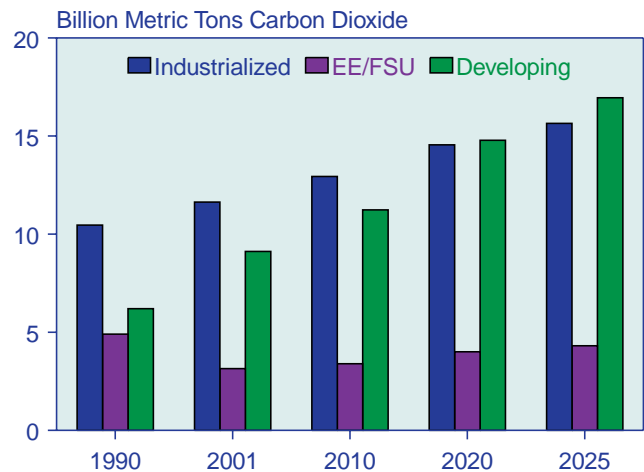
As of November 26, 2003, 119 countries and the European Community had ratified the Kyoto Protocol. Thirty-one of the ratifying nations are the so-called Annex I countries, which are required to limit or reduce their greenhouse gases relative to 1990 levels under the terms of the Protocol.⁶ The Kyoto Protocol will enter into force 90 days after it has been ratified by at least 55 of the parties to the United Nations Framework Convention on Climate Change (UNFCCC), including a representation

Figure 17. World Energy-Related Carbon Dioxide Emissions by Fuel Type, 1970-2025



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/. **Projections:** EIA, System for the Analysis of Global Energy Markets (2004).

Figure 18. World Energy-Related Carbon Dioxide Emissions by Region, 1990-2025



Sources: **1990 and 2001:** Energy Information Administration (EIA), *International Energy Annual 2001*, DOE/EIA-0219 (2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/. **Projections:** EIA, System for the Analysis of Global Energy Markets (2004).

⁶As of November 26, 2003, the following Annex I countries had ratified, accepted, approved, or acceded to the Kyoto Protocol: Austria, Belgium, Bulgaria, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, and the United Kingdom.

of Annex I countries accounting for at least 55 percent of the total 1990 carbon dioxide emissions from the Annex I group. Countries that already have ratified the Protocol include Annex I countries responsible for about 44 percent of total Annex I carbon dioxide emissions in 1990.

Because Russia accounted for 17 percent of the 1990 Annex I carbon dioxide emissions, its ratification would bring the Protocol into force for its signatories if Russia met the Protocol's requirements for verifying and monitoring emissions levels. Conflicting statements concerning the prospects for Russia's ratification of the Kyoto Protocol have recently been released. In December 2003, Andrei Illarionov, a senior adviser to President Vladimir Putin, said that the country was not planning to ratify the treaty. Two days later, the Russian deputy economic minister, Mukhamed Tsikhanov said, "There are no decisions about ratification apart from the fact that we are moving towards ratification" [2]. Most Russia watchers agree that no action will be taken with regard to the treaty until well after the national elections scheduled for March 2004 [3].

Both China and India ratified the Kyoto Protocol in 2002. Although both countries account for significant amounts of the world's carbon dioxide emissions, their ratification does not affect the implementation of the Protocol, because neither country is an Annex I member. In 2001, China and India together accounted for 17

percent of total world carbon dioxide emissions, as compared with the 24-percent share made up by U.S. emissions in that year.

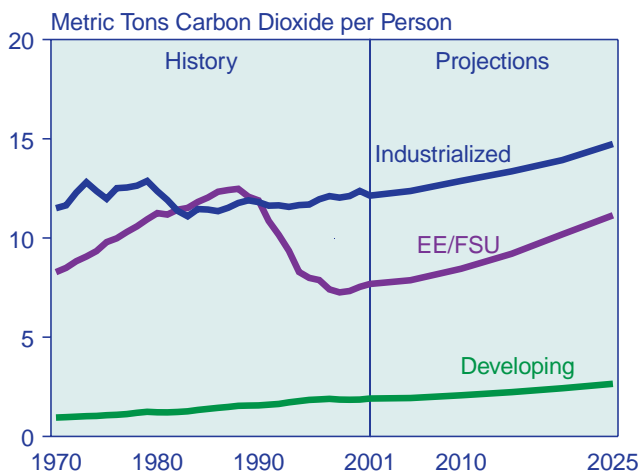
In the United States, the Bush Administration has stated that it will not seek to ratify the Kyoto Protocol. Its policy on limiting greenhouse gas emissions focuses on initiatives aimed at reducing greenhouse gas intensity as an alternative to the Protocol.⁷ Under the President's Clear Skies Initiative⁸ and Global Climate Change Initiative, the United States will work to reduce greenhouse gas intensity by 18 percent from 2002 levels by 2012 [4]. Carbon dioxide intensity is defined as the amount of carbon dioxide emitted per dollar of GDP. This measurement illustrates the relationship between emissions and the expansion of economic activity. The Administration argues that reducing the amount of greenhouse gases emitted per dollar of GDP will slow the rate of increase in emissions without sacrificing needed economic growth.

World carbon dioxide intensity has improved (decreased) substantially over the past three decades, from 1,100 metric tons per million 1997 dollars of GDP in 1970 to 739 metric tons per million 1997 dollars in 2001 (Table 2). Although the pace of improvement in emissions intensity is expected to slow over the forecast period, it still continues to improve in the reference case projections, dropping to 566 metric tons per million 1997 dollars in 2025, about 24 percent less than in 2001.

On a regional basis, the most rapid improvements in carbon dioxide intensity are expected to occur among the transitional economies of the EE/FSU and in China. Russia's carbon dioxide intensity improves by 2.5 percent per year in the forecast, as the country continues to recover from the economic upheaval of the 1990s and replaces old and inefficient capital stock as economic recovery progresses. Outside Russia, carbon dioxide intensity in the rest of the FSU region falls even more rapidly, by 3.2 percent per year between 2001 and 2025, with economic recovery expected to continue throughout the forecast.

In addition to improved efficiency of capital equipment, the FSU nations are also expected to increase their use of less carbon-intensive natural gas for new electricity generation and other end uses rather than the more carbon-intensive oil and coal. There are expansive natural gas resources in Russia, but there are also significant gas resources in several other key economies of the FSU, including Turkmenistan, Uzbekistan, and Kazakhstan, as well as to a lesser extent in Azerbaijan and Ukraine.

Figure 19. Energy-Related Carbon Dioxide Emissions per Capita by Region, 1970-2025



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/. **Projections:** EIA, *System for the Analysis of Global Energy Markets* (2004).

⁷Greenhouse gases are transparent to solar (short-wave) radiation but opaque to long-wave (infrared) radiation and thus prevent long-wave radiant energy from leaving the Earth's atmosphere. The most important greenhouse gases are water vapor, carbon dioxide, methane, nitrous oxide, and several engineered gases, including hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

⁸The Clear Skies Initiative proposes a voluntary program that would use a "cap and trade" system, allowing companies to trade emissions credits in an effort to achieve significant reductions in emissions of mercury, nitrogen oxides, and sulfur dioxide.

Those resources have only just begun to be developed and have not been as widely utilized as the resources in Russia. Development of natural gas reserves over the forecast period is expected to allow the other nations of the FSU region to achieve more rapid improvements in carbon dioxide intensity than is projected for Russia.

Eastern Europe began its economic recovery much earlier than the nations of the former Soviet Union. As a result of strong investment in improving the efficiency of energy use among Eastern European countries and a push to increase the use of natural gas, carbon dioxide intensity fell by nearly 40 percent in Eastern Europe between 1990 and 2001, as compared with only 5 percent in Russia and 9 percent in the other FSU nations. Improvement in carbon dioxide intensity in Eastern

Europe is projected to continue outpacing that in Russia, at 2.9 percent per year from 2001 to 2025.

Developing Asia is expected to see fairly rapid improvement in carbon dioxide intensity over the projection period, primarily as a result of rapid economic growth, rather than a switch to less carbon-intensive fuels. China, in particular, is expected to remain heavily reliant on fossil fuels, especially coal, in the *IEO2004* reference case, but its annual GDP growth is projected to average 6.1 percent, compared with an expected 3.3-percent annual rate of increase in fossil fuel use from 2001 to 2025. China's carbon dioxide intensity is expected to decrease by 2.6 percent per year over the forecast period.

Table 2. World Carbon Dioxide Intensity by Selected Countries and Regions, 1970-2025
(Metric Tons Carbon Dioxide per Million 1997 U.S. Dollars of Gross Domestic Product)

Region	History				Projections				Average Annual Percent Change	
	1970	1980	1990	2001	2010	2015	2020	2025	1970-2001	2001-2025
Industrialized Countries										
North America										
United States	1,154	946	729	606	528	489	457	431	-2.1	-1.4
Canada	1,272	1,090	855	757	699	655	611	581	-1.7	-1.1
Mexico	673	827	929	760	714	674	625	596	0.4	-1.0
Western Europe										
United Kingdom	813	696	521	377	329	307	282	261	-2.4	-1.5
France	535	484	288	248	207	189	170	157	-2.5	-1.9
Germany	855	711	519	358	330	311	309	292	-2.8	-0.8
Italy	487	439	391	351	330	311	292	274	-1.0	-1.0
Netherlands	780	773	666	579	537	501	463	425	-1.0	-1.3
Industrialized Asia										
Japan	457	386	259	263	244	229	215	207	-1.8	-1.0
Australia/New Zealand	1,190	795	770	733	636	598	564	551	-1.5	-1.2
EE/FSU										
Russia	2,804	3,120	3,603	3,425	2,579	2,277	2,061	1,877	0.6	-2.5
Other Former Soviet Union	4,537	4,763	5,334	4,873	2,932	2,610	2,385	2,215	0.2	-3.2
Eastern Europe	3,558	3,698	3,124	1,923	1,449	1,239	1,096	947	-2.0	-2.9
Developing Countries										
Asia										
China	9,703	8,218	5,288	2,538	1,824	1,619	1,468	1,340	-4.2	-2.6
India	1,719	1,965	1,933	1,764	1,369	1,244	1,140	1,044	0.1	-2.2
South Korea	936	1,033	783	789	620	555	505	477	-0.6	-2.1
Middle East	1,391	1,565	2,069	2,225	1,908	1,752	1,624	1,519	1.5	-1.6
Africa	1,108	1,199	1,345	1,348	1,076	1,008	945	885	0.6	-1.7
Central and South America	686	611	637	638	607	561	532	505	-0.2	-1.0
Total World	1,100	1,008	877	739	658	621	591	566	-1.3	-1.1

Sources: **History:** Derived from Energy Information Administration (EIA), *International Energy Annual 2001*, DOE/EIA-0219 (2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/. **Projections:** EIA, System for the Analysis of Global Energy Markets (2004).

World Economic Outlook

Economic growth is among the most important factors to be considered in projecting changes in the world's energy consumption over time. In the *IEO2004* forecast, assumptions about regional economic growth, measured in gross domestic product (GDP) in real 1997 U.S. dollars, underlie the projections of regional energy demand (see box below for discussion of real GDP). The *IEO2004* reference case projection for economic growth is based on projections provided in the Energy Information Administration's *Annual Energy Outlook 2004* for the United States and by Global Insight, Inc., for all other countries [5]. The framework employed for the projections reflects the interaction of many economic variables and underlying relationships, both in the short term and

in the medium to long term. In the short term, households and businesses make spending decisions (the demand side) based on their expectations of future movements in interest rates, prices, employment, incomes, wealth, fiscal and monetary policies, exchange rates, and world developments. In the long run, it is the ability to produce goods and services (the supply side) that ultimately determines the growth potential for any country's economy.

While the short-term movements of actual output of a nation move around a trend, depending upon which stage of the business cycle the economy is in, the medium- to long-term forecast has to do with projecting the trend in output itself. The *IEO2004* reference case economic forecast is a projection of possible economic

Converting Gross Domestic Product for Different Countries to U.S. Dollars: Market Exchange Rates and Purchasing Power Parity Rates

The world energy forecasts in *IEO2004* are based primarily on projections of GDP for different countries and regions, which for purposes of comparison are expressed in 1997 U.S. dollars. First, GDP projections are prepared for the individual countries in terms of their own national currencies and 1997 prices of goods and services. Then, the projections are converted to 1997 U.S. dollars by applying average 1997 foreign exchange rates between the various national currencies and the dollar. The resulting projections of real GDP are thus based on national 1997 prices in each country and the 1997 market exchange rate (MER) for each currency against the U.S. dollar.

An alternative method for converting GDP projections in different national currencies to U.S. dollars would employ exchange rates based not on currency markets but on the concept of "purchasing power parity" (PPP). PPP exchange rates are derived through a process of equalizing the purchasing power of different currencies by eliminating differences in price levels for various goods. As one example, if the price of a hamburger is \$2.20 in the United States and 60 rupees in India, then the PPP exchange rate for hamburgers between the two currencies can be calculated as $60/2.2$, or 27.3 rupees to the dollar.^a Similarly, the concept of PPP for one good can be generalized to various baskets of goods and services in different countries to derive PPP rates for converting aggregate national income and product accounts to U.S. dollars.^b

The table on the following page shows 2001 GDP and the *IEO2004* projections for 2025 GDP, converted to

1997 U.S. dollars based on 1997 MER and PPP rates for various countries and regions, as well as the ratios of the two results. For most of the industrialized countries, the ratio of 2001 GDP based on MER to that based on PPP is close to 1, indicating that the cost of living in those countries generally is reflected in the exchange rates for their currencies. Two exceptions are Mexico and Japan. For Mexico the ratio is 2.3, implying a much lower cost of living than in the United States and thus an economy that is 2.3 times larger than suggested by the MER-based real GDP calculation. For Japan the ratio is 0.7, implying a higher cost of living than in the United States and, in terms of purchasing power, an economy that is 30 percent smaller than suggested by the MER-based GDP. The ratios for the developing countries are much larger—including values of 5.1 for China and 5.6 for India.

In terms of the *IEO2004* forecasts, however, the apparent discrepancy between the MER and PPP conversion results for 2001 GDP does not mean that the two methods would yield different energy demand projections. Comparison of the PPP/MER ratios for historical 2001 GDP and projected 2025 GDP shows that, for each country and region, the two ratios are identical. In other words, it makes no difference for the energy demand forecasts whether the GDP forecasts are based on MER or PPP as long as they are consistent over the entire period, because both forecasts are based on volumes, which do not reflect changes in exchange rates and prices over time.

(continued on page 18)

^aSee "McCurrencies," *The Economist* (April 24, 2003).

^bThe main sources of information on purchasing power parity are the International Comparison Program (ICP) of the United Nations, web site <http://pwt.econ.upenn.edu>, and the Joint OECD-Eurostat PPP Programme, web site www.oecd.org.

growth, from the short term to the long term, in a consistent framework that stresses demand factors in the short term and supply factors in the long term. Currently, based on historical trends, the world economy is operating below its potential. Given the recent positive economic news coming from the United States, Japan, Western Europe, China, and Russia, the expectation is that the world economy will continue moving toward its long-term growth potential in 2004 and 2005.

Beyond 2005, the outlook for medium- to long-term economic growth depends on the underlying demographic and expected productivity trends in each economy. These in turn depend on population growth, labor force participation rates, productivity growth, and national savings and capital accumulation. These factors determine the nature and character of long-term growth, especially in developed industrial economies that have well-established and stable political institutions and markets for goods and services, labor, and financial assets. These economies generally have well-defined

property rights and well-developed human and physical infrastructures.

In developing economies that are still in the process of building their human and physical capital infrastructures, establishing regulatory mechanisms to govern markets, and ensuring political stability will play an important role in determining medium- to long-term growth potential. The transitional economies face their own unique sets of problems as they move from central planning to decentralized private markets. Therefore, in contrast to the developed world, the range of uncertainty about the reference case projections for developing and transitional economies is higher.

Industrialized World

The U.S. economy has started to improve vigorously after a number of serious setbacks in the past three years, including the terrorist attacks of September 2001, the significant loss of stock market wealth since 2000, corporate accounting scandals, the war on terrorism, and the wars

Comparison of Real GDP by Region and Country for 2001 and 2025 Converted to 1997 U.S. Dollars Based on Purchasing Power Parity Rates (PPP) and Market Exchange Rates (MER)

Region	2001 Real GDP			Projected Real GDP, 2025		
	PPP	MER	PPP/MER	PPP	MER	PPP/MER
Industrialized Countries	23,542	25,077	0.9	41,848	44,545	0.9
United States	9,394	9,394	1.0	18,881	18,881	1.0
Canada	823	751	1.1	1,570	1,427	1.1
Mexico	1,062	464	2.3	2,640	1,153	2.3
Western Europe	8,624	9,513	0.9	13,993	15,423	0.9
United Kingdom	1,399	1,492	0.9	2,494	2,655	0.9
France	1,448	1,601	0.9	2,384	2,629	0.9
Germany	1,842	2,284	0.8	2,679	3,313	0.8
Italy	1,307	1,269	1.0	2,028	1,971	1.0
Japan	3,087	4,411	0.7	4,592	6,563	0.7
Australia/New Zealand	734	428	1.7	1,155	674	1.7
EE/FSU	2,137	1,022	2.1	5,593	2,680	2.1
Former Soviet Union	1,376	632	2.2	3,709	1,710	2.2
Eastern Europe	762	389	2.0	1,899	971	2.0
Developing Asia	12,391	3,536	3.5	41,051	11,714	3.5
China	6,074	1,202	5.1	25,155	4,976	5.1
India	2,902	520	5.6	9,808	1,757	5.6
South Korea	822	562	1.5	2,209	1,510	1.5
Other Asia	2,756	1,253	2.2	7,569	3,471	2.2
Middle East	1,100	584	1.9	2,608	1,389	1.9
Turkey	410	183	2.2	1,101	492	2.2
Central & South America	1,980	1,510	1.3	4,763	3,650	1.3
Brazil	986	863	1.1	2,372	2,076	1.1

Sources: Energy Information Administration, *Annual Energy Outlook 2004*, DOE/EIA-0383(2004) (Washington, DC, January 2004); Global Insight, Inc., *World Overview* (Lexington, MA, September 2003); and International Monetary Fund, "How Should We Measure Global Growth?", in *World Economic Outlook: Public Debt in Emerging Markets* (September 2003), pp. 18-19.

in Afghanistan and Iraq. Yet the recession of 2001 was one of the mildest on record, with recovery proceeding slowly in 2002 and 2003. The mildness of the recession was the result of a collapse in business investment, which was largely offset by sustained private spending on consumption, a strong housing market, and expansionary fiscal and monetary policies. In the mid-term, the U.S. economy is projected to grow by an average of 3.2 percent per year between 2005 and 2010, with somewhat slower growth—2.8 percent per year—expected between 2010 and 2025 (Table 3 and Figure 20).

In Canada, economic growth was more robust than that in the United States from 1998 through 2002; however, in conjunction with the general worldwide economic slowdown, it slowed substantially during the first half of 2003. The slowdown in the United States (one of Canada's major trading partners), the appreciation of the Canadian dollar, and some SARS-related problems

contributed to the Canadian slowdown [6]. As the recovery proceeds in the United States, the Canadian economy is expected to rebound, and average economic growth rates of 3.0 percent per year between 2005 and 2010 and 2.5 percent per year between 2010 and 2025 are projected in the *IEO2004* reference case.

Growth in Mexico's economy was disappointing during the first half of 2003, reflecting in part the sluggishness of the U.S. economy. Mexico's estimated economic growth rate for the year is 1.5 percent. Unlike the Canadian dollar, there has been no sharp appreciation of the Mexican peso against the U.S. currency. Output remains well below potential. Global financial markets remain friendly to Mexico in terms of the availability and cost of credit and the volume of foreign direct investment. In general, strong trade ties with the United States are expected to help cushion Mexico from the deeper economic troubles that have hampered other countries in

Table 3. Annual Growth in World Gross Domestic Product by Selected Countries and Regions, 1977-2025
(Percent per Year)

Region	History				Projections		
	1977-2001	2001	2002	2003	2001-2025	2005-2010	2010-2025
Industrialized Countries	2.7	0.9	1.5	1.7	2.4	2.6	2.4
United States	3.0	0.3	2.4	2.3	3.0	3.2	2.8
Canada	2.9	1.9	3.3	2.0	2.7	3.0	2.5
Mexico	3.3	-0.3	0.9	1.5	3.9	3.6	4.4
Western Europe	2.2	1.7	1.0	0.7	2.0	2.2	2.1
United Kingdom	2.3	2.1	1.7	2.0	2.4	2.5	2.5
France	2.2	2.1	1.2	0.3	2.1	2.2	2.2
Germany	1.9	1.0	0.2	0.0	1.6	1.8	1.7
Italy	2.2	1.7	0.4	0.3	1.9	2.1	2.0
Japan	2.9	0.4	0.2	2.5	1.7	1.8	1.7
Australia/New Zealand	3.1	2.5	3.7	2.6	3.0	3.0	2.9
EE/FSU	-0.4	4.6	4.0	5.1	4.1	4.4	3.9
Former Soviet Union	-1.0	5.9	4.8	6.1	4.2	4.5	3.8
Eastern Europe	0.8	2.6	2.7	3.4	3.9	4.1	3.9
Developing Countries	4.5	2.4	3.5	3.9	4.6	5.2	4.5
Asia	6.8	3.9	5.6	5.2	5.1	5.8	4.7
China	9.5	7.3	8.0	7.7	6.1	6.8	5.5
India	5.2	5.6	4.3	5.8	5.2	5.4	5.1
South Korea	6.9	3.2	6.3	2.8	4.2	5.6	3.4
Other Asia	5.8	0.5	3.6	3.5	4.3	5.1	4.2
Middle East	3.3	-1.7	3.3	3.9	3.7	4.0	3.6
Turkey	3.3	-7.5	7.8	5.0	4.2	4.2	3.9
Africa	2.7	3.2	3.0	3.3	4.0	4.5	3.9
Central and South America	2.4	0.5	-1.2	1.1	3.7	4.1	4.2
Brazil	2.7	1.4	1.5	0.5	3.7	3.9	4.1
Total World	2.8	1.3	2.0	2.3	3.0	3.2	3.0

Sources: **History:** Global Insight, Inc., *World Overview* (Lexington, MA, September 2003). **Projections:** Global Insight, Inc., *World Overview* (Lexington, MA, September 2003); and Energy Information Administration, *Annual Energy Outlook 2004*, DOE/EIA-0383(2004) (Washington, DC, January 2004).

Latin America. By the same token, Mexico's future growth is also more dependent on U.S. growth. In the *IEO2004* reference case, Mexico's GDP is projected to grow by an average of 3.9 percent per year from 2001 to 2025.

Economic performance in Western Europe, particularly the Eurozone, has also been disappointing. Real GDP growth (and growth of real domestic demand) has been sluggish for the past 3 years, and fiscal and monetary policy actions to induce more satisfactory growth have not been exercised [7]. The region's actual GDP is well below potential, and even with some economic acceleration there is little reason to expect that the gap between actual and potential output will shrink significantly any time soon. Moreover, some analysts believe that macroeconomic policy (particularly, monetary policy) in the Eurozone has not been aggressive enough in confronting the widening output gap. In the face of accumulating evidence of underlying economic sluggishness, the European Central Bank has cut key interest rates far less and much more slowly than has the U.S. Federal Reserve [8].

Over the medium to long term there are structural impediments to economic growth in many European countries—particularly relating to labor markets, product markets, and costly social welfare systems. Reforms to improve the competitiveness of European labor and product markets could yield significant dividends in terms of increases in regional output. Several countries have recently introduced or at least proposed substantive reforms, including further liberalization of labor and product markets in Germany and pension reforms in France, Italy, and Austria [9]. In the *IEO2004* reference case, Western Europe's GDP is projected to grow by 2.0 percent per year between 2001 and 2025—a full percentage point lower than the average annual growth rate projected for U.S. GDP over the same period.

Japan, the world's second largest economy, grew by only 0.2 percent in 2002, with strong exports being the major factor preventing the economy from falling into recession [10]. Although not robust, Japan's positive growth performance during the first and second quarters of 2003 surprised most analysts [11]. Japan's future long-term growth still has great potential. The country's highly skilled labor force and strong work ethic should allow high rates of growth, provided that more flexible labor policies are adopted, allowing greater mobility for workers. Toward the end of the decade, normal attrition is expected to eliminate excessive employment in the industrial sector, allowing consolidation and improved efficiencies. More importantly, the bankrupt firms kept afloat by creditors are expected to be gone and, therefore, no longer a drain on the economy. In addition, the bad loans that have plagued Japan's banks are expected

to be reduced to the point where lending can again take place.

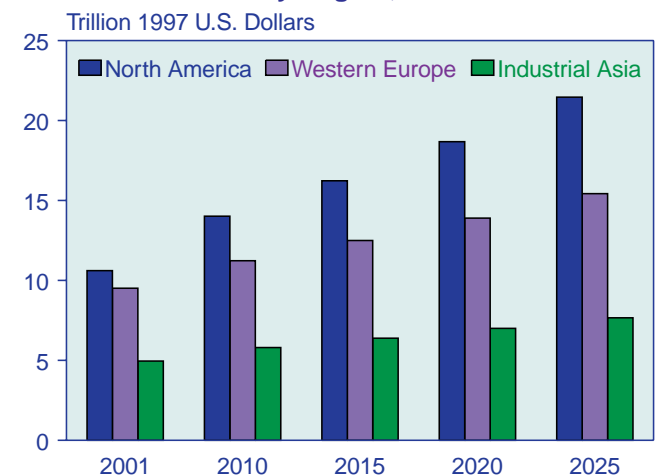
On the potentially negative side is Japan's declining population. The number of people is expected to peak in 2007, and the average age is expected to continue rising as a result of a low birth rate and high longevity. This implies that transfer payments by the government to the elderly could become increasingly burdensome. Because of the demographic trends, Japan's projected average annual GDP growth rate of 1.7 percent from 2001 to 2025 is less than its projected average per-capita GDP growth rate of 2 percent per year. For the same reasons, Japan's high savings rate is expected to decline. With less need to invest overseas, capital outflows from Japan should fall, which would allow the yen to strengthen, reducing the country's trade surplus [12].

Eastern Europe and the Former Soviet Union

For the past several years, the economies of the FSU continue to be largely sheltered from global economic uncertainties, having recorded strong growth each year since 2000. Robust domestic demand in both Russia and Ukraine, in addition to rising oil prices and corresponding hydrocarbon investment in the Caspian region, has been the primary cause of the expansion. In Central Asia, many economies continue to surge as a result of large oil and gas investments, while smaller economies are benefiting from expansion in their mining and metals sectors [13].

Economic growth in the FSU region is expected to slow from 6.1 percent in 2003 to 5.3 percent in 2004 and 4.9 percent in 2005, based on the assumption of a decline in

Figure 20. Industrialized World Gross Domestic Product by Region, 2001-2025



Sources: **2001:** Derived from Energy Information Administration (EIA), *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/. **Projections:** EIA, System for the Analysis of Global Energy Markets (2004).

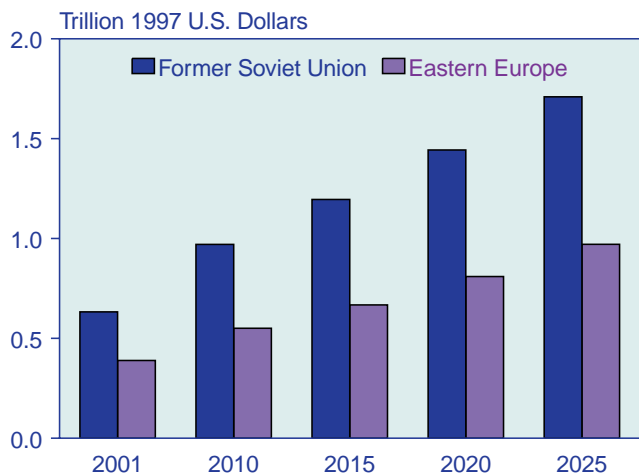
oil prices in both 2004 and 2005 and a corresponding decline in the growth impetus produced by higher state spending. Although structural reforms are being pursued in many FSU countries, in general, implementation is not as advanced or as widespread as in the Eastern European economies, and in some cases there is significant resistance to structural reforms. This implies lower long-run growth in comparison.

The recent boom in hydrocarbon prices has provided an important impetus to growth, facilitating the introduction of a number of reforms in oil-exporting economies and contributing to an increase in investment outlays, particularly in the energy sector. However, given the volatility of energy market prices, these economies will not be able to sustain the growth rates recently achieved until diversification from energy becomes more broadly based. Given the degree of energy dependence in many of the FSU countries, particularly Russia, the projected softening of oil prices in the *IEO2004* reference case forecast implies a slowing down of the region's growth from recent high rates.

Most Eastern European countries had positive GDP growth by the mid-1990s, following the declines associated with the dissolution of the Soviet Union. Catastrophic floods in August 2002 had strong negative impacts on the important regional economy of the Czech Republic. Also, the slowdown among the economies of the industrialized world dampened some demand for East European goods. Therefore, economic growth in the Eastern European economies has been flat for the past year.

The accession of 10 Eastern European countries to membership in the European Union in May 2004 is expected

Figure 21. EE/FSU Gross Domestic Product by Region, 2001-2025



Sources: **2001:** Derived from Energy Information Administration (EIA), *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/. **Projections:** EIA, *System for the Analysis of Global Energy Markets* (2004).

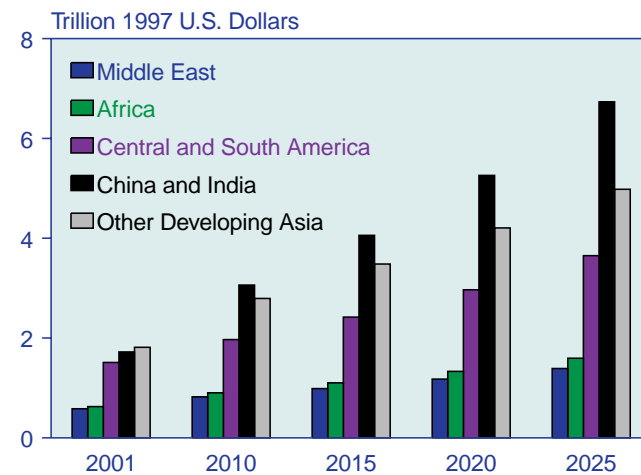
to provide a boost to confidence and to economic activity in the mid-term; and an average annual expansion of 3.9 percent per year is projected for Eastern Europe's GDP over the 2001-2025 period (Figure 21). Although participation in the Eurozone will be neither immediate nor automatic, membership in the European Union is expected to provide stimulus to inward foreign direct investment flows—thereby boosting domestic investment and growth. Stronger economic growth in Western Europe will also provide a short-term boost.

Developing World

Much of the growth in world economic activity between 2001 and 2025 is expected to occur among the nations of developing Asia, where regional GDP is projected to grow by 5.1 percent per year (Figure 22). For the most part, the nations of developing Asia experienced positive and accelerating economic growth in 2002. Real GDP in the region grew by 5.6 percent in 2002, as compared with 3.9 percent in 2001. However, the renewed economic slowdown in the developed world, relatively high oil prices in the first part of 2003, and the SARS outbreak in East Asia dampened the pace of regional growth in the first half of 2003.

IEO2004 projects an average annual growth rate of approximately 6 percent over the 2001 to 2025 period for China, developing Asia's largest economy. Economic growth in China is expected to be the highest among the world's major economies and by 2025, based on share of world GDP, China is expected to be the third largest economy in the world, behind the United States and Japan (Table 4). In terms of structural issues that have implications for the medium to long term, China still needs to reform overstuffed and inefficient state-owned

Figure 22. Developing World Gross Domestic Product by Region, 2001-2025



Sources: **2001:** Derived from Energy Information Administration (EIA), *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/. **Projections:** EIA, *System for the Analysis of Global Energy Markets* (2004).

companies and a banking system that is carrying a significant amount of nonperforming loans. Membership in the World Trade Organization is expected to force the government to pursue the reforms, which are expected to transform the Chinese economy into one that is more market oriented and, hence, more efficient. Another major structural factor for China is its present political system. Unlike most European ex-Communist countries, China has done nothing structural to reform its political system.

Structural problems aside, China possesses some very favorable factors for long-term growth. The country has a very high saving rate, at around 40 percent, which allows for faster capital accumulation. It has an abundance of natural resources and a huge, underutilized labor force of both low-skilled and highly skilled workers. Finally, China also is a magnet for attracting capital

from abroad. Inflows of foreign capital have averaged \$40 billion per year in the past several years [14]. In addition to complementing local savings, foreign investment facilitates technology transfer and boosts productivity.

Economic growth in another rapidly emerging economy of the region, India, slowed in late 2002 and early 2003, mainly reflecting the effects of a severe drought on the country's large agricultural sector. Annual GDP growth in 2002 was 4.3 percent, in contrast to 5.6 percent in 2001. Economic activity appears to have picked up significantly in the second quarter of 2003, with recovery in the country's agricultural sector. In addition, falling agricultural prices are helping to provide room for the Reserve Bank of India to ease interest rates, which will be a positive factor for investment and economic growth. Aside from a recovery in agricultural output, growth in India is likely to be supported by continued strong expansion

Table 4. Shares of World Gross Domestic Product by Selected Countries and Regions, 2000-2025
(Percent)

Region	2000	Projections				
		2005	2010	2015	2020	2025
Industrialized Countries	77.8	75.9	73.7	71.6	69.7	67.9
United States	29.3	29.5	29.5	29.3	29.1	28.8
Canada	2.3	2.4	2.3	2.3	2.2	2.2
Mexico	1.5	1.4	1.4	1.5	1.6	1.8
Western Europe	29.3	28.0	26.7	25.5	24.5	23.5
United Kingdom	4.6	4.5	4.4	4.3	4.2	4.0
France	4.9	4.7	4.5	4.3	4.1	4.0
Germany	7.1	6.6	6.1	5.7	5.4	5.1
Italy	3.9	3.7	3.5	3.3	3.2	3.0
Japan	13.8	12.9	12.1	11.3	10.7	10.0
Australia/New Zealand	1.7	1.7	1.7	1.7	1.7	1.7
EE/FSU	3.1	3.4	3.6	3.8	4.0	4.1
Former Soviet Union	1.9	2.2	2.3	2.4	2.5	2.6
Eastern Europe	1.2	1.2	1.3	1.4	1.4	1.5
Developing Countries	19.1	20.6	22.7	24.6	26.3	28.0
Asia	10.7	12.3	13.9	15.4	16.7	17.9
China	3.5	4.5	5.3	6.1	6.8	7.6
India	1.5	1.8	2.0	2.2	2.4	2.7
South Korea	1.7	1.9	2.2	2.3	2.3	2.3
Other Asia	3.9	4.1	4.5	4.8	5.1	5.3
Middle East	1.9	1.9	1.9	2.0	2.1	2.1
Turkey	0.6	0.6	0.7	0.7	0.7	0.8
Africa	1.9	2.0	2.1	2.2	2.3	2.4
Central and South America	4.7	4.5	4.7	4.9	5.2	5.6
Brazil	2.7	2.6	2.7	2.8	3.0	3.2

Sources: **2000:** Global Insight, Inc., *World Overview* (Lexington, MA, September 2003). **Projections:** Global Insight, Inc., *World Overview* (Lexington, MA, September 2003); and Energy Information Administration, *Annual Energy Outlook 2004*, DOE/EIA-0383(2004) (Washington, DC, January 2004).

in the information technology services sectors now burgeoning in the Bangalore area [15].

The mid-term prospects for India are positive as it continues to privatize state enterprises and increasingly adopts free market policies. It is expected that India will continue structural reforms, including reforms in trade, banking, privatization, and infrastructure. These factors—combined with improvement in human capital indicators in recent years, such as rising literacy rates and school enrollments and declining infant mortality rates—are expected to lead to an increase in productivity [16]. Accelerating structural reforms—including ending regulatory impediments to consolidation in labor-intensive industries, labor markets, and bankruptcy reforms, as well as agricultural and trade liberalization—remain essential to stimulate potential growth and to reduce poverty in the medium to long term [17]. In the long term, through its vast and cheap labor force, India is well placed to reap the benefits of globalization [18]. Average annual GDP growth in India over the 2001-2025 forecast period is projected at 5.2 percent.

After contracting by 1.2 percent in 2002, the aggregate economy of Central and South America (Figure 22) is making a limited recovery. This reflects tentative recoveries in Argentina and Uruguay as well as calming of pre-election jitters in Brazil at the end of 2002. Growth in 2003 is estimated at 1.1 percent. Although the region is on a favorable recovery path, its growth rate remains well below potential. The weak international environment and domestic economic and/or political problems in a number of countries are constraints. Growth in the region remains heavily dependent on the volume of foreign capital flows. Although foreign direct investment continues to be the major source of external finance, inflows are generally weak, while portfolio flows have been volatile [19].

Brazil, South America's largest economy, has been affected by the lingering global economic weakness. After growing at a rate of 1.5 percent in 2002, Brazil's economy is estimated to have an annual growth of 0.5 percent in 2003. One of the main factors in this dismal growth has been the continued high level of domestic nominal and real interest rates. Domestic interest rates have remained high because the central bank had to contend with the upsurge of inflation and of inflationary expectations induced both by the large depreciation of the Brazilian currency, the real, in 2002 and by the large injections of liquidity that the central bank undertook a year ago to keep domestic short-term interest rates at unsustainably low levels. As is the case in most Latin American countries, Brazil still needs foreign capital to support stronger domestic economic growth, due to a lack of domestic savings.

Brazil is in a strong position to attract large flows of foreign capital, if it is able to make those investments secure and foreign investors can expect an appropriate return. Thus, President Lula's signals and actions regarding government policy toward private businesses and foreign investors are crucial to securing a steady flow of funds from abroad, which will enable the country to sustain high economic growth over the medium term. Over the 2005 to 2010 period, Brazil's economy is projected to grow at an annual rate of 3.9 percent. Barring any unforeseen negative developments, that growth rate is projected to be maintained over the long run.

In the long term, beyond macroeconomic stability and commitment to sound fiscal and monetary policies, the countries of Central and South America will have to tackle governance issues and attempt to correct severe economic disparities between the wealthy and the poor in the region's societies. They will also need to develop the mature financial markets necessary to generate resources sufficient to allow them to become less dependent on foreign finance, thus allowing investments in physical infrastructure and human capital to be financed domestically [20].

In the Middle East, the overarching event in 2002-2003 was the war in Iraq, provoking continued high oil prices. In the rise of uncertainty surrounding the situation in the Persian Gulf in 2002 and early 2003, oil prices surged and oil exporters lifted oil production. Combined with fiscal expansion programs, high oil prices led to an expansion of output growth to 3.2 percent in oil-exporting countries in 2002 [21]. Private-sector growth in Saudi Arabia and several other Gulf countries is expected to remain weak as a result of the disruption caused by the war in Iraq, but companies from Saudi Arabia and Kuwait will benefit from subcontracting work associated with the reconstruction of the Iraqi infrastructure.

For 2004, a stronger global growth environment and progress in addressing key regional problems in Iraq and elsewhere still offer the hope that regional real GDP growth in the Middle East will be about 3.7 percent, increasing to a rate of 4.1 percent in 2005, which is expected to be sustained through 2010. According to the IMF, the key policy issue for Middle Eastern countries is accelerating growth to reduce generally high unemployment rates and absorb the rapidly growing labor force. The central issues to be addressed are structural and institutional in nature. The priorities vary across countries but include a reduction in the role of the government, strengthening of institutions and governance, trade liberalization, and diversification away from oil production [22].

Africa's aggregate GDP grew by an estimated 3.3 percent in 2003. Better global prospects for growth in 2004 and some recent strengthening in non-oil commodity

prices suggest that Africa should be expected to do better in 2004 and 2005, with annual GDP growth projected at 4.4 percent. In the longer run, Africa will continue to face formidable obstacles to growth from low savings and investment rates, limited quantity and quality of infrastructure and human capital, negative perceptions of international investors, and especially HIV/AIDS.

In principle, higher standards of governance and improved policies should encourage higher savings and investment and raise productivity and economic growth in Africa. At the same time, however, it will not be easy for the nations of Africa to overcome the obstacles listed above. Moreover, Africa remains highly dependent on primary commodity exports and thus is exposed to high external volatility [23]. Although those factors indicate downside risks to the projections, achieving the moderate improvement projected in the *IEO2004* forecast seems a plausible baseline expectation. For Africa as a whole, average annual GDP growth of 4.0 percent is projected over the 2001 to 2025 period.

Alternative Growth Cases

Expectations for the future rates of economic growth are a major source of uncertainty in the *IEO2004* forecast. To account for the uncertainties associated with economic growth trends, *IEO2004* includes a high economic growth case and a low economic growth case in addition to the reference case. The reference case projections are based on a set of regional assumptions about economic growth paths—measured by GDP—and energy elasticity (the relationship between changes in energy consumption and changes in GDP). The two alternative growth cases are based on alternative assumptions about possible economic growth paths; assumptions about the elasticity of energy demand are held constant, at reference case values (Figure 23).

For the high and low economic growth cases, different assumptions are made about the range of possible economic growth rates among the industrial, transitional EE/FSU, and developing economies. For the industrialized countries, 0.5 percentage point is added to the reference case GDP growth rates for the high economic growth case and 0.5 percentage point is subtracted from the reference case GDP growth rates for the low economic growth case. Outside the industrialized world and excluding the former Soviet Union, reference case GDP growth rates are also increased and decreased by 1.0 percentage point to provide the high and low economic growth case estimates.

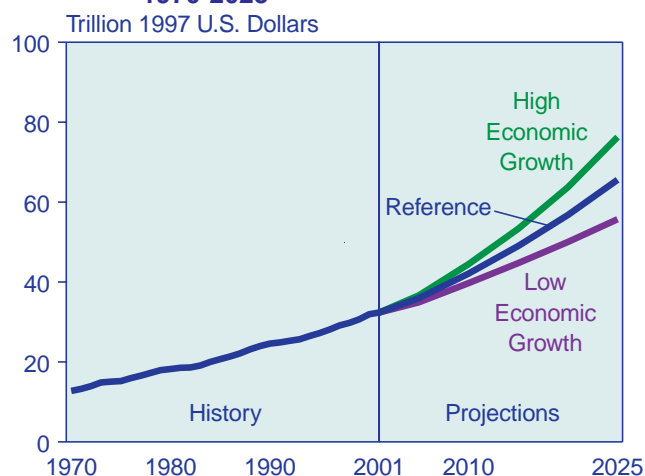
The FSU suffered a severe economic collapse in the early part of the decade and, until recently, has shown wide variation in its year-to-year economic growth. Between 1990 and 2001, its annual growth rate in GDP has varied from -15 percent in 1992 to +9 percent in 2000. Given this

wide range, the FSU nations may be characterized as being a region with considerably more future uncertainty than other regions of the world. As a result, 1.5 percentage points are added and subtracted from the reference case GDP assumptions to derive the high and low macroeconomic forecasts for the FSU region.

The *IEO2004* reference case shows total world energy consumption reaching 623 quadrillion Btu in 2025, with the industrialized world projected to consume 281 quadrillion Btu, the transitional EE/FSU countries 76 quadrillion Btu, and the developing world 266 quadrillion Btu. In the high economic growth case, total world energy use in 2025 is projected to be 710 quadrillion Btu, 87 quadrillion Btu (or 44 million barrels per day oil equivalent) higher than in the reference case (Figure 24). Under the assumptions of the low economic growth case, worldwide energy consumption in 2025 is projected to be 81 quadrillion Btu (40 million barrels per day oil equivalent) lower than in the reference case, at 542 quadrillion Btu. Thus, there is a substantial range of 168 quadrillion Btu, or about one-fourth of the total consumption projected for 2025 in the reference case, between the projections in the high and low economic growth cases.

Corresponding to the range of the energy consumption forecasts, carbon dioxide emissions in 2025 are projected to total 32,032 million metric tons in the low economic growth case (5,092 million metric tons less than the reference case projection of 37,124 million metric tons) and 42,551 million metric tons in the high economic growth case (5,427 million metric tons higher than the reference case projection).

Figure 23. World Gross Domestic Product in Three Economic Growth Cases, 1970-2025



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/. **Projections:** Global Insight, Inc., *World Economic Outlook*, Vol. 1 (Lexington, MA, Third Quarter 2004); and EIA, *System for the Analysis of Global Energy Markets* (2004).

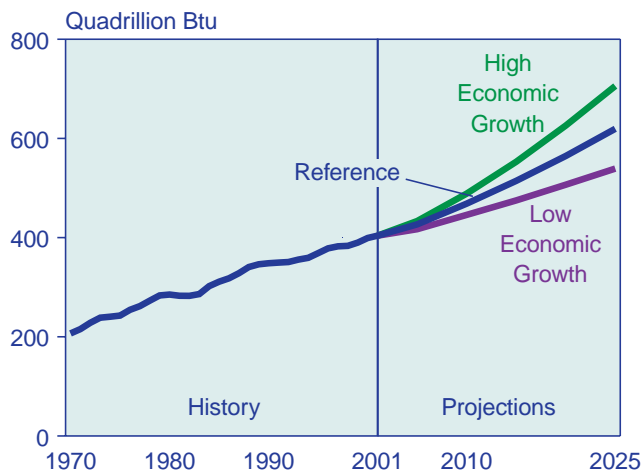
Trends in Energy Intensity

Another major source of uncertainty surrounding long-term forecasts is the relationship of energy use to GDP over time. Economic growth and energy demand are linked, but the strength of that link varies among regions and their stages of economic development. In industrialized countries, history shows the link to be a relatively weak one, with energy demand lagging behind economic growth. In developing countries, demand and economic growth have been more closely correlated in the past, with energy demand growth tending to track the rate of economic expansion.

The historical behavior of energy intensity in the former Soviet Union is problematic. Since World War II, the EE/FSU economies have had higher levels of energy intensity than either the industrialized or the developing countries. In the FSU, however, energy consumption grew more quickly than GDP until 1990, when the collapse of the Soviet Union created a situation in which both income and energy use declined but GDP fell more quickly and, as a result, energy intensity increased. Over the forecast horizon, energy intensity is expected to decline in the region as the EE/FSU nations continue to recover from the economic and social problems of the early 1990s. Still, energy intensity in the EE/FSU region is expected to be more than double that in the developing world and five times that in the industrialized world in 2025 (Figure 25).

The stage of economic development and the standard of living of individuals in a given region strongly influence the link between economic growth and energy demand.

Figure 24. World Primary Energy Consumption in Three Economic Growth Cases, 1970-2025



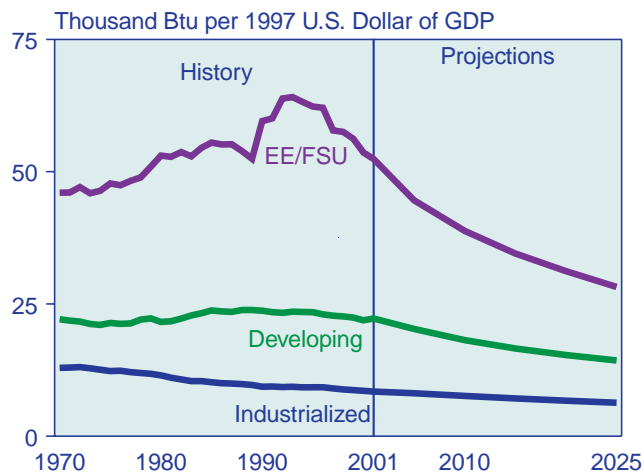
Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/. **Projections:** EIA, System for the Analysis of Global Energy Markets (2004).

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

References

1. D.F. Barnes et al., "Tackling the Rural Energy Problem in Developing Countries," *Finance & Development*, Vol. 34, No. 2 (June 1997), pp. 11-15.
2. A. Kirby, "Russia's Climate Tussle Spins On," *BBC News Online* (December 4, 2003).
3. A.C. Revkin, "Into Thin Air: Kyoto Accord May Not Die (or Matter)," *The New York Times* (December 4, 2003), p. A6.
4. The White House, Office of the Press Secretary, "President Announces Clear Skies & Global Climate Change Initiatives" (Press Release, February 14, 2002), web site www.whitehouse.gov/news/releases/2002/02/20020214-5.html.
5. Energy Information Administration, *Annual Energy Outlook 2004*, DOE/EIA-0383(2004) (Washington, DC, January 2004); and Global Insight, Inc., *World Overview* (Lexington, MA, September 2003). India's GDP growth rates were adjusted downward, based on the judgment of EIA analysts.

Figure 25. World Energy Intensity by Region, 1970-2020



Sources: **History:** Derived from Energy Information Administration (EIA), *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/. **Projections:** EIA, System for the Analysis of Global Energy Markets (2004).

6. International Monetary Fund, "Economic Prospects and Policy Issues," in *World Economic Outlook: Public Debt in Emerging Markets* (Washington, DC, September 2003), p. 25, web site www.imf.org/external/pubs/ft/weo/2003/02/.
7. Global Insight, Inc., *World Overview* (Lexington, MA, September 2003), pp. 19-35.
8. M. Mussa, "A Global Growth Rebound: How Strong for How Long?" (Institute for International Economics, September 9, 2003), web site www.iie.com/publications/papers/mussa0903.pdf.
9. International Monetary Fund, "Economic Prospects and Policy Issues," in *World Economic Outlook: Public Debt in Emerging Markets* (Washington, DC, September 2003), p. 28, web site www.imf.org/external/pubs/ft/weo/2003/02/.
10. United Nations, *World Economic and Social Survey 2003* (New York, NY: United Nations Publications, January 2003), Chapter 1, p. 9, web site www.un.org/esa/policy/wess/.
11. "Moving Forward—If United States Can Keep Pace," *Washington Post* (November 16, 2003), p. F2.
12. Global Insight, Inc., *Asia and Oceania: Quarterly Review and Outlook* (Lexington, MA, Third Quarter 2003).
13. United Nations, *World Economic and Social Survey 2003* (New York, NY: United Nations Publications, January 2003), Chapter 1, p. 10, web site www.un.org/esa/policy/wess/.
14. Global Insight, Inc., *Asia and Oceania: Quarterly Review and Outlook* (Lexington, MA, Third Quarter 2003), pp. 9-15.
15. World Bank, *Global Economic Prospects 2004: Realizing the Development Promise of the Doha Agenda* (Washington, DC, September 2003), Appendix 1, "Regional Economic Prospects," web site www.worldbank.org/prospects/gep2004/full.pdf.
16. World Bank, *Global Economic Prospects 2004: Realizing the Development Promise of the Doha Agenda* (Washington, DC, September 2003), Appendix 1, "Regional Economic Prospects," p. 239, web site www.worldbank.org/prospects/gep2004/full.pdf.
17. International Monetary Fund, "Economic Prospects and Policy Issues," in *World Economic Outlook: Public Debt in Emerging Markets* (Washington, DC, September 2003), p. 37, web site www.imf.org/external/pubs/ft/weo/2003/02/.
18. "Making a Splash," *The Economist* (August 7, 2003).
19. United Nations, *World Economic and Social Survey 2003* (New York, NY: United Nations Publications, January 2003), Chapter 1, web site www.un.org/esa/policy/wess/.
20. World Bank, *Global Economic Prospects 2004: Realizing the Development Promise of the Doha Agenda* (Washington, DC, September 2003), Appendix 1, "Regional Economic Prospects," p. 244, web site www.worldbank.org/prospects/gep2004/full.pdf.
21. World Bank, *Global Economic Prospects 2004: Realizing the Development Promise of the Doha Agenda* (Washington, DC, September 2003), Appendix 1, "Regional Economic Prospects," p. 253, web site www.worldbank.org/prospects/gep2004/full.pdf.
22. International Monetary Fund, "Economic Prospects and Policy Issues," in *World Economic Outlook: Public Debt in Emerging Markets* (Washington, DC, September 2003), p. 47, web site www.imf.org/external/pubs/ft/weo/2003/02/.
23. World Bank, *Global Economic Prospects 2004: Realizing the Development Promise of the Doha Agenda* (Washington, DC, September 2003), Appendix 1, "Regional Economic Prospects," pp. 251-253, web site www.worldbank.org/prospects/gep2004/full.pdf.