Chapter 6

Transportation Sector Energy Consumption

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

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

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

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

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

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

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

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

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

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

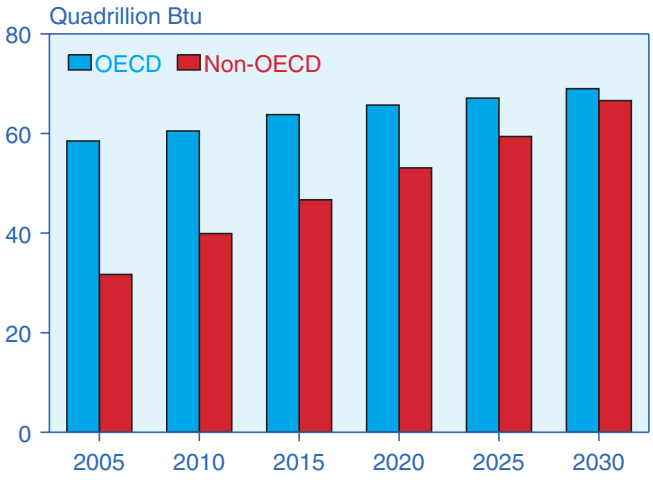
In the projections, the transportation sector continues to rely heavily on liquids to meet demand for travel. Total world liquids consumption increased by 35 percent from 2005 to 2030, and the transportation sector accounts for three-fourths of the increase. Given the world oil price environment projected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

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

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

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

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

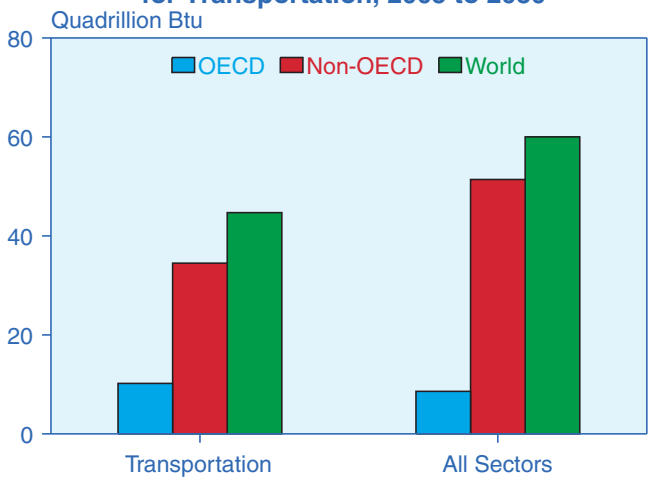


Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2008).

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

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

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



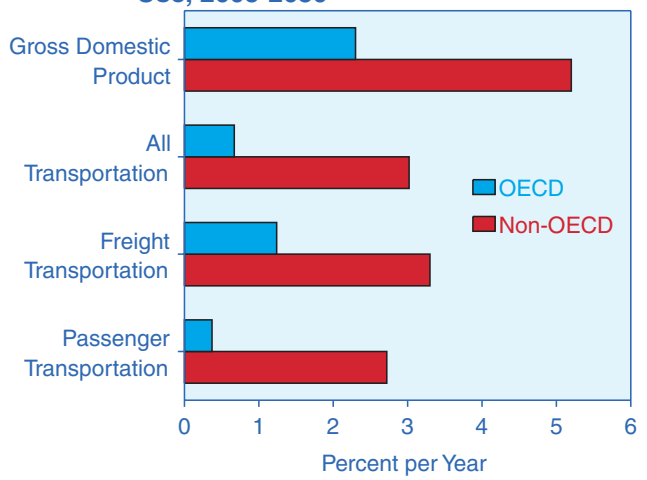
Sources: **2005:** Derived from Energy Information Administration (EIA), *International Energy Annual 2005* (June-October 2007), web site www.eia.doe.gov/iea. **2030:** EIA, World Energy Projections Plus (2008).

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

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

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

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



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

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

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

OECD Countries

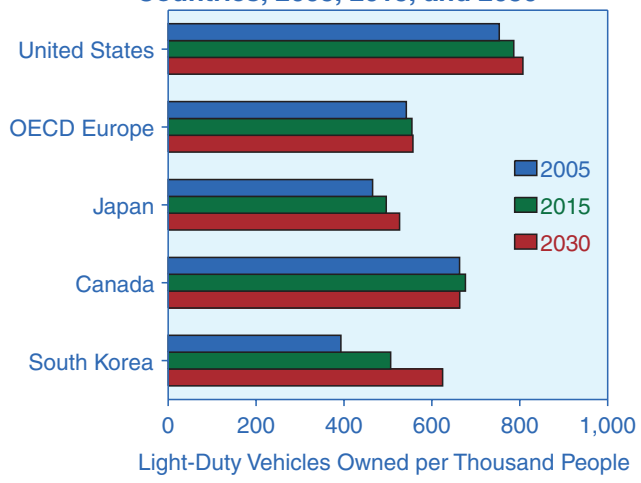
Transportation infrastructure in the OECD countries generally is well established. Roads and highways connect most population centers, and motorization levels (vehicles per 1,000 people), which already are fairly high, probably will reach saturation over the course of the projection period (Figure 69).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

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

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

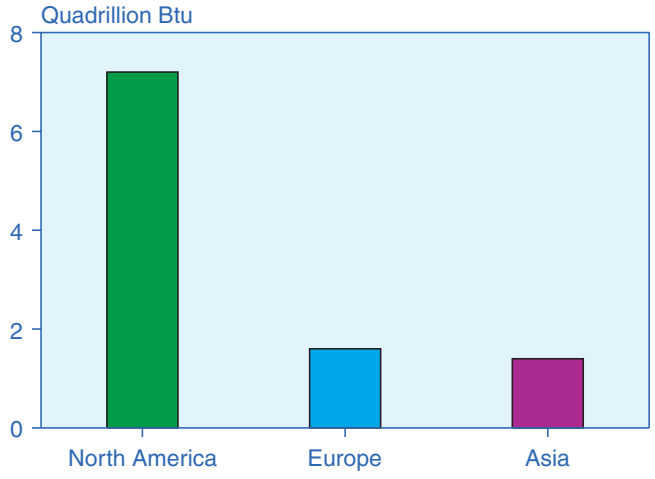
Another impact of EISA2007 on projected energy use in the U.S. transportation sector is a large increase in biofuel consumption. Total U.S. biofuel consumption rises from 0.3 quadrillion Btu (3.7 billion gallons) in 2005 to 2.8 quadrillion Btu (29.7 billion gallons) in 2030, when it represents about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

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



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

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



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

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

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

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

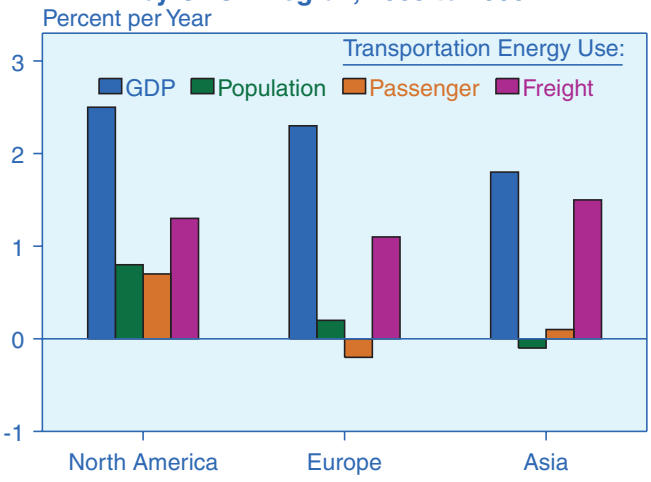
In November 2004, Ontario enacted the Regulation 535/05, "Renewable Fuel Standard," which required an average 5-percent ethanol blend share in the motor gasoline sold in the province, to be achieved by January 1, 2007 [*5*]. British Columbia has passed Bill 16 "The 2008 Greenhouse Gas Reduction (Renewable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

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

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

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

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



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

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

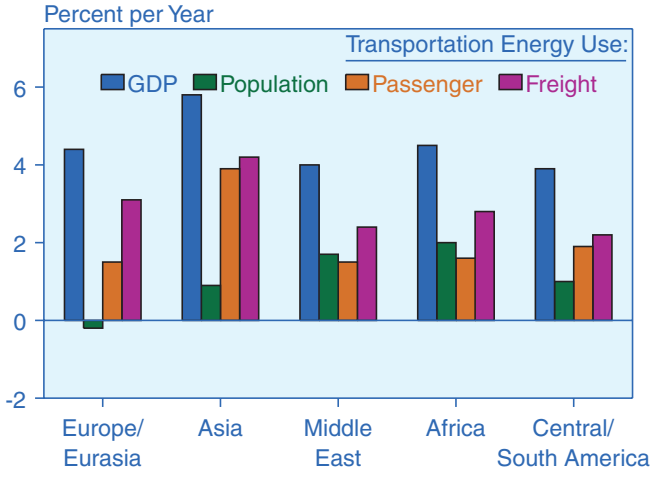
South Korea is the fastest-growing economy in the region, and its transportation energy use is projected to grow by 1.9 percent per year in the *IEO2008* reference case. The country has the region's strongest projected GDP growth, averaging 3.5 percent per year from 2005 to 2030, and its transportation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

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

Non-OECD Countries

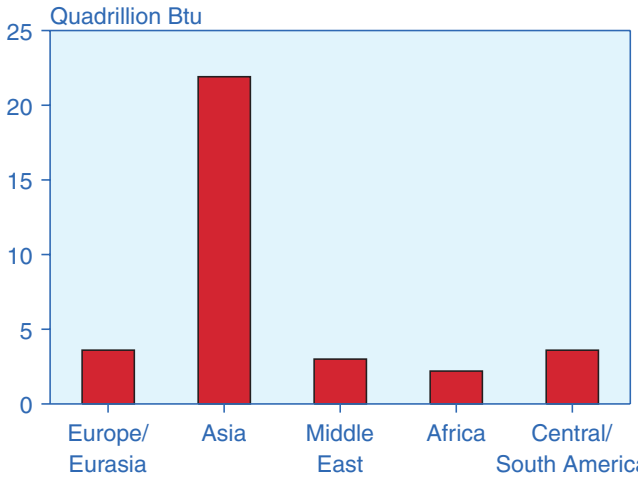
The projected average growth rate of transportation energy use in the non-OECD countries from 2005 to 2030, at 3.0 percent per year, is more than quadruple the projected rate for OECD countries, and their use of liquids in the transportation sector is expected to double over the period. Transportation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

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



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

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



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

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

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

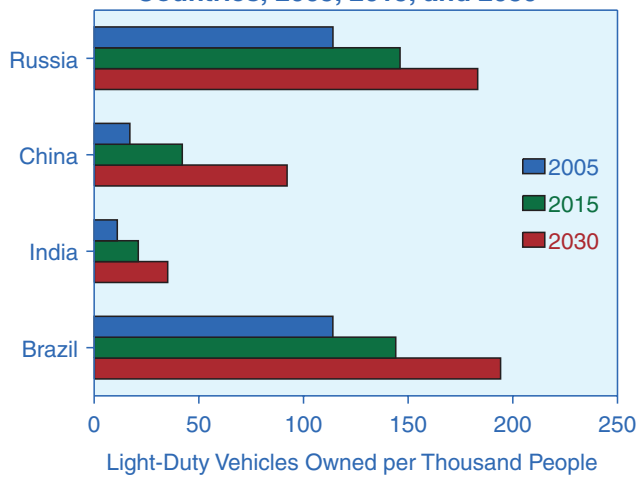
Both China and India have become major vehicle manufacturers. In 2006, China produced nearly 7.2 million motor vehicles, the third-highest production level in the world after Japan and the United States and more than one-tenth of the world's total production [***11***]. In 2007, motor vehicle production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

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

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

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

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



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

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

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

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

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

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

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

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

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

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

References

1. D.H. Straszheim, "Commentary: Why, In China, Gas Is $2.49 A Gallon," *Forbes Magazine* (May 28, 2008), web site www.forbes.com.
2. Statement of Guy Caruso, Administrator, Energy Information Administration, before the U.S. Senate Committee on Energy and Natural Resources (March 4, 2008), pp. 4-5.
3. National Energy Board of Canada, *Canada's Energy Future: Reference Case and Scenarios to 2030*, (Calgary, Alberta, November 2007), pp. 20-21.
4. "Government Notices: Department of the Environment," *Canada Gazette*, Vol. 140, No. 52 (December 30, 2006), web site www.canadagazette.gc.ca.
5. Ontario Ministry of Agriculture, Food and Rural Affairs, *Ontario Growth Fund Round Two: Invitation to Proponents* (Guelph, Ontario, July 23, 2007), p. 2; and email correspondence from Ken Newel, National Energy Board Canada (April 4, 2008).
6. R. Speer, "BC Leads the Nation with New 5% Biodiesel Target," Canadian Renewable Fuels Association, Press Release (April 1, 2008), web site www.marketwire.com.
7. Global Insight, Inc., "Canada: Ontario To Introduce C$520 Mil. in Ethanol Subsidies Over 10 Years" (June 17, 2005), web site www.globalinsight.com (subscription site).
8. Manitoba Science, Technology, Energy and Mines; "Manitoba's Ethanol Sales Mandate," web site www.gov.mb.ca/stem/energy/ethanol/index.html.
9. R. Steenblik, "Independent Québec: Backing Away from Corn Ethanol" (November 13, 2007), web site http://gristmill.grist.org/story/2007/11/13/102057/43.
10. National Bureau of Statistics of China, web site www.stats.gov.cn/tjsj/ndsj/2006/html/P1609E.xls.
11. L.H. Teslik, "China's Motor Vehicle and Aerospace Industries," Backgrounder, Council on Foreign Relations (October 8, 2007), web site www.cfr.org/publication/14399/chinas_motor_vehicle_and_aerospace_industries.html.
12. International Organization of Motor Vehicle Manufacturers, "2007 Production Statistics," web site http://oica.net/2007-production-statistics/ (2007).
13. International Organization of Motor Vehicle Manufacturers, "Production Statistics" (1998-2007), web site http://oica.net/category/production-statistics/.
14. D. Fortson, "Indian Tiger Swallows Britain's Jaguar," *The New Zealand Harold* (March 28, 2008), web site www.nzherald.co.nz/section/3/story.cfm?c_id=3&objectid=10500549.
15. S. Chatterjee, "Honda Bullish on Indian Market, Ramps Up Production, Dealer Network," *International Business Times* (February 26, 2008), web site http://in.ibtimes.com/articles/20080226/honda-motor-jazz-civic-hybrid-accord_2.htm.
16. J. Reers, "The Russian Auto Landscape," *Automotive Design and Production* (May 2006), web site www.autofieldguide.com/columns/0506strat.html.
17. International Energy Agency Data Services, *Energy Balances of Non-OECD Countries* (2007), web site http://data.iea.org (subscription site).
18. M. Markey, "Topic Report: Oil Consumption Growth in the Middle East" (December 17, 2007), Apache Corporation, web site www.apachecorp.com/explore/explore_features/browse_archives/View_Article/?docdoc=662.
19. R. Kirk, "Explosive Oil Consumption Growth in the Top Oil Exporting States," *Energy Bulletin* (July 25, 2006), web site www.energybulletin.net/node/18475.
20. T. Rideg, "Brazil Auto Boom: Can Supply Keep Pace?" *Latin Business Chronicle*, (August 13, 2007), web site www.latinbusinesschronicle.com/app/article.aspx?id=1537.
21. "GM and Renault Doing Well in Brazil. Car Industry Hits Record Sales," *Brazzil Magazine* (February 8, 2008), web site www.brazzilmag.com/content/view/9114/54/; and "Brazil's 2006 Vehicle Sales Top 1.9 Million in 2006," *Global Refining & Fuels Report*, Vol. 11, No. 1 (January 3, 2007), web site www.worldfuels.com (subscription site).
22. P. Nastari, "The Brazilian Fuel Ethanol Experience," in *Ethanol in the 21st Century: New Sources, New Uses* (Sacramento, CA, April 1998).
23. W. Lemos, "Flex-fuels Pump Up Ethanol," *ICIS News* (November 12, 2007), web site www.icis.com (subscription site).
24. W. Lemos, "Flex-fuels Pump up Ethanol" *ICIS News* (November 12, 2007); and "Brazil Flexible-fuel Vehicles Surpass 5m Units," *ICIS News* (April 8, 2008), web site www.icis.com (subscription site).
25. Global Insight, Inc., "Brazil Launches New Biodiesel Auctions" (November 14, 2007), web site www.globalinsight.com (subscription site).