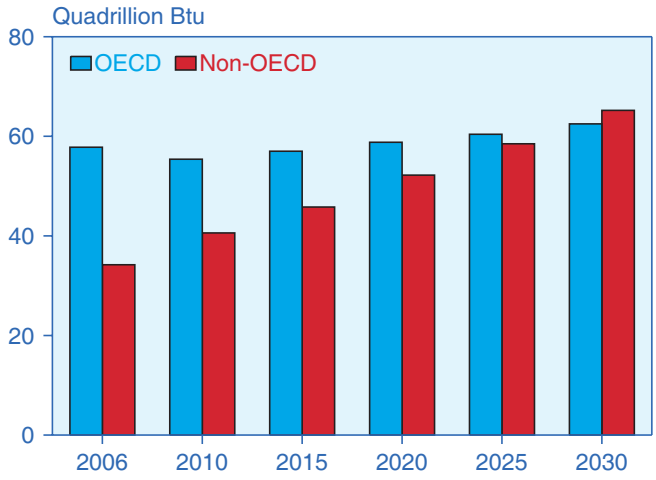
Chapter 7
Transportation Sector Energy Consumption

In the IEO2009 reference case, transportation energy use in the non-OECD countries increases by an average of 2.7 percent per year from 2006 to 2030, as compared with an average of 0.3 percent per year for the OECD countries.

Over the next 25 years, world demand for liquids fuels is projected to increase more rapidly in the transportation sector than in any other end-use sector. In the *IEO2009* reference case, the transportation share of total liquids consumption increases from 51 percent in 2006 to 56 percent in 2030. Over the 2006-2030 period, transportation accounts for nearly 80 percent of the total increase in world liquids consumption. Much of the growth in transportation energy use is projected for the non-OECD nations. Many rapidly expanding non-OECD economies are expected to see strong growth in energy consumption as transportation systems are modernized and income per capita increases the demand for personal motor vehicle ownership. Non-OECD transportation energy use increases by an average of 2.7 percent per year from 2006 to 2030, as compared with an average of 0.3 percent per year for transportation energy consumption in the OECD countries, where transportation systems are generally well established (Figure 69 and Table 13).

In the transportation sector, energy 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 patterns in

Figure 69. OECD and Non-OECD Transportation Sector Liquids Consumption, 2006-2030



Sources: **2006:** Derived from Energy Information Administration (EIA), *International Energy Annual 2006* (June-December 2008), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2009).

Table 13. World Energy Consumption for Transportation by Country Grouping, 2006-2030
(Quadrillion Btu)

Region	2006	2010	2015	2020	2025	2030	Average Annual Percent Change, 2006-2030
OECD	**57.8**	**55.4**	**57.0**	**58.8**	**60.4**	**62.5**	**0.3**
North America	32.6	31.8	32.8	33.6	35.0	36.9	0.5
Europe	17.8	16.5	16.7	17.4	17.5	17.6	0.0
Asia	7.4	7.1	7.5	7.8	7.9	8.0	0.3
Non-OECD	**34.2**	**40.6**	**45.8**	**52.2**	**58.5**	**65.2**	**2.7**
Europe and Eurasia	6.8	7.7	8.1	8.5	8.7	9.0	1.2
Asia	13.0	15.8	19.6	24.4	28.8	33.2	4.0
Middle East	5.0	6.0	6.6	7.2	7.9	8.9	2.4
Africa	3.3	3.8	4.0	4.2	4.5	4.7	1.5
Central and South America	6.0	7.3	7.5	7.9	8.6	9.4	1.9
Total World	**91.9**	**96.0**	**102.8**	**111.0**	**118.9**	**127.7**	**1.4**

Note: Totals may not equal sum of components due to independent rounding.
Sources: **2006:** Derived from Energy Information Administration (EIA), *International Energy Annual 2006* (June-December 2008), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2009).

transportation energy demand is important, because distances traveled and modes used to attain access in the future may differ from historical trends.

Because access to people, goods, and services (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 profound effects on the amount of energy consumed. For example, advances in communication technologies have made it possible for consumers to have a high degree 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.[37]

The difference between mobility and access is particularly important for the analysis of transportation systems in today's rapidly developing and urbanizing economies. Transportation equipment provides no services without roads, rail lines, ports, and airports. Such infrastructure is expensive to build and maintain, and infrastructure decisions made in the near term affect energy use (and greenhouse gas emissions) in the future. Where urban rail systems are built, they affect modes of travel to and from workplaces for many years to come.

Development that proceeds without a plan may result in the need to construct infrastructure in "catch-up mode," with developers continually addressing existing congestion problems rather than shaping transportation demand patterns. Suburban sprawl in one generation limits economical transportation choices in the future. In particular, in the developing non-OECD regions where urbanization is still in early stages and much of the urban transportation infrastructure has not yet been built, transportation energy needs over the long-term future will be affected substantially by policy decisions made in the coming decades.

In many non-OECD countries, walking and bicycling play important roles in personal transport, and handcarts and draft animals are widely used in commerce. Given its large base level in those countries, small declines in the nonmotorized share of the transportation activity translate into very large growth rates for motorized travel. Uncertainty about the future role of nonmotorized transport in the world's emerging economies introduces additional uncertainty to the *IEO2009* projections, as does uncertainty about the form and pace of urbanization. For example, will rapid urbanization in developing Asia follow the U.S. pattern of ring roads surrounding central cities, or will mixed land-use patterns and more compact cities be emphasized as a matter of policy?

Another uncertainty in non-OECD nations, where buses now account for a major share of motorized passenger transport, is whether attractive and affordable bus systems will be developed to maintain heavy ridership or personal automobiles will replace buses for most trips. The answers to such questions will shape future transportation energy consumption, and the answers are highly uncertain. Further, the outlook does not incorporate any changes in transportation energy use that might occur as a result of future legislation or policies aimed at reducing greenhouse gas emissions, which could also substantially alter the projections.

The *IEO2009* reference case assumes that, as personal income grows in the developing non-OECD nations, demand for personal motor vehicles will grow, and 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) and urban design that reduces vehicle miles traveled, among other improvements to transportation networks. 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 3.6 percent per year from 2006 to 2030, while energy use for public passenger travel (rail and bus) also increases by a robust 2.8 percent per year.

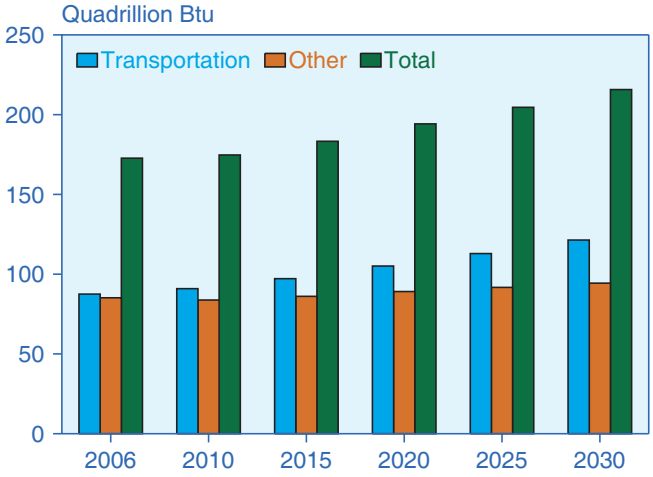
Projected world oil prices in the *IEO2009* reference case are significantly higher than projected in last year's outlook. In *IEO2009*, oil prices are 80 percent higher in 2030 than projected in *IEO2008*. As a result, consumers in end-use sectors other than transportation (notably, the electric power 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 1.4 percent per year on average from 2006 to 2030—only 0.2 percentage points below the average increase in the *IEO2008* reference case.

In the *IEO2009* projections, the transportation sector continues to rely heavily on liquid fuels to meet demand for travel. Total world liquids consumption increases by 25 percent from 2006 to 2030 (Figure 70). Given the world oil price environment projected in the reference case, economic incentives will prompt consumers to find substitutes for liquid fuels. In the OECD nations, liquids

[37] Commerce conducted via the Internet ("e-commerce") may also reduce the number of consumer shopping trips; however, because getting the product to individual consumers' residences quickly via delivery vans is a fuel-intensive process, it is unclear whether consumption of transportation fuels would decline as a result.

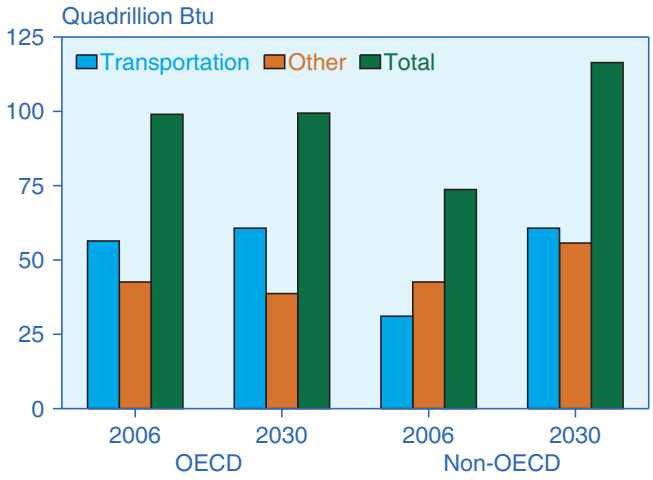
consumption outside the transportation sector is projected to decline (Figure 71), especially in the electric power sector, where the use of petroleum products declines by 1.3 percent per year from 2006 to 2030. In the non-OECD nations, the transportation sector accounts for 69 percent of the projected increase in liquids consumption, with liquids used for feedstock in the chemical industry accounting for most of the rest. Worldwide, the non-OECD nations are expected to account for 87 percent of the total increase in transportation energy use.

Figure 70. World Liquids Consumption by End-Use Sector, 2006-2030



Sources: **2006:** Derived from Energy Information Administration (EIA), *International Energy Annual 2006* (June-December 2008), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2009).

Figure 71. OECD and Non-OECD Liquids Consumption by End-Use Sector, 2006 and 2030



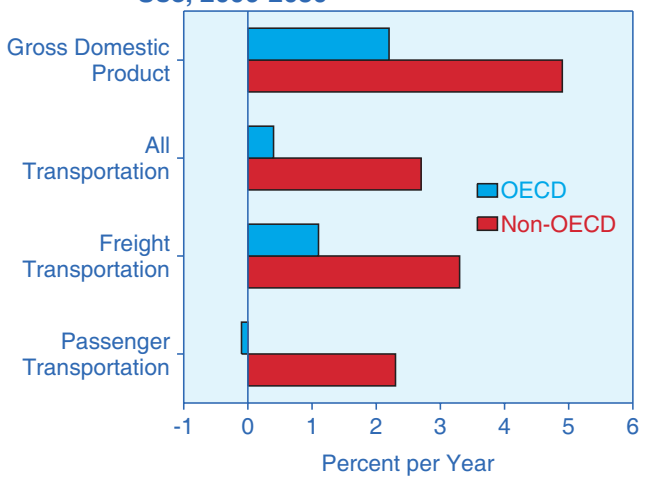
Sources: **2006:** Derived from Energy Information Administration (EIA), *International Energy Annual 2006* (June-December 2008), web site www.eia.doe.gov/iea. **2030:** EIA, World Energy Projections Plus (2009).

Growing demand for transportation services in the non-OECD countries is the most important factor affecting the projections for world liquids consumption. In 2006, the OECD nations consumed 81 percent more liquid fuels for transportation than the non-OECD nations. In 2030, however, the totals for OECD and non-OECD liquids consumption for transportation are approximately equal at 61 quadrillion Btu. For the OECD countries, the transportation share of total liquids consumption increases from 57 percent in 2006 to 61 percent in 2030. For the non-OECD countries, the transportation share of total liquids consumption increases from 42 percent in 2006 to 52 percent in 2030.

Growth in fuel consumption to move both freight and people is correlated with economic growth (as measured by GDP) in both 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 2006 to 2030, the rate of increase in total transportation energy consumption is 15 percent of the projected GDP growth rate in the OECD countries, compared with 55 percent in the non-OECD countries (Figure 72).

In the non-OECD nations, transportation energy services need to be considered within the broader context of economic and social development. 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

Figure 72. Average Annual Growth in OECD and Non-OECD Gross Domestic Product and Transportation Sector Delivered Energy Use, 2006-2030



Sources: **2006:** Derived from Energy Information Administration (EIA), *International Energy Annual 2006* (June-December 2008), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2009).

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.[38] Passenger transportation energy use includes fuels used in light-duty vehicles, buses, aircraft, and passenger trains. In 2006, about two-thirds of transportation energy use in the OECD countries was for passenger travel; that share declines slightly from 2006 to 2030. For the non-OECD nations, passenger travel accounted for 56 percent of total transportation energy use in 2006, and the share falls to 51 percent in 2030. Although energy consumption for passenger transportation grows by 2.4 percent per year in the non-OECD countries and declines by 0.1 percent per year in the OECD countries, passenger-related energy use in the developing world remains far below levels in the OECD on a per capita basis.

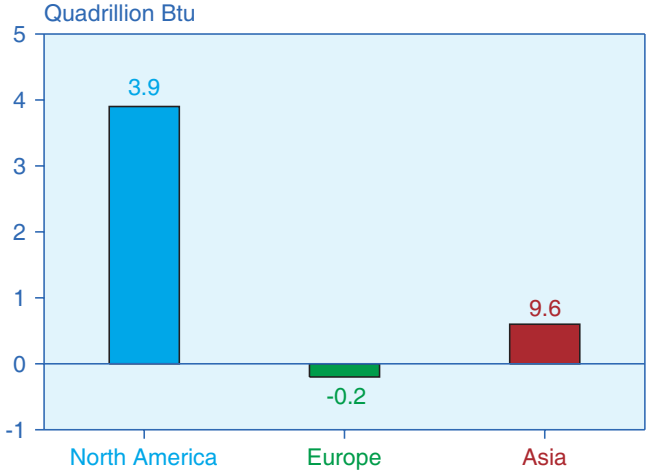
OECD Countries

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 high, probably will reach saturation over the course of the projection period. 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 2006 to 2030. It is projected to grow at an average annual rate of 0.3 percent in the *IEO2009* reference case, from 57.8 quadrillion Btu in 2006 to 62.5 quadrillion Btu in 2030 (see Figure 71). The projection assumes that infrastructure developments in the OECD nations represent incremental changes to existing transport systems.

North America accounts for 92 percent of the increase in OECD liquids consumption for transportation in the reference case (Figure 73), and the United States accounts for 79 percent of that increase (even though the rate of increase in U.S. transportation liquids use is less than one-half the corresponding rate for Mexico). U.S. delivered energy consumption in the transportation sector grows from 28.6 quadrillion Btu in 2006 to 31.9 quadrillion Btu in 2030. In 2030, U.S. transportation energy demand is about 1.1 quadrillion Btu lower than the amount projected in last year's outlook,[39] largely because of higher energy prices and a revision in the way the Energy Independence and Security Act 2007 (EISA2007) corporate average fuel economy (CAFE) standards are handled. EISA2007 includes provisions for improving the CAFE standards applicable to new light-duty vehicles (both cars and light trucks). To meet the mandated fuel economy levels, sales of unconventional vehicle technologies[40]—such as flex-fuel, hybrid, and diesel vehicles—increase over the projection period, and the growth of new light truck sales slows.

In 2008, U.S. Public Law 110-343, the Energy Improvement and Extension Act of 2008 (EIEA2008) was enacted. EIEA2008 Title II, Section 205, provides a tax credit for the purchase of new, qualified plug-in electric drive motor vehicles.[41] According to the legislation,

Figure 73. Change in OECD Transportation Sector Liquids Consumption by Region, 2006-2030



Sources: **2006:** Derived from Energy Information Administration (EIA), *International Energy Annual 2006* (June-December 2008), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2009).

[38] In the *IEO2009* projections, fuel use in dedicated freight aircraft is included with fuel use in passenger aircraft.

[39] Primarily as a result of lower projected industrial output, U.S. energy demand for freight transportation is 0.8 quadrillion Btu lower in the *updated AEO2009* reference case (April 2009) than in the *published AEO2009* reference case projection (March 2009) discussed in this report.

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

[41] The *updated AEO2009* reference case (April 2009) incorporates ARRA2009 modifications to the plug-in hybrid electric vehicle tax credits that increase the number of vehicles covered to 200,000 per manufacturer and also eliminate the tax credit's expiration on December 31, 2014. In addition, the *updated* reference case includes the ARRA tax credit of 10 percent against the cost of a qualified plug-in all-electric vehicle.

beginning two calendar quarters after the first quarter in which the cumulative number of qualified plug-in electric vehicles sold reaches 250,000, the credit will be reduced by 50 percent in the first two calendar quarters of the phaseout period and by another 25 percent in the third and fourth calendar quarters. The credit is scheduled to be eliminated after December 31, 2014, regardless of how many qualifying vehicles have been sold. In the *IEO2009* reference case, plug-in hybrid electric vehicle sales grow quickly as a result of the tax credits, rising to 90,000 annually in 2014. In 2030, plug-in hybrid electric vehicles account for 2 percent of all sales of new light-duty vehicles in the United States [***1***]. Overall, hybrid vehicle sales increase from 2 percent of new light-duty vehicles in 2007 to 38 percent in 2030.

The *updated AEO2009* reference case (April 2009), incorporates ARRA2009 modifications to the U.S. tax credits for plug-in hybrid electric vehicles, which increase the number of vehicles covered to 200,000 per manufacturer and eliminate the tax credit's expiration on December 31, 2014. In addition, the *updated* reference case includes the ARRA2009 tax credit of 10 percent against the cost of a qualified plug-in all-electric vehicle. ARRA2009 also contains several changes to the plug-in hybrid electric vehicle tax credit originally included in EIEA2008, and those changes also are included in the *updated AEO2009* reference case.

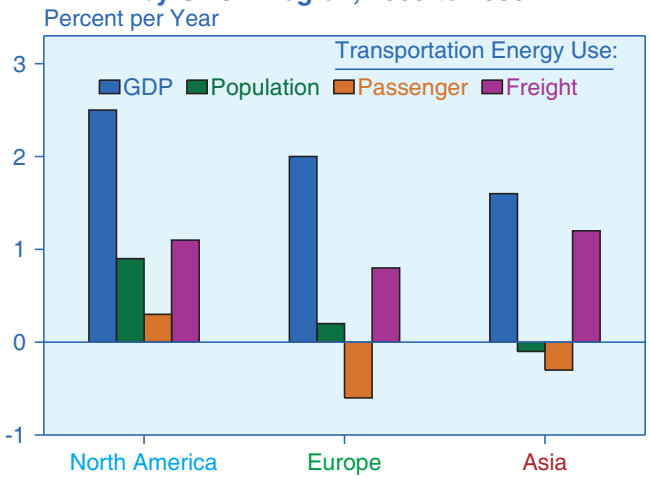
For plug-in hybrid electric vehicles, ARRA2009 allows a $2,500 tax credit for the purchase of qualified vehicles with a battery capacity of at least 4 kilowatthours. Starting at a battery capacity of 5 kilowatthours, plug-in hybrids earn an additional battery credit of $417 per kilowatthour, up to a maximum of $5,000. The maximum total hybrid vehicle credit that can be earned is capped at $7,500 per vehicle. Tax credit eligibility and phaseout are specific to the individual vehicle manufacturers. The credits are phased out when cumulative sales of qualified vehicles reach 200,000 vehicles. The phaseout period begins two calendar quarters after the first date later than December 31, 2009, on which a manufacturer's sales reach the cumulative sales maximum. The credit is reduced to 50 percent of the total value for the first two calendar quarters of the phaseout period and then to 25 percent for the third and forth calendar quarters, before being eliminated entirely thereafter. The credit applies to plug-in hybrid vehicles with gross vehicle weight rating less than 14,000 pounds. The ARRA2009 tax credit for qualified plug-in all-electric vehicles with a battery capacity of at least 4 kilowatthours is subject to the same phaseout schedule as the credits for plug-in hybrid electric vehicles.

Canada's current mix of transportation energy use is similar to that in the United States (personal motor vehicles are fueled largely by motor gasoline rather than diesel or alternative fuels), and it is projected to remain so in the *IEO2009* 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 2006 to 2030 [***2***].

In Mexico, relatively strong GDP growth (3.4 percent per year) is projected to increase energy consumption in the transportation sector at an average rate of 1.0 percent per year, from 1.5 quadrillion Btu in 2006 to 2.0 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 *IEO2009* reference case. OECD Europe's population increases by 0.2 percent per year; the countries of the region already have mature transportation systems; and improvements in energy efficiency over the course of the projection result in passenger transportation energy use that declines by an average of 0.6 percent per year from 2006 to 2030 (Figure 74). Despite the slow growth projected for OECD Europe's population, economic growth continues at an average rate of 2.0 percent per year, and energy use for freight transportation grows by an average of 0.8 percent per year. The growth in fuel use

Figure 74. Average Annual Change in Gross Domestic Product, Population, and Energy Consumption for Transportation by OECD Region, 2006 to 2030



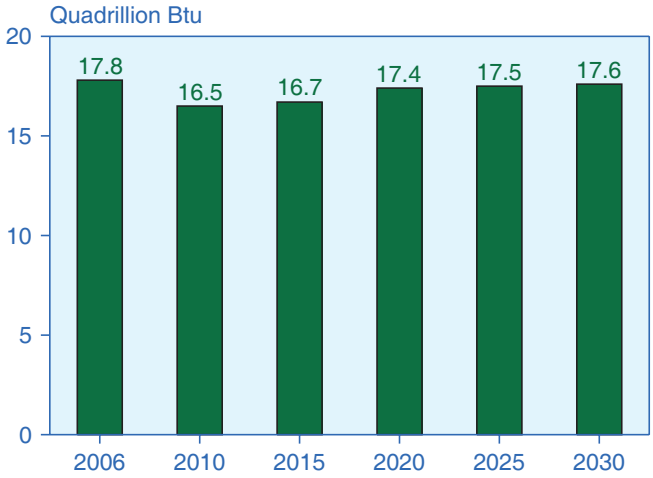
Sources: **2006:** Derived from Energy Information Administration (EIA), *International Energy Annual 2006* (June-December 2008), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2009).

to move freight outweighs the decline in fuel use for passenger transport over the projection period.

OECD Europe's transportation energy consumption contracts strongly in the short term, as a result of the runup in world oil prices from 2004 to mid-2008 and the present global recession. In the reference case, OECD Europe's transportation energy use falls from 17.8 quadrillion Btu in 2006 to 16.5 quadrillion Btu in 2010, then rises slowly to 17.6 quadrillion Btu in 2030, as the region's economies recover in the long term (Figure 75). The transportation share of total delivered energy use in OECD Europe falls slightly, from 29 percent in 2006 to 28 percent in 2010, and remains at that level for the rest of the projection.

With increasing concerns about the impacts of freight road transport on pollution and congestion, the European Union (EU) has introduced a program to shift the modal shares of freight transport. The EU's Marco Polo program provides funding to commercial projects that result in a reduction in freight road transport by shifting it to "rail, sea, and inland waterways."[42] As part of the program, a subsidy of 2 euros per metric ton-kilometer is offered for freight shifted from road to one of the alternative transportation modes. The stated goal of the program is to reduce congestion and pollution and to allow for the "more reliable and efficient transport of goods." Marco Polo began in 2007, and 450 million Euros have been committed for the period through 2013 to fund mode-switching projects.

Figure 75. Energy Consumption for Transportation in OECD Europe, 2006-2030



Sources: **2006:** Derived from Energy Information Administration (EIA), *International Energy Annual 2006* (June-December 2008), web site www.eia.doe.gov/iea. **2030:** EIA, World Energy Projections Plus (2009).

OECD Asia, like OECD Europe, generally has well-established transportation infrastructures; however, with population in the region as a whole projected to contract (averaging -0.1 percent per year from 2006 to 2030), a decline in passenger transport demand is expected. The region's passenger transportation energy use declines by about 0.3 percent per year from 2006 to 2030 in the *IEO2009* reference case (see Figure 74). In the near term, the global economic recession has a strong dampening affect on transportation sector energy use, as manufacturing and consumer demand for goods and services slows substantially. Total demand for transportation fuels in OECD Asia declines from 7.4 quadrillion Btu in 2006 to 7.1 quadrillion Btu in 2010, then increases slowly to 8.0 quadrillion Btu in 2030. The largest increases are expected in South Korea, Australia, and New Zealand.

In Japan, transportation energy use declines by 0.3 percent per year on average, as the population declines by a total of 7.5 percent (10 million people) from 2006 to 2030. As a result, energy use in the country's passenger transportation sector in 2030 is projected to be 9 percent below the 2006 level. Although Japan's GDP growth averages 0.8 percent per year, its energy use for freight transportation increases on average by only 0.4 percent per year.

In South Korea, transportation energy use is projected to grow by 0.7 percent per year in the *IEO2009* reference case. The country has the region's strongest projected GDP growth, averaging 3.3 percent per year from 2006 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 26 percent in 2006 to 29 percent in 2030. Energy use for freight transportation in South Korea is projected to increase by an average of 1.7 percent per year, and its share of OECD Asia's total energy use for freight movement increases from 29 percent in 2006 to 34 percent in 2030, reflecting an increase in its share of OECD Asia's total GDP from 16 percent to 23 percent.

In Australia/New Zealand, transportation energy use is projected to grow by average of 1.2 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 *IEO2009* reference case, rising from 0.5 quadrillion Btu in 2006 to 0.8 quadrillion Btu in 2030, at an average annual rate of 2.3 percent. Air travel

[42] Under the Director General for Energy and Transport of the European Commission, 450 million euros has been committed to the Marco Polo project for 2007-2013.

also is 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 demand for business and vacation travel. Passenger air travel in Australia/New Zealand increases by 3.5 percent per year over the projection period, from 79 billion passenger miles traveled in 2006 to 181 billion passenger miles traveled in 2030.

Non-OECD Countries

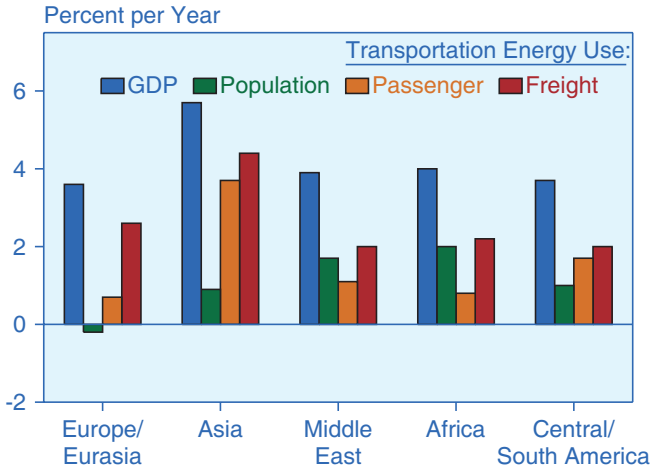
The projected average growth rate for transportation energy use in the non-OECD countries from 2006 to 2030, at 2.7 percent per year, is 8 times higher than the projected rate for OECD countries, and the use of liquids in the non-OECD transportation sector as a whole nearly doubles over the period. In non-OECD Asia, transportation energy consumption for both passenger and freight transportation increases more rapidly than in the other non-OECD countries (Figure 76). In total, China, India, and the other developing countries of non-OECD Asia are expected to sustain high rates of economic growth over the forecast, accounting for almost one-half of the increase in world GDP from 2006 to 2030. In 2030 they represent 37 percent of the world economy, up from 22 percent in 2006. Over the same period, non-OECD Asia's share of world transportation liquids consumption increases from 14 percent to 27 percent (Figure 77).

China has been, and is projected to continue to be, the fastest-growing economy among non-OECD countries. From 2006 to 2030, China's GDP increases by an average of 6.4 percent per year in the reference case projection, and its use of transportation fuels increases by 4.8 percent per year for passenger and 5.2 percent per year for freight transportation. From 1996 to 2006, growth in the combined length of China's highways averaged 11.3 percent per year, and GDP expanded by an annual average of 9.3 percent [*3*]. Over the same period, passenger miles traveled and ton-miles of highway freight travel increased at annual rates of 7.5 and 6.9 percent, respectively. India, similarly, has been expanding its road infrastructure to keep pace with economic growth.

China's passenger transportation energy use per capita is projected to triple over the projection period, and India's is projected to double. Nevertheless, China's energy consumption per capita for passenger transportation in 2030 still is only about one-fourth of South Korea's, and India's is less than one-tenth of South Korea's (Figure 78). In part, this is because of the importance of nonmotorized transport—including handcarts and bicycles—in China and India. It is also explained in part by the differences between rural and urban population shares in China and India and in South Korea.

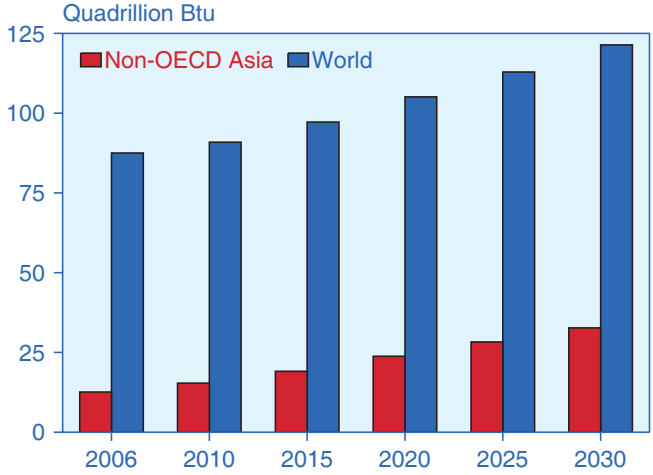
In 2007, according to the United Nations, 42 percent of China's population and only 29 percent of India's population were considered urban [*4*]. In contrast, 81 percent of South Korea's total population is urban. The urban share of total population is expected to increase in both China and India, but even in 2025 the United Nations expects China's urban share of population to be only 57 percent and India's only 37 percent. As a result, even with the fast-paced economic growth projected for China and India in the *IEO2009* reference case, their levels of transportation energy use per capita in 2030 do not reach the corresponding level in substantially more urban South Korea.

Figure 76. Average Annual Change in Gross Domestic Product, Population, and Energy Consumption for Transportation by Non-OECD Region, 2006 to 2030



Sources: **2006:** Derived from Energy Information Administration (EIA), *International Energy Annual 2006* (June-December 2008), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2009).

Figure 77. Non-OECD Asia and World Transportation Sector Liquids Consumption, 2006-2030



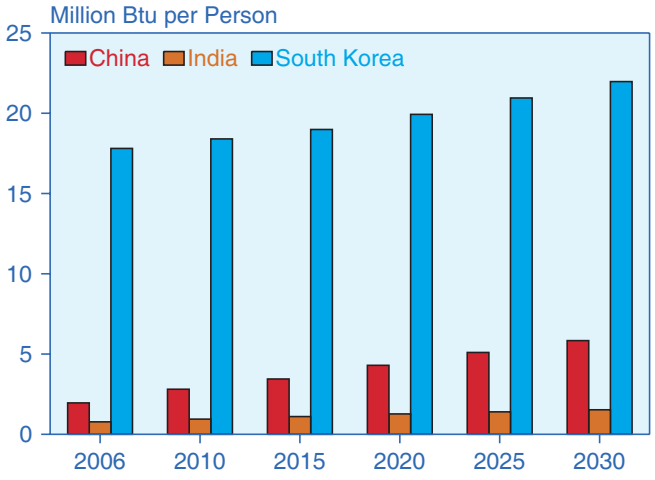
Sources: **2006:** Derived from Energy Information Administration (EIA), *International Energy Annual 2006* (June-December 2008), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2009).

Both China and India have become major vehicle markets. In fact, China became the world's second-largest vehicle market after the United States in 2006, when sales exceeded those in Japan [*5*]. In 2007, China produced nearly 8.9 million motor vehicles, an increase of 22 percent over production in 2006. The country became the third-largest vehicle producer in the world after Japan and the United States and accounted for more than one-tenth of the world's total motor vehicle production [*6*]. The recent economic downturn reduced the growth in China's vehicle sales to less than 7 percent in 2008, the first time since 1999 that annual growth in sales had fallen below 10 percent [*7*].

A further reduction in vehicle sales growth is expected for China in 2009. The Chinese government is trying to shore up sales, however, with a 50-percent cut, as of January 20, 2009, in the car purchase tax on low-emission vehicles with engines under 1.6 liters—from 10 percent to 5 percent of the vehicle purchase price [*8*]. Several domestic manufacturers of eligible cars, including Chery, Geely, and BYD, posted record high sales in the month after the incentive was announced; however, it is unclear how long the trend will last, given the country's slowing economic growth. The sales incentive is scheduled to end on December 31, 2009.

In addition, China's government announced plans for an economic stimulus package valued at 4 trillion Yuan (about $585 billion U.S. dollars), as the global economic situation worsened. Of the total package, 1.8 trillion Yuan is expected to be used for infrastructure improvements in the electric power and transportation sectors, including construction of new railways, subways, and airports in the southwestern part of the country, where an earthquake caused extensive damage in May 2008 [*9*].

Figure 78. Energy Consumption for Passenger Transportation per Capita in China, India, and South Korea, 2006-2030



Sources: **2006:** Derived from Energy Information Administration (EIA), *International Energy Annual 2006* (June-December 2008), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2009).

India's motor vehicle sales also have been affected by the global economic difficulties. In 2008, car sales through October were only 5.6 percent higher than in 2007—the slowest monthly growth since July 2005 [*10*]. Difficulties for consumers trying to obtain financing—because of both high borrowing costs and more difficult loan conditions stemming from the global economic crisis—make the growth in India's car sales will remain relatively weak in the near term. As in China, concerns about the drop in Indian car sales have prompted the national government to offer incentives to support sales by reducing the value-added tax on vehicle purchases and reducing motor fuel costs by 10 percent in December [*11*].

India's automobile producers manufactured 2.3 million vehicles in 2007, making it the world's tenth-largest motor vehicle producer [*12*]. The Indian automotive industry is a fairly important component of the country's economy, accounting for about 5 percent of its total GDP. India's motor vehicle manufacturers aspire to improve their penetration of the world's automotive sector. 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, although clearly the worsening economic climate may delay the achievement of such a target [*13*].

The *IEO2009* reference case projection assumes robust growth in travel for both personal (cars and 2- and 3-wheel vehicles) and public (bus and rail) land transport modes in non-OECD Asia. In China, for instance, while passenger travel (annual passenger miles) in personal vehicles grows at an average of 5.0 percent from 2006 to 2030, public vehicle travel also increases by 3.3 percent per year. Total passenger travel using public vehicles more than doubles over the projection period. 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 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, and motorcycles will continue to replace bicycles.

Figure 79 compares travel shares of personal and public vehicles for passenger land travel in non-OECD Asia (China, India, and other non-OECD Asia) and OECD Asia (Japan, South Korea, and Australia/New Zealand). The public vehicle share of passenger land travel declines modestly in both OECD Asia and non-OECD Asia in the *IEO2009* reference case. In OECD Asia, the decline is from 32 percent to 28 percent and in non-OECD Asia the decline is from 66 percent to 59 percent between 2006

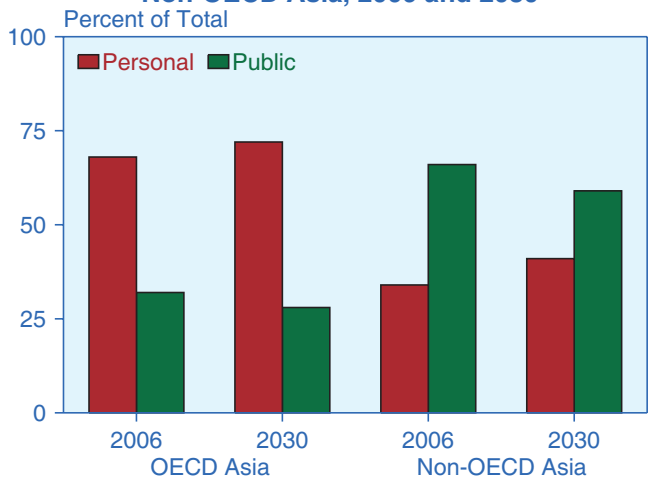
and 2030. Thus, reliance on public transport in 2030 in non-OECD Asia is still twice the level in OECD Asia.

Differences in the way in which passenger services are provided help explain the large disparity in passenger transportation energy use per capita shown in Figure 78. The reference case projects substantial increases in travel by both public and personal modes over the next two decades; however, small differences from the projected modal shares in 2030 would have large impacts on the projected levels of energy use. If China's transportation system developed in a manner similar to South Korea's, significantly more energy would be required for passenger travel in China in 2030.

Russia is another non-OECD country in which the transportation sector has been growing rapidly over the past several years, as higher energy prices (Russia is a net exporter of oil and natural gas) have bolstered the economy and spurred robust growth in car sales. Motor vehicle sales in Russia increased by 29 percent from 2006 to 2007, and total sales reached 3.2 billion in 2008 [***14***]. Not surprisingly, because of the collapse of commodity prices in late 2008 and the global economic downturn, the outlook for Russia's personal automobile sales in 2009 is fairly pessimistic. Some analysts are projecting a decline in sales by as much as 25 to 50 percent this year.

In the *IEO2009* reference case, Russia's energy consumption for passenger transportation declines at an average rate of 0.8 percent per year from 2006 to 2030, while the Russian population declines by an average of 0.6 percent per year (for a total population reduction of 19 million).

Figure 79. Personal and Public Transportation Shares of Total Passenger Miles Traveled in OECD Asia and Non-OECD Asia, 2006 and 2030



Sources: **2006:** Derived from Energy Information Administration (EIA), *International Energy Annual 2006* (June-December 2008), web site www.eia.doe.gov/iea. **2030:** EIA, World Energy Projections Plus (2009).

Thus, passenger energy use per capita is projected to decrease by an average of 0.2 percent per year.

The population in the rest of non-OECD Europe and Eurasia is expected to be virtually unchanged between 2006 and 2030, while energy consumption for passenger transportation per capita is projected to increase at a yearly rate of 1.1 percent, compared with 3.7-percent annual growth in income per capita. Based on economic growth averaging 3.7 percent per year in non-OECD Europe and Eurasia (excluding Russia), energy use for freight transportation is projected to grow by an average of 2.8 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.

Energy consumption for transportation in the Middle East grows by an average of 2.4 percent per year from 2006 to 2030 in the reference case, to a total of 8.9 quadrillion Btu in 2030. 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 the Middle East, at a rate greatly exceeding the world average. From 2000 to 2006, the Middle East's total transportation energy use increased by an annual average of 5.5 percent, compared with the worldwide increase of 2.4 percent per year [***15***]. The region's oil and natural gas producers had some of the fastest growth in transportation energy demand from 2000 to 2006: 4.7 percent per year in Saudi Arabia; 6.9 percent per year in Iran; 7.7 percent per year in Kuwait; and an impressive 16.4 percent per year in Qatar.

Saudi Arabia, Kuwait, and Iran, among other Middle Eastern nations, have maintained transport subsidies for their citizens despite the persistent high world oil prices of the past few years, which has discouraged conservation or efficiency of use [***16***]. On the other hand, high world oil prices have increased revenues from oil exports in many of the exporting nations, and as a result several transportation infrastructure projects, including those for mass transit, are underway. For instance, the government in Saudi Arabia has launched a $624 billion investment program that will run through 2020, including $140 billion for transportation infrastructure.

There are plans to expand the Saudi rail system by adding 2,400 miles of new rail lines. Similar in geographic size to OECD Europe, Saudi Arabia currently has a rail network consisting of only one 283-mile passenger line between Riyadh and the port of Dammam and one 350-mile freight line between the two cities. One of the three new major railway projects is the East-West

railway project (also known as the "Saudi Land Bridge"), a 600-mile line that will link the capital Riyadh to the Red Sea port of Jeddah, and a 75-mile line from Dammam north along the Gulf coast to Jubail. The second project is the Mecca-Medina Rail Link, which will be a 315-mile high-speed passenger railway connecting Jeddah with the two holy cities [***17***]. A third rail project, the North-South Railway (NSR) already is under construction and should be completed by 2010 [***18***]. The NSR freight project consists of 1,400 miles of rail that will link northern Saudi Arabia with the Gulf coast and Riyadh.

Air travel infrastructure is also being expanded in several Middle Eastern countries. As countries in the region become increasingly prosperous, the demand for business and leisure air travel is expected to rise. In the United Arab Emirates, construction of the Dubai World Central International Airport is currently underway. It is set to become the world's largest airport and should be able to handle between 120 and 150 million passengers and 12 million metric tons of cargo annually. Construction of the first of six runways was completed in 2007, and the entire project is expected to be operational by 2015 [***19***]**.** In Qatar, the new Doha International Airport has been under construction since 2004, with the first phase scheduled for completion by the end of 2009, when it will be able to accommodate 24 million passengers annually [***20***]. Upon completion of the final phase in 2015, its capacity will have been expanded to 50 million passengers per year.

Transportation energy use in Central and South America is projected to increase by 1.9 percent per year from 2006 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 [***21***]. 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 [***22***]. In the *IEO2009* reference case, energy use by light-duty vehicles in Brazil increases by an average of 3.8 percent per year from 2006 to 2015, before slowing to 2.9 percent per year from 2015 to 2030.

In 1975, the Brazilian government launched its National Alcohol Program to increase the use of ethanol in the transportation fuel mix [***23***]. Subsequently, ethanol consumption in Brazil rose from 0.1 billion gallons in 1975 to 4.4 billion gallons in 2007 [***24***]. Its reliance on biofuels (and ethanol in particular) to fuel its transportation sector has focused attention on Brazil, as other nations of the world have begun to increase alternative fuel use in the face of sustained high world oil prices over recent years. Although the global economic downturn may affect the short-term growth potential of Brazilian biofuels, it is expected that, as world economies recover and oil prices again begin to rise, ethanol production will continue to expand, along with the country's biofuels-consuming automobile fleet, which may account for as much as one-half of the total fleet by 2013 [***25***].

Flexible-fuel vehicles (FFVs)[43] have become increasingly popular in Brazil. According to Brazil's vehicle manufacturers' association, Associação Nacional dos Fabricantes de Veículos Automotores (Anfavea), the number of FFVs sold each year in Brazil has increased strongly since their introduction in March 2003, from 49,000 in 2003 to 3 million in 2008 [***26***]. FFVs now account for nearly 86 percent of new automobile sales in Brazil.

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