CHAPTER 12

Transport

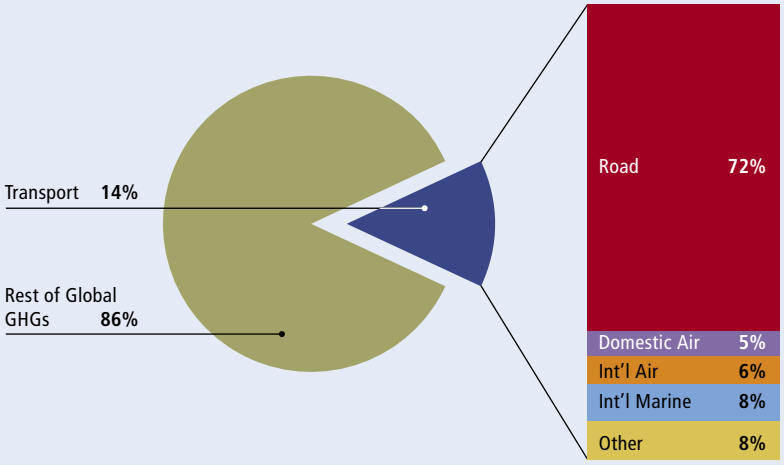
Emissions

Transport[104] accounts for about 14 percent of global GHG emissions, making it a major contributor to global climate change (Figure 12.1). This is equivalent to 18 percent of global CO_2 emissions and 24 percent of CO_2 emissions from energy-related sources. Within this sector, road transport, at 72 percent of the sector and 10 percent of global GHG emissions, accounts for the largest share. Aviation (domestic and international) amounts to about 12 percent of transport emissions, and 2 percent of overall GHGs.

With respect to energy sources, transport is dominated by oil, which amounts to 96 percent of energy supply and 97 percent of emissions (Figure 12.3). Gas accounts for about 3 percent, and biomass 0.5 percent (with 68 percent of biomass used in transport coming from one country, Brazil).

Figure 12.4 shows transport-related CO_2 emissions of the top emitting countries, in both absolute and per capita terms. Together, these countries account for 87 percent of global emissions from this sector, with the five largest emitters accounting for two-thirds of the global total. The United States far outranks all other countries, with 35 percent of global emissions, about twice the EU's total and seven times the emissions of the next highest country, Japan. The U.S., Australia, and Canada are prominent in their high per capita emissions. As with electricity, cross-country differences in transport emissions owe largely to wide variations in per capita consumption patterns, discussed in Chapter 7. The predominant mode of

Figure 12.1. GHGs from Transportation



Sources & Notes: IEA, 2004a. See Appendix 2.A for sources and Appendix 2.B for sector definition. Absolute emissions in this sector, estimated here for 2000, are 5,743 $MtCO_2$.

transport in China's urban areas, for instance, is public transit, cycling, and walking, whereas in the U.S. and Europe, automobiles are predominant.[105]

In some countries, transport is the fastest growing source of GHG emissions. From 1990 to 2002, transport-related emissions grew 20–25 percent in most industrialized countries, but much faster in many developing countries (Figure 12.5). The fastest growth was in South Korea, Indonesia, and China, where transport emissions doubled. Among major emitters, CO_2 from this sector declined only in Russia and Ukraine.

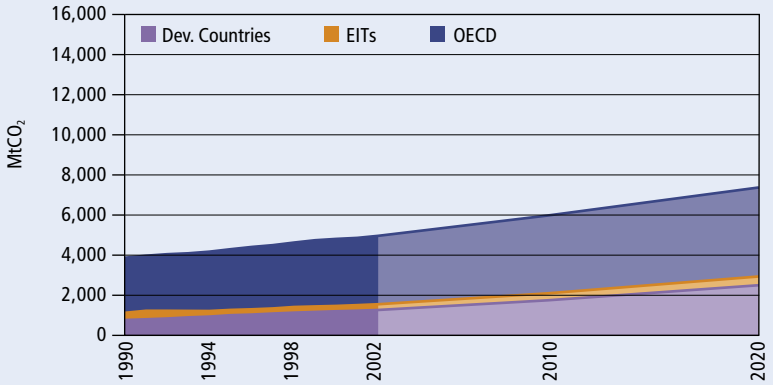
By 2020, the IEA expects global transport emissions to increase by 50 percent.[106] Increases of about 30 percent are projected in developed countries (Figure 12.5). Much higher increases are projected in developing countries, including China (143 percent), India (67 percent), Indonesia (122 percent), Mexico (71 percent), and the Middle East (68 percent).

Sector Context

The transport sector—and motor vehicles in particular—is notable for its high concentration of actors and significant international integration. Motor vehicle production—which includes passenger cars, light commercial vehicles, heavy duty trucks, and buses—is concentrated among relatively few countries and companies (Figures 12.6 and 12.7). Production is dominated by the U.S., EU-25, and Japan, with China rapidly increasing its production levels. Over the 5-year period from 1999 to 2004, China's vehicle production increased more than 175 percent, approaching half of Japanese levels by 2004. South Korea, Canada, and Brazil also have significant vehicle production. At the company level, five multinational automakers—General Motors, Ford, Toyota, Volkswagen, and DaimlerChrysler—produce about half of all motor vehicles (Figure 12.7). Major auto companies are largely headquartered in the United States, Japan, Europe, and South Korea. Virtually all manufacturers, however, have assembly and production facilities in multiple countries. Joint ventures are also common among major manufacturers, particularly in developing countries.

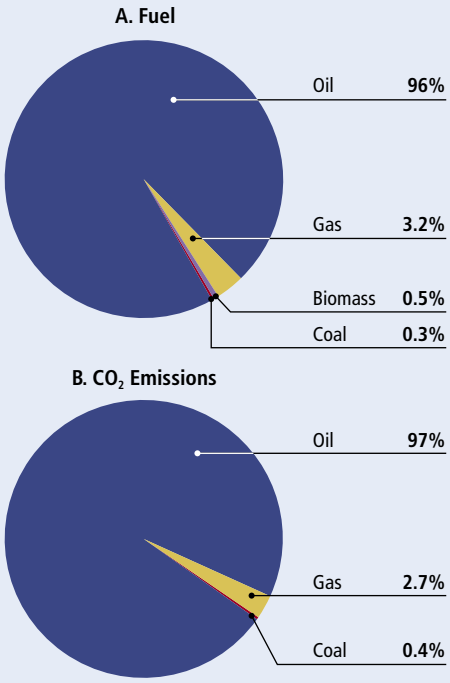
Motor vehicles, parts, and related accessories are heavily traded products. In 2003, world trade in automotive products reached $724 billion, amounting to 10 percent of all global trade.[107] A significant portion of this trade is regional, within Europe (37 percent)

Figure 12.2. GHGs from Transportation, Trends and Projections



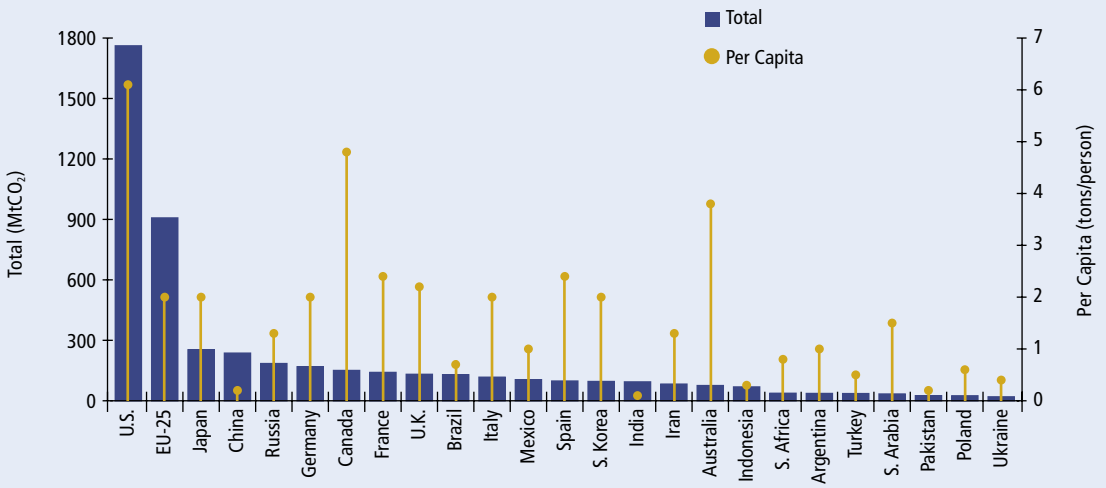
Sources: IEA, 2004b,c.

Figure 12.3. Transportation *(shares by fuel)*



Sources & Notes: WRI, based on IEA, 2004a,b.

Figure 12.4. CO_2 from Transportation, Total and Per Capita, 2002
Top 25 GHG emitters



Source: WRI, CAIT.

Figure 12.5. CO_2 from Transportation

Country	% of World 2002	% Change 1990–2002	% Change Projected 2002–2020*
United States	35.5	24	30
EU-25	18.3	23	31
Japan	5.1	20	–
China	4.8	101	143
Russia	3.7	-29	49
Canada	3.0	21	–
Brazil	2.6	60	77
Mexico	2.1	21	71
South Korea	1.9	120	–
India	1.9	15	92
Australia	1.5	23	29
Indonesia	1.4	109	122
World	**100.0**	**40**	**50**

Notes: CO_2 from international bunker fuels is not included. Growth rates for Russia are from 1992 (not 1990). *Projections are drawn from IEA (2004c). The projected figure for the U.S. includes Canada; Australia includes New Zealand. "–" signifies no data.

Figure 12.6. Motor Vehicle Production

Country	Vehicle Production Millions 2004	Vehicle Production % Change since 1999
EU-25	18.3	0
U.S.	12.0	-8
Japan	10.5	6
China	5.1	177
France	3.7	15
S. Korea	3.5	22
Canada	2.7	-11
Brazil	2.2	64
Mexico	1.6	1
India	1.5	85
Russia	1.4	18
Poland	0.6	4
Indonesia	0.4	346
Argentina	0.3	-15
World		**14**

Sources & Notes: OICA, 2000; OICA, 2005. Vehicles include passenger cars, light commercial vehicles, heavy-duty trucks, and buses.

Figure 12.7. Leading Motor Vehicle Manufacturers

Company (& other brands)	Total Vehicles, 2004 Millions	% World	Country(s) of Origin
General Motors (Opel, Vauxhall)	8.1	12.6	U.S., Germany
Toyota	6.8	10.6	Japan, U.S.
Ford (Volvo, Jaguar)	6.6	10.4	U.S., Germany
Volkswagen Group (VW, Audi)	5.1	7.9	Germany, Spain, China
DaimlerChrysler (Evobus)	4.6	7.2	U.S., Germany
PSA Peugeot Citroën	3.4	5.3	France, Spain
Honda	3.2	5.0	Japan, U.S.
Nissan	3.2	5.0	Japan, U.S.
Hyundai-Kia	2.8	4.3	South Korea
Renault-Dacia-Samsung	2.5	3.9	France, Spain
Fiat-Iveco-Irisbus	2.1	3.3	Italy, Brazil
Suzuki-Maruti	2.0	3.1	Japan, India

Sources & Notes: OICA, 2005. Vehicles include passenger cars, light commercial vehicles, heavy duty trucks, and buses.

and within North America (13 percent).[108] Trade flows between Europe and North America, as well as between Asia and North America, are also significant.

The EU-15, Japan, and the U.S., are the largest exporters, with export product values of $125, $103, and $69 billion, respectively, in 2003.[109] Some developing countries are increasingly producing automobiles for export, often through joint ventures with major automakers. The share of domestic output that is exported from Mexico, for instance, is 60 percent.[110] The largest importers are the United States, EU-15, and Canada, with import product values of $181, $67, and $49 billion, respectively.[111] The share of domestic consumption that is imported is often very large, such as in large EU countries (30–67 percent), Australia (52 percent), and the U.S. (32 percent).[112] Other countries consume primarily domestically manufactured cars, with imports constituting a small share; this includes Japan (3 percent), South Korea (6 percent), and India (5 percent).[113]

Uniformity is high for all transport products. Most automobiles, trucks, and buses are produced on assembly lines, with similar production methods employed by different firms. Furthermore, while vehicle models may vary widely, the number of propulsion technologies involved is very small. All road vehicles use one of a few major types of internal combustion engine, fueled by gasoline, diesel, or natural gas.

Governments play a significant role in the transport sector, but not as fundamental as with electricity. Interventions tend to be oriented around safety and fuel efficiency regulations—particularly in developed countries—and transportation infrastructure like roads, highways, seaports, and airports. Existing national fuel efficiency regulations may provide a pathway for coordinated action at the sectoral level.

Difficulty in attributing emissions to countries depends on the mode of transport. Ground transport is relatively easy to attribute. Although there some exceptions, such as in Europe, emissions almost always occur within the same national boundaries where fuels are purchased.[114] Emissions for *international* transport, however, nearly all occur in or over international territory, raising ambiguities concerning attribution, as discussed in more detail below.

Aviation, as noted above, represents approximately 12 percent of CO_2 emissions from transport when international flights are included (and about 1.6 percent of the world GHG total).[115] Emissions from international flights are more than half of overall air emissions.[116] Air travel—and associated CO_2 emissions—have grown at tremendous rates over the past few decades. Since 1960, passenger traffic has grown at about 9 percent per year, though the rate has slowed in recent years as the industry has matured.[117] Looking ahead, passenger and freight traffic are expected to grow at rates well in excess of GDP growth.[118]

The global warming effect of aviation is larger than suggested by the numbers and emissions trends discussed above, which are based on fossil fuel consumption. The climate impacts of air travel are amplified when ozone-producing NO_x emissions, contrail formation, water vapor release, and other high-altitude effects of aircraft use are accounted for. Most of these effects are characterized by high levels of uncertainty, and are difficult to account for. The IPCC estimates that, although aircraft accounted for only 2 percent of anthropogenic emissions in 1992, they produced an estimated 3.5 percent of total radiative forcing from human activities.[119] IPCC projections suggest that radiative forcing from aircraft may increase by a factor of nearly four by 2050, accounting for 5 percent of total radiative forcing from human activities.[120]

Figure 12.8 shows the breakdown of total and international air emissions from the top 10 countries in this subsector. Although all the countries shown are within the top 25 overall emitters, some countries with large international aviation emissions are not among the top overall emitters. Hong Kong, the Netherlands, Thailand, and Singapore rank 8, 9, 11, and 12 respectively in this category, mainly because they are large air transit hubs.

Figure 12.8. CO_2 from Aviation, 2002

	Total Air			International Air		
Country	% World	(Rank)	% Change from 1990	% World	(Rank)	% Change from 1990
United States	37.2	(1)	7	14.3	(2)	31
EU-25	20.3	(2)	49	30.3	(1)	59
Japan	5.0	(3)	42	6.0	(5)	59
United Kingdom	4.9	(4)	54	6.1	(4)	65
Russia	4.5	(5)	–	8.3	(3)	–
Germany	3.3	(6)	25	5.9	(6)	48
France	3.1	(7)	69	4.1	(7)	52
China	2.8	(8)	611	0.8	(27)	442
Canada	2.4	(9)	19	0.8	(24)	3
Spain	2.0	(10)	75	2.3	(13)	137
World			**38**			**38**

Source: Calculations based on IEA, 2004a.

Aviation emissions, as suggested above, are measured at the point of refueling and do not depend on subsequent destinations or nationalities of passengers, or high-altitude effects. Accordingly, attributing aviation emissions to particular countries is controversial, and for this reason emissions in this sector are excluded from the Kyoto Protocol. Parties to the Climate Convention have requested assistance in dealing with air emissions from the International Civil Aviation Organization (ICAO), although no formal agreements have been reached.

While measurement and attribution of emissions are more problematic for aviation than for motor vehicles, the two subsectors have otherwise similar characteristics. Aviation products are highly uniform, as nearly all medium and large commercial aircraft rely on jet engine propulsion. Production is highly concentrated. Nearly all jet aircraft are manufactured by five companies, operating primarily in North America and Europe. Boeing Corporation, headquartered in the United States, and Airbus S.A.S, headquartered in France, manufacture almost all large (100+ seat) commercial jet aircraft. Smaller jet aircraft, including regional corporate jets, are manufactured mainly by Bombardier (Canada), Embraer (Brazil), and Gulfstream, a division of General Dynamics (United States). According to industry sources, these manufacturers accounted for nearly all of the approximately 16,000 jet aircraft in service worldwide in 2003.[121] Industry forecasts project demand for almost 24,000 new jet aircraft through 2023.[122]

Given the high concentration of actors, it is not surprising that cross-border trade is significant. The U.S. exports 40 percent of its production of aircraft, nearly half of which go to developing countries.[123] Other significant producers, such as France, Germany, Canada and the United Kingdom, export over 50 percent of their domestic aircraft production.[124]