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Chapter 4:

Carbon Dioxide Emissions from Road Transport in Latin America

by Lee Schipper, Elizabeth Deakin, and Carolyn McAndrews

Today, Latin America is a small contributor to the world's emissions of greenhouse gases (GHG). However, the region's car ownership, use and emissions are higher than would be predicted on the basis of population or gross domestic product (GDP), and car traffic clogs the streets and pollutes the air of many Latin American cities. Furthermore, Latin American carbon emissions from transport, mostly from cars, are predicted to grow threefold by 2030 as both automobile ownership and vehicle use expand. The total emissions will still be small compared to those of developed countries, but they will not be trivial.

As a heavily motorized and urbanized part of the developing world, Latin American cities suffer from notorious congestion and air pollution. Yet, Latin America has also become one of the birthplaces of Bus Rapid Transit (BRT), first in Curitiba Brazil, but now in an increasing number of large cities. Reducing carbon dioxide (CO_2) emissions from urban transport in Latin America as population and incomes in urban areas grow is a challenging goal, but it is one that many cities are already pursuing. Substantial additional gains seem achievable. This chapter reviews the challenges these cities face.

Global GHG and CO_2 Trends—Where Is Latin America?

There is broad consensus that GHGs are warming the planet (IPCC 2007). Many human activities produce GHG emissions, but roughly two-thirds of the total anthropogenic emissions comes from fossil fuel combustion for transportation, buildings, and industry. Anthropogenic GHGs, including methane, CO_2 and small quantities of other potent gases, also come from agriculture, mining, natural gas production, landfills, and industrial processes. Land use changes that remove plants that absorb CO_2 contribute to the problem.

Figure 4-1 shows the origin of CO_2 emissions from all fossil fuel combustion by region of the world. About half of the total emissions comes from Organization of Economic Cooperation and Development (OECD) countries, excluding Mexico, and about 20 percent are emitted in China, but only seven percent are from Latin America. On a per capita basis, the world average was 4.3 metric tonnes of CO_2 per capita, while that from Latin America was only 2.5 tonnes per capita.

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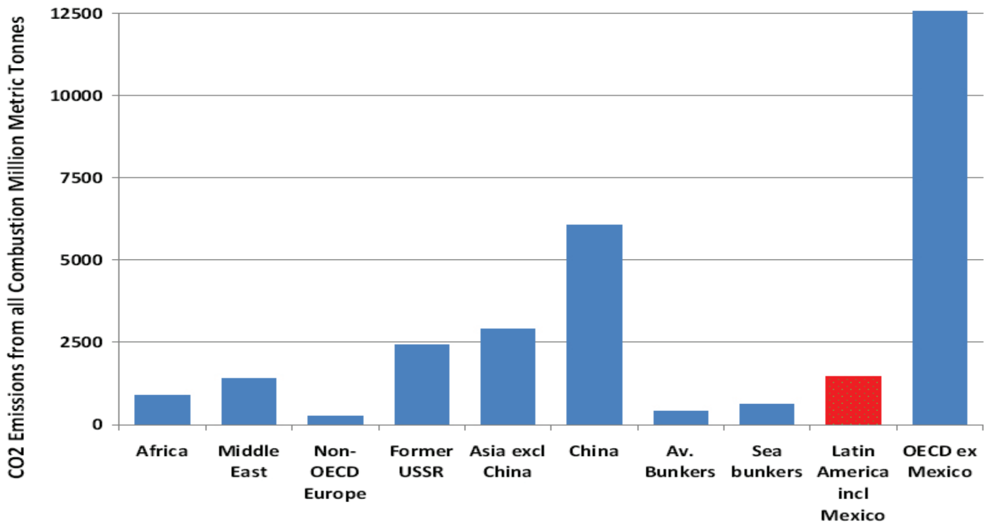
Figure 4-1: CO_2 emissions from all fossil fuel combustion by country or region in 2006 (million metric tonnes)

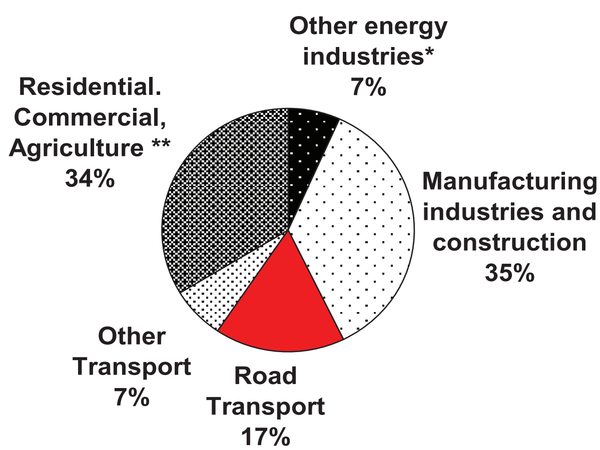


Source: International Energy Agency (IEA 2008)

Figure 4-2 shows global CO_2 emissions among major energy consuming sectors in 2006. Figure 4-3 shows the pattern just for Latin America, including Mexico, in the same year. Interestingly, road transport represents a full one-third of the total CO_2 emissions in Latin America, higher than the world average share.

In explaining differences in CO_2 emissions among regions or countries, the most obvious factors are population and level of development, as measured by per capita income. A host of additional factors share in explaining differences, including geography and local climate, degree of urbanization, land uses, fuel mix, and the efficiency of energy use (IEA 1997). Differences in policies, available technologies, and fuel prices shape the latter factors.

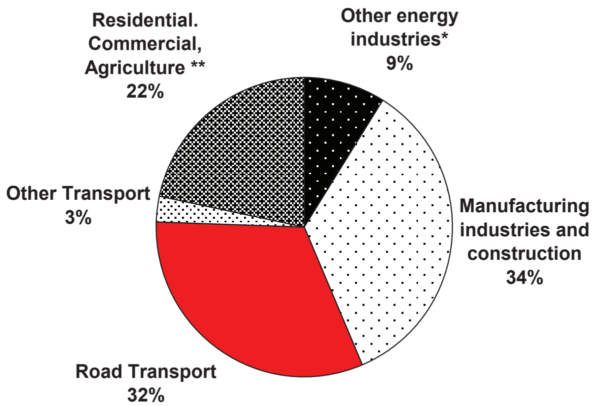
Figure 4-2: CO_2 emissions for the entire world by sector, including electricity losses allocated to end-us sectors, 2006



Source: IEA

In comparison with the world as a whole, the CO_2 emissions in Latin America are more heavily concentrated in transportation, which produces 35 percent of its total emissions, compared to a 24 percent transport share throughout the world. Furthermore, transport emissions are concentrated in road transport, which accounts for over 90 percent of the region's transport emissions.

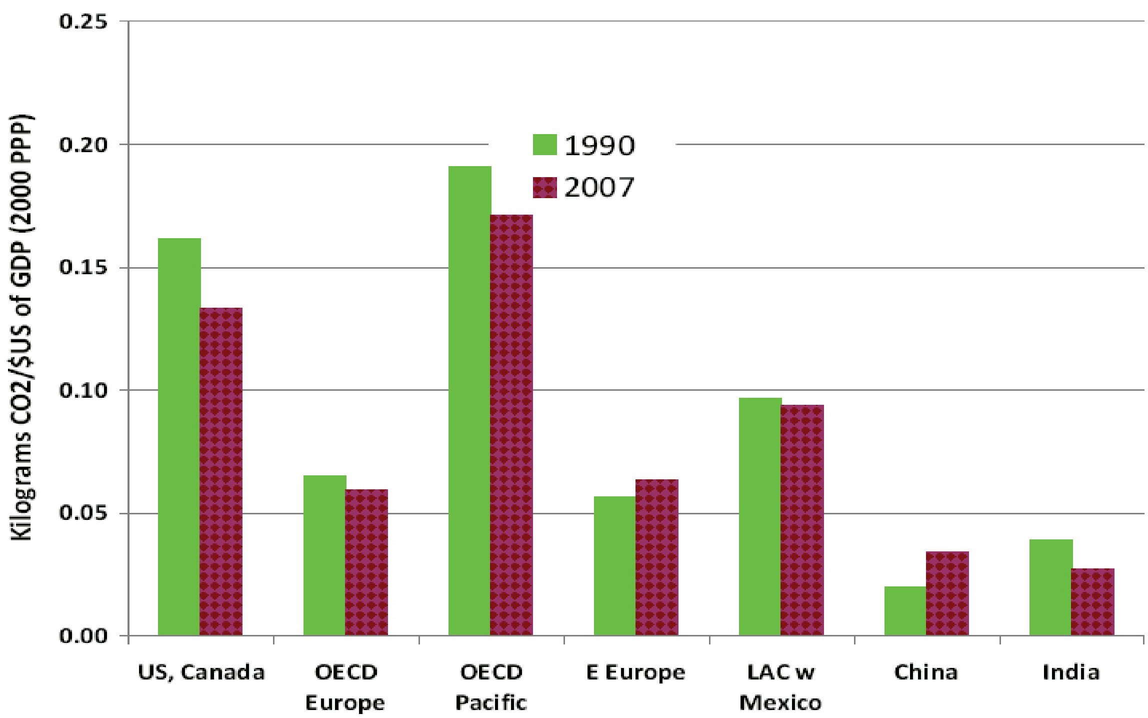
Figure 4-3: CO_2 emissions for Latin America including electricity losses allocated to end-use sectors, 2006.
Total 2.5 metric tonnes CO_2/capita



Source: IEA

For the world as a whole, the transport emissions/GDP ratio has declined by about 20 percent since 1990 (IEA 2008). As shown in Figure 4-4, however, regional differences are large, with some regions showing increases in the ratio, while others have achieved substantial decreases. For Latin America, the ratio of road transport CO_2 emissions to GDP has declined slightly, by less by 0.5 percent per year. In other words, transport emissions in Latin America have increased at almost the same rate as GDP has grown.

Figure 4-4: Ratio of road transport CO_2 emissions to GDP for regions, 1990 and 2007



Source: IEA. Note the data for India are 1996 and 2007 as there are no road-transport diesel data before 1996.

Data from the International Energy Agency (IEA) indicate that direct emission increases from tailpipes have been driven in large part by the rising importance of fossil fuels for transport, especially in populous Brazil, where use of ethanol from sugar cane did not keep pace with the demand for automobile fuels after 1990. Tailipipe emissions from ethanol produced from sugar cane are significantly lower than those of gasoline. Emissions from other sectors in Latin America grew less rapidly than those from road transport. Thus the importance of road transport in the Latin America emissions story has increased over time.

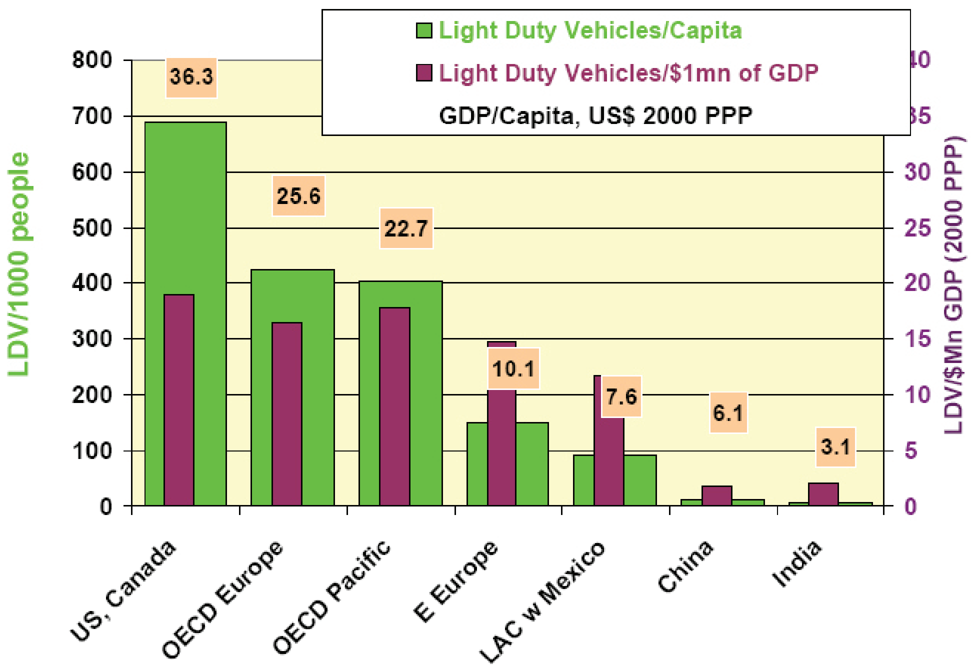
Road Transport in Latin America

An understanding of CO_2 emissions from road transport in the region requires a clear picture of the vehicle fleet and vehicle use, usually measured in vehicle-kilometers (km) of driving. Data on vehicle ownership and yearly usage have been developed by the International Energy Agency and the World Business Council for Sustainable Development (WBCSD 2004) and are used here, with some modifications.

Vehicle Ownership

Figure 4-5 shows light duty vehicle (LDV) ownership in different regions of the world, relative to both population and GDP, in 2005. Among the developing regions shown, Latin America had a per capita ownership of light duty vehicles of 86 vehicles per 1,000 people, mostly private cars, SUVs, and light trucks.

Figure 4-5: Light duty vehicle ownership vs. income and population, 2005, selected regions



Source: IEA MoMo Database (IEA 2009)

Notes: 10 to 20 percent of these light duty vehicles are commercial vans or pickups. GDP per capita in USD $1,000 (2000 PPP) shown above each region. 1990 data are from 1996, as previous years contain diesel used in stationary sectors.

The high level of motorization in Eastern Europe is explained in large part by a rapid increase in cars bought used after 1990 and the stronger presence of Western European automobile manufacturing in Eastern Europe after that time. Even though China and India have much larger populations, the per capita auto ownership is very low and even the absolute numbers of LDVs in those two giants were still well below the number in Latin America in 2005.

Vehicle Use and Emissions in Latin America

Data estimated by the WBCSD's Sustainable Mobility Project (WBCSD 2004) and more recently refined by the International Energy Agency (Fulton et al. 2009) provide information on vehicle types, their energy intensities, and the average km driven each year for Latin American countries. CO_2 emissions by vehicle type can be calculated from these data. The total fuel use for each particular fuel and vehicle type is calculated using the estimated numbers of vehicles, distance/vehicle, and fuel/distance, with national road fuel use as tabulated by the IEA used as the control total. Table 4-1 presents the results.

Table 4-1: Road transport emissions in Latin America in 2000 by vehicle type: The role of light duty vehicles

Vehicle Type	*Vehicles (100,000)*	*Km / year*	*Energy, EJ*	*Emissions Mtonnes CO_2*	*Share of total CO_2 Emissions*
LDV Pass.	40,127	13,000	2.11	155.4	41.70%
Motorcycles	6,948	7,500	0.05	3	0.80%
Minibuses	930	40,000	0.21	14.1	3.80%
Buses	511	40,000	0.2	14.5	3.90%
LDV freight	4,459	13,000	0.23	16.2	4.40%
Med Trucks	5,385	22,000	1.15	77.6	20.80%
Heavy Trucks	2,314	50,000	1.38	92.2	24.70%
Total	-	-	5.33	372.9	-

Note: 1 EJ (exajoule=10^{18} joules) = 24 MTOE (million tonnes of oil). Data adjusted to include Mexico. Emissions for rail were included in the original Sustainable Mobility Project spreadsheets but are omitted here.

Source: WBCSD Sustainable Mobility Project and IEA.

For the region as a whole, about half of road transport emissions are for passenger traffic, the other half for freight travel. The dominant vehicles are LDVs, most of which are passenger cars. The urban share of traffic (VKT), emissions and the number of passenger kilometers traveled were estimated. The results are shown in Table 4-2.

Table 4-2 shows that about 60 percent of all road transport emissions in Latin America appear to be associated with urban areas, with LDVs responsible for well over half of the urban emissions. Further

Table 4-2: Estimated urban share of traffic and emissions by vehicle type, Latin America 2000

Vehicle Type	*Urban Share of VKT*	*Urban VKT (billion)*	*Vehicle Occupancy (people)*	*Passenger km (billion)*	*Emissions MTonnes CO_2*	*Share of Urban CO_2*
LDV and Motorcycles	80%	453	2	907	127	61.50%
Mini Buses	80%	30	20	595	11	5.50%
Buses	50%	10	50	511	7	3.50%
Light Trucks	80%	46	-	-	13	6.30%
Medium Trucks	50%	59	-	-	39	18.80%
Heavy Trucks	10%	12	-	-	9	4.50%
Total	-	510	-	2013	208	100%

assuming that LDVs in urban regions have an average occupancy of two people, motorcycles one person, minibuses 20 people, and large buses 50 people, it appears that two trillion passenger km of driving occurred in these motorized modes in Latin American urban areas in 2000.

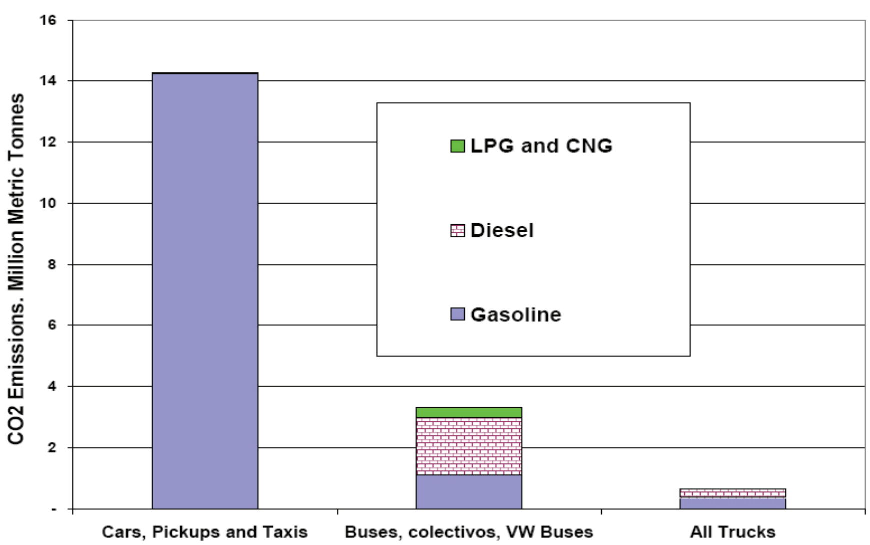
Table 4-3: CO_2 emissions, vehicles and traffic, Mexico City, 2006

Vehicle Type	*Mtonnes CO_2*	*Vehicles (100,000)*	*Billion VKT*
Cars	10.49	3,395.80	46.31
Taxis	2.6	155.1	10.38
VW Bus Colectivos	0.7	39.7	2.64
Other Colectivos	0.74	36.1	2.54
Pick Up	0.83	133.4	3.48
Other Vehicles < 3 t	0.63	81.6	1.8
Truck Tractors	1.63	60.9	1.38
Autobuses	1.87	43.1	1.79
Other Vehicles < 3 t	0.54	100.8	2.2
Motorcycles	0.37	180.7	4.47
Totals	20.4	4,227.30	76.98

Source: Mexico City Emissions Inventory (SMA, 2006)

Data from major metropolitan regions of Latin America are consistent with the estimates of urban traffic and emissions generated from national and regional data for specific cases. Table 4-3 and Figure 4-6 show the results for Mexico City in 2006. The data come from the region's emissions inventory, which is updated every other year.

Figure 4-6: CO_2 emissions from the main classes of transport emitters in the Mexico City Metropolitan Area, 2006



Source: Mexico City SMA emissions inventory estimated by vehicle, distance, and fuel intensity.

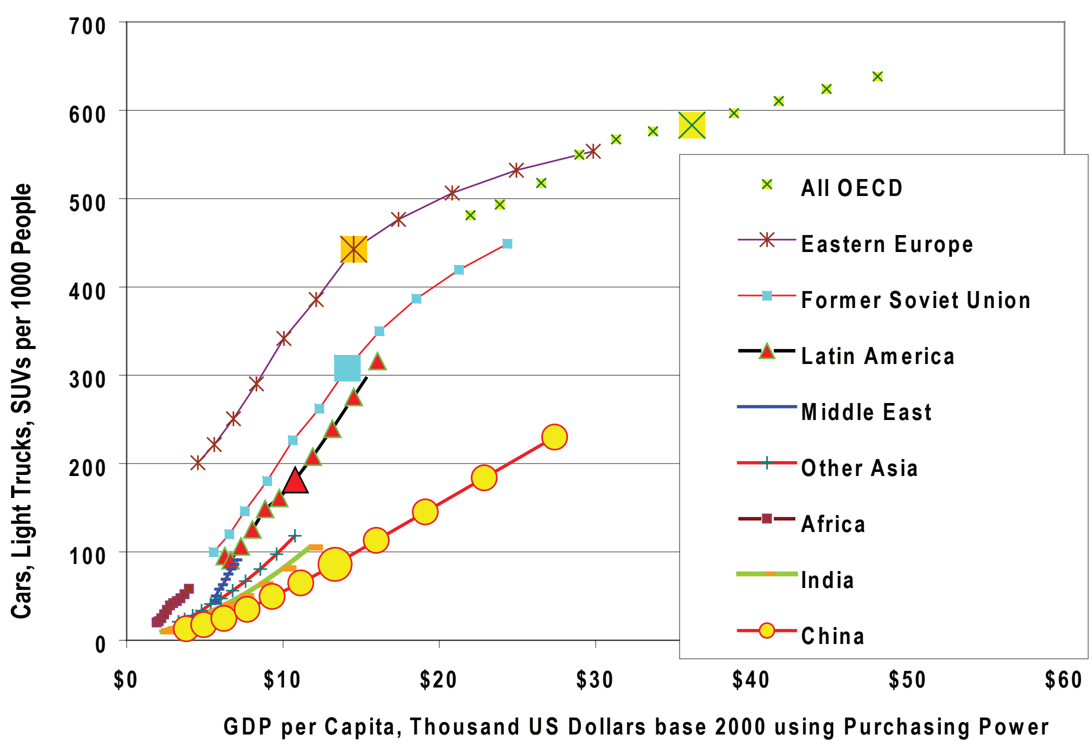
The results show that individual cars, pickup trucks, taxicabs, and motorcycles account for 68 percent of the CO_2 emissions from all transportation sources in Mexico City (SMA 2006). Traffic is also dominated by small individual vehicles, which account for almost 83 percent of the VKT. Interestingly, Mexico City car ownership is lower than that in many other large Mexican cities, so the share of emissions in LDVs may be even higher in other Mexican urban areas, where there are more cars per capita. This also implies that the light duty personal vehicle fleet in other Mexican cities is an even greater contributor to CO_2 emissions than it is in Mexico City.

Patterns for Santiago de Chile (Escobar 2007), Bogotá (Giralto 2005), and Sao Paulo (Vasconcellos personal communication 2008; Melor de Alvares personal communication 2008) are similar. LDVs account for less than 25 percent of travel, but more than 60 percent of VKT and CO_2 emissions in these urban areas.

Present trends in the Latin America region point to increasing automobile ownership and use. Latin America will probably approach Europe's level of motorization in the 1960s by 2030, but with far more urban regions of over five million people than Europe has even now. Between 2004 and 2006, Latin America had four urban agglomerations with 10 million people or more—Mexico City, Sao Paulo, Buenos Aires and Rio de Janeiro. Europe had just one, Paris. Lima, Bogotá, Santiago and Bel Horizonte in Latin America each had between five and 10 million people, while Europe had just London and Madrid. Latin America had eight more cities among the world's 100 largest urban areas (UN 2007). Traffic in these largest cities tends to be the most congested. Thus the prospects for future traffic problems in the face of growing motorization in all these large Latin American cities are daunting.

Figure 4-7 shows forecasts of LDV ownership in 2030 versus per capita GDP for Latin America, China, OECD nations, the Former Soviet Union, and Eastern Europe. According to this projection, per capita income in Latin America will almost double by 2030, with per capita LDV ownership, predominately cars,

Figure 4-7: Sustainable Mobility Project projections of future LDV ownership by region



Source: WBCSD 2004

rising to 200 per 1,000 when Mexico is included. This means that, relative to GDP, growth in CO_2 emissions could continue to rise faster in Latin America than in other developing countries, where fuel efficient motor scooters and e-bikes are a major portion of motorization.

The Sustainable Mobility Project foresees a more than tripling of total LDV VKT in Latin America by 2030 and a sixfold increase by 2050. The VKT growth is pushed up by growth in population, and LDV ownership increases are supported by rising affluence. The estimates are consistent with historical evidence from Europe and North America (Schipper and Marie-Lilliu 1999; U.S. BTS 2009). However, the Sustainable Mobility Project did not foresee any major changes to transportation policy that could slow the rise in LDV use. Thus, the projections are not inevitable, but illustrative of where present trends lead.

Table 4-4 shows the WBCSD data for 2000 and projections for 2030 for LDV ownership per 1,000 population, VKT per vehicle and per capita VKT. VKT per vehicle is treated as constant, which is approximately the OECD experience from the 1970s and 1980s, except for periods of very high oil prices.

Table 4-4: Global projections of LDV and use

	LDVs/1000		*VKT/LDV*		*VKT/Capita 2030*	
Region	*2000*	*2030*	*2000*	*2030*	*2000*	*2030*
OECD North America	779.7	825	17,600	17,600	13,723	14,080
OECD Europe	390.2	511	12,500	12,500	4,877	6,388
OECD Pacific	438	546.1	10,000	10,000	4,380	5,461
FSU	100	308.4	13,000	13,000	1,300	4,009
Eastern Europe	201	442.6	11,000	11,000	2,211	4,869
China	13	86	10,000	10,000	130	860
Other Asia	21	56.1	10,000	10,000	210	561
India	10	39.8	8,000	8,000	80	318
Middle East	42	68.9	13,000	13,000	546	896
Latin America	95.2	181.5	12,000	12,000	1,142	2,178
Africa	20	41.9	10,000	10,000	200	419

Source: WBCSD 2004

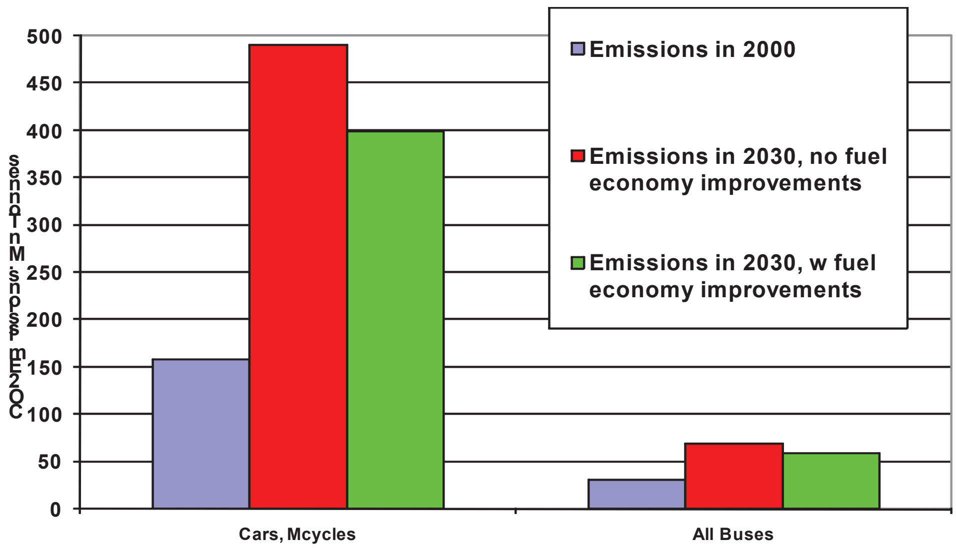
On-road fuel economy in Latin America is projected to improve from an estimated 11.8 liters per 100 km in 2000 to about 9.4 liters per 100 km by 2030 and to 8.3 liters per 100 km over 50 years. The improvement is a drop of about 20 percent in terms of fuel use per km. For comparison, the European Union hopes that by 2030 its fleet will use less than 6.5 liters per 100 km on the road, below the present value of 7.8 liters per 100 km, also a 20 percent improvement (Schipper 2009).

Since cars in Latin America are smaller and less powerful than those in the European Union, the high fuel intensity for LDVs in Latin America may seem odd. The explanation appears to be poor traffic conditions, as suggested by the relatively high in-use fuel intensities of small cars in the Mexico City, Sao Paulo, Bogotá, and Santiago emissions inventories.

Models used to simulate fuel use in traffic in Latin America, like MODEC (Goicoechea 2007; Osses et al. 2000) or Mobile 6 Mexico and COPERT (COPERT 2009; Rogers 2006) show rising fuel use per km with greater congestion. If congestion continues to worsen in Latin American cities, this gap between vehicle potential fuel economy and real-world performance will increase, erasing some of the benefits of improved vehicles. Conversely, measures that reduce congestion lead to improvements in in-use fuel economy (Skabardonis 2004).

When the Sustainable Mobility Project projections for vehicles, VKT, and fuel economy for each mode are combined without further mitigation, emissions from passenger vehicles in Latin America are forecast to more than double by 2030, despite improvements in vehicle fuel economy. This is shown in Figure 4-8. By 2050, emissions are expected to increase to four times their current value. Emissions from trucks grow less rapidly than those for cars, while emissions from buses are not seen as growing much at all. Indeed, while opportunities to reduce emissions per vehicle-km or passenger-km in buses should not be ignored, those reductions would be minor compared to the growth in emissions from LDVs.

Figure 4-8: Sustainable Mobility Project estimates of CO_2 emissions from Latin American road transport, 2000 actual and 2030 projected.



Source: Sustainable Mobility Project, 2004

A business as usual forecast prepared for the Sustainable Mobility Project shows that emissions growth in Latin America is expected to be substantial, but will still be outpaced by that of other regions or countries. Some of the other countries start with lower individual motorization and are catching up over the forecast period. Others have higher overall incomes or rates of economic growth. Although these projections suggest that Latin America will remain a relatively modest contributor to total world CO_2 emissions, it would still be a relatively high emitter from road transport compared to population and GDP.

Projected GHG emissions could change substantially if the basic factors driving them, primarily incomes and vehicle fuel economy, change unexpectedly. For example, a number of analysts believe that the vehicle fuel economies could be much higher. To illustrate how this might change emissions, Table 4-5 shows the effect of a global achievement of 6.4 liters per 100 km by 2030. Such fuel economy, consistent with current projections for the EU in 2030, would mean that Canada and the United States would see a decline in CO_2 production from LDVs, rather than the increase estimated by the WBCSD. Latin America would still see an increase in emissions, but a smaller one.

The Transport CO_2 Challenge for Latin America

Present levels of CO_2 emissions from road transport in Latin America are high by developing world standards. Not coincidentally, per capita ownership and use of LDVs in Latin America are also high. In urban regions, around 70 percent of CO_2 emissions from road transport arise from the use of LDVs, which are by far the most common vehicle on the streets and in general the greatest contributors to both congestion and pollution. The high CO_2 emissions from road transport in Latin America can be seen as a symptom of transport problems caused by high car ownership and use. Addressing these transport problems likely would reduce car use and fuel consumption, which, in turn, would reduce CO_2 emissions.

Table 4-5: Effects of a global fuel standard of 6.4 liters per 100 km achieved in actual traffic

Region	*I* Base Case: 2030 emissions w/ WCSD Fuel Economies	*II* 2030 Emissions w/ Global 6.4 l/100 km Fuel Economy	*III* 6.4 l/100 km Emissions as % of Base Case Emissions	*IV* Emissions Change 2000-2030 w. Base Case Fuel Economies	*V* Emissions Change 2000-2030 Using 6.4 l/100 km Fuel Economy
OECD North America	1623	952	58.70%	132.40%	77.60%
OECD Europe	535	532	99.50%	109.60%	109.10%
OECD Pacific	219	171	77.70%	99.70%	77.50%
Former Soviet Union	229	153	66.70%	272.40%	181.80%
Eastern Europe	82	63	76.50%	166.30%	127.20%
China	303	198	65.20%	664.10%	433.00%
Other Asia	174	116	66.60%	322.60%	214.90%
India	103	70	68.00%	459.10%	312.30%
Middle East	67	45	67.50%	253.60%	171.20%
Latin America	29	198	67.20%	266.80%	179.20%
Africa	168	97	57.90%	313.30%	181.30%

Source: Columns I and IV WBCSD 2004. Columns, II, III and VI, this study.

The data and trends-extended forecasts for vehicle ownership and use, fuel economy improvements, and predicted emissions present serious challenges for transport policymakers in Latin America and elsewhere. Without additional interventions, emissions will grow substantially during a period in which combating global warming would necessitate their substantial reduction. The large forecasts of increased VKT in Latin America also would increase traffic in urban regions, which implies worsening congestion and other transport problems unless increases in road capacity keep pace with or exceed traffic growth.

Strategies that improve the fuel economy of LDVs and bus fleets are likely to reduce emissions per kilometer by 20 percent by 2030, according to the SMP projections used above. This still leaves emissions from road transport in Latin America more than doubling over the same period. Even a major increase in fuel efficiency over and above the projected levels would result in significantly increased emissions in Latin America. This means that there is a need to consider additional interventions.

If reductions in transport emissions are to be achieved, many analysts now conclude that the growth in individual vehicle use must be moderated and transit vehicle use and non-motorized travel must increase in relative importance. Further reductions in CO_2 emissions can be accomplished through changes in urban development and transport paths, not just in Latin America but around the world. Such changes could reduce growth in vehicle ownership or vehicle use, or both.

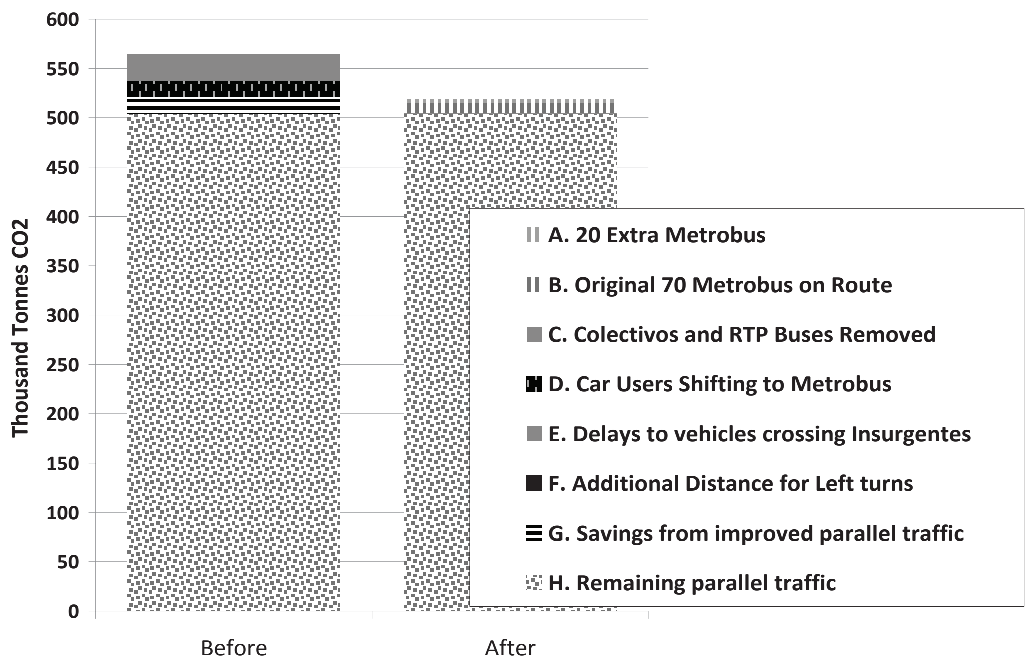
Additional CO_2 reduction can be attained through well planned urban transport investments. Many Latin American cities are already steering transport growth in more carbon efficient directions by investing in high quality public transportation and new facilities for bikes and pedestrians. These travel choices improve accessibility for a large portion of the population while managing traffic, cutting pollution and moderating CO_2 emissions.

Latin American leadership in implementing new travel options is creating models from which others can learn. Cities such as Curitiba and Bogotá are already widely emulated for their creative investments in urban planning and BRT. These activities provide good transport, while reducing carbon emissions, and their success puts pressure for change on countries slower to reduce carbon emissions.

The progress of bus rapid transit is one of many important transportation measures spreading in cities around the world, a measure that most consider originating in Latin America. A recent update for Mexico by the Fonadin, the national fund for infrastructure, projects more than 2.2 million new trips per day on BRT and over 1.2 million trips per day on rail lines in Mexico's major cities (Mier y Tieran 2009). Such changes must of necessity take road space and other resources from cars. The experience from Metrobús suggests the good outcome there gives political momentum to this refocusing of transport planning and infrastructure development.

The challenge for Latin America is that CO_2 per se is not a driving factor compared with other externalities or transport variables. Still, it is clear there are substantial CO_2 savings from BRT. Figure 4-9 illustrates this for a specific bus rapid transit (BRT) project in Mexico City, Metrobús (Schipper et al. 2009). It shows the components of reductions in CO_2 emissions from introduction of a BRT corridor along one of Mexico City's busiest routes (Rogers and Schipper 2005; Rogers 2006). Included are the CO_2 emissions of all vehicles in the corridor before the BRT lanes were created and after. Rogers' original estimates (2006), subsequently updated by him in 2009, show that this project reduced emissions in the corridor from all traffic by 10 percent. Of those reductions, about one-third came from the direct substitution of 90 large articulated buses for over 300 small buses, one-third came from bus riders who used to take cars for the same journeys, and one-third came from smoother resulting traffic in the corridor. No special steps were taken to use low-carbon fuels, hybrid electric buses or other technological options aimed specifically at fuel saving or CO_2. It is encouraging that these reductions occurred without any special effort to save CO_2.

Figure 4-9: Emissions in Insurgentes corridor before and after Metrobús



Sources: Rogers, 2006 and Rogers, 2009

Legend explanations: A and B are the emission from Metrobús after; C is the emissions of the transit vehicles removed; D is the emissions imputed before drivers switched to Metrobús; E and F are the extra emissions from delays and circuity imposed by Metrobús; G, shown as emissions before reductions due to smoother traffic on Insurgentes after Metrobús was put in place. H gives the remaining emissions from all parallel traffic on Insurgentes.

How important are the savings of CO_2 emissions in comparison with other changes brought about by this project? The question can best be answered by monetizing the results using information about the damages from air pollution, the value of CO_2, the value of time, and other variables, even if the valuations of externalities and transport benefits is uncertain (Maddison et al. 1996). If the results of the Metrobús BRT program were monetized, however, the role of CO_2 savings is seen to be small compared with other benefits of this program.

Table 4-6: Annual benefits of Metrobús Project

Nature of annual benefit or savings	*Low CO_2 value (USD \$5/tonne)*	*High CO_2 value (USD \$85/tonne)*
Time savings of bus riders	\$1.32	\$1.32
VKT external costs -- reduction in traffic	\$2.19	\$2.19
Air Pollution Reduction /Health Benefits	\$3.00	\$3.00
Fuel savings from bus switch	\$3.68	\$3.68
Fuel saving, mode switch car to bus	\$3.66	\$3.66
Fuel savings to parallel traffic	\$1.56	\$1.56
CO_2 reduction from bus switch	\$0.09	\$1.75
CO_2 reduction, mode shift car to bus	\$0.13	\$2.58
CO_2 reduction in parallel traffic	\$0.05	\$0.87
CO_2 Reduction, total value	\$0.27	\$5.20
Reduction in accidents/death (not estimated)		
Total first year annual value US\$ Million (2005)	\$15.69	\$20.62

Source: CO_2 and fuel calculations made in this study, based on Rogers 2006; Other savings taken from INE 2006.

Table 4-6 shows the results. INE (2006) used a value of time of approximately $0.60 (U.S. dollars) per hour multiplied by the number of hours saved. They estimated the value of reduced road wear and the value of health benefits of lower air pollution. Excluded were values derived from fewer accidents and lower loss of life, important variables unfortunately not addressed in the INE study. Added to the INE valuations, we estimated fuel cost savings by buses, parallel traffic and consumers who left their cars at home. The CO_2 savings from Figure 4-9 were also factored in at a value of $5.00 per metric tonne of CO_2 and at $85.00 per tonne. The former value is what Mexico City received for savings from a carbon fund. The latter is the much higher estimate developed by the Stern Report (Stern 2006). It is notable that even when CO_2 is valued at the high end, it only comprises about 20 percent of the total benefits shown. At the lower end, its value almost vanishes. In either case the estimate of other benefits was low because INE did not count reductions in traffic accidents and fatalities. With CO_2 valued so low compared with other transport benefits, CO_2 saved from improved traffic and transport can be seen as an important co-benefit of good transport strategies. Interestingly, Mexico City could have chosen hybrid buses that were tested before the Metrobús project was finished (Schipper et al. 2007). This choice would have increased the savings of CO_2 by only around 3,000 tonnes/year, yet the hybrid drivetrains would have cost at least $100,000/bus more than the buses actually chosen (Schipper et al. 2009).

Conclusions

Additional investments in transportation facilities and services that increase access and quality of life, while also cutting carbon, would benefit cities in Latin America and around the world. Transit, pedestrian and bicycle facilities, improved traffic management, and coordinated transport and land use are important low-carbon access and mobility strategies. Most cities could also gain by strategically coordinating transport investments, creating networks of transit operating on traffic-managed streets and arterials conveniently reached by bikeways and pedestrian ways and serving mixed-use neighborhood and commercial district centers. In addition, most cities could benefit from pricing policies for fuels, parking, and other transport services that better reflects marginal social and economic costs. Such pricing is not only efficient, but can generate revenue that can be used for further transport improvements.

Thus there are many options open to Latin American authorities to restrain CO_2 emissions from urban transport. Improvements to vehicle technology that keep fuel use per kilometer low are important, but longer-term changes in transport policy and infrastructure that also improve the quality of mobile life, however complex to implement, may have an even greater impact on CO_2 by restraining its growth in the first place.

The challenge for authorities in Latin America and other regions is to make the transport changes for their own value and reap the co-benefits of lower CO_2 emissions. Currently, the rewards of a third party paying for the CO_2 savings would be small compared to the rewards from saved fuel and time. Can authorities make these changes, if the rewards from carbon reduction are so small?

The answer may be yes if the focus is kept on improvements in transport and quality of life. The CO_2 savings from Metrobús helped boost the project's popularity in the planning phases, particularly when the city's full endorsement was politically important. The fact that the initial success of this line led to both its extension (the implementation of a new line, the Eje 4) and planning of at least a half dozen more lines gives weight to the argument that changes in transport policy that have obvious transport benefits can set off chain reactions. A recent World Bank Urban Transport Strategy makes the case for strong measures to make individual vehicle users face the externalities they cause other travelers, who are the majority in Latin American and other developing cities (World Bank 2008). Following their advice may provide larger carbon restraint as a co-benefit than any other group of measures.

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