Carbon Dioxide Emissions from Urban Road Transport in Latin America: CO2 Reduction as a Co-benefit of Transport Strategies

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Abstract

We review aggregate trends in CO2 emissions from road transport in Latin America. Comparison with other regions, as well as with automobile ownership and use suggests that road transport the emissions in this region are closely connected to high automobile ownership and use. Examination of detailed estimates of vehicle stocks, use and fuel intensity as well as data from four large metropolises in the region confirms this suggestion. The same data show that it is cars that are the main reason for congestion, high levels of air pollution, and other transport related externalities in urban regions. Thus mitigation of CO2 emissions from urban transport means dealing directly with cars and car use. Widely cited projections of car ownership and use in 2030 suggest that car use will more than triple. Even with a 20% reduction in fuel use and emissions/km, CO2 emissions will be well above present levels. But if the fundamental problems of urban transport that plague Latin America today are addressed, car use will grow by considerably less, restraining CO2 emissions considerably as a co-benefit of transport strategies. A review of the impact of a BRT project in Mexico City shows a reduction of 10% in traffic-related emissions in the BRT corridor even without fuel and emissions being addressed directly. One third of those savings arose because Metrobus riders left cars at home and took the bus. The monetized value of the CO2 externality is small compared to other benefits of Metrobus as a transport project. Thus CO2 reduction can be evaluated as a co-benefit of a transport project. Confronting other large transport externalities such as congestion would likely lead to reductions in car use and greater use of other modes. Thus we argue that CO2 should be treated as a symptom of transport problems, particularly high rates of car use. Doing this may offer significant restraint in CO2 emissions at little or no “cost” of saved CO2.

Latin America and the Caribbean in the Global CO2 Context

Today, Latin America is a small contributor to the world's emissions of greenhouse gases. However, the region's car ownership, use, and emissions are higher than would be predicted on the basis of population or GDP, and car traffic clogs the streets and pollutes the air of many Latin American cities. Furthermore, Latin American carbon emissions from transport - mostly cars - are predicted to grow three-fold by 2030 as both auto ownership and vehicle-kilometers traveled expand. The total emissions will still be small compared to those of OECD 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 as Figures 1a-b, from Mexico City and Porto Alegre Brazil symbolize, as well as poor enforcement of traffic laws and difficulties with walkability, shown in Figures 1c-d. Yet Latin America has also become one of the birthplaces of Bus Rapid Transit (1), not only in Curitiba Brazil (Figure1e) but now in an increasing number of large cities, as the bus from Transmilenio moving by stuck traffic in Bogota in Figure 1-f symbolizes.

Figure 1a (Left): Cyclist in heavy traffic on the Circuito Interior Mexico City.
Figure 1b (Right): Smoking bus in Porto Alegre, Brazil.
Photographs courtesy of Lee Schipper.

Figures 1C (left) Cars In Contra-flow Lane of Eje Central, Mexico City, Hurrying to Exit the Lane as a Bus Moves Against Their Flow. Photo Lee Schipper, Figure 1d- Pedestrians trying to cross the P Periférico in Guadalajara Photo Carolyn Mcandrews.

Figure (1-e3) Left: Buses unloading in Curitiba.
Figure 1-f4 (Right): Transmilenio bus scoots by a traffic jam in Bogotá.
Photos courtesy of Lee Schipper.

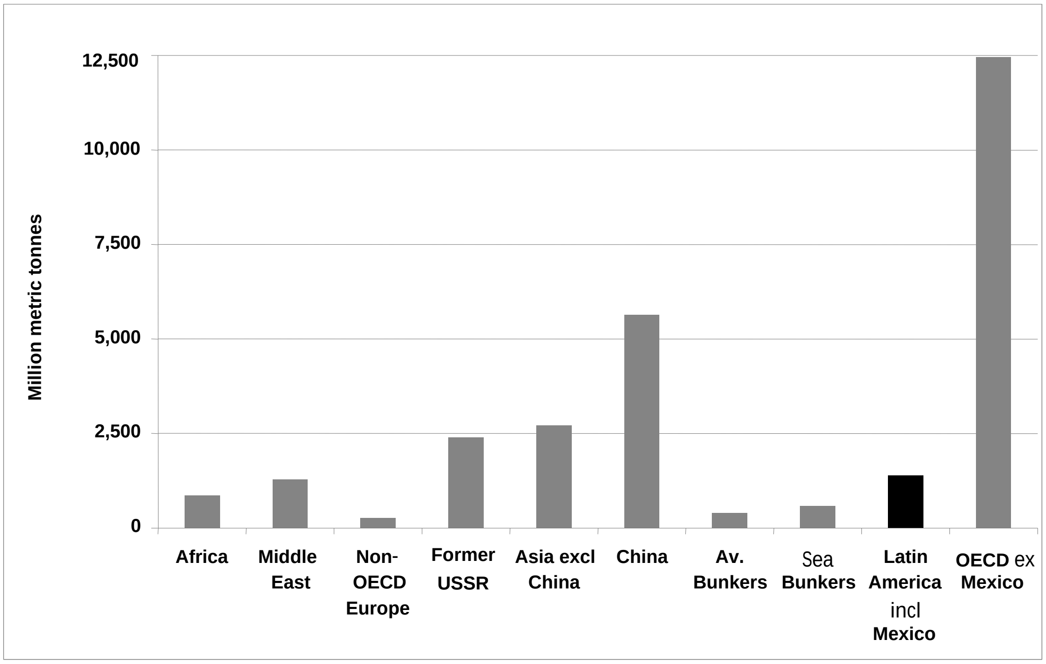
Reducing the CO_2 emissions from urban transport in Latin America as population and incomes in urban areas grow is a challenging goal, but it is one that many cities are already pursuing. Substantial additional gains seem achievable. Latin American cities face and finds that most of the strategies for improving mobility and reducing transportation externalities will also reduce carbon emissions compared to a “business as usual” alternative. The carbon reduction from transportation investments compares favorably in many cases to those achievable through vehicle and fuel switching.

This paper first charts out aggregate indicators linking high motorization to high CO_2 emissions for Latin America’s GDP. We estimate the share of traffic and emissions in urban areas to show that light duty vehicles, principally cars, dominate both and are the principal cause of congested streets. In discussing mitigation we suggest that direct actions to reduce emissions in individual vehicles must be complemented with measures slowing the growth in use of individual vehicles, measures justified by good transport policies.

A. Global GHG and CO2 trends – Where is Latin America?

There is broad consensus that greenhouse gases (GHG) are warming the planet (2). 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 (2005 data). Figure 2 shows the origin of CO_2 emissions from all fossil fuel combustion by region of the world. About half of the total CO_2 emissions comes from OECD countries (excluding Mexico), about 20% from China, and only 7% from Latin America including Mexico and the Caribbean. On a per capita basis, the world average was 4.3 metric tonnes of CO_2/capita while that from Latin America was only 2.5 tonnes/capita (2). In this work carbon or carbon dioxide is always given in metric tonnes of CO_2. Conversion from quantities of fuel (in liters, tones, or energy units) is made with coefficients supplied by the IPCC.

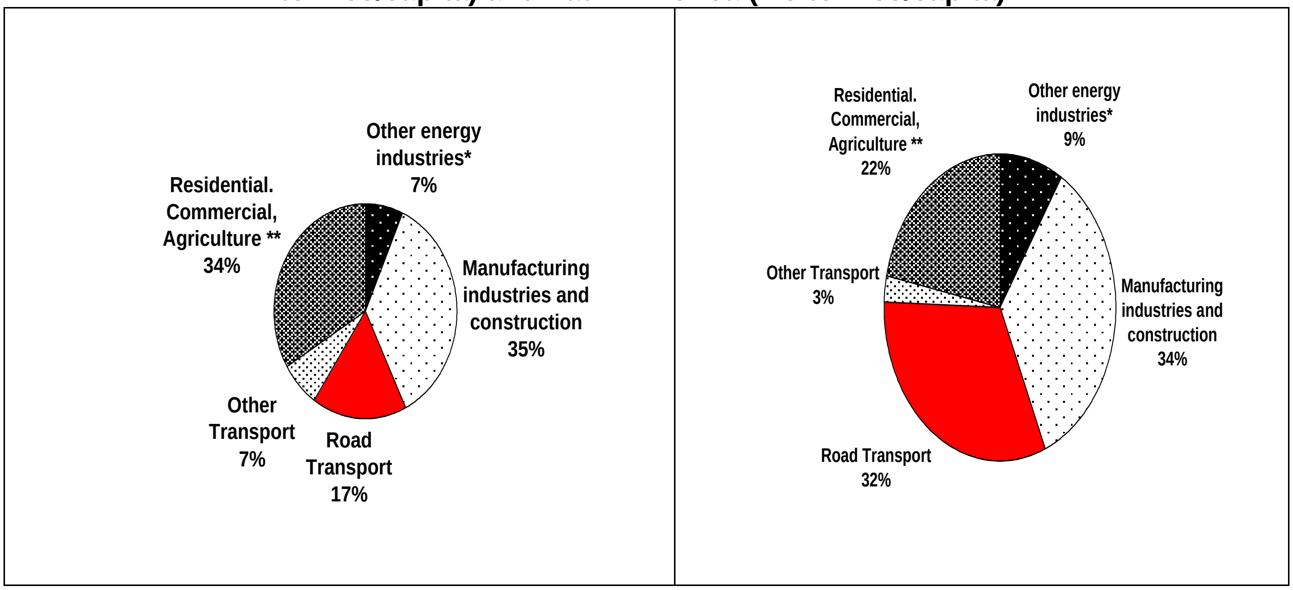
Figure 2 CO2 Emissions from All Fossil Fuel Combustion by Country or Region in 2006



Source: International Energy Agency (IEA, 2008).

Figure 2 shows global CO_2 emissions another way, by main energy consuming sector (as shares) in 2006. Figure 3a shows the pattern for Latin America only (including Mexico) in the same year. Interestingly, as Figure 3b shows, road transport represents a full one third of the total CO_2 emissions in Latin America, higher than the world average share. In these portrayals, emissions from electricity production have been allocated by the IEA to sectors where the electricity is consumed.

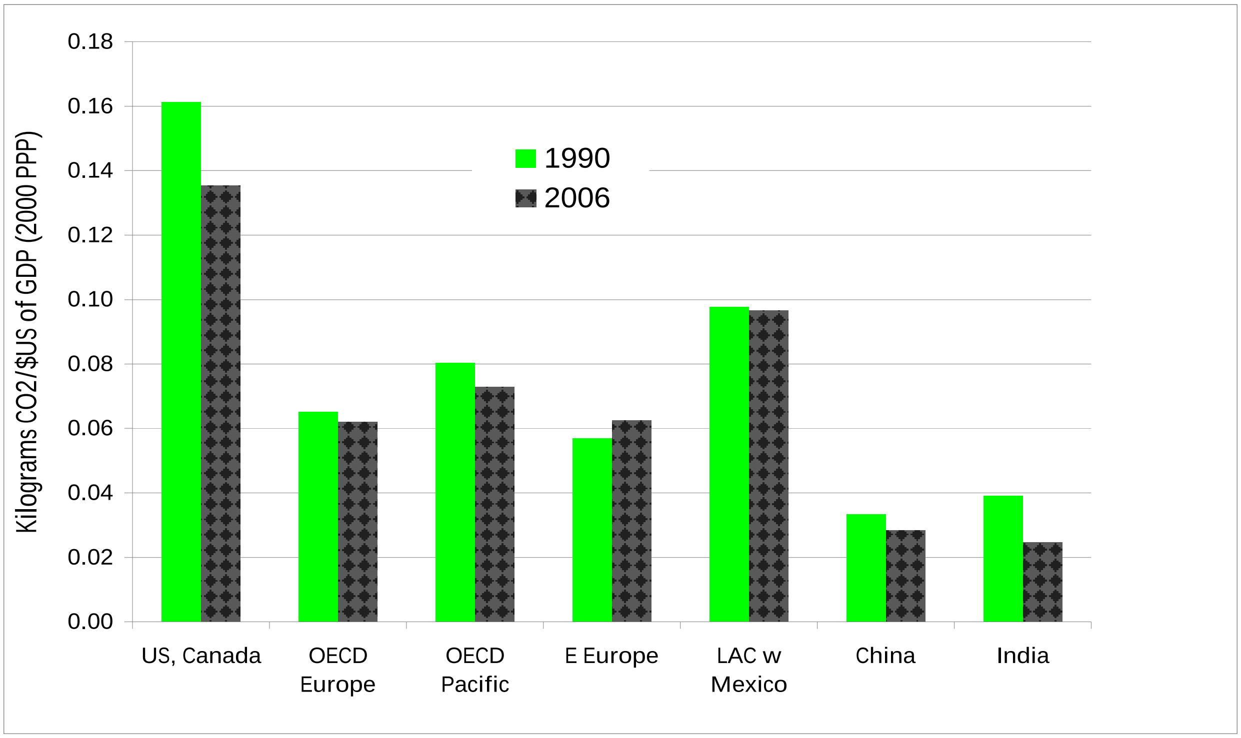
Figure 3a and b CO2 Emissions for Entire World by Sector in 2006 (total 4.3 tonnes/capita) and Latin America (2.5 tonnes/capita)



In explaining differences in CO2 emissions among regions or countries, the most obvious factors are population and level of development, as measured by per capita income. But a host of additional factors share in explaining differences – geography and local climate, degree of urbanization, land uses, fuel mix, and the efficiency of energy use. (3) Differences in policies, available technologies, and fuel prices shape the latter factors.

Using data from (4), Figure 4 shows that regional differences in the ratio of transport emissions to GDP (and its changes over time from 1990 to 2006) are large. Some regions show increases in the ratio while others have achieved substantial decreases. For Latin America, the ratio of road transport CO2 emissions to GDP has declined only slightly, by less by 0.5%/year during the years shown. In other words, transport emissions in Latin America have increased at almost the same rate as GDP has grown. Emissions increases were 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. Emissions from other sectors in Latin America grew less rapidly than those from road transport, increasing the importance of road transport to overall Latin America emissions. Can this trend be reversed?

Figure 4 Ratio of Road Transport CO2 Emissions to GDP for Regions, 1990 and 2006



Source: IEA 2009. Note 1990 data for India are from 1996, as previous years contain diesel used in stationary sectors.

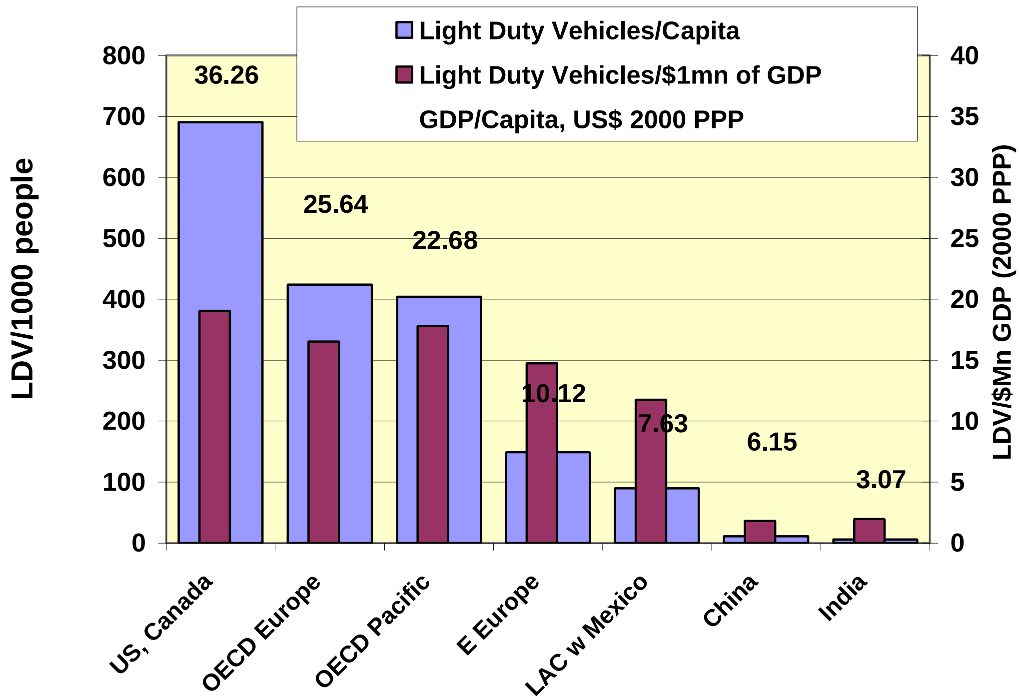
B. Road Transport in Context in Latin America: Motorization and Emissions in Urban Regions

An understanding of CO_2 emissions from road transport in the region requires a clear picture of the vehicle fleet and vehicle use (in vehicle-km). Data on vehicle ownership and yearly usage have been developed by International Energy Agency for the World Business Council for Sustainable Development's "Sustainable Mobility Project" (SMP) (5) and are used here, with some modifications.

i. Vehicle Ownership

Figure 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. Relative to its GDP, Latin America has the highest motorization in the developing world. The high level of motorization in Eastern Europe is explained in large part by a rapid increase in cars bought used after 1990 and 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 so low that the absolute numbers of LDVs in those two giants were still well below the number in Latin America in 2005.

Figure 5 Light Duty Vehicle Ownership vs. Income and Population, 2005, Selected Regions



Source: IEA MoMo Database (6).
Notes: 10-20% of these light duty vehicles are commercial vans or pickups. GDP/Capita in USD $1,000 (2000 PPP) shown above each region.

ii. Vehicle Use and Emissions in Latin America

Data estimated by (5) and more recently refined by the International Energy Agency (6) provide information on vehicle types, their energy intensities, and the average km driven each year for Latin American countries. Estimate of vehicle utilization (passengers/vehicle) give total travel by mode. 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. CO_2 emissions by vehicle type can be calculated from these data. Table 1 presents their results. For the region as a whole, about half of road transport emissions are for passenger traffic, the other half for freight travel. The dominant vehicle type is light duty vehicles, most of which are passenger cars.

Table 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 CO2	Share of total CO2 emissions
LDV Pass.	**40,127**	**13,000**	**2.11**	**155.4**	**41.7%**
Motorcycles	6,948	7,500	0.05	3.0	0.8%
Minibuses	930	40,000	0.21	14.1	3.8%
Busses	511	40,000	0.20	14.5	3.9%
LDV freight	4,459	13,000	0.23	16.2	4.4%
Med Truck	5,385	22,000	1.15	77.6	20.8%
Heavy Truck	2,314	50,000	1.38	92.2	24.7%
Total			5.33	372.9	

Source: WBCSD Sustainable Mobility Project and IEA.

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.

Table 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 CO2	Share of urban CO2
LDV and motorcycles	**80%**	**453**	**2**	**907**	**127**	**61.5%**
Mini Buses	80%	30	20	595	11	5.5%
Buses	50%	10	50	511	7	3.5%
Light Truck	80%	46			13	6.3%
Medium Truck	50%	59			39	18.8%
Heavy Truck	10%	12			9	4.5%
Total		510		2013	208	100*

Source: Original calculations. LDV, or light duty vehicles, include all cars, vans, pickups and SUVs, of which an estimated 10% are for strictly commercial purposes and counted under LDV freight

For this study, we estimated the urban share of traffic (VKT) and emissions, as well as passenger kilometers traveled. The term “urban area” is used loosely here to exclude emissions arising from long-distance intercity road traffic as well as traffic confined to rural areas. To develop these estimates from the SMP data in Table 1, we assumed that 80% of car, motorcycle and minibus use and fuel consumption is in or around urban areas, largely because the incomes to support car ownership as well as mini-bus use are 80% in urban areas. We estimate that 50% of large bus traffic is in cities, while that 90% of the truck activity, the other half of the bus activity, and 10% of car traffic is intercity. To estimate passenger kilometers, we assume the vehicle occupancies shown in the table. Assuming two passengers per car is reasonable, consistent with European experience in the early 1970s (7).

SMP did estimate fuel use/km for each vehicle type. Since congestion tends to be much worse in urban areas than elsewhere, and congestion tends to boost fuel use per km, it was tempting to raise fuel use per km for the urban share. On the other hand, urban vehicles (and roads) may be somewhat newer, cleaner and better maintained than those in rural areas, which would reduce fuel use/km. For simplicity we let these factors balance, and adopted the SMP intensities for urban vehicles. Since urban rail, mostly electric-powered, contributes very little emissions from electricity generated to run it in even countries and cities with the most urban rail, e.g., European countries (or cities like Paris and London), we excluded rail systems. See (7).

Table 2 shows the results. It appears that about 60% of all road transport emissions in Latin America appear to be associated with urban areas, with light duty vehicles responsible for well over half of the urban emissions. Further we estimate that in 2000, two trillion passenger km were produced in these motorized modes in Latin America urban areas.

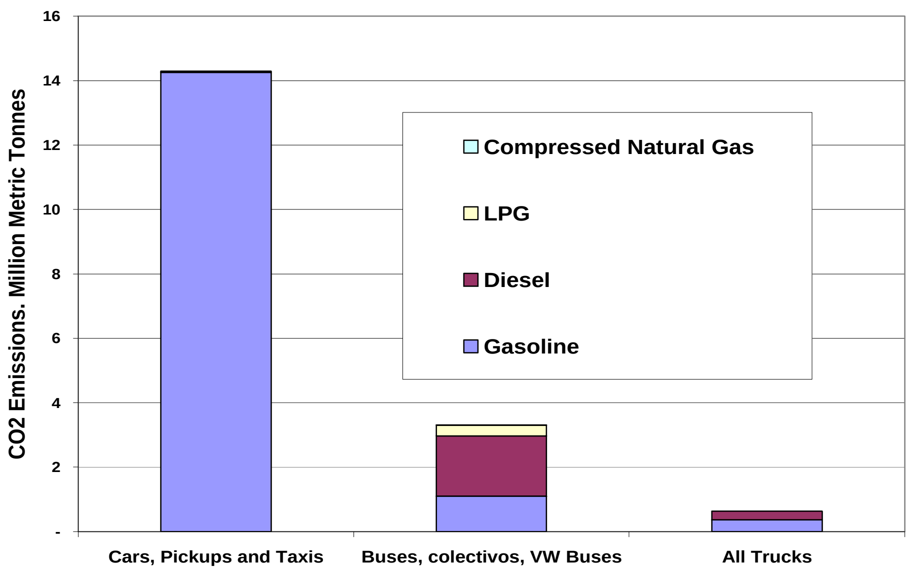
Data from major metropolitan regions of Latin America are consistent with these estimates of urban traffic and emissions. Table 3 and Figure 6 show the data for Mexico City in 2006. The data come from the region’s emissions inventory, which is updated every other year (8).

Table 3 CO2 Emissions, Vehicles, and Traffic, Mexico City, 2006

Vehicle Type	Mtonnes CO2, all fuels	Vehicles (100,000) all fuels	Billion VKT, all fuels
Cars	10.49	3,395.8	46.31
Taxis	2.60	155.1	10.38
VW Bus Colectivos	0.70	39.7	2.64
Other Colectivos	0.74	36.1	2.54
Pick Up	0.83	133.4	3.48
Other veh < 3 t	0.63	81.6	1.80
Truck Tractors	1.63	60.9	1.38
Buses	1.87	43.1	1.79
Other Veh < 3 t	0.54	100.8	2.20
Motorcycles	0.37	180.7	4.47
Totals	20.40	4,227.3	76.98

Source (8). Colectivos are 10-35 passenger vans and small buses.

Figure 6 CO2 Emissions from the Main Classes of Transport Emitters of CO2, Mexico City Metropolitan Area, 2006



Source: Mexico City SMA Emissions Inventory estimated by vehicle, distance, and fuel intensity

These data show that in Mexico City, CO2 from transport arises overwhelmingly (68%) in individual vehicles, i.e., cars, pickups, taxis and motorcycles. Traffic is also dominated by these individual vehicles, which account for almost 83% of VKT. Interestingly, Mexico City car ownership is lower than that in many other large Mexican cities, so the share of emissions in light duty vehicles 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 CO2 emissions than it is in Mexico City.

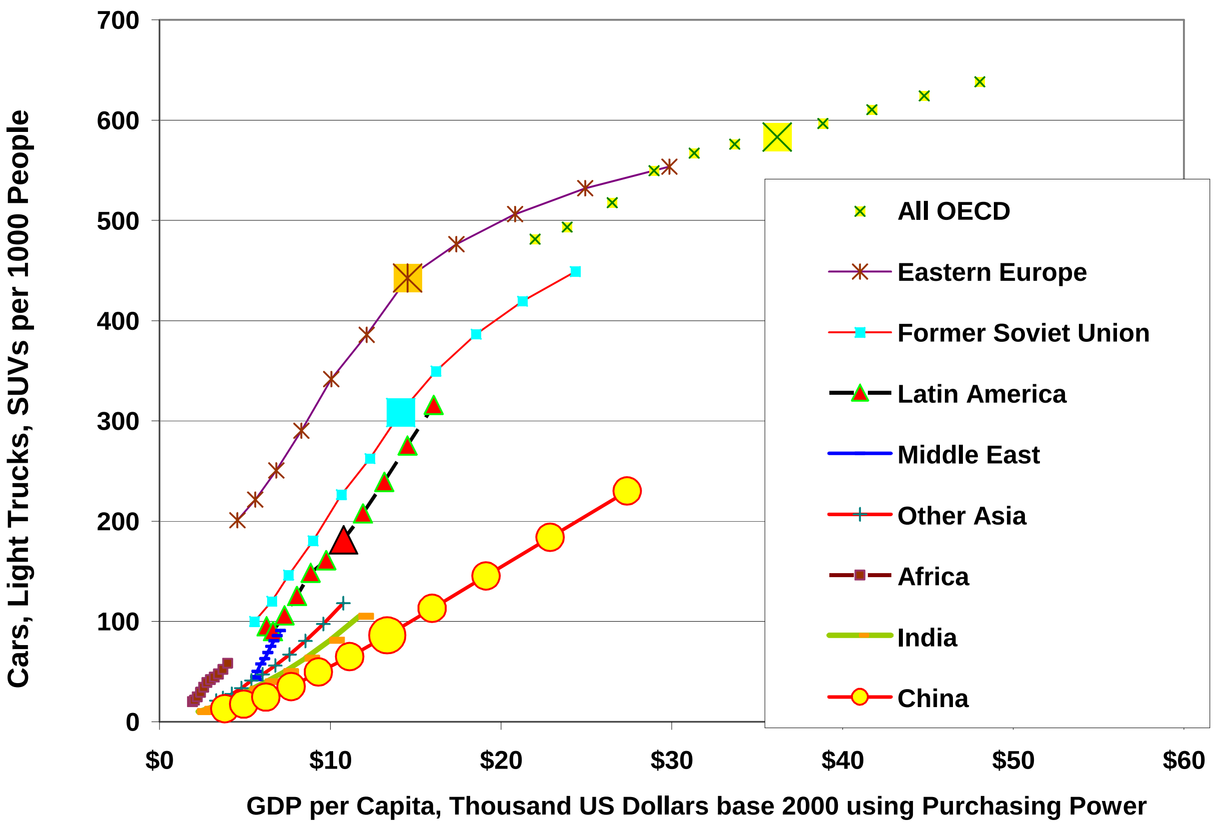
Patterns for Santiago de Chile (9,10), Bogotá (11,12), and Sao Paulo (13,14) are similar. Light duty vehicles account for less than 25% of travel, but more than 60% of VKT and CO2 emissions in these urban areas. Light duty vehicles are at the heart of congestion in Latin American cities (as in most of the world): Unfortunately, Figures 1a and 1e are representative of the region. High car use and high levels of congestion are key reasons why surface transport by bus or trolley sharing the same roadways is slow, and in this case the cars even slow the contra-flow bus lane.

This review of available data provides a strong link between high light duty (car) ownership and use and high CO2 emissions from urban transport suggested by the regional data for Latin America. If the same light duty vehicles are the main components of traffic congestion and many other traffic and transport related externalities, such as air pollution and accidents, then we may be justified in saying that the high CO2 emissions relative to incomes is a symptom of broader transport problems related to the dominance of private cars in urban traffic in Latin America.

iii. Projections of Vehicles and Emissions to 2030 and Beyond

Present trends in the Latin America region point to increasing auto ownership and use. Latin America will probably approach Europe's level of motorization of the1960s by 2030, but with far more urban regions of over 5 million than Europe has even now. In 2004-6, Latin America had four urban agglomerations with over 10 million (Mexico City, Sao Paulo, Buenos Aires, and Rio were all about 10 million). Europe had just one, Paris (just below 10 million). Between 5 and 10 million, Between 5 and 10 million Latin America had Lima, Bogotá, Santiago and Bel Horizonte, while Europe had London and Madrid, with Barcelona at 4.9 million. Latin America had eight more cities among the world's 100 largest urban areas, Europe three more. (15) 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 America cities are daunting.

Figure 7 - Sustainable Mobility Project Projections of Future Light Duty Vehicle Ownership by Region



Source: (8).

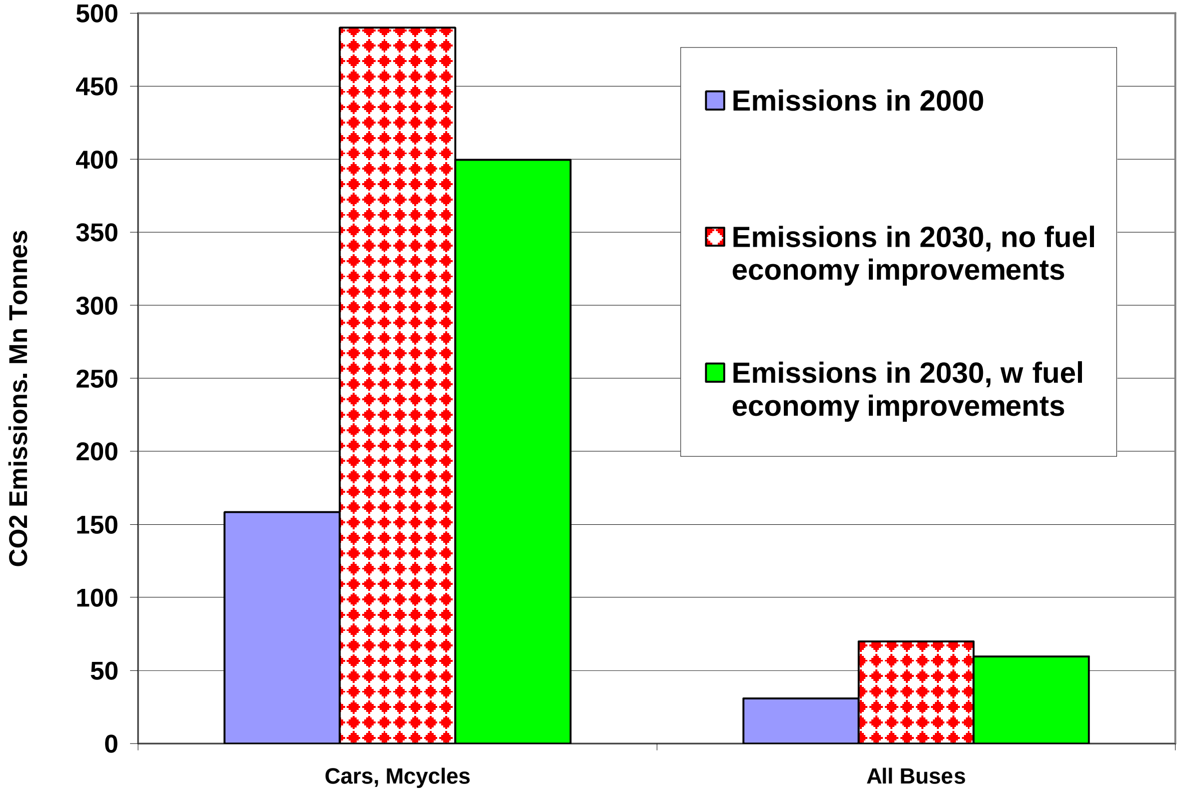
Figure 7 shows SMP projections for light duty vehicle ownership for five year intervals, 2000 to 2050 (5,6). Per capita GDP is on the horizontal axis. The points for 2030 for Latin America, China, the OECD, the Former Soviet Union and Eastern Europe, have been enlarged to stand out. That the slope of the curve for Latin America is steeper than that for most other developing regions means car ownership is expected to increase rapidly relative to GDP.

According to this projection, by 2030, Latin America's per capita income will almost double, with per capita light duty vehicle ownership – predominately cars – rising to 200 per 1000 when Mexico is included, the level of "Eastern Europe" as defined by WBCSD. Further, (5) and (6) project that most of the growth will be in cars and light duty trucks, not two wheelers that characterize Asia. This means that relative to GDP growth 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 same projections foresee a more than tripling of total LDV VKT in Latin America by 2030 and a six-fold 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 (7,16). The projections also see Latin America maintaining the high ratio of LDV to GDP implied by its present position in Figure 7. However, the projections behind Figure 7 did not foresee any major changes to transportation policy that could slow the rise in LDV use. This must mean that left untreated, congestion and other transport problems in urban regions simply will get worse.

In fact, when the projections for vehicles, VKT, and fuel economy for each mode are combined, but no other mitigation is included, emissions from passenger vehicles in Latin America are forecasted to more than double by 2030 despite improvements in vehicle fuel economy (Figure 8). The third bar in Fig. 8 has fuel economy improvements built in while the 2nd bar does not. By 2050 (not shown), emissions are expected increase to four times their current value. Emissions from trucks, not shown, 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 light duty vehicles. Is there any alternative?

Figure 8 Sustainable Mobility Project Estimates of CO2 Emissions from Latin America Road Transport. 2000 Actual and 2030 projected



Source: (5)

C. Mitigation of CO2 Emissions: Complementary Strategies

The SMP projections shown in Figure 8 do imply some restraint in CO2 emissions. On-road fuel economy of light duty vehicles in Latin America is projected to improve from an estimated 11.8 l/100 km in 2000 to about 9.4 liters/100 km by 2030 and to 8.3 liters/100 km over 50 years. The improvement is a drop of some 20% in fuel use per km. For comparison, the EU hopes that by 2030 its fleet will use less than 6.5 liters/100 km on the road, below the present value of 7.8 l/100 km, also a 20% improvement (17). Since cars in Latin America are smaller and less powerful than those in the EU, the high fuel intensity for light duty vehicles in Latin America may seem odd. The explanation appears to be poor traffic conditions, seen in 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 (10, 18) or COPERT and Mobile 6 Mexico (19, 20) show rising fuel use/km with greater congestion. If congestion continues to worsen in Latin America cities, this gap between vehicles' 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 (21).

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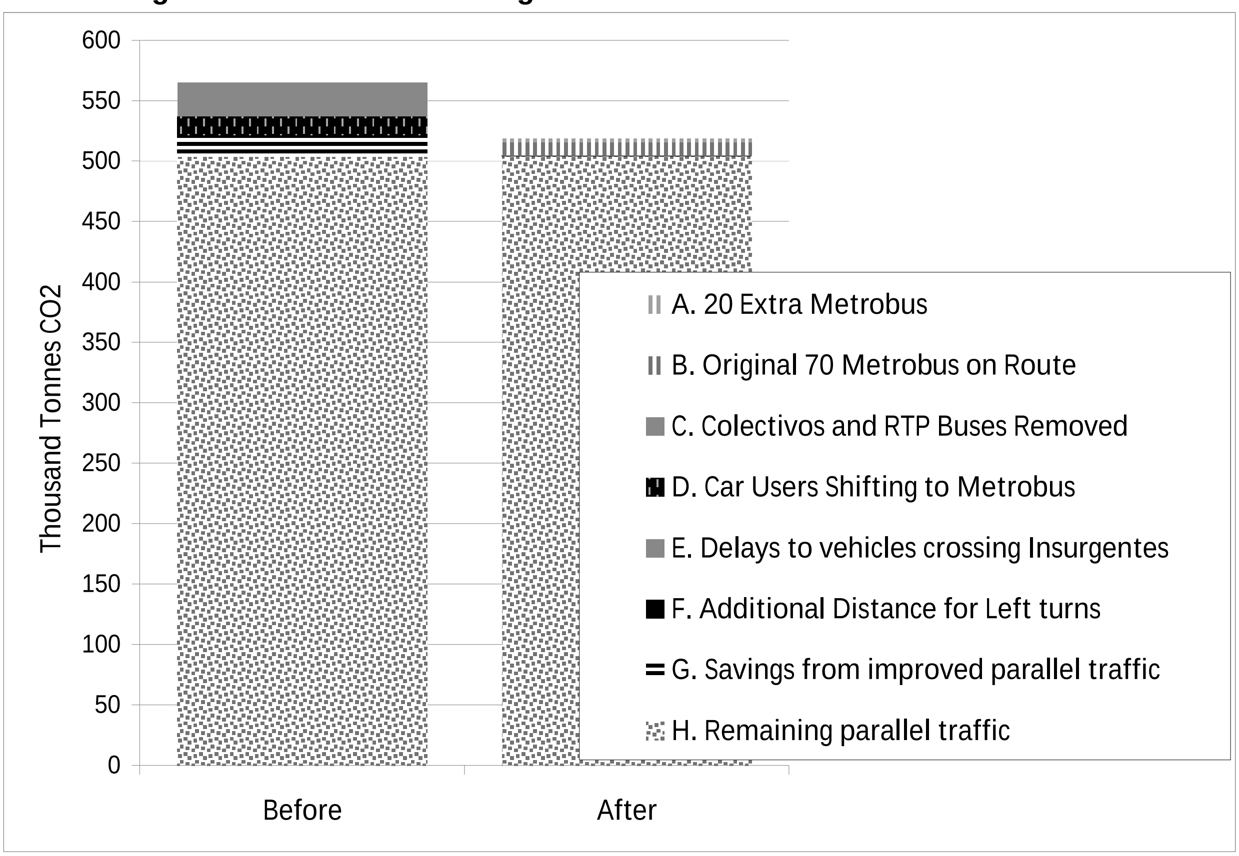
Latin American governments may begin to address the issue of fuel economy directly. Lacy (22) for example has developed a proposed set of fuel economy standards for Mexico consistent with the improvements in fuel economy that went into the projections in Figure 8. As noted, this step still leaves emissions 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 still result in significantly increased emissions in Latin America. This means that there is reason to consider additional interventions to boost fuel economy. Still the large projected increase in car ownership and use is far greater than foreseeable improvements in fuel economy. Can this growth in CO_2 emissions be reduced further by reducing growth in car use?

The answer is ‘perhaps’, if policy makers recognize that is that CO_2 per se is not a driving factor compared for transportation with other externalities or transport variables. Figure 9 illustrates this for a specific project in Mexico City, Metrobús (23). Shown are the components of reductions in CO_2 emissions from introduction of a BRT corridor along one of Mexico City’s busiest routes. Included are the emissions of all vehicles in the corridor before the BRT lanes were created, and after. Roger’s original estimates (20), subsequently updated by him (24) show that this project reduced emissions in the corridor from all traffic by 10%. Of those reductions, about 1/3 came from the direct substitution of 90 large articulated buses for over 300 small buses (“A” “B” and “C” in Figure 9), 1/3 came from bus riders who used to take cars for the same journeys (“D”), and 1/3 came from smoother resulting traffic in the corridor, including some increases arising from problems for cross and left-turning traffic (“E”- “H”). No special steps were taken go use low-carbon fuels, hybrid 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. These reductions illustrate the co-benefits of transport strategies that come at no “cost” to save the CO_2, i.e., they are justified alone as transport measures.

Figure 9. Emissions in Insurgentes Corridor Before and After Metrobús



Source: (20) and (25) as tabulated in (23).

Notes: 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 in the corridor before that were saved because traffic on Insurgentes is smoother after Metrobús is put in place. H gives the remaining emissions from all parallel traffic on Insurgentes.

When the results are monetized, the perspective changes. Table 4 shows the results. The National Institute of Ecology (25) estimated time savings using a value of time of approximately 60 US cents/hour and other values for reduced road wear and health benefits of lower air pollution. Excluded are any value to fewer crashes and reduced loss of life, important variable not addressed in the INE study. To the benefits we add the value of fuel saved by buses, parallel traffic, and consumers who left their cars at home. In addition we include the CO2 savings from Figure 9 at a value of $5/metric tonne of CO2 and at $85/tonne. The former value is what Mexico City received for savings from a carbon fund and below what an economic study of climate change uses (26). The latter is the much higher estimate developed by the Stern Report (27). It is notable that even when CO2 is valued at the high end it only comprises about 20% of the total benefits shown; at the lower end its value almost cannot be seen. Estimates form the US, Canada, and Europe find the same relatively low value of the CO2 externality, when compared with other externalities of transport on a per kilometer basis (28-31) With CO2 valued so low compared with other transport benefits, CO2 saved from improved traffic and transport can be seen as an important co-benefit of good transport strategies, but will not be a driving force in project selection and design.

Table 4. Annual Benefits of Metrobús Project

Nature of annual benefit or savings	**Low CO2 value (USD $5/tonne)**	**High CO2 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
CO2 reduction from bus switch	$0.09	$1.75
CO2 reduction, mode shift car to bus	$0.13	$2.58
CO2 reduction in parallel traffic	$0.05	$0.87
Co2 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: CO2 and fuel calculations made in this study,
Based on (24) and (26) as complied in (23).

In considering what buses to use for Metrobus, [23] considered how much energy and CO2 emissions would have been saved if parallel hybrid buses were employed. Based on experience of hybrids in other regions, it was estimated such vehicles would have saved an additional 3000 tonnes of CO_2/year. These savings, however, would have cost at least an additional $10 million for the hybrid buses then available. Even counting the significant savings of fuel, adding the hybrid option would be expensive. While it should be considered, planners should also ask whether the same expenditures, if devoted to better station access or other aspects of Metrobus service might actually be more cost effective by attracting more riders. Considering technical options for saving CO_2 and fuel together with options that improve overall system performance might reveal system improvements that give more total benefits than CO_2-oriented technology measures alone.

D. Summary: The Transport - CO2 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 light duty vehicles in Latin America are also high. In urban regions, around 70% of CO_2 emissions from road transport arise from the use of light duty vehicles, which are by far the most common vehicle on the streets and in general the greatest contributors to both congestion and pollution as well. What the aggregate data show is that 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 somewhat, which would reduce CO_2 emissions as well.

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

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 increased 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, vehicle use, or both.

Additional CO_2 reduction can be attained through well-planned urban transport investments. Many Latin America 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 America 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 bus rapid transit. These activities improve transport while reducing carbon emissions, and their success puts pressure for change on countries that have been slow to adopt carbon reduction policies.

The challenge for authorities in Latin America and other regions is to make the transport changes suggested by the externalities illustrated in Table 4 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 alone are so small? And given the slow progress in improving transport all through the developing region, as argued in this paper for Latin America, can carbon make a difference? A recent World Bank Urban Transport Strategy makes the case for strong measures to make individual vehicle users face the externalities they cause on other travelers, who are the majority in Latin American and other developing cities (32). Following their advice may provide larger carbon restraint as a co-benefit than any other group of measures.

Reference 1 charts out the progress of bus rapid transit as one of many important transportation measures spreading in cities around the world. A more recent update for Mexico alone by the “Fonadin” (the national fund for infrastructure (33) projects more than 2.2 million new trips/day on BRT and over 1.2 million trips/day on rail lines in Mexico’s major cities. Such changes must of necessity take road space (and other resources) from cars. The experience from Metrobus suggests the good outcome there gives political momentum to this refocusing of transport planning and infrastructure development.

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.

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