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Implementation of sustainable urban transport in Latin America

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ABSTRACT

Transportation provides vital support to the economic and social development of Latin America cities, but current growth patterns and trends are not sustainable. While non-motorized and public transport modes have the largest shares in passenger transport, there is a strong increase in ownership and use of cars and motorcycles. In Latin America in 2010 there were 2.5 new motor vehicle registrations for every new child being born.

Motorization results in congestion, air pollution, and greenhouse gas emissions. In addition, motorization increases the use of fossil fuels and results in reduction of physical activity, which in turn increases obesity and related illnesses. Costs of negative externalities are estimated to be around 18% of the average income of 15 selected cities in the region. There is a direct relation between fatalities and air pollution with automobile use, so curbing motorization might prove beneficial for the society at large.

There is considerable evidence from Latin America that it is possible to modify motorization trends. This can be done through reallocation of resources already dedicated to transportation to emphasize the provision of access for people and goods rather than maximizing transport activity. Mainstreaming sustainable transport will benefit from cooperation among countries – as it was agreed in the Bogotá Declaration (Foro de Transporte Sostenible de América Latina, 2011). It will also require improved information and institutions, and support from the international community, through focused financial instruments, development assistance and technical cooperation.

1. Introduction

Transport is at the heart of human development and economic activity. However the current transport patterns, based primarily on automotive transport powered by fossil fuels, generate multiple social, economic and environmental impacts, and are not sustainable (Dalkmann & Sakamoto, 2011). Transport planning and investment therefore requires a paradigm shift, to favor access rather than mobility, focus on efficient modes of transport, and promote low carbon and clean vehicles and fuels. This paradigm shift can be summarized in three types of actions: avoid long and unnecessary motorized travel, shift the movement of goods and people to most efficient modes and improve the technology and operational management of transport services (Dalkmann & Brannigan, 2007).

This paper recognizes the multiple dimensions of urban transport; provides a definition of sustainable transport consistent with the human and economic development needs of countries in Latin America; presents a diagnosis of current conditions of selected countries and cities in the region; lists examples of best practices in Latin America and assess the status of sustainable urban transport policies; and presents a strategic framework for sustainable growth of the transport sector which was agreed by representatives of 8 governments in South America and México in September 2011.

As most Latin American cities are at an intermediate stage of development, they have the opportunity to develop their transport systems in a manner consistent with the principles of the Avoid–Shift–Improve paradigm. If so, they can avoid large negative impacts associated with unchecked growth of motorization and forego major and much more expensive retrofits of their transport systems and urban fabric later on, as has been the case in other developing and industrialized nations. There are good practices across the region, by they remain dispersed, and often secondary to road expansions. There is an opportunity to scale up these initiatives into mainstream practices. This requires, however actions on policy, financing and institutional development.

2. A vision toward sustainable urban transport

There are many definitions of sustainable transport, derived from the general concept of sustainability: meeting current needs

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Table 1
Population and urbanization for South American countries and México (2010).

	Population (2010)	Percent urban population (2010)
Argentina	40,738,000	93.11
Bolivia	10,131,000	66.39
Brazil	195,498,000	85.01
Chile	17,133,000	87.52
Colombia	46,299,000	78.51
Ecuador	13,773,000	65.00
Paraguay	6,460,000	61.42
Peru	29,495,000	73.37
Uruguay	3,372,000	92.41
Venezuela	29,043,000	93.59
México	112,323,000	78.81

Economic Commission for Latin America and the Caribbean, ECLAC, 2011.

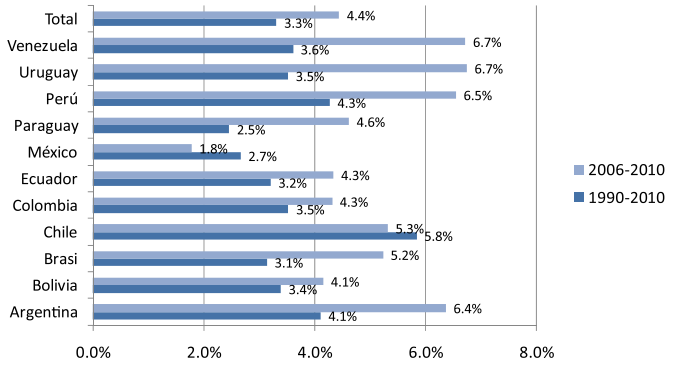

Fig. 1. GDP annual growth in South America and México 1990–2010 and 2006–2010 (Economic Commission of Latin America and the Caribbean, ECLAC, 2011).

without compromising the ability of future generations to meet their own needs (United Nations, 1987). Some of these definitions have been compiled by Litman (2011). In line with the many definitions of sustainable transport, government representatives of 8 South American countries and México embraced the following definition (based on Dalkmann & Huizenga, 2010): "*the provision of services and infrastructure for the mobility of goods and people, needed for economic and social development and for improving quality of life and competitiveness. These services and transport infrastructure provide safe, reliable, economical, efficient, equitable and affordable mobility, while mitigating the negative impacts on health and the local and global environment, in the short, medium and long term without compromising the development of future generations*." (Foro de Transporte Sostenible de América Latina, 2011).

This understanding of sustainable transport is consistent with the principles of the "Green Economy" (UNEP, 2011). The Secretary General of the UN in his report on the objective and main themes of the Rio+20 UN Conference on Sustainable Development stated "*Green Economy in the context of Sustainable Development and Poverty Eradication is broader than simply low-carbon growth. The social dimension and poverty eradication remain paramount for most developing countries*". (UN General Assembly, 2010) This makes the transport sector an excellent fit for the green economy theme of the Rio + 20 conference. The main driver for development of the transport sector in developing countries has been and continues to be to enable, facilitate and catalyze economic and social development.

Urban transportation is at the intersection of human development and the environment and both need to go forward in a balanced way. This is not the current situation: there is a deep imbalance created mainly by the heavy reliance on motorized transport powered by fossil fuels. The prevailing paradigm results in high inefficiency in the freight and passenger transport; high logistics costs; congestion; air pollution; road traffic deaths and injuries; high energy consumption and increase in greenhouse gas emissions. The negative impacts are particularly strong in the most vulnerable population: children, elderly, disabled and low-income population (Dalkmann & Sakamoto, 2011).

It is not likely that the situation in developing and emerging countries will improve under the current transport paradigm and the pressures arising from rapid economic growth (Candiracci, 2009). As a result, it is expected to have further increased congestion, pollution, crashes, negative health impacts, energy consumption and greenhouse gas emissions. For example, the World Health Organization projects that road crashes will be the fifth leading cause of death in 2030, with over 2 million deaths a year (WHO, 2004). Meanwhile, the International Energy Agency, projects that energy consumption from transport under the Business as Usual scenario will increase by 50% by 2030 and 80% by 2050, with the majority of these increases coming from the expansion of individual motorized transport in developing countries (IEA, 2010).

This can change. Studies informing the document "Transport: Investing in Energy and Resource Efficiency, Green Economy Report, UNEP" (Dalkmann & Sakamoto, 2011), show that by making use of available resources (USD 419 billion per year for the next 40 years) and introducing enabling policies, it is possible to achieve a 68% reduction in overall greenhouse gases emissions (8.4 Giga

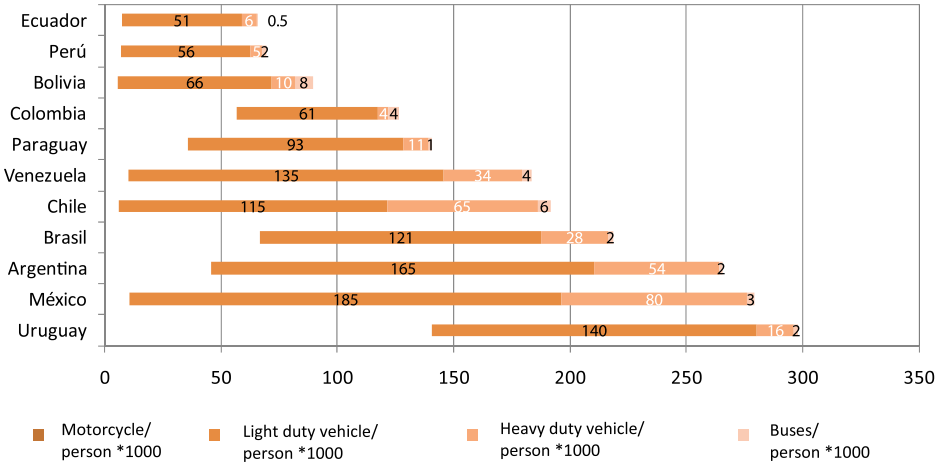

Fig. 2. Motorization by type of vehicle (FTS survey, ECLAC, 2011; UNCRD-IDB, 2011).

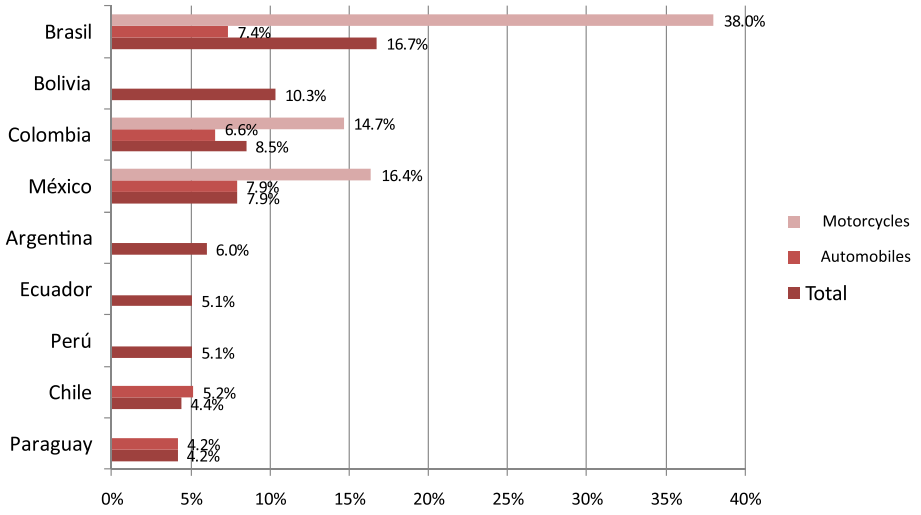

Fig. 3. Annual growth rates of motor vehicles 2000–2010 (FTS survey, UNCRD-IDB, 2011).

tones of CO_2), with respect to the trend line scenario (BAU 2050). Moreover, this reallocation involves employment gains of around 10%. These estimations do not include positive impacts on accessibility and health, which are also very high. The potential to reduce Greenhouse Gas emissions in the transport sector has been demonstrated in a range of studies (Huizenga & Bakker, 2010).

3. Sustainable urban transport conditions in Latin America

3.1. General conditions

While countries in Latin America share similar characteristics, they are important differences in population – from 3 million in Uruguay to 195 million in Brazil, and urbanization – from 61% in Paraguay to 93% in Venezuela and Argentina (Table 1). In 2010, 82% of people in South America and México lived in urban areas (ECLAC, 2011). This makes it the most urbanized developing region of the planet, and one which is characterized by large economic and social inequality.

The urban population of Latin America and the Caribbean is expected to further increase from 394 million in 2000 to 609 million in 2030 and most of this natural growth will occur in medium-sized cities (Candiracci, 2009).

The countries in Latin America have had a moderate economic growth of 3.3% annually over the past 20 years and 4.4% annually between 2000 and 2005 (ECLAC, 2011). There are variations between countries (Fig. 1). The largest average annual growth over the past 20 years was in Chile (5.8%) and the lowest in Paraguay (2.5%). It is worthwhile to note that the global economic crisis has not affected growth trends in most countries. The most notable exception is México.

Sustained economic growths in combination with urbanization have placed considerable pressure on both transport infrastructure and services in Latin America. In general the countries and cities have not been able to keep up with the increased travel demand resulting from a larger and more affluent urban population.

3.2. Urban transport supply indicators

3.2.1. Motorization

Motorization levels in South America and México are still low relative to industrialized countries, where often more than 600 cars per thousand inhabitants can be found (Schipper, Deakin, McAndrews, & Frick, 2010). Vehicle ownership ranges from 66 vehicles per thousand inhabitants in Ecuador to 298 vehicles per thousand inhabitants in Uruguay (UNCRD-IDB, 2011; Fig. 2). The higher number for Uruguay is explained by the high ownership rates of motorcycles (141 per thousand inhabitants) and light vehicles (140 per thousand inhabitants). The country with the highest relative number of cars is México with 185 per thousand persons. It is important to note that the reliability of data on vehicle ownership is low, as they usually refer to the initial registration and not the actual number of vehicles on the road; in many cases there is no annual registration of vehicles and vehicles no longer in use are not removed from the registry.

Although indicators show relatively low levels of vehicle ownership, annual growth is high (UNCRD-IDB, 2011, Fig. 3). Countries report annual growth between 4% (Paraguay) and 17% (Brazil). This growth is mainly driven by increases in light duty vehicles and motorcycles. The annual growth in motorcycles is extremely high in Brazil (38%), México (16%) and Colombia (15%). These countries have seen a decline in road safety indicators.

The average age of the vehicle fleet is high (Table 2). Of the countries which reported average vehicle ages Ecuador was the lowest with 10 years and Bolivia the highest with 23 years. A considerable problem is several of the countries is the import of second-hand vehicles: 40% of the vehicles registered in México are imported second-hand from the USA (CTS México, 2011).

There is also great variation in the type of fuel used between countries. Bolivia, Brazil, Chile, Ecuador, Peru and Uruguay are dominated by gasoline vehicles. In Argentina, Colombia and

Table 2
Average age of fleet and type of fuel vehicle (or fuel sales) in 2010.

	Fleet average age (years)	Fuel participation according to	Gasoline	Diesel	Biofuel	CNG	Other
Argentina	19.5	Sales	21.1%	65.9%	0.0%	13.1%	0.0%
Bolivia	23.0	Vehicles	79.6%	18.9%	0.0%	1.7%	0.0%
Brazil		Vehicles	58.5%	12.1%	4.5%		24.9%
Chile	11.1	Sales	79.5%	20.3%	0.0%	0.1%	0.0%
Colombia		Sales	41.8%	58.0%			0.2%
México		Vehicles	97.1%	2.5%		0.04%	0.3%
Ecuador	10.0	Vehicles	88.8%	11.1%	0.0%	0.0%	0.1%
Paraguay	14.2	Sales	31.0%	65.6%	0.0%	0.0%	3.5%
Peru	17.0	Vehicles	79.4%	14.0%	5.3%	0.4%	1.0%
Uruguay		Vehicles	80.0%	20.0%	0.0%	0.0%	0.0%

Note: others include flex-fuel, liquefied gas GLP and electric. In Brazil all "other vehicles" are flex-fuel vehicles (FTS survey, UNCRD-IDB, 2011).

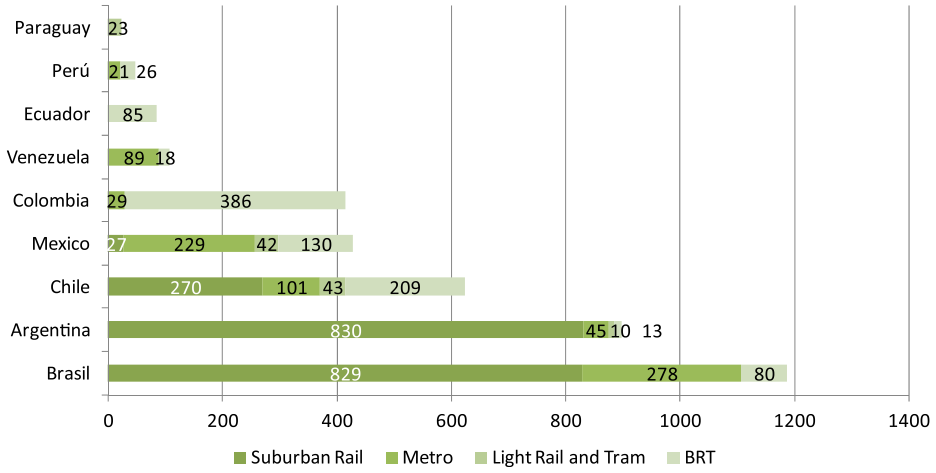

Fig. 4. Mass transit supply in selected Latin American countries (FTS survey, UNCRD-IDB, 2011).

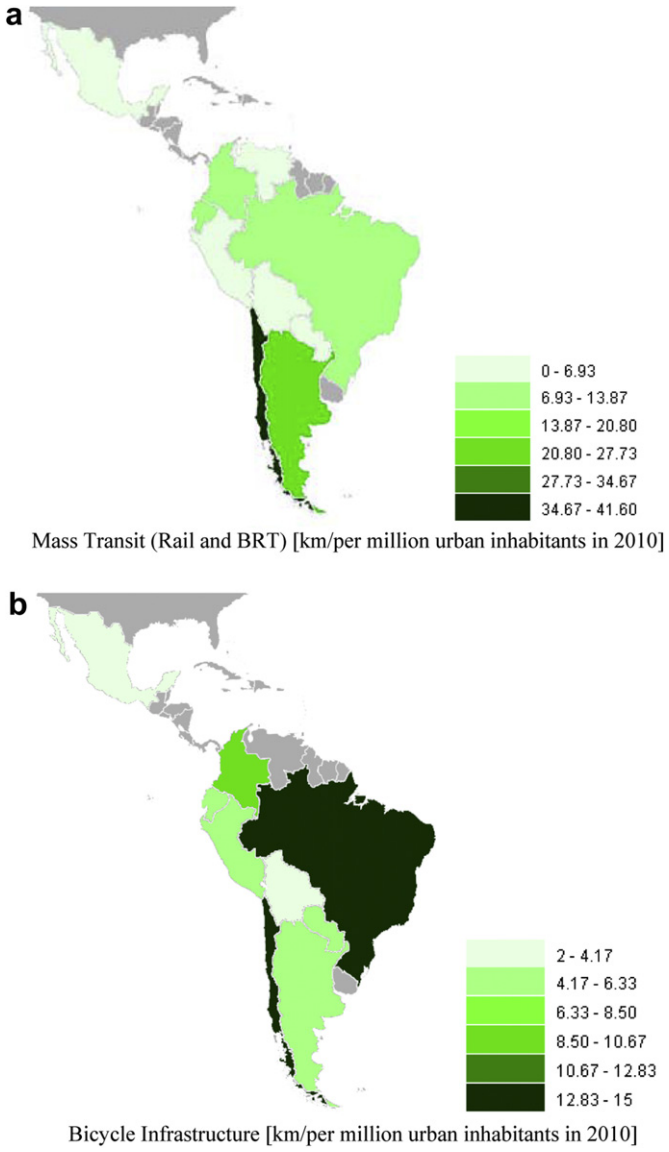

Fig. 5. Availability of mass transit and bicycle infrastructure (FTS survey, UNCRD-IDB, 2011).

Paraguay diesel dominates fuel sales. With the exception of Argentina, there is a low penetration of compressed natural gas (CNG).

As for biofuels, Peru reports 5% and Brazil 4.5% of dedicated biofuel powered vehicles (mainly ethanol). Brazil has a very high number of flex-fuel vehicles (24.9%) which operate on both gasoline and ethanol although detailed numbers of the relative use of gasoline and ethanol in these vehicles are lacking. It is noteworthy that all countries mix ethanol in the gasoline (approximately 10% in volume).

Biofuels, such ethanol, are considered renewable sources of energy, but are likely to generate changes in agricultural cropping patterns and land management practices, possibly further threatening our natural resource base (WRI, 2010). It is not clear, how production decisions and policy developments surrounding the expansion of the ethanol industry will affect the environment, especially water quality and climate change. There are also impacts on the food prices. These concerns are particularly relevant with corn based ethanol, and in lesser degree with other feedstock (WRI, 2010).

3.2.2. *Sustainable urban transport infrastructure and services*

Countries included in the FTS survey (UNCRD-IDB, 2011) reported a total of 42 cities with mass transit (rail and Bus Rapid Transit – BRT) and 327 cities with bike lanes (85% in Brazil). In terms of total kilometers, the largest mass transit availability is in Brazil (829 km suburban railway, 278 km Metro and 80 km of BRT, in a total of 16 cities, Fig. 4). Argentina has the largest suburban rail network (830 km). The largest extension of BRT corridors is in Colombia (386 km in 6 cities).

Availability of mass transit ranges between 2.2 and 41.6 km per million urban inhabitants (Peru and Chile, respectively; no mass transit in Uruguay and Bolivia; Figs. 4 and 5). Availability of bike lanes ranges from 2 to 15 km per million urban inhabitants (México and Brazil, respectively; no report on Uruguay; Fig. 5).

While the length of metro and suburban rail systems has not grown substantially in the last decade, both BRT and bike lanes have grown explosively and there are signs that this growth will continue in the coming decade. It is expected though, that the emphasis will shift from the establishment of new systems to expansion of existing ones and integration with the rest of public transport.

3.3. *Urban transport modal split*

Data on urban modal split is not consolidated by the national governments, but there have been efforts to collect the data

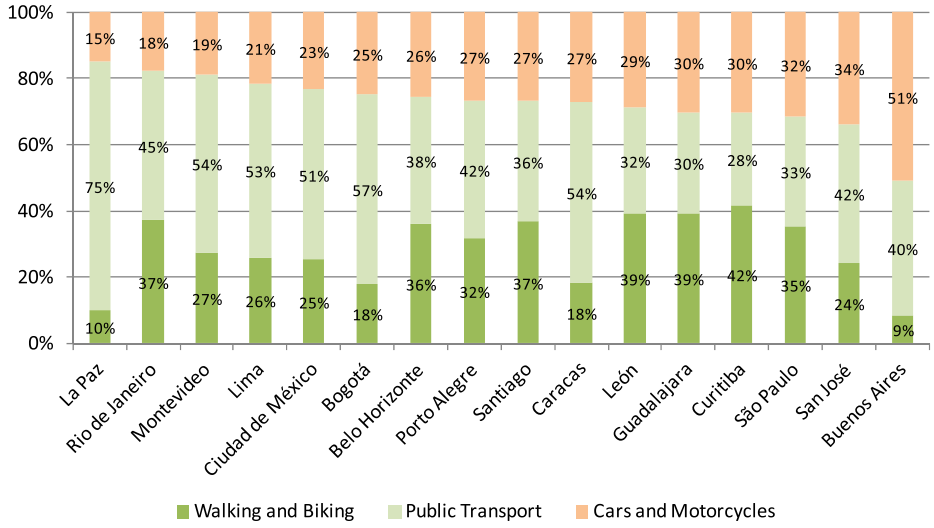

Fig. 6. Modal share for passenger urban mobility in selected cities (2007) (OMU CAF, 2010 – all cities except La Paz; FTS survey, UNCRD-IDB, 2011 for La Paz).

systematically in several cities (OMU CAF, 2010). In a sample of 16 cities, walking and cycling is still an important form of urban transport; in the case of Santiago its share is 37%. In all cities public transport share is over 40% (Fig. 6); in the case of La Paz it is 75%. Buenos Aires is the only city that reports the majority of trips by individual motor vehicles; the share of individual car and motorcycle trips is still below 34% for all the other cities.

Data indicates that the Latin American cities still have relatively sustainable modal shares, but face strong pressures of urban expansion and motorization, as indicated above. It is also important to indicate that, with the notable exception of Brazilian cities and Santiago, public transport is dominated by small private operators, using medium size vans (combis) or minibuses under dispersed ownership (one vehicle–one owner). These operators compete for passengers in the street (competition in the market), under informal economic rules. This causes severe negative externalities: congestion, pollution, and accidents.

3.4. Transport externalities

There are no consistent performance indicators available in Latin America which can be used for a comprehensive documentation and comparison of urban transport sector outputs and externalities. There are efforts to cover this information gap, like the Latin American Urban Transport Observatory (OMU CAF, 2010), which has collected consistent data on 15 cities with an aggregate population of 107 million people. A summary of transport externalities: travel time, traffic fatalities, and pollutant emissions, and their equivalent economic value are presented in Table 3. There are large variations among cities.

The city with the smallest aggregated externalities per person (under the data and assumptions used in this estimation) is Curitiba USD 591 per person per year, reflecting average travel times of 40 min per person per day, 4.2 fatalities per year per 100,000 population and aggregated emission costs of USD 52 per person per year.

The city with the largest externalities per person is México City with USD 1326 per person per year, as a result of 88 min per person per day, 11 traffic fatalities per year per 100,000 population and aggregated emission costs of USD 73 per person per year. Santiago has relatively low emissions and fatalities, but large travel time (87 min per person per year), resulting in high aggregated externalities (USD 1156 per person per year).

Fig. 7 indicates the economic value of externalities as compared with the average income for selected cities. Externalities represent between 10% (Caracas) and 29% (Lima) of the average income. In average for the 15 cities in the sample externalities represent 18% of the average income, a relatively high toll on the society.

3.5. Analyzing drivers of transport externalities

The data set collected by CAF (OMU CAF, 2010) contains a large number of variables; nevertheless, it only covers 15 cities, providing insufficient data for statistical analysis. However, it allows the identification of some relationships among variables. Fig. 8 presents the relationship between the automobile kilometers per day per person and the externalities (travel time, fatalities and pollution), as well as the relationship with the aggregated economic value of externalities for 15 selected cities.[1]

Road fatalities, pollution and total externalities show a direct relationship with vehicle kilometers per day per person (Fig. 8). More automobile kilometers increase the exposure to road incidents, and fuel consumption and emissions. There is a lot of variability not explained by automobile kilometers traveled, however. The age and type of the fleet, increase in motorcycle fleet, dispersed management and informality of small public transport vehicles, infrastructure quality, operational practices, rules, education and enforcement, among other variables will affect the externalities as well.

In the case of travel time automobile kilometers do not generate any significant difference. This is the result of the relative high use of public transport, but also of the dynamics of automobile use. At the beginning the shift to automobiles may reduce travel times, but increased automobile use on limited road networks results in congestion. Once high level of congestion is achieved, the initial time savings are lost, as suggested by the flat trend (Fig. 8).

Similar analyses are possible for other variables. With the limited data set (OMU CAF, 2010), it is possible to say that metropolitan area, density, modal shares and availability of mass transit, by themselves do not significantly explain externalities (travel time, road fatalities and emissions). Nonetheless, more information is required to confirm this statement.

[1] Belo Horizonte, Bogotá, Buenos Aires, Caracas, México City, Curitiba, Guadalajara, León, Lima, Montevideo, Porto Alegre, Rio de Janeiro, San Jose, Santiago and São Paulo.

Table 3
Transport externalities in selected cities (2007).

Metropolitan areas	Travel time	Traffic fatalities	CO	HC	NO_x	SO_2	PM	CO_2	Economic value
	Minutes/person/day	Deaths/100,000 people /year	Ton/million people/day						USD/person/year
Belo Horizonte	46.00	7.30	35.0	8.33	5.18	0.187	0.312	813	709.56
Bogotá	67.93	6.94	71.0	9.76	7.02	0.243	0.141	1021	983.17
Buenos Aires	64.62	6.92	74.9	19.82	9.20	0.633	0.693	1733	962.11
Caracas	62.20	5.96	126.4	20.29	8.61	0.765	0.444	1284	927.38
México City	87.57	11.29	128.3	20.77	8.40	0.400	0.426	1328	1325.51
Curitiba	40.41	4.20	39.1	9.47	4.60	0.174	0.313	775	591.10
Guadalajara	65.60	15.84	93.0	9.58	8.46	0.229	0.343	1142	1114.33
León	60.99	14.33	57.4	6.32	6.32	0.147	0.221	822	1014.99
Lima	72.85	6.32	96.1	8.58	10.55	1.627	0.625	1441	1049.79
Montevideo	45.18	10.78	39.4	6.18	4.45	0.603	0.528	668	758.49
Porto Alegre	40.26	11.40	51.8	12.58	6.10	0.293	0.410	1040	719.64
Rio de Janeiro	59.72	12.29	63.4	14.00	9.84	0.318	0.468	1449	981.47
San José	45.86	7.93	65.3	10.49	6.37	1.088	0.699	1099	735.77
Santiago	86.59	5.35	11.6	1.28	2.17	0.348	0.232	1036	1156.22
São Paulo	55.56	14.20	68.6	16.93	6.19	0.490	0.437	1200	961.90
Average	**66.00**	**9.60**	**78.1**	**14.34**	**7.56**	**0.512**	**0.440**	**1264**	**1014.40**

Note: data on travel time, fatalities and emissions from OMU CAF (2010), economic value estimated by the authors. Assumptions: 310 days per year; value of time: USD 2.35/h; value of life: USD 1673.584/fatality; value of emissions: carbon monoxide (CO) – USD 1000.0/ton; hydrocarbons (HC) – USD 2200.0/ton; nitrogen oxides (NO_x)-USD 2500.0/ton; sulfur dioxide (SO_2) – USD 800.0/ton; particulate matter (PM) – USD 30,500.0/ton; carbon dioxide (CO_2) – USD 20.0/ton.

4. Looking into the future of sustainable transport in South America and México

4.1. Current trends on urban transport in Latin America

The development of urban transport in Latin America will be guided by a moderate urban population growth (1–3% annually, according to ECLAC, 2011) and a moderate to high economic growth (ranging from 4 to 6% annually, according to ECLAC, 2011). This will generate increased demand for freight and passengers transport, especially inside cities. Such economic growth is very crucial for the reduction of poverty.

Current trends and experience from other countries indicate that private travel modes will continue growing, if no action to curb motorization is taken and no alternative modes of transport provided. In some countries the number of motorcycles increases more than 10% annually and the average growth rate of light duty vehicles is around 6%. There is also a proliferation of small public transport vehicles.

Ability of governments to fund road expansion according to the unabated motor travel demand needs is limited. As a result, a business as usual scenario (high motorization rate with low growth of road transport infrastructure) will exacerbate congestion, air pollution, road fatalities, lack of physical activity, fossil fuel consumption, and greenhouse gas emissions. It will also impact vulnerable populations the most, and will lock cities in a pattern of social exclusion.

South America and México are estimated to have on the order of 77,000 deaths a year from traffic accidents in 2020, if current rates are kept constant (Hidalgo, 2011) – a modest assumption in the face of rapid motorization, particularly increase of motorcycle use. It will also double greenhouse gas emissions from the transport sector in 2030 despite improvements in vehicle fuel economy (Schipper et al., 2010).

At the same time, adaptation to climate change will become increasingly important as transport infrastructure is particularly vulnerable to climate change. Extreme weather events are

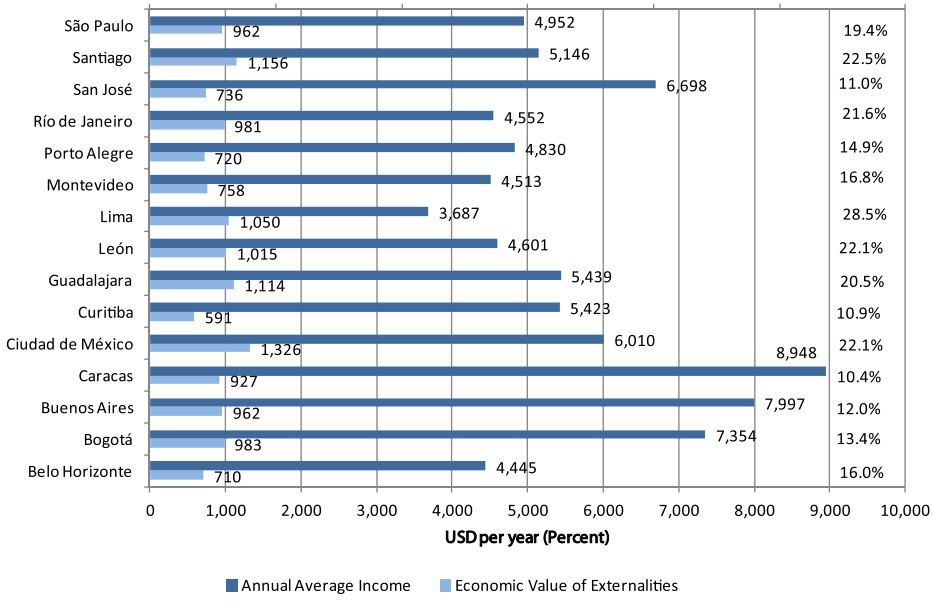

Fig. 7. Economic value of externalities and average income for selected cities (2007) (based on data provided by OMU CAF, 2010).

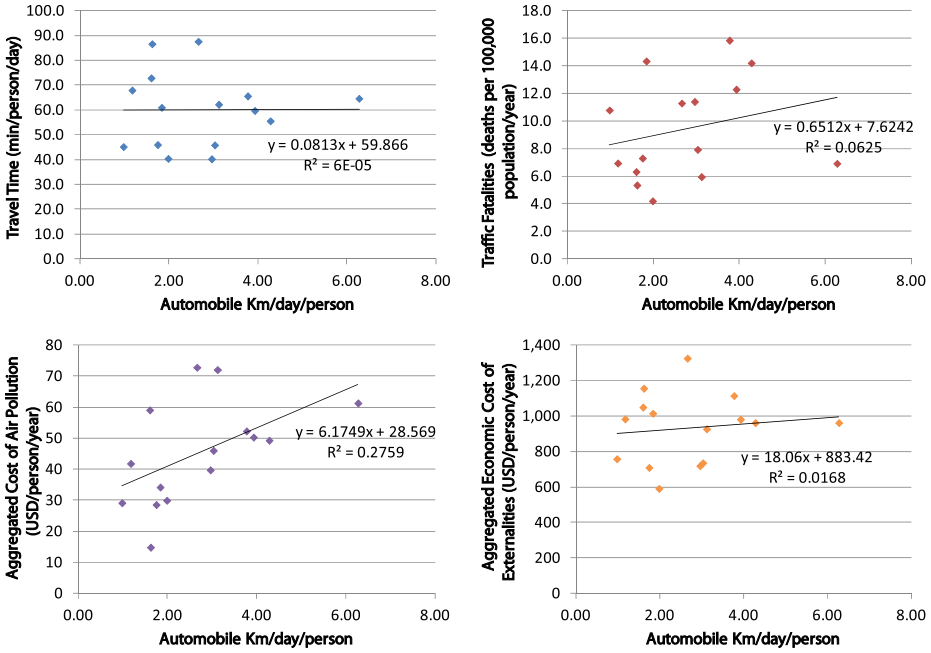

Fig. 8. Relationship between automobile use and externalities for 2007 (based on OMU CAF, 2010).

becoming more frequently in the region, causing landslides and floods and rapid deterioration of the road networks.

4.2. Avoid–Shift–Improve approach and its growing application in urban transport in Latin America

Some local and national governments in the region are taking action and shifting the prevailing paradigms toward a more sustainable growth trajectory (Table 4). The paradigm shift entails a concerted approach to favor accessibility over mobility, prioritizing efficient modes of transport and promoting low carbon and clean vehicles and fuels and transport operations. The paradigm shift can be summarized in three types of actions: to *avoid* long and unnecessary motorized travel, *shift* the motor vehicle growth trends, and *improve* the technology and operational management of transport activities (Dalkmann & Brannigan, 2007).

This policy approach, which was originally used to promote the environmental sustainability of transport, also works well to stimulate the social and economic sustainability (Dalkmann & Sakamoto, 2011). For instance, shifting transport of passengers from individual cars to public transport has a positive impact on road safety. As fossil fuel prices increase such shifts will also improve the economic sustainability of transport, whether the fuels are subsidized – cost for government, or not – cost for transport users.

Enabling factors for the Avoid–Shift–Improve approach involve enhanced institutional capacity among relevant departments, and well established coordination mechanisms among transport, health, environment, finance and planning agencies at various levels of government.

There is great deal of experience in Latin America with sustainable transport best practices that fit under the three main components of the Avoid–Shift–Improve approach. Latin America is especially advanced in the implementation of Bus Rapid Transit, with 17 cities with operational systems, inspired in Curitiba and Bogotá.

Despite the advances, there is still a long way to go, especially the introduction of demand management measures, as those implemented in Singapore (vehicle registration caps and dynamic congestion pricing), London (congestion pricing), Milan (air pollution pricing) and San Francisco (parking controls with dynamic pricing). Several cities have introduced some type of administrative restrictions using license plate numbers; nevertheless these experiences have proven non sustainable in the medium and long term (Mahendra, 2008) or even negative regarding its intended purpose. For instance the plate restriction mechanism imposed in México City (Hoy no Circula) has actually increased air pollution (Davis, 2007).

4.3. Mainstreaming of Avoid–Shift–Improve approach in national urban transport in South America and México

Following the assessment of the implementation of the different components of the Avoid–Shift–Improve approach it is possible to make a comparative assessment of urban transport related policies in Latin America with the objective to determine their progress in re-orienting their policies and actions toward sustainable urban transport (see Table 5). Countries are divided in 3 categories:

- Intermediate: countries which have made considerable progress in institutionalizing sustainable transport in policies and/or financing in all three components of Avoid–Shift–Improve. Implementation of sustainable urban transport has gone well beyond the stage of pilot testing. Countries in this category include: Brazil, Chile, Colombia and México;
- Initial: countries where start has been made with the development of policies or action plans for activities under one or two components of Avoid–Shift–Improve approach. Implementation activities are less in number and often smaller in scale. Countries in this category include Argentina, Ecuador, Peru and Venezuela:
- Basic: countries where the implementation of sustainable urban transport is still in its initial phase. Implementation activities are limited to specific areas and are often still only on pilot basis. Countries in this category include Bolivia, Paraguay and Uruguay

Table 4
Avoid–Shift–Improve related best practice examples in Latin America.

	Strategy	Activity/project types	Examples
Avoid long and unnecessary motor vehicle trips	Dense and mixed-use urban development	Renovation of historic districts and downtown areas	Quito (historic downtown renewal), Guayaquil (downtown recovery), Pereira (old market renovation Ciudad Victoria)
		Master plans, integration of land use and transport planning	Curitiba (Plan Director); Rosario (Urban Plan), Brazilian and Colombian Cities (comprehensive plans requirement under urban development laws)
	Use of information technologies to reduce trips	Tele-work, virtual meetings through improved connectivity and internet access	Information technologies and connectivity agendas in several countries in the region
Shift individual motorization toward transit, biking and walking	Improved facilities for biking and walking	Recovery of invaded sidewalks and public spaces	Buenos Aires (pedestrian streets Florida and Lavalle), Santiago (downtown pedestrianization Huérfanos and Ahumada), Bogotá (citywide public spaces plan), Quito (historic downtown pedestrianization)
		Rehabilitation of waterfront sidewalks with adequate design, urbanism and furniture	Guayaquil (Malecon 2000 and Estero Salado) Rio de Janeiro (Promenades in Ipanema, Copacabana and other beaches)
		Bikeways and bike lanes, safe bike parking	Bogotá, Medellín, León, Buenos Aries, Several Chilean cities (introduction of permanent bike paths and bike lanes; safe parking at transit stations)
	Improved public transport systems	BRT	Curitiba, Quito, Bogotá, León, México DF, Guayaquil, Pereira, Guadalajara, Estado México, Bucaramanga, Barranquilla, Medellín, Mérida, Buenos Aires
		Integrated Systems	São Paulo, Santiago, Cali, Medellín, León (Bogotá forthcoming)
		Metro	Santiago, Sao Paulo, Rio de Janeiro, Porto Alegre, Belo Horizonte, Caracas, Los Teques, Valencia, Maracaibo, México, Monterrey, Guadalajara, Concepción
		Cable cars	Caracas, Medellín, Manizales, Rio de Janeiro (Cali forthcoming)
	Disincentives to individual motor vehicle use	Taxes on fuels and registration	High taxes on fuel (descending order): Peru, Brazil, Uruguay, Paraguay, Colombia, Chile, Argentina, México and Bolivia (Ecuador and Venezuela provide subsidies)
		Administrative restrictions (using plate numbers)	El Alto, Sao Paulo, Santiago, Bogotá, Medellín, Pereira, Quito, México, Guadalajara, Pachuca, Puebla, Toluca
		Urban tolls	Santiago (Costanera Norte), Lima, Buenos Aires
Improve the technology and transport management	Clean and low-carbon fuels	Elimination of lead content, reduction of sulfur content, use of biofuels. Compressed Natural Gas (CNG) and Gas to Liquid (GTL)	Lead removed in all countries in Latin America. Ethanol Program in Brazil, Sulfur reduction in Chile, Colombia and México City, CNG in Lima and Medellín BRT Systems
	Clean and low-carbon vehicles	Fuel Economy Standards	Under development in México
	Safe cars and roads	Hybrids (internal combustion engine-electric), Trolleybuses	Guadalajara, México DF, Quito, Mérida, Rosario, Mendoza
		Latin America New Car Assessment Program	Brazil, Argentina and México
		Road Inspection Program	Paraguay
	Command and control Improved management	Technical inspection programs, including air pollutant controls	Chile, México, Colombia
		Traffic control networks, centralized dispatch and control of transit services	Integrated systems in Brazil, centralized traffic management in several cities (most notably Sao Paulo, Monterrey, Cali, Medellín)

5. The way forward with sustainable urban transport in Latin America

5.1. Choices in motorization pattern

Countries in Latin America do not start from zero in its path toward sustainable transport, as was described in Section 4. International experience also shows that countries have a choice when it comes to the development of the pattern of motorization. Rather than opting for a pattern of high use of private vehicles (as the one in the United States or Australia), cities have the possibility of a more balanced approach (as in Europe) or select what was labeled by UITP as the most efficient pattern (Tokyo, Amsterdam, Hong Kong, Madrid, see Fig. 9). This pattern has the smallest role for private motorized vehicles in meeting demand for transport and the highest share of public transport, walking and biking.

Cities in Latin America are generally in between the most efficient and the European pattern. This is confirmed by the information presented in Section 3.3. Will cities in Latin America move in the future more toward the European pattern and become a bit less sustainable or will they move toward what is described as the most efficient pattern? It is possible to construct arguments in support of both scenarios.

For the most efficient scenario: never before in history has there been such awareness on the negative societal impacts of unbridled private motorization. The majority of countries in Latin America

Table 5
Indicative grouping of South American countries and México based on orientation of national policies and projects toward sustainable urban transport.

Status	National policies	Implemented projects (examples)	Countries
Intermediate	• National funding for Sustainable Transport projects (e.g. mass transit and biking) • Coordination among transport, environment, health, and urban development agencies	• Mass transit in several cities with national Support • Vehicle inspection programs • Clean fuels • Air quality monitoring	Brazil Colombia Chile México
Initial	• National support to sustainable transport actions	• Mass transit in 1–2 cities (local initiatives) • Reduction of sulfur content in Diesel	Argentina Ecuador Peru Venezuela
Basic	• Initial proposals under discussion (policies, legislation)	• Proposed Plans or studies being developed, including legislation reform	Bolivia Paraguay Uruguay

Note: Venezuela has several mass transit projects in operation, but also has several policies oriented to individual motorized transport including road construction and extensive fuel subsidies.

have a strong tradition in public transport and walking. Also, the growing support for the Avoid–Shift–Improve approach provides policy makers with a strategic framework for structuring sustainable transport policies in an integrated manner.

Practitioners have the benefit of extensive testing of a wide range of sustainable transport practices. The macro-economic insights on the long term negative impacts of policies supporting private motorization justify restructuring of transport related taxes, user charges and subsidies toward the realization of sustainable urban transport infrastructure and services. Development of clean low-carbon transport technologies has accelerated in recent years. Finally, because of global concerns on amongst others climate change and road safety there will be growing external funding for sustainable low-carbon transport.

The arguments in favor of a less optimistic scenario and one which would take Latin American cities more toward the European pattern acknowledge all of the arguments presented above. The speed with which motorization is taking place will prevent however the reorientation of urban transport systems in Latin America toward the most efficient pattern. This is evidenced for example in México City where the construction of BRT corridors and additional metro capacity has been offset by an annual growth of 500,000 vehicles per year.

For the most efficient pattern to be realized it would be necessary to match the development of cleaner vehicles and the provision of more and better public transport, coupled with disincentives on the ownership and use of individual vehicles. It is doubtful whether there is a sufficient political will and public acceptance for such policies, despite the fact that at least 12 large cities have administrative restrictions based on plate numbers. In addition, there is a need to develop institutional capacity to plan, implement, operate and continuously improve these practices.

Particular attention needs to be given to the proliferation of motorcycles – through better education of drivers and enforcement of the safety rules, adaptive infrastructure to consider this type of vehicles, and demand management measures. Also to the transformation of the dispersed and informal public transport services, into regulated and integrated systems.

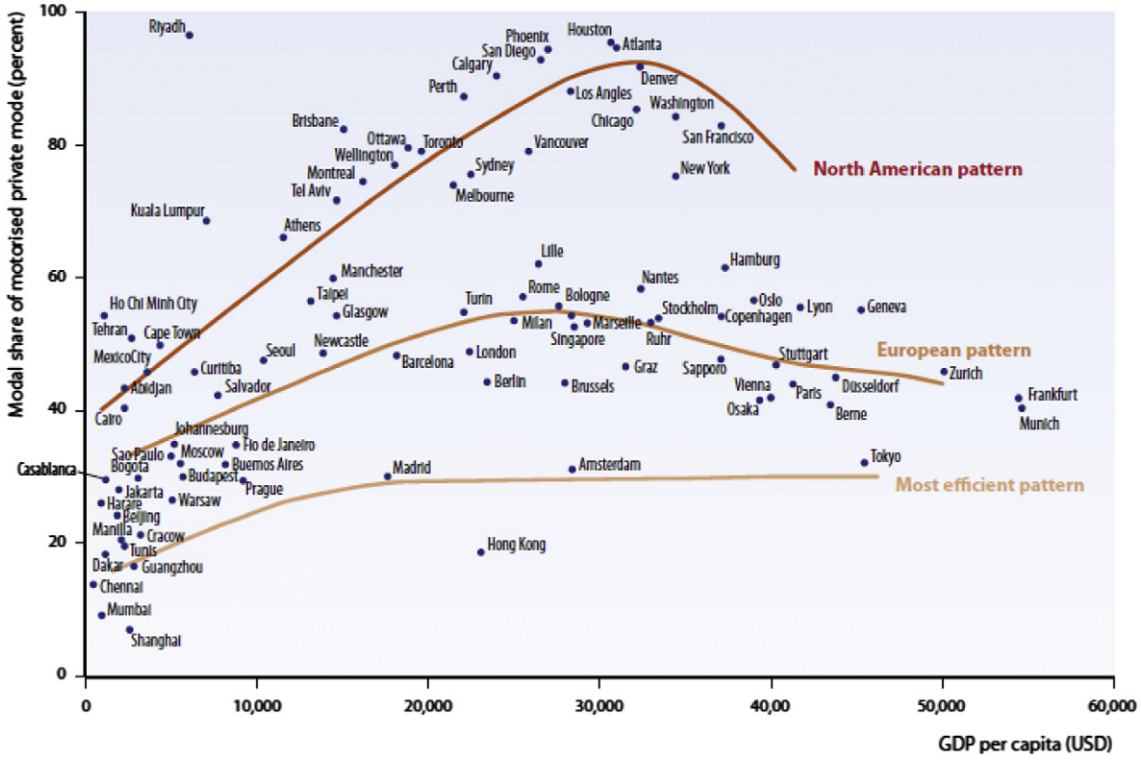

Fig. 9. Toward a green development trajectory –GDP per capita vs. modal share of motorized private mode (UITP, 2006, cited by Dalkmann & Sakamoto, 2011).

5.2. Supportive global and regional initiatives

Policy makers and practitioners in sustainable urban transport in Latin America can benefit from a range of global and regional initiatives promoting regional transport coordination and cooperation as well as special agendas for road safety, public transport and sustainable development. See Box 1 for an overview.

Box 1. Enabling global and regional processes for the further evolution of sustainable urban transport in South America and México.

The Agenda 21 for Sustainable Development adopted at the United Nations Conference on Environment and Development held in Rio de Janeiro, Brazil from 3 to June 14, 1992, included transport. Transport was also an important element of the Johannesburg Plan of Implementation adopted at the 2002 World Summit on Sustainable Development. Subsequent meetings of the Commission on Sustainable Development (CSD-9, CSD-19), reaffirmed that improving accessibility through sustainable transport can promote economic and social development, can help developing countries in their integration into the global economy, and contributes to the eradication of poverty. These results will be considered in the United Nations Conference on Environment and Development Rio+20, in Rio de Janeiro, Brazil from 20 to June 22, 2012 (see http://www.un.org/esa/dsd/susdevtopics/sdt_transport.shtml).

The General Assembly of the United Nations, through Resolution 64/255 of March 2010, officially proclaimed the Decade of Action for Road Safety 2011–2020. This initiative provides a framework for countries and communities to enhance their actions to save lives on roads worldwide. The World Health Organization, following a broad consultative process, issued the Plan of Action for the Decade of Action for Road Safety 2011–2020; the actions proposed are generally consistent with the principles of sustainable transport and their implementation could help to fast-track the implementation of sustainable transport in South America and México (see http://www.who.int/roadsafety/decade_of_action/es/index.html).

Participants at the First South American Meeting of Ministers Responsible for Transport and Road Safety, Lima, 14–15 March, 2011, agreed on actions to stop the increase in the number of deaths and injuries caused by traffic accidents. These actions included the implementation of sustainable transport practices (see http://www.mtc.gob.pe/portal/banner_sudtranvial/notas.pdf).

Representatives from 16 agencies managing Integrated Transit Systems and Bus Rapid Transit (BRT), met in the city of Guayaquil on April 28, 2011 during the Second General Assembly of the American Association of Integrated Systems BRT-SIBRT Transport. They agreed to promote the adoption of regional transportation policy and sustainable urban development and to advance efforts to persuade policy makers to include mobility and sustainable urban development explicitly and systematically in the development priorities of the countries (see http://www.sibrtonline.org/noticias/31/).

Discussions at the Conference for Sustainable Transportation, Air Quality and Climate Change for Latin America and the Caribbean, held in Rosario, Argentina, from 11 to 14 May 2011, advanced to the concepts outlined in the 2020 Bangkok Declaration (Fifth Environmentally Sustainable Transport Forum in Asia) and the Declaration of Bellagio on Transport and Climate Change (see http://cleanairinstitute.org/evento_rosario_declaracion_r.php).

Box 2. Bogotá Declaration – sustainable transport objectives (Foro de Transporte Sostenible de América Latina, 2011).

A. Strategies to *Avoid* unnecessary motorized travel and reduce travel distances.
   - Increase the efficiency of transport and distribution of goods through urban and interurban intelligent logistics systems and specialized logistics infrastructure.
   - Seek for a reduction of individual motorized travel at the urban level by integrating the concepts of land use and accessibility, and using strategic planning tools for urban and regional development.
   - Increase the virtual interaction between people using information and telecommunication technologies.

B. Strategies to *Shift* the trend of individual motorization to safer, efficient and environmentally-friendly modes.
   - Promote increased use of maritime, river, and railway modes to transport goods and people, through strategic investments in these modes, as well as the promotion of intermodal logistics management.
   - Promote and preserve the use and safety of pedestrian and bicycle transportation, as an integral part of efficient sustainable transport systems.
   - Promote the use of more sustainable modes of interurban passenger transport, such as buses and trains, including the implementation of high quality services that, according to the demand conditions, offer alternatives to private cars and air transport.
   - Promote the expansion and improvement to public transport services, based on attending the user's needs, in such a way that these are affordable, safe, reliable and of high quality.
   - Promote measures to discourage increased share of private motor vehicles in the total number of trips, through Transport Demand Management.
   - Promote a behavioral change toward sustainable mobility alternatives through information and education of the population.

C. Strategies to *Improve* technology and management of transport services.
   - Promote the increased use of cleaner vehicles and fuels, and greater energy efficiency and emission control measures in all transport modes.
   - Work to establish progressive, appropriate and affordable, (i) improved fuel quality standards including reducing the sulfur content of fuels, (ii) measures for fuel saving, and (iii) measures to reduce emissions of air pollutants for all types of road, air and water vehicles.
   - Work to establish or improve technical vehicle inspection regimes, and to progressively implement safety standards, and standards to reduce atmospheric emissions.
   - Promote the adoption of Intelligent Transportation Systems such as electronic tolls, transportation control centers and user information in real time, promoting transparent communication of the costs of services and sources of payment. Search the formalization and integration of public transport services to ensure accessibility, quality and safety.
   - Promote the adoption of permanent traffic management and control schemes, to primarily ensure transport quality and safety.

D. Cross-cutting strategies.
   - Include sustainable transport consideration within the strategies of the Decade of Action for Road Safety. In this context, promote the adoption of

a policy of "zero tolerance" to reduce the number of injured and dead from traffic accidents. Consider actions to reduce traffic safety problems resulting from increasing share of motorcycles in the total trips.
- Promote the continued monitoring of the impacts of emissions and noise generated by transport in health, and incorporating mechanisms to assessing the corresponding impacts in economic analyses.
- Promote mitigation of GHG emissions that contribute to climate change, by considering sustainable transport actions following the paradigm of "Avoid–Shift–Improve".
- Work on the adaptation of transport infrastructure, existing services and new projects to reduce their vulnerability to the adverse effects associated with climate change.
- Promote special consideration to vulnerable users in planning, implementation and operation of infrastructure and sustainable transport systems, through actions aimed at improving the quality, safety and accessibility for all, especially for women, the elderly, disabled persons, children and low-income people.
- Promote the adoption of innovative financing mechanisms for building sustainable transport infrastructure and providing complementary services.
- Work on the institutional, regulatory and economic aspects that allow the development of sustainable transport, including management, human resources training and interagency coordination.
- Encourage the widespread distribution of information on sustainable transportation at all levels of government and to the public.
- Advance in the development and allocation of adequate financial resources to the institutions dedicated to the planning, development, and implementation and monitoring of sustainable transport.
- Promote greater transparency and good governance practices through the application of appropriate tools, and foster the integration of transport, environment, and urban development and health policies.

The actual usefulness of these regional and global declarations and processes for policy makers and practitioners on urban transport will be determined by the follow-up to these declarations. The main expectation is that national and local governments and the international development community will be able to redirect the transport sector funding toward sustainable urban transport instead of mainly focusing on the construction of roads that encourage further motorization.

5.3. The Bogotá Declaration on sustainable transport objectives

The most recent regional initiative directly relevant to sustainable urban transport in Latin America is the Foro de Transporte Sostenible (FTS), (Sustainable Transport Forum) which brought together government representatives of 9 countries in South America and México. The resulting Bogotá Declaration on Sustainable Transport Objectives contains 23 goals divided over 4 different strategies: (a) Strategies to Avoid unnecessary motorized travel and reduce travel distances, (b) Strategies to Shift the trend of individual motorization to safer, efficient and environmentally-friendly modes, (c) Strategies to Improve technology and management of transport services, and (d) Cross-cutting strategies (see Box 2).

6. Conclusions

Promoting transport infrastructure and services development is necessary to support economic growth and social equity. This development can be achieved in a way that is consistent with the human health and environmental needs.

Latin American cities currently show a "sustainable" transport mix, with large shares of public and non-motorized transport (higher than 65% in most cities). At the same time they face rapid motorization: up to 17% annual growth in the last decade, mainly driven by motorcycles. This rapid growth has direct influence on increasing externalities, particularly traffic fatalities and air pollution. The economic value of externalities is estimated in 18% of the average income in 15 selected cities.

Moving the current growth trajectory toward a more sustainable one requires a paradigm shift, by adopting policies to *avoid* long and unnecessary motorized travel, to *shift* the growth trends of individual motor vehicle travel favoring non-motorized and public transport, and to *improve* technology and operational management of transport activities.

The paradigm shift is possible with the resources available for the transportation sector – from public and private sources, which are now oriented toward individual motorized transport. Latin America has experience in the adoption of low-cost, high impact and rapid deployment, sustainable transport actions. The development and expansion of the BRT concept is one of these experiences. But actions have advanced in isolation; the creation of a joint agenda by the countries in the region capitalizes on and potentiates these experiences.

There are different levels of progress in the generation of sustainable transport policies by countries in the region, as well as multiple opportunities for collaboration. The agreement achieved during the FTS in Bogotá (Foro de Transporte Sostenible de América Latina, 2011) is a good start, and includes specific strategies to implement the paradigm shift to *Avoid–Shift–Improve*, as well as several transversal actions. The Bogotá Declaration highlights the need to improve the quality and quantity of information in the transport sector, as well as the development of technical capacity and coordination mechanisms in institutions. In addition to the ministries of transport, it requires the cooperation of health, environmental, planning and finance authorities, as well as agencies of sub-national level.

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