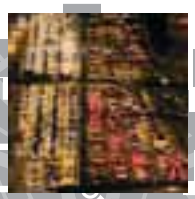
DEDICATED TO MAKING A DIFFERENCE




# m4d
# mobility
## for development

World Business Council for
Sustainable Development

# The Mobility for Development project

The Mobility for Development project set out to investigate what the sustainable mobility challenge means for some of the world's fastest growing cities and regions, and to discuss solutions with key stakeholders in each location. The aims of the project were to:

- Raise awareness of the importance of mobility as a driver of economic development
- Develop a better understanding of the sustainable mobility challenges in rapidly growing cities in the developing world so that business can engage more effectively with policy-makers on this issue
- Investigate ways to narrow the "mobility opportunity divide" and mitigate negative transport impacts through innovative and profitable business solutions.

## Participating companies

BP (project co-chair), Toyota (project co-chair), Brisa, General Motors, Michelin, Petrobras


## Acknowledgements

We would like to extend our gratitude and appreciation to Dr. George Eads for his contribution as lead consultant for this project.

We would further like to thank Prof. Yoshitsugu Hayashi of Nagoya University and the authors of the background reports:

- Bangalore: The Energy and Resources Institute (TERI); dialogue organized by Renault and Toyota*
- Dar es Salaam: Dr. Lucy M. Mboma of the University of Dar es Salaam; dialogue organized by BP*
- São Paulo: Engenharia de Tráfego e de Transportes S/C Ltda (TTC); dialogue organized by Brisa*, GM*, Michelin*, Petrobras* and Conselho Empresarial Brasileiro para o Desenvolvimento Sustentável (CEBDS Brazil)
- Shanghai: Prof. Pan Haixiao of Tongji University; dialogue organized by Michelin* and China Business Council for Sustainable Development (CBCSD)


www.wbcsd.org/web/m4dev.htm

* Mobility for Development project member

# mobility
## for development

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# Foreword

Mobility is essential to economic and social development. It enables people to access goods, services and information as well as jobs, markets, family and friends. Mobility can enhance quality of life, but the development of mobility in today's conditions also brings congestion, air pollution, traffic-related accidents and the environmental costs of transportation.

The situation is nowhere more acute than in the cities of the developing world where rapid growth, population density, poverty and inequality, limited public capacity and resource shortages add further to the challenge of enabling people and goods to move about sustainably.

As members of the business sector we are keen to see our products and services penetrate new markets in the developing world. We also recognize that we have to play our part to increase access to mobility and to reduce its negative impacts. We believe that through effective engagement with others these goals are achievable.

This is why we initiated the WBCSD Mobility for Development project to research the state of mobility in rapidly growing cities at various stages of economic development.

The project builds on earlier work of the WBCSD, summarized in the publication: *Mobility 2030: Meeting the Challenges to Sustainability*. The report concluded: "*Today's system of mobility is not sustainable. Nor is it likely to become so if present trends continue."* With 3 billion people surviving on less than US$ 2 per day who are poorly served by existing mobility systems, the urgent challenge is not only to reduce the environmental footprint of mobility, but also to increase the spread of its benefits to those currently excluded. *Mobility 2030* referred to this as "narrowing the mobility opportunity divide", i.e., finding ways to help increase the mobility opportunities for people at all societal levels.

The project set out on a process of research, dialogue and learning in four cities – Bangalore in India, Dar es Salaam in Tanzania, São Paulo in Brazil and Shanghai in China – to better understand how public agencies, business and civil society in these rapidly growing cities are working to develop solutions to the mobility opportunity divide and the negative impacts associated with mobility.

Four common themes emerge from our research:

- **Sustainable mobility is a key contributor to development.** Each of the cities we studied has experienced rapid urban and economic growth, accompanied by growth in transportation, both passenger and freight, public and private. We saw not only how the efficient movement of people and goods opens up opportunities for broad economic development, but also how the problems of uncontrolled, uncoordinated and under-resourced transport development are obstacles to development.

- **Cities can learn from one another and history.** Although there are no universal solutions or blueprints for sustainable mobility development, the cities studied and others around the world share common issues. While the path to address challenges is particular to each city, stakeholders can nevertheless benefit from the experiences – both good and bad – of other cities, and apply this learning to their own situation.

- **Each component of society has a role to play, both individually and in collaboration with others.** Government at national, regional and municipal levels, business as both a provider and user of mobility solutions, and citizens as individuals and as members of civil society organizations must join together in the search for appropriate local solutions. We cannot find solutions without such collaboration. Each of us must approach the challenge with our own commitment, passion and intelligence, as well as with the foresight and an open mind necessary to learn from and work with others. At the same time, we must all take responsibility for our personal choices with respect to the sustainable use of transport and mobility services.

- **It takes motivated and committed leadership to create a functioning mobility system.** Cities need overarching institutions to coordinate transport and regional development, and accountable leadership capable of mobilizing stakeholder support, setting overall priorities for transport systems and associated financing, and ensuring effective coordination between institutions.

Our findings can only present a snapshot of the status of mobility in these cities today. However, we hope that the dialogues we initiated in each city will not be one-off events, but part of a continuing debate, through which results will be measured over time.

We believe that breaking down barriers between mobility's different stakeholders is a crucial step to understanding its complexity. It is also necessary to identify obstacles and synergies and create governance structures that work at the speed and scale needed to achieve sustainable mobility.

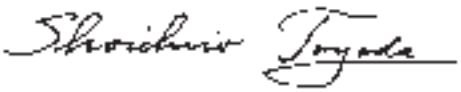
This needs to take place not only in the regions and cities where the challenge is greatest, but also at a global level in order to understand and learn from interactions, good practices and solutions.

As members of the mobility sector, our companies are committed to making a contribution to this dialogue and towards finding sustainable solutions that promote and preserve access and opportunity for all.

BP p.l.c.

**Luc Bardin**
Group Chief Sales & Marketing Officer
Project co-chair

Toyota Motor Corporation



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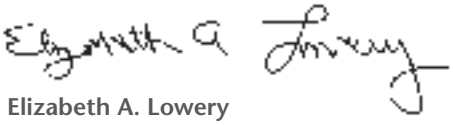

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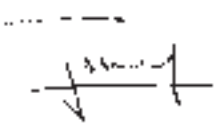


**Jean-Dominique Senard**
Managing Partner

# Introduction – The global context

## Mobility as driver of development

From the roads and bridges of the Roman Empire and the railroads that connected the American West, to the growth in motor vehicle use in the dynamic cities of the developing world, it has long been acknowledged that there is a positive relationship between faster, more reliable and more affordable means of transportation, economic growth and development.

A growing body of empirical evidence shows the development dividends that mobility brings to people in both rural and urban settings.[1] Mobility allows people to gain access to goods and information, and to markets, jobs and essential services. It unlocks new resources, promotes competition and enables businesses, cities and regions to become more efficient and competitive. This creates wealth, reduces prices and facilitates higher living standards for consumers. In particular, mobility enables:

- **Trade** – Freight mobility has played a crucial role in the dramatic increase in developing countries' participation in world trade in the last two decades. In 2006 developing countries' share of world exports reached 35% for primary commodities, 40% for manufactured goods and 25% for services.

- **Urbanization** – Cities are major engines of economic growth, both in their own right and as trading hubs for a wider rural hinterland. Urban mobility is crucial to the economic health of growing cities and the quality of life of their residents. Passenger and goods transportation systems need to be efficient, clean and safe, as well as to support the broader urban landscape of vibrant streets and safe neighborhoods providing access to housing, commercial, cultural and green spaces. The mobility sector also plays a crucial role as a job provider for an expanding workforce.

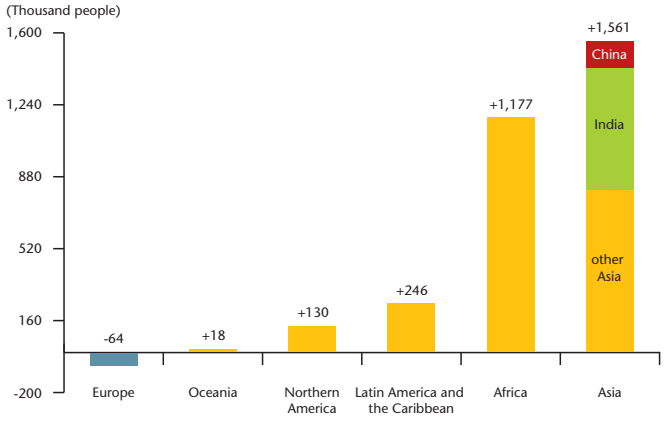
- **Rural development** – The first step in moving from subsistence to commercial agriculture is often the development of new roads. Transport improvements assist agricultural modernization and pave the way for electricity lines, water pipes and financial services improving quality of life and freeing up household members, particularly women and girls, from spending significant time traveling in order to meet basic needs.

- **Poverty reduction** – The major effect of mobility on poverty reduction comes through general economic growth. Empirical evidence shows that national economic growth is positively correlated with poverty reduction and with improvements in key human development indicators such as mortality rates and life expectancy.[2] Mobility is also acknowledged as a key factor in reaching many of the Millennium Development Goals for poverty reduction (see Box 1).

## Mobility challenges

Today, one billion people in the world survive on less than US$ 1 per day, while almost half of the world's population lives on the equivalent of less than US$ 2 a day. Clearly economic opportunities need to be expanded and opened up so that more of the world's population can enjoy life unfettered by hunger, insecurity, ill-health and unfulfilled potential.

Figure 1: Population growth (estimates to 2050)




Source: UN world population prospects, 2006 revision

By 2050 the world's population will have increased again by half, to reach 9 billion, with the vast majority of this growth taking place in the rapidly growing cities of today's developing countries (see Figure 1). If these individuals, cities and nations are to be able to reach their goals for development there will need to be more, and more efficient, growth in trade, in agricultural productivity, in manufacturing and service industries and in poverty reduction.

Mobility gaps and problems are an obstacle in each of these areas.

- **Trade** – Progress in trade integration in the least developed countries has been slow, with the fifty least developed countries still accounting for less than 1% of global trade in 2006.[3] Poor accessibility and high freight transport costs are key barriers to greater integration into global and regional markets. Unreliability, lengthy customs formalities and delays also increase costs, necessitate inventory holding and make it very difficult for producers to trade in time-sensitive goods. Ultimately all this impacts on the welfare of producers and consumers.

### Box 1: Mobility and the Millennium Development Goals

The Millennium Development Goals (MDGs) reflect the global commitment to halve poverty by 2015. These goals were chosen not only because of the moral imperative of assisting the poorest, but because they aim to get all countries to a baseline from where economic growth and ongoing improvements in human welfare can become self-sustaining, by targeting the factors that trap individuals, communities and nations in poverty. While mobility is rarely the only factor needed get out of these traps, it is an essential element. The Box below highlights the relevance of mobility to the MDGs.[4]

| MDG | Positive mobility contribution | Potential negative mobility contribution |
|---|---|---|
| **1. Eradicate extreme poverty and hunger** | • Stimulates economic growth, promotes competition, efficiency and innovation to make goods and services more affordable<br>• Facilitates access to jobs and markets<br>• Improves food security by increasing production and distribution efficiency<br>• Facilitates growth of manufacturing and service sectors<br>• Generates jobs in transport sector | • Cost and time burden of transportation for the working poor prevents them investing in assets<br>• Transport infrastructure investment is often not driven by poverty reduction goals; therefore the mobility needs of the poor are given low priority |
| **2. Achieve universal primary education** | • Facilitates access to school, particularly in rural areas<br>• Delivery of school supplies<br>• Prevents isolation of rural communities, attracts teachers | |
| **3. Promote gender equality and empower women** | • Promotes women's mobility and increases the efficiency of daily chores, such as water and wood collection, creating time to pursue other activities | • Insufficient priority given to basic needs, such as water and waste disposal, mean that the poor (and particularly women) are still forced to meet basic needs in time-intensive ways<br>• Gender specific transport needs not always addressed (e.g., safety, freedom from sexual harassment) |
| **4. Reduce child mortality** | • Facilitates access to health facilities and services<br>• Assists in combating major preventable diseases by enabling education, vaccination and disease prevention campaigns in rural communities<br>• Attracts health service staff to rural areas | • Increases risk of road accident-related deaths and injuries |
| **5. Improve maternal health** | • Facilitates access to health facilities and services, medicines and supplies<br>• Facilitates access to maternity services<br>• Facilitates access to education | |
| **6. Combat HIV/ AIDS, malaria and other diseases** | • Facilitates access to health services<br>• Facilitates implementation of education programs | • Aggravates spread of HIV/AIDS along transport corridors |

| MDG | Positive mobility contribution | Potential negative mobility contribution |
|---|---|---|
| 7. **Ensure environmental sustainability** | • Enables waste management<br>• Facilitates access to natural resources (can also be a negative effect)<br>• Supports disaster management and rehabilitation activities | • Greenhouse gas emissions<br>• Conventional pollution<br>• Depletion of natural resources<br>• Land-use impacts |
| 8. **Develop a global partnership for development** | • Facilitates trade<br>• Facilitates access to and from landlocked countries and regions<br>• Facilitates access to decent and productive work for youth<br>• Facilitates the establishment of information and communications technology networks | • Personal motorized transport and suburbanization can segregate neighborhoods into islands of wealth and poverty |

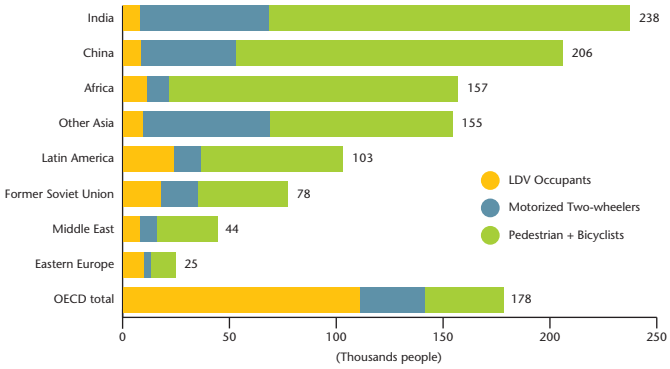
- **Urbanization** – While average household incomes are growing in most cities, large disparities in wealth and major gaps in the mobility opportunities between the richest and poorest urban residents remain. Around one billion people globally live in urban slums facing overcrowded, polluted and dangerous living conditions, often not served by roads or transport services.[5] The rapid growth of cities and their transport activities is outstripping the capacity of local and regional governments to cope with the impacts on safety, air quality and public spaces.

- **Rural development** – The World Bank estimates that around 900 million rural dwellers, mainly in the least developed countries, are without reliable access to transport (defined as living within 2 km of an all-weather road).[6] In rural Tanzania for example, only 38% of the population has reliable access to transport and the average distance to public transport is 54 km.[7]

- **Poverty reduction** – Global data on mobility trends show that access to mobility services is improving in many countries; however, the mobility opportunity gap both between and within countries is rising. In Africa, the Middle East and the least developed countries of Asia overall levels of mobility are stagnant and look likely to remain low.[8] Even within countries where mobility levels are rising, the poor, rural dwellers, women, children, the elderly and the less able are often disadvantaged by a lack of mobility opportunities.

Urban systems and transport modes that have evolved over the centuries for cities of a much smaller scale are proving inadequate for the needs of the 21st century. It has become clear that land, energy, ecosystem services and capital are all in limited supply. As a result, developing world cities are at risk of descending towards unsustainable gridlock and environmental degradation.

Figure 2: Annual vehicle-related road deaths




Source: WBCSD *Mobility 2030: Meeting the Challenges to Sustainability* (2004)

The World Health Organization estimates that urban air pollution (from transport and non-transport sources) causes 800,000 premature deaths each year, while around 1.2 million people are killed and 50 million injured in road accidents, most of them in developing countries.[9] Actual figures for road-related deaths are likely to be higher, due to underreporting. Over half of road accident victims in developing countries are pedestrians or cyclists (see Figure 2).[10]

The impacts of unsustainable transportation are not only felt locally. It is predicted that climate change, unless averted, could wipe out up to one-fifth of global productivity.[11] Transportation already uses half of world petroleum production and produces 20% of greenhouse gas emissions,

with road transport being the largest energy user and source of emissions. While transportation is only responsible for 10% of greenhouse gas emissions from developing countries, it is the fastest growing source.[12]

## Towards sustainable mobility

Improved mobility is clearly needed to enable development, and this in turn will generate further growth in transport activity. Individuals and governments recognize the link between mobility and prosperity, and those with the means to do so are grasping the opportunities that trade and urbanization offer by investing in transport infrastructure, modernized public transport systems and private vehicles. However, the patterns of development and transportation demonstrated in the developed world, and increasingly being adopted by developing countries, do not offer a model of sustainable mobility.

In its report *Mobility 2030: Meeting the Challenges to Sustainability*, the WBCSD defined sustainable mobility as:

| | | |
|---|---|---|
| *"The ability to meet society's desires and needs to move freely, gain access, communicate, trade and establish relationships* | *…without….* | *sacrificing other essential human or ecological values, today or in the future."*[13] |

The report stated: "Today's system of mobility is not sustainable. Nor is it likely to become so if present trends continue." It presented twelve indicators to assess the status of global mobility and proposed seven goals to improve the outlook for sustainable development:

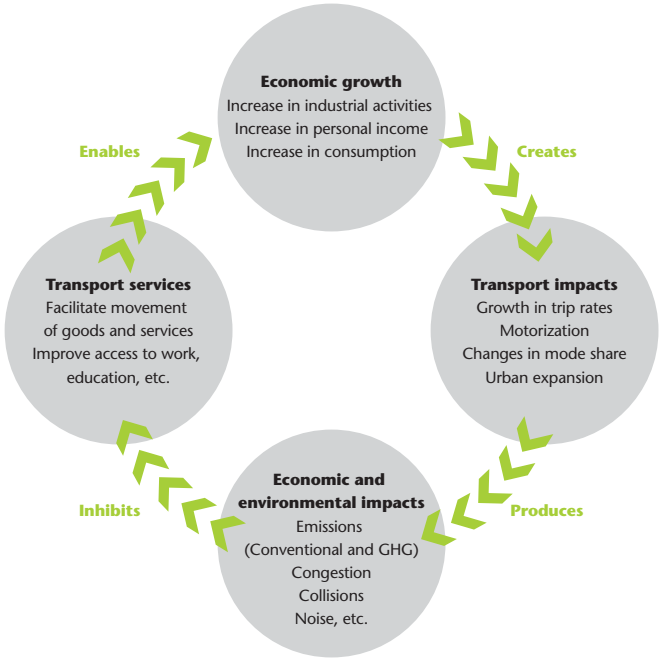
1. Ensure that the emissions of transport-related conventional pollutants do not constitute a significant public health concern anywhere in the world
2. Limit transport-related greenhouse gas (GHG) emissions to sustainable levels
3. Significantly reduce the total number of road vehicle-related deaths and serious injuries from current levels in both the developed and the developing worlds
4. Reduce transport-related noise
5. Mitigate congestion
6. Narrow the "mobility opportunity divides" that inhibit the inhabitants of the poorest countries and members of economically and socially disadvantaged groups within nearly all countries from achieving better lives for themselves and their families
7. Preserve and enhance mobility opportunities for the general population of both developed and developing-world countries.

The business case for sustainable mobility solutions is clearly recognized. A recent survey of automotive industry executives found that environmental issues are the fastest growing concern, and many executives cited fuel-efficiency and alternative fuel sources as the most important trends in the industry today.[14]

As *Mobility 2030* highlighted, cleaner fuels and more efficient vehicles will play a critical role in the shift towards sustainable mobility. New approaches to energy sources, energy carriers and the vehicles and engine technologies that underpin transportation systems are all in development. New combinations of propulsion systems and fuels, such as hybrid engines and biofuels are already in commercial use, while others, such as battery-powered electric vehicles, fuel cells and advanced biofuels are moving at different paces towards commercial viability. Lighter engines and the use of new materials enable a virtuous circle of progressive weight reductions in the body and suspension of a vehicle, and the ability to use even smaller engines with improved fuel consumption. The end-point of such a virtuous circle may be a completely new automobile concept.[15]

For sustainable mobility in developing countries, the urgent challenge is how to simultaneously address the problems of "too much and too little": already "too much" of transportation's negative impacts in many places and still "too little" opportunity for mobility for many people. This dilemma is illustrated by the mobility cycle outlined in Figure 3. Solving it will require major changes in people and goods transport systems, from public to paratransit to personal, and how society uses them.

Figure 3: The sustainable mobility dilemma




Source: WBCSD (2004), adapted from Molina and Molina (2002)

Economic growth can enable investments in equipment, education and institutional controls to mitigate the negative impacts of transportation.[16] However, urban transportation experts note that this is not an automatic relationship, and in the absence of proactive planning, transport problems, road safety and environmental impacts tend to get worse rather than better with economic growth.[17] Economists note that mass automobile ownership generally takes off when income levels reach an average of US$ 5,000.[18] However, high levels of inequality mean that affordable motorization can take off much more quickly than the national capacity to invest in needed infrastructure. Institutional quality, accountability and transparency have also been found to play a significant role in allowing countries to effectively enable and regulate transport systems.[19]

Successfully addressing the complex challenges of sustainable mobility in developing countries will require the close collaboration of all stakeholders, from government, business and citizens groups, to identify and implement the governance structures and the infrastructure solutions needed. This report identifies some of the barriers and potential solutions to achieving this.

## The Mobility for Development project

The Mobility for Development project set out to investigate what the sustainable mobility challenge means for some of the world's fastest growing cities and regions, and to discuss solutions with key stakeholders in each location.

The aims of the project were to:

- Raise awareness of the importance of mobility as a driver of economic development
- Develop a better understanding of the sustainable mobility challenges in rapidly growing cities in the developing world so that business can engage more effectively with policy-makers on this issue
- Investigate ways to narrow the "mobility opportunity divide" and mitigate negative transport impacts through innovative and profitable business solutions.

Figure 4: City locations


In order to advance these aims, we set out on a process of research, dialogue and learning in four cities: Bangalore in India, Dar es Salaam in Tanzania, São Paulo in Brazil and Shanghai in China (see Figure 4).

## About this report

The following chapters provide an introduction to the state of mobility and its subsequent challenges in each of the four cities based on background reports prepared by local research organizations (consultants and academics) in each country. The reports draw on existing data from municipal, national and third-party sources, as well as on the discussions at the local dialogues.

While our original research set out to study people and freight mobility, and in spite of the impact of freight movement on urban mobility and emissions, the focus of participants in each of the dialogues was overwhelmingly on people transport over freight transport. The emphasis on personal mobility is therefore reflected in this report.

It has been difficult to collect consistent and quality data across the four cities. This lack of consistency makes it difficult to draw valid comparisons between the cities.

The chapter "What we have learned" explores common themes from the four cities, using the framework of goals and indicators for sustainable mobility proposed by the *Mobility 2030* report. The "Conclusions" chapter summarizes the learning from the research and from the dialogues. We end the report with key messages for business, governments and citizens.

The full background reports for each city along with details of data sources can be accessed at www.wbcsd.org/web/m4dev.htm.

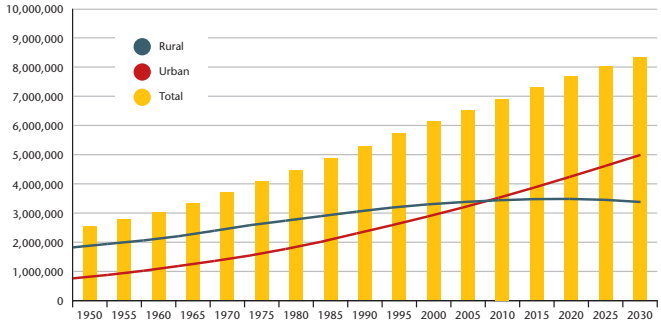
*Note: The data sources used in the four background reports are referenced in Appendix 2 at the back of this report.*

# Investigating mobility challenges in four cities

## Why cities?

While we recognize that rural mobility is crucial to development, we chose to focus on urban mobility because of the extraordinary challenge posed by the rapid growth and motorization of developing country cities. The United Nations predicts that more than 80% of population growth in the next ten years will take place in cities in the developing world (see Figure 5). The World Development Report 2009 highlights the critical role that cities, ports and transport hubs play in economic and human development. It argues that nations can accelerate their development by promoting transformations along the three dimensions of economic geography: higher densities, as seen in the growth of cities, shorter distances, as workers and businesses migrate closer to densely populated areas, and fewer divisions, as countries thin their economic borders and enter world markets.[20] Decisions about mobility systems, infrastructure and urban development are crucial to economic integration and will impact the quality of life in the cities and the regions they serve for years to come.

Figure 5: Rural and urban population trends (1950-2030)

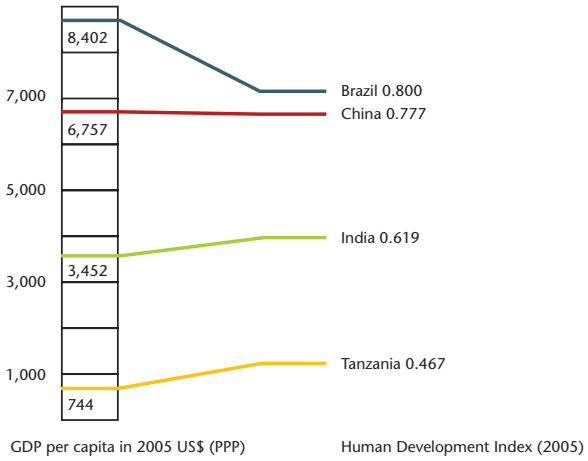



Source: World Urbanization Prospects: The 2007 Revision Population Database

## Why these locations?

Each city is unique. Nevertheless, Bangalore, Dar es Salaam, São Paulo and Shanghai share common challenges and were chosen to provide a representative reflection of the mobility issues experienced by cities and regions across the developing world. Each one of them is striving towards higher levels of economic prosperity and human development. Each one is encountering mobility challenges as infrastructure and transport services struggle to keep up with the demands of growing populations, expanding vehicle fleets and increasing trade. We realize that this is a very small sample of the world's major cities and their associated mobility challenges, but we believe that many of the observations and lessons are applicable to other cities around the world.

Figure 6: National development (2005)




Source: UNDP, Human Development Report 2007/2008

| | GDP (US$ PPP, 2005) | Gini Index | HDI (2005) |
|---|---|---|---|
| Brazil | 8,402 | 57 | 0.800 |
| China | 6,757 | 46.9 | 0.777 |
| India | 3,452 | 36.8 | 0.619 |
| Tanzania | 744 | 34.6 | 0.467 |
| | The GDP calculated with purchasing power parity (PPP) equalizes the purchasing power of different currencies in terms of a standard basket of goods. This takes into account the relative cost of living and the inflation rates of different countries, rather than just a nominal Gross Domestic Product (GDP) comparison. | The Gini index is a measure of income inequality between 0 (absolute equality) and 100 (absolute inequality). Current national values range from 25 to 60. | The Human Development Index (HDI) developed by the UN combines indicators of life expectancy, educational attainment and income into a single index for both social and economic development. The maximum is 1 and minimum 0. |

Source: UNDP, Human Development Report 2007/2008

The cities are part of national economies at different stages of development. Tanzania, with a per capita GDP of around US$ 750 is one of the poorest countries in the world, and has a relatively low Human Development Index (HDI) of less than 0.5. India and China are considered to have medium levels of human development; while Brazil has entered the league of the world's high human development nations (see Figure 6).

Just one indicator of what this means in practice is that while people in China and Brazil have nearly a 90% chance of living beyond 40, in India that figure is 83% and in Tanzania it is only 64%.[21]

While the cities we studied are in countries with very different levels of per capita income, they are all experiencing increased motorization, and are challenged by relatively high levels of inequality.

Each of the cities is connected to a wider hinterland through trade and migration. Shanghai and Dar es Salaam also play important roles as port cities. São Paulo is well connected to the nearby port of Santos, while Bangalore is integrated into the global economy through its virtual trade in high-tech services. Each city has expanded outwards along arterial roads and swallowed up nearby towns and villages. It is difficult to draw a clear boundary around any of the cities and often the area of municipal responsibility does not cover the true extent of the urbanized area.

The cities differ widely in their municipal powers and ability to raise and spend money. In the case of Dar es Salaam, the city spends very little on transport and must rely on international donor support. In Bangalore and São Paulo there are more resources, though distribution of revenue sources and expenditure responsibilities is highly fragmented between national, state and city level. In Shanghai the municipal authority operates as a powerful city state with the ability to raise taxes, sell land and set regulations.

As the cities become more prosperous, they have also grown more divided. Migrants from the countryside settle wherever they can afford to. Often this means living in simple self-built houses that are not served by roads, water and sewage systems, power supplies, policing or public transportation. In Bangalore and São Paulo, slums fill the spaces between smart suburbs and modern shopping malls, while in Dar es Salaam they are along the roads leading to the city. In Shanghai there are fewer informal settlements, but many people live in cramped conditions in old tenements, or newer low-rent housing.

## Local research and stakeholder engagement

In each city, the project member companies worked with a local research organization to gather information about the mobility challenges and the approaches being taken to overcome them. Using the indicators and goals developed in the *Mobility 2030* report as a guide, as much data as possible was collected to give a picture of the state of mobility and its challenges in each area, including the solutions being proposed, planned and implemented. The city summaries included in this report are based on the research and the key data collected in the four cities during 2007 and 2008, as well as on the findings of the dialogues conducted in each city.

Local dialogues made a significant contribution to the research. In each city the WBCSD and the companies, together with the local research organization, hosted a meeting where individuals and organizations from government, public transport operations, transport users and civil society with a stake in improving mobility in the region came together, sometimes for the first time, to discuss and debate the problems and opportunities for sustainable mobility at that location and to test the key findings of the research. The opinions, comments and suggestions originating from participants in these sessions helped identify priority concerns for stakeholders in each city and informed the conclusions and messages included in this report. Participant viewpoints in each of the dialogues are highlighted within each city chapter. The full city background reports can be downloaded from www.wbcsd.org/web/m4dev.htm.

*Note: It has been difficult to collect consistent and quality data across the four cities. This lack of consistency makes it difficult to draw valid comparisons between the cities. The data sources used in the four background reports are referenced in Appendix 2 at the back of this report.*


# Bangalore

India

## Bangalore snapshot

Bangalore is the administrative, industrial and cultural capital of the Indian state of Karnataka. Over the past 30 years it has grown from a university city, known for its parks and green spaces, into a major center for the high-tech industry. It is now the fifth largest and second fastest growing city in India. The city has rapidly motorized and has outgrown its transport infrastructure. Congestion threatens the city's ability to attract business, and to improve the quality of life of all its citizens.

On 12 September 2007, 62 representatives from automobile organizations, information technology (IT) companies, academic and research institutes, government bodies and non-governmental organizations (NGOs) came together at The Energy and Resources Institute's (TERI) Southern Regional Center in Bangalore. They discussed the challenges to making mobility in the city more sustainable and socially inclusive, while supporting the city's bid for continuing international competitiveness and to consider possible solutions.

*"I look forward to the formulation of a practical policy for this wonderful city. The policy should include views of all stakeholders including government, industry and the people. We should also have a practical implementation action plan for the policy – since, without implementation, no policy will be useful. If we manage to do this, we can help make Bangalore a better place to live."*

*(Participant, Bangalore dialogue, 12 September 2007)*

*Note: This chapter is based on the background report written by The Energy and Resources Institute (TERI), India, as well as on the discussions at the Bangalore dialogue. Access the full Bangalore background report on www.wbcsd.org/web/m4dev.htm*

## India's Silicon Valley

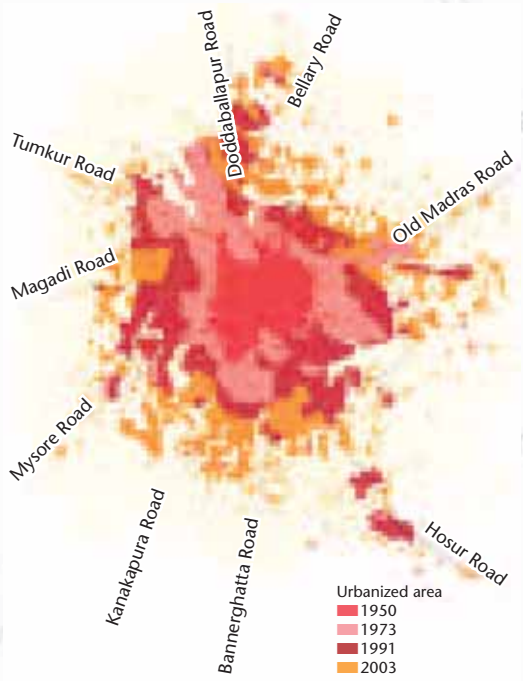
Following economic reforms in the late 1980s and early 1990s, India has experienced spectacular growth, with its economy growing at between 7% and 9% each year over the past ten years, to become the second fastest growing large economy in the world.[22] It is predicted that the country could have more than 580 million middle class consumers by 2025. However, despite India's dynamism, more than a quarter of the population lives below the poverty line. Much of India's business growth has been concentrated in heavy industry, chemicals and engineering and more recently in business-process outsourcing and information technology. However, these industries make little use of the unskilled labor that the country has in abundance. Wage gains are therefore concentrated at the top. The government recognizes the need for more "inclusive growth".[23]

Bangalore is one of India's economic success stories. Until the late 1990s the city was a regional administrative, industrial and scientific center and a base for publicly owned heavy industry. With economic liberalization, Bangalore's skilled labor force, research capacity, temperate climate and competitive real estate made it an attractive base for the emerging high-tech and business process outsourcing industries. Homegrown and international companies including Wipro, Infosys, Microsoft, Intel, Yahoo and Google have established campuses on Bangalore's outskirts and the city now attracts 1 in 3 of India's IT professionals, and half of its IT investment. It is also developing as a center for healthcare and high-tech research and design.[24] The city's appeal as the "the Garden City of India" has been a crucial factor in attracting both international business and highly skilled individuals.

Per capita income in Bangalore, at 55,000 Rupees, is the highest of any city in India.[25] Nonetheless, it must be remembered that most of Bangalore's residents do not work in call-centers or IT parks, but are engaged in textile weaving, manufacturing, repair work, retailing, food-processing, recycling and taxi and rickshaw driving.[26] Inequality is rising: in 1991 the richest one-fifth of Bangalore's population earned on average five times more than the poorest, by 2001 they earned 14 times more.[27] According to a 1999 survey, 2.2 million people live in slum conditions in the city.[28]

Bangalore's population has tripled over the past 30 years, from 2 to 6 million, through a combination of natural growth, migration and incorporation of neighboring towns and villages. A further million people visit the area each day.[29] Migrants include both highly skilled workers drawn from all over India and abroad, as well as the rural poor from Karnataka and neighboring states. By 2015 the population is projected to reach 8.4 million, putting Bangalore into the league of the 30 biggest urban settlements in the world.[30]

Figure 7: Urban expansion (1950-2003)




Source: World Urbanization Prospects: The 2007 Revision Population Database

Bangalore's city center is densely crowded with narrow streets. Therefore the city government has encouraged a policy of peripheral development. It has restricted city center densification and encourages industry and residents to move to the outskirts, co-opting rural roads as city streets and villages into suburbs. From 1977 to 2001 the city area increased from 177 km$^2$ to 565 km$^2$ (see Figure 7).

## Mobility in Bangalore

Bangalore's infrastructure and urban planning has not kept pace with its exploding population, increasingly sophisticated expectations and the sheer numbers of vehicles and people on the road. Traffic congestion, environmental pollution and accidents have increased, despite motorization being in its infancy in the city, and these problems now impinge on the image of the city, the productivity of its companies, and the happiness of its residents.

Getting around Bangalore's expansive city area demands long journeys, generally by road, as there are few facilities for suburban rail travel, and as yet no metro. The average trip length for city residents has been reported to be 12-13 km.[31] Most employees of the industrial and IT firms live a considerable distance from their work, some commuting 25 km each day. Faced with an increasingly dispersed city, an outdated road network, severe congestion and competition from private vehicles, Bangalore's public transport system struggles to provide a comfortable, speedy and affordable service. Major gaps have now opened up between the type and level of service offered and the city's development needs, leading to a hemorrhaging of passengers from the bus service onto newly affordable scooters, further adding to congestion and pressure on the roads.

### Public transport

Public and paratransit services in the form of buses and auto-rickshaws play an important part in mobility in Bangalore. In 2006, 58% of all motorized trips in the city were made using these means.[32]

Paratransit services in the city are provided by 96,000 auto-rickshaws, 40,000 taxis and a growing number of "maxi-cab" share-taxis. The three-wheeled auto-rickshaws can muscle their way through gaps in the congestion for a relatively speedy journey. However, passengers suffer from poor safety and overcharging, while other road users are affected by pollution and chaotic driving and stopping. Although there is some regulation of auto-rickshaws, such as metered fare rates, paratransit is not integrated into the city's public transport system. Recently some efforts have been made in this direction, with designated stands near major destinations and bus stops to encourage a more controlled pick-up and drop-off system by auto-rickshaws and improve integration for passengers.

Bangalore's buses are operated by the Bangalore Metropolitan Transport Corporation (BMTC), which runs at a profit and is seen as one of the most successful bus operations in India. However, the city's suburban development demands many links between residential and business areas, which traditional mass public transportation struggles to provide. Routes and fares are set by the state authorities, with buses traditionally charging low fares, but offering uncomfortable and infrequent services. About 5,300 BMTC buses provide services on more than 5,100 routes in the city corporation limits and 25 km beyond. Journeys to and from new suburbs, informal settlements and satellite towns often involve city center transfers that are hampered by poor integration between different bus lines and congestion around the terminals.

In a survey conducted in 2006, more than 70% of passengers were dissatisfied with the delays, waiting time and distance to bus stops. More than 90% of the people had a journey time that exceeded 60 minutes, and most had to wait between 15-30 minutes for their bus.[33] Unsatisfied with this service, many large employers have started to run their own shuttle services, and some, such as Wipro and Infosys, have contracted BMTC to provide dedicated bus services for their employees.

# Bangalore mobility

### Public and paratransit transport
Buses operated by Bangalore Metropolitan Transport Corporation (BMTC): 5,362 buses provide services on 5,178 routes.
Paratransit service: 96,000 auto-rickshaws (3 wheelers) and 40,000 taxis.

### Road network
Total network is 7,750 km

### Vehicle ownership (2001)
Automobiles: 40 per 1,000 people
Motorcycles: 204 per 1,000 people

### Trip frequency
There is no reliable estimate.

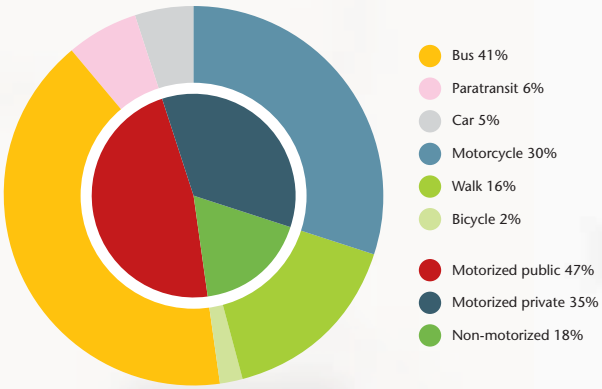
### Fatalities
0.145 per 1,000 people (2004)

### Characteristics of trip length/trip time
There is no reliable data.

### Expenditure on transport
Average per capita monthly income in Bangalore is Rupees (Rs.) 4,600 (2001). The poor, with household income of 2,000-4,000 Rs., spend 15-25% of their income on travel every month (TERI interview).

### Public transport basic fares
BMTC services: Ordinary bus: 3-15 Rs. (increase 0.2 Rs./km), Pushpak service (express/air conditioned): 2-20 Rs. (increase 0.22 Rs./km)
Auto-rickshaws: 12 Rs. (increase 6 Rs./km)

Figure 8: Transport modal shares (Bangalore)




Source: Bangalore City Development Plan (JNNURM)

Competition with paratransit, private transport and employer shuttle buses has led the bus company to revisit its own strategy. It has developed improved bus services, offering transport at different levels of comfort and cost. Most recently, premium air-conditioned buses have been introduced on strategic routes, such as those running to major industrial parks, in an attempt to attract drivers back to public transport. Air-conditioned "Volvo buses" and women-only pink buses also offer a higher level of comfort. BMTC is investing in Global Positioning System (GPS) tracking on its buses, which will not only enable better central control, but will also allow it to provide real-time information to passengers through electronic signs at bus stops and SMS messages.

*"Earlier people thought it was below their dignity to travel by public transport. Public transport in Bangalore had no room to carry people's ego, but now we are focusing on making public transport more attractive, fashionable and comfortable."*

*(Participant, Bangalore dialogue, 12 September 2007)*

Premium bus services are still faced with the same congested roads that slow down all transport. Without dedicated bus lanes, better bus stops and more efficient transfers, it will be impossible for even an improved bus fleet to achieve a level of speed and convenience comparable to personal modes. The city is therefore planning to switch bus routes from a radial to a grid route plan, improve depots, passenger information and ticketing systems and interchange facilities, and create dedicated bus lanes and signal priority for public transport.

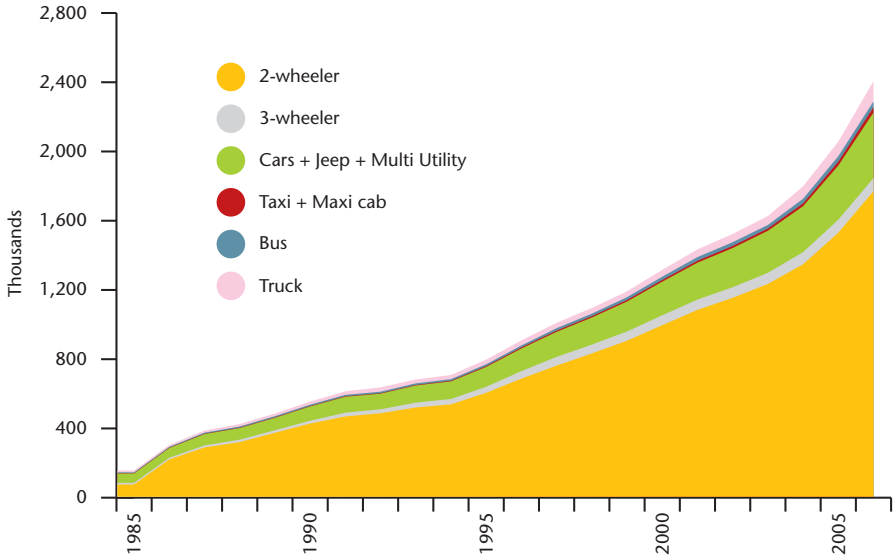
## "Meet the Zippies"

With infrequent direct public transit services, inefficient transfers and oft-compromised safety and privacy on cramped buses, Bangaloreans increasingly aspire obtaining their own means of transport. ''Meet the Zippies,'' declared Thomas Friedman in the New York Times in 2004, highlighting the generation of young, upwardly mobile Indians zipping around India's cities on motor scooters, *"When you go to a developing country and you see a lot of motorcycles around, that's the best sign possible, because it is a sign of young, lower middle class people who have left the countryside, come to the city and found jobs and earned enough to give up the bicycle and buy a motor scooter. And Bangalore is full of motor scooters."*[34]

Two-wheelers are popular across India, and particularly in Bangalore. They are affordable, easy to maneuver and cheap to run, and they have enabled many to achieve the goal of moving from bicycles or the bus to driving their own motorized transport. In 1988 only 1 in 16 households had a personal vehicle; by 2007 this figure had risen to more than 1 in 3, with the vast majority of these being owners of two-wheelers (see Figure 9).[35]

However, two-wheelers have their own drawbacks: their drivers and passengers are particularly vulnerable to accidents and injuries, and their two-stroke engines burn an oil-and-gasoline mix that is contributing a disproportionate and rising amount of carbon monoxide (CO) and nitrogen oxide (NOx) pollution to Bangalore's environment. Two-wheelers are often overloaded and driven haphazardly. Passengers rarely wear helmets.

Figure 9: Vehicular growth rates in Bangalore (1985-2005)




Source: Indian Ministry of Shipping, Road Transport & Highways (MoSRTH), 2007

## Garden city or gridlocked city?

Bangalore's massive expansion from garden city to global IT center has not been accompanied by integrated planning for the use of urban space or by adequate investment in infrastructure. Industrial and commercial developments that cluster along radial roads and high-tech industries developing at the city's edge are not served by transverse links. Chaotic junctions, narrow and inconsistent road widths, mixed road use and the search for on-road parking add to problems on the roads. There are few provisions to keep buses, high occupancy vehicles, pedestrians and bicyclists separate from other traffic.

Congestion is a major problem in Bangalore and is regularly highlighted in both the local and even international media and in political campaigns. Average traffic speed has fallen from 15-18 km/h in 1990 to 10-14 km/h in 2006, which is slow even compared to other growing Asian cities. Nearly all the major junctions are operating above their capacities, risking citywide gridlock.[36]

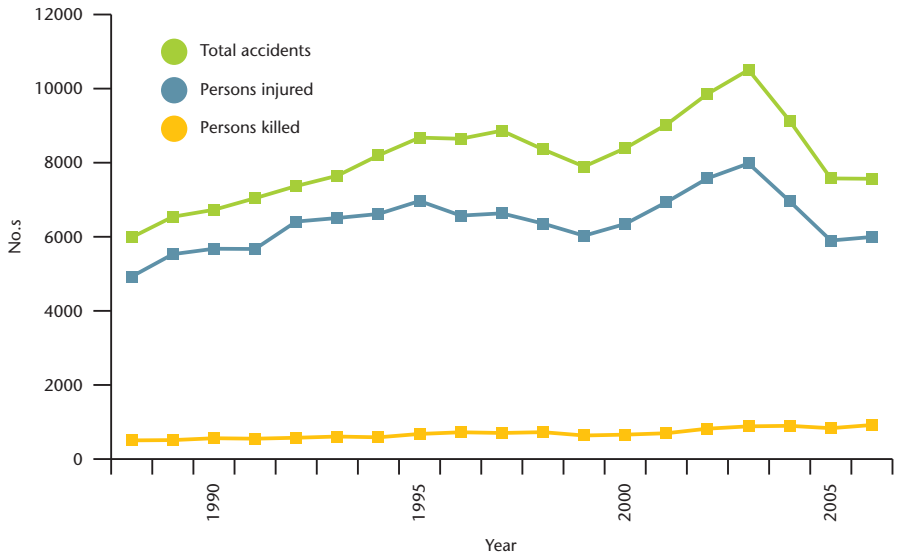
Traffic Police estimate that 35% of the road network is in poor condition, while they do not measure sidewalk adequacy. Throughout India, road building practices do not appear to be properly controlled, with roads deteriorating rapidly once put in place. This is also compounded by the limited nature of truck inspection with widespread overloading contributing to road damage. Pedestrian sidewalks are often non-existent, sacrificed to road widening or infringed upon by commercial activities, parking or scooter drivers.

## Health risks

Pollution levels in Bangalore are not as high as Delhi, Kolkatta or Mumbai. However, levels of NOx and dust pollution remain too high to meet National Ambient Air Quality Standards.

The total number of road accidents in Bangalore rose until very recently and the number of road-related deaths continues to rise. In 2002, there were 6,958 accidents and nearly 900 deaths on Bangalore's roads, making it fifth among India's fourteen major cities for road traffic deaths (see Figure 10).[37] A study of road-related head injuries found that poor road design was responsible for one-third of injuries, while two-thirds were caused by behavioral factors such as not wearing helmets, driving under the influence of alcohol, driving poorly maintained vehicles, driving without lights, overtaking recklessly and speeding, or by pedestrians crossing in the middle of the road.[38]

Figure 10: Road traffic injury trends in Bangalore (1988-2006)




Source: Indian Ministry of Shipping, Road Transport & Highways (MoSRTH), 2007

*"There are structured programs in the country to combat diseases like malaria, tuberculosis, etc. and the number of deaths yearly in road crashes far exceed the deaths caused by these diseases. However, there are no such structured and dedicated programs, nor a strong political commitment to address road safety in India yet."*

*(Participant, Bangalore dialogue, 12 September 2007)*

## The other-side of Boomtown

While increasing numbers of Bangalore's residents are able to travel by personal motor vehicle or air-conditioned shuttle buses, for many of those who travel regularly by public transport and non-motorized means, the mobility situation is poor and getting worse.

Estimates differ, but most measures of mobility in Bangalore find that on average the number of trips per person is a little over one trip per day. This probably underestimates walking trips, but nevertheless indicates low rates of mobility among the population in general.

Although bus fares are kept low, they are still barely affordable for the poorest.[39] The BMTC provides

subsidized fares for various sections of society, but research by TERI in the course of this case study found that residents in Bangalore's slums spend between 15% and 25% of their household income on travel, and report that this conflicts with spending on other necessary services like health, education, shelter and food. Walking trips are hindered by non-existent or obstructed sidewalks and by difficult street crossings.

*"Mobility cannot be understood merely as right to unhindered access. It has to do with the larger array of spaces wherein we have designed spaces for various use. An old man's right to cross the road is just as valid as the company executive who wants to drive to work."*

*(Participant, Bangalore dialogue, 12 September 2007)*

Poorer workers and pedestrians spend a larger proportion of their time outdoors and exposed to automotive pollutants and accident risk.

## Governance for mobility

In response to the scale of urban expansion, Bangalore's Municipal Council has recently been extended to include seven other city councils and one town council at its outskirts to form the Greater Bangalore Municipal Area. Despite this, the financial and institutional capacity of Bangalore's state and local governments has struggled to keep up with the demand and the expectations generated by its demographic and economic growth.

A wide range of agencies are involved in planning and delivering urban transport in Bangalore. Trip origin and destination surveys have only recently begun. Projections for the future are therefore often based on inadequate datasets and weak assumptions, leading to unrealistic plans that cannot be achieved. Although the city is one of the fastest growing and soon to be one of the most populous in India, the first transport master plan study was launched only recently.

In 2005 the government of India launched the Jawaharlal Nehru National Urban Renewal Mission (JNNURM), a seven-year program of investment in 63 of India's cities. The program provides central government funding for transport and other urban infrastructure improvements and makes requirements for institutional reforms at the city level to make these investments sustainable.[40] In 2006 the government also laid out its National Urban Transport Policy (NUTP), providing a framework for pro-public transport policy and emphasizing moving people and not vehicles. City development plans are required, in principle, to be in line with NUTP guidelines. Emissions controls are also set at the national level.

The vision of India's National Urban Transport Policy is to:

- Recognize that people occupy center-stage in our cities and all plans would be for their common benefit and well-being
- Make our cities the most livable in the world and enable them to become the "engines of economic growth" that power India's development in the 21st century
- Allow Indian cities to evolve into an urban form that is best suited for the unique geography of their locations and is best placed to support the main social and economic activities that take place in the city.

The NUTP clearly states in its guidelines that states/cities need to give priority to public transport:

- Based on technology (high-capacity bus, metro, light rail, monorail, etc.) best suiting the city's travel demand requirements on various corridors for the next 30 years
- Preceded by comprehensive city-wide plans drawn up comprising trunk and feeder corridors
- Integrated into a single system that allows seamless travel between one mode and the other and also between systems managed by different operators
- Inclusive of non-motorized transport to improve safe access to public transport
- Backed by institutional mechanisms set up by the government to ensure good coordination.

The NUTP prescribes the setting up of an umbrella body called Unified Metropolitan Transport Authorities in all million-plus cities in India. These bodies would have the statutory backing and the requisite powers to manage the various aspects of urban transport, including fuel quality, emissions norms, public transport, land-use planning and safety in order to make mobility more sustainable.

While India's national policy is acknowledged to be in line with

international thinking on urban transport, it has also been criticized for its lack of guidance on the good data, rigorous impact analysis and consultative decision processes needed to implement it.[41]

Participants in the dialogue echoed the recommendations of the NUTP, emphasizing the need for more equitable allocation of road space and greater safety measures, as well as giving priority to public transport and non-motorized transport. They also stressed that the severity of the road safety problem is not recognized adequately in the city and enforcement of existing traffic laws remains weak.

## Towards solutions

Bangalore is currently banking on increased road infrastructure, improved public transport systems and intelligent transport systems to solve its mobility woes, and is taking some steps to control pollution. There are strong calls for improvements in public transport and infrastructure, while retaining the city's green spaces.

### Infrastructure development

The most common response to the problem of congestion and inefficient road space use has been to increase the road capacity in Bangalore by, for example, building flyovers and converting roads into one-way streets. However, this has not been able to meet the surging demand of private vehicles and often these measures have only succeeded in shifting the point of congestion further up the traffic stream. Progress is being made in Bangalore on the construction of a belt highway that will tie together the industrially built-up areas and the transportation hub, including the airport, as well as a subway system that will stretch beneath the city. However, citizens are concerned that trees and green spaces in the city are being removed to make way for more roads, while new suburbs are being developed with little thought as to how to best serve these areas with public transport.

*"The knee jerk reaction to solving the congestion problem in the city is to widen all the roads in the central core area of the city. This will destroy the soul of the garden city, by the time we decongest the city."*

*(Participant, Bangalore dialogue, 12 September 2007)*

### Public transport improvement

Participants in the dialogue placed their best hopes on the city's efforts to improve public transport and tempt people away from private transport. And they felt that both the pull of better public transport and the push of demand management would be needed to achieve decongestion and the use of effective public transport. Although Bangalore has a comprehensive bus system that runs at a profit, it recognizes that it needs to improve the speed, reliability, comfort and reputation of public transport if it is to succeed in moving greater numbers of people on Bangalore's already crowded roads. In addition to the bus system, a bus rapid transport (BRT), metro and suburban rail system are also planned. The BRT system will provide a modern, high-capacity bus system in the outer ring roads and on a dedicated corridor. Commuter rail links covering 62 km and an airport rail service are also planned. Development has already begun on the 33 km "Namma" metro rail system that is expected to handle over 800,000 passengers per day. However, while seeking to improve the speed and comfort of public transport, the city must also maintain fares that are competitive and affordable. With the marginal cost of driving a scooter estimated at less than one rupee per kilometer, it is difficult for public transport, particularly elevated or underground systems, to compete.[42]

*"Finding solutions like building more roads and flyovers to tackle challenges of rapid motorization will not work from the viewpoint of making mobility sustainable for the whole city. The only thing that can make a difference and which has been proven worldwide is investing in mass transport that works."*

*(Participant, Bangalore dialogue, 12 September 2007)*

### Intelligent transportation systems to improve transport flow

The Bangalore City Police is implementing an integrated traffic improvement program to reduce congestion, crashes and pollution levels in the city and to improve traffic enforcement and accident response. Under this plan the city's roads will be categorized into concentric zones with different traffic management approaches. The central area will have area traffic control systems, one-way streets, dedicated bus lanes, no-auto-rickshaw zones, parking controls, access restriction and toll roads. Improved road markings and traffic signs, better enforcement, smart information systems and education campaigns are all being developed. Central to these plans is the use of intelligent transportation systems (ITS) to enable smart signals and variable message signs, automated enforcement, automated congestion information, better central control and rapid response to congestion, emergencies, incidents and accidents.

### Pollution control

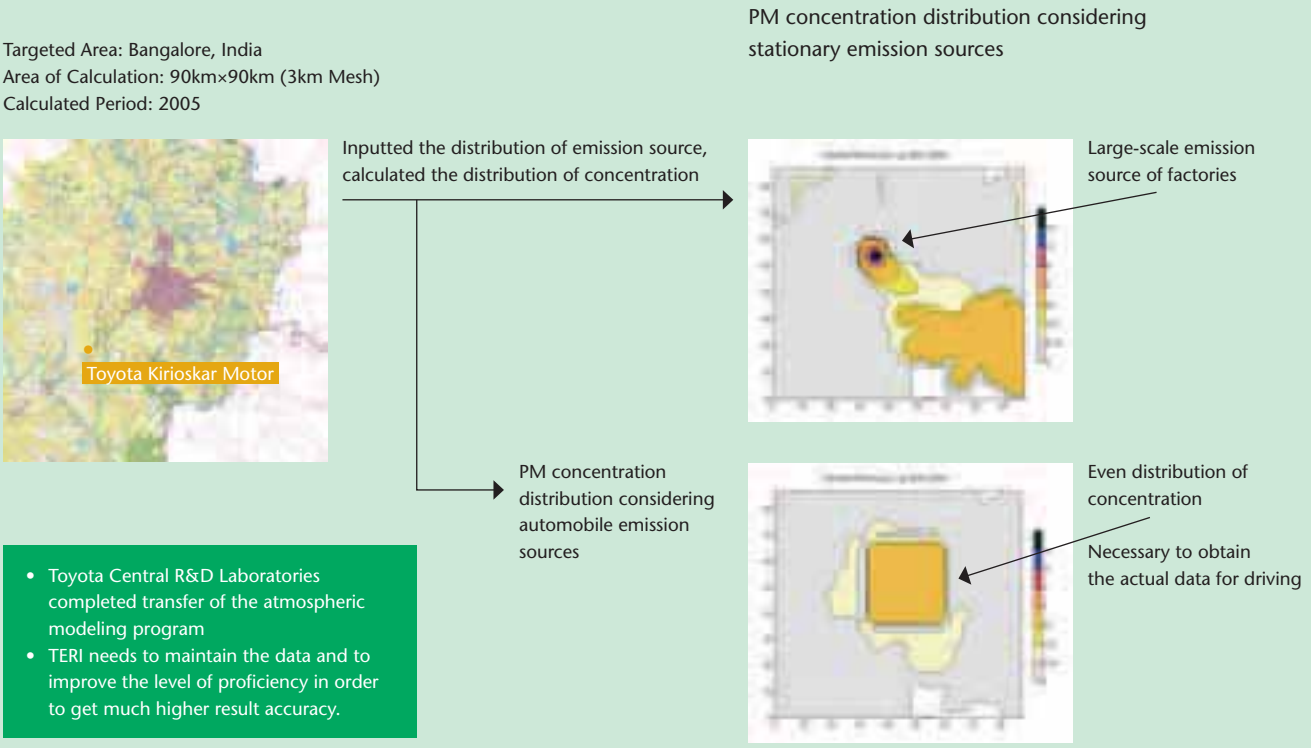
Between 1994 and 2000, India removed lead from gasoline and sulfur from diesel. Its emissions norms currently lag behind Europe's by four to five years for all vehicle categories except for two-and three-wheelers where it has some of the world's most stringent standards. These regulations and improvements in fuel quality have succeeded in bringing down sulfur dioxide levels in the city to meet national standards.[43] However, diesel vehicles (which include all commercial

### Box 2: Technology support for pollution modeling

Air pollution is likely to continue to be a critical issue as India experiences continued future economic growth. Therefore, Toyota Motor Corporation, with technical support from Toyota Central Research & Development Laboratories, has supported TERI in acquiring a computer program for three-dimensional atmospheric modeling that can calculate the ozone generation from volatile organic compounds (VOC) and NOx emissions, and also secondary-generated particulate matter.

Since 2005, Toyota Laboratories has been providing technical support to TERI to implement this three-dimensional atmospheric model in Bangalore. As a result, the program and know-how have successfully been transferred to TERI for their independent research. An overview of the simulation and the results are shown in Figure 11 below:

Figure 11: Results simulation of Bangalore atmospheric modeling




Source: Toyota

This model will enable TERI to make best use of the information and to stimulate measures for improving air quality in Bangalore.

Furthermore, cooperative study has started with institutions in China, India and Europe in order to clarify the emission sources of NOx and VOC in Asia, which are the causes of increasing ozone concentrations in the Northern Hemisphere, and to support national action to address this problem.

vehicles, buses and many cars and taxis) as well as poorly maintained two stroke two-wheelers are significant contributors to the city's pollution problem. Many auto-rickshaws have been found to be running on adulterated petrol. The city has been taking steps to address these pollution sources. Auto-rickshaws have been ordered to convert to liquefied petroleum gas (LPG); however, implementation of this policy has faced several hiccups and in 2006 only 58% of the entire three-wheeler fleet had been converted. Pollution checks are now mandatory for all vehicles and those over 15 years old are subject to a green tax and a "Green Fitness License". However, these initiatives are not supported by the necessary network of vehicle fitness, maintenance and inspection centers needed to ensure all vehicles are in compliance.[44]

Information about the sources and potential trends of transport emissions is a key element in any strategy to effectively reduce pollution (see examples in Box 2).

Very little is being done to control traffic demand or encourage a mode shift to public transport in Bangalore, although major private sector employers are beginning to address the issue by practicing "pragmatic transport demand management" (see Box 3).

The prospect of modernizing Bangalore into India's "silicon valley" has captured

### Box 3: Pragmatic transport demand management

Bangalore's employers are focused on the problem of enabling their employees to get to work in comfort and with ease, without exacerbating the city's congestion problems. They are creating their own transport plans and strategies.

- **Shuttle buses** – Many major employers, including Infosys, Wipro and Toyota Kirloskar Motor (TKM), provide commuter shuttle bus services for their employees. This acts as an incentive to employees to use public transport and also removes cars from the roads. Twelve thousand of Infosys's 18,000 employees use BMTC-contracted shuttle bus services to get to work. TKM provides 92 buses for 24 routes covering the city center and suburbs in a service used by 90% of employees.

- **Telework and telecommuting** – Although there are significant barriers to large-scale telework in Bangalore (including bandwidth, business and workforce maturity and data security issues), some companies have started to experiment with telework centers and telecommuting from home. For example, Healthscribe in Bangalore has employed over 100 people to work out of their homes. Multinational companies, such as Accenture, Cisco Systems, IBM, Intel, Microsoft and Texas Instruments, are also looking to apply their global telework practices within their Indian operations. IBM in Bangalore allows employees from project manager upwards to work from home, while Accenture allows all employees in functional areas like human resources, finance and marketing to telecommute. Infosys uses telework to enable expectant and new mothers to continue working while staying close to home.

the imagination of the government, media and investors. Thus Bangalore's commuter headaches are regularly highlighted in both the local and even international media, and are the focus of public debate and policy-makers' attention. Urban planning therefore tends to focus on the concerns of the city's elite, favoring more road space for vehicles rather than better or more affordable public transport, safer spaces for pedestrians and non-motorized mode users, or transport facilities for vulnerable sections of the population. Indeed, major works aimed at decongestion, such as road widening, construction of elevated highways and planning formalization, can often make the situation for pedestrians worse and also impact directly on the livelihoods of the poor by shifting informal enterprises away from their established locations.

Participants in the dialogue felt strongly that a council for sustainable mobility involving stakeholders from across government, business, academia and citizens' organizations could play a useful role in keeping mobility for development on the agenda and enabling a coordinated response to mobility that reflects the needs of all of Bangalore's inhabitants.

*"From a civic body point of view, I must confess that thinking about the mobility problems of the poor living in the slums does not come under our radar, so the poor are more or less left to fend for themselves when it comes to organizing their mobility."*

*(Participant, Bangalore dialogue, 12 September 2007)*

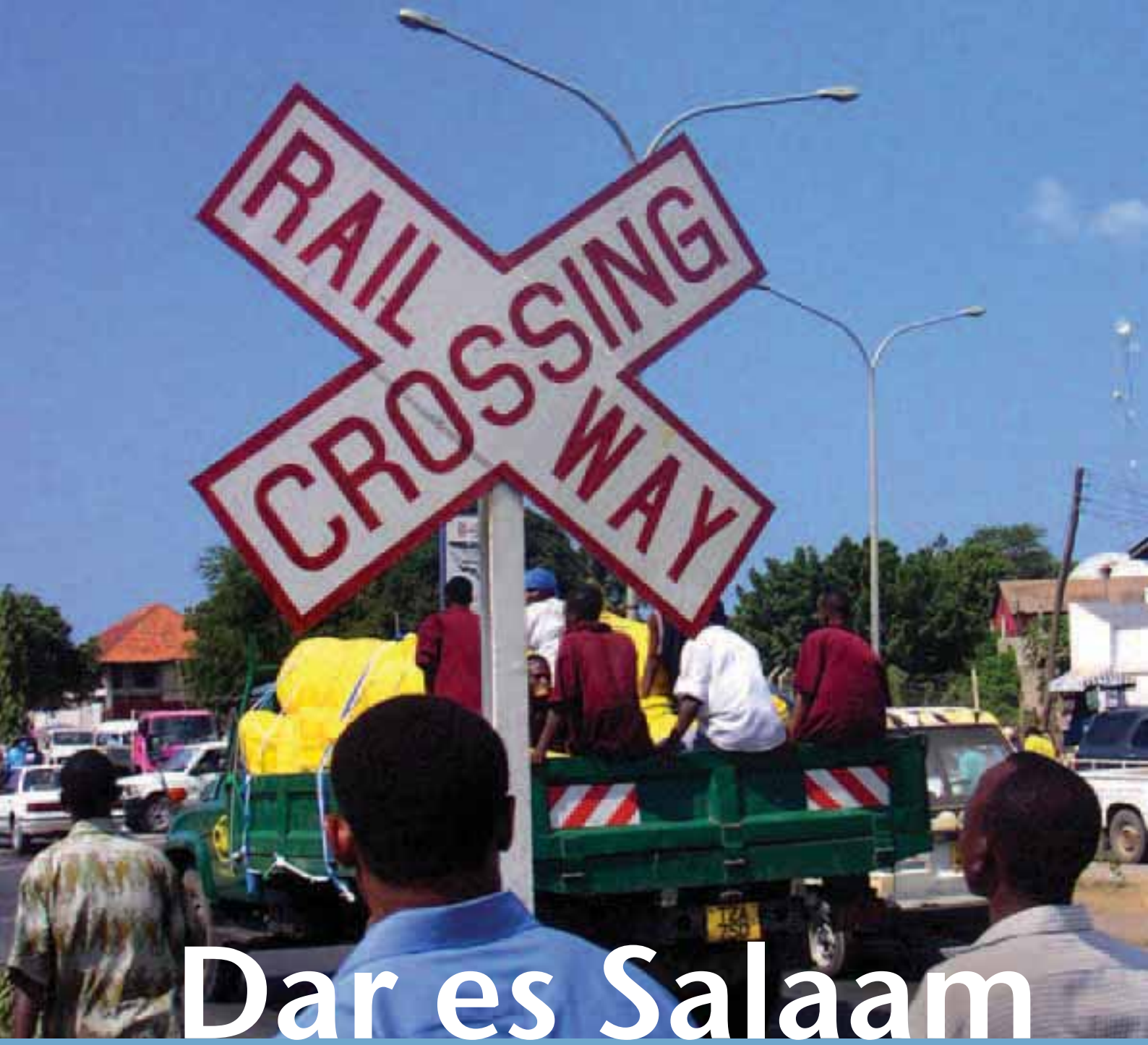
## Summary

**Bangalore's reinvention as "the byte basket of India" has enabled many to benefit from economic growth and the mobility opportunities that it brings. But the city now faces urgent mobility challenges. Aging infrastructure and urban planning have not kept pace with an exploding population, increasingly sophisticated expectations and the sheer numbers of vehicles and people on the road. Traffic congestion, environmental pollution and accidents have increased despite motorization being in its infancy in the city, and are now impinging on the image of the city, the productivity of its companies and the happiness of its residents.**

**The financial and institutional capacity of Bangalore's state and local governments has struggled to keep up with the demand and the expectations generated by its demographic and economic growth. After years of underinvestment, Bangalore's municipal government recognizes the urgent need to improve its road infrastructure and traffic management. But building more roads alone will not solve the city's problems and citizens are concerned about the corresponding loss of green space. The city's poorer residents suffer disproportionately from the negative effects of transport activities, including pollution and accidents; however, their concerns are given low priority.**

**A metro system and better bus services are planned, with dedicated bus lanes, more efficient transfers and improvement and integration of the paratransit system recognized as crucial for public transport to achieve a level of speed and convenience comparable with personal modes. However, at the same time, very little is being done to encourage a mode-shift to public transport, or to control traffic demand growth, and development of new suburbs is uncoordinated with public transport.**

**The Bangalore dialogue called for the setting up of a multi-stakeholder council for sustainable mobility to enable a coordinated response on urban planning and transportation policy in the city.**

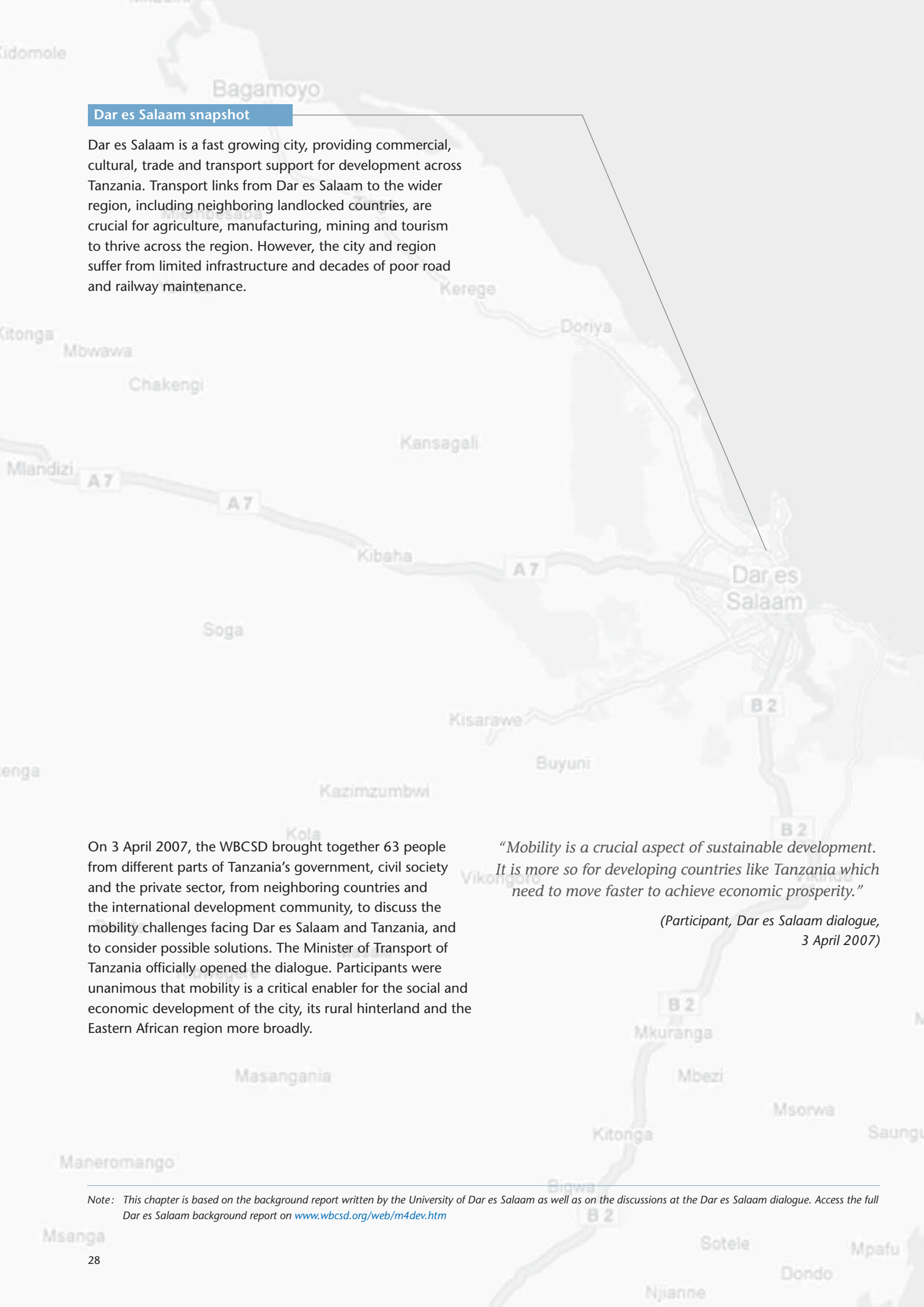



# Dar es Salaam

## Tanzania

## Dar es Salaam snapshot

Dar es Salaam is a fast growing city, providing commercial, cultural, trade and transport support for development across Tanzania. Transport links from Dar es Salaam to the wider region, including neighboring landlocked countries, are crucial for agriculture, manufacturing, mining and tourism to thrive across the region. However, the city and region suffer from limited infrastructure and decades of poor road and railway maintenance.




On 3 April 2007, the WBCSD brought together 63 people from different parts of Tanzania's government, civil society and the private sector, from neighboring countries and the international development community, to discuss the mobility challenges facing Dar es Salaam and Tanzania, and to consider possible solutions. The Minister of Transport of Tanzania officially opened the dialogue. Participants were unanimous that mobility is a critical enabler for the social and economic development of the city, its rural hinterland and the Eastern African region more broadly.

*"Mobility is a crucial aspect of sustainable development. It is more so for developing countries like Tanzania which need to move faster to achieve economic prosperity."*

*(Participant, Dar es Salaam dialogue, 3 April 2007)*

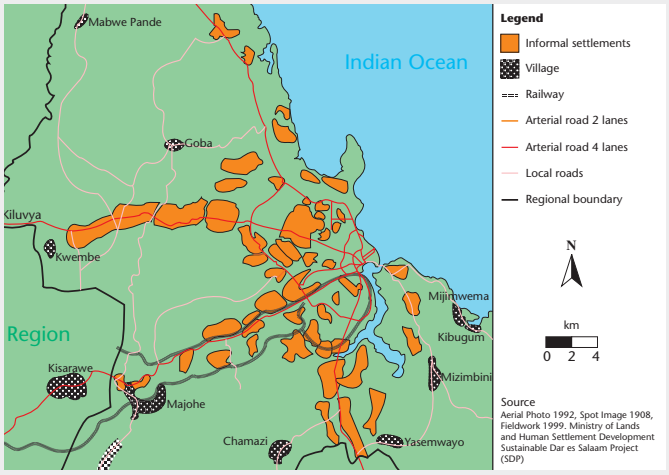
*Note: This chapter is based on the background report written by the University of Dar es Salaam as well as on the discussions at the Dar es Salaam dialogue. Access the full Dar es Salaam background report on www.wbcsd.org/web/m4dev.htm*

## From "Peaceful Harbor" to regional hub?

Dar es Salaam is the commercial, cultural, trade and transport hub of Tanzania. Its origins as a "peaceful harbor" are reflected in its name, and the commercial center remains concentrated around the harbor. Tanzania's political stability, economic liberalization, macro economic reform, debt relief and rising exports have contributed to steady economic growth since the early 1990s. Annual GDP growth rose from less than 1% in 1993 to nearly 6% twelve years later. Dar es Salaam's urban dynamism has played a key role in saving the country from economic stagnation. Nevertheless, Tanzania remains a poor, predominantly rural and agricultural country. In 2005, its GDP amounted to US$ 750 per person on a purchasing power parity basis. The country has set a goal of reaching the level of income and welfare of a middle-income country by 2025 and recognizes that it needs to continue to increase its productivity and international competitiveness to meet this goal.

About one in four Tanzanians already live in towns and cities and the urban population is increasing rapidly. With a population of 3.7 million and growing at over 4% a year, Dar es Salaam is the third fastest growing city in Africa.[45] Industrial and residential developments have spread out along the main arterial roads that radiate from the city. In between the formal developments, unplanned settlements have sprung up to accommodate people migrating to the city (see Figure 12). Three-quarters of Dar es Salaam residents live in these settlements that are situated on marginal land and along flood-prone river valleys. Their homes are self-built houses made of wood, metal sheeting and mud brick and are often not served by roads, water, sewage, power supplies, policing or public transportation.

Figure 12: Informal settlements in Dar es Salaam




Industrial sites are clustered in a few peripheral estates and there is a marked separation between residential areas and places of work. This means that many people flock to the central business district, or commute from one side of the city to the other each day. The rapid increase in population in Dar es Salaam's suburbs has not been matched by an expansion of schools in these areas, so each day many of Dar es Salaam's school children join the peak hour commute towards the city center.

Consumption expenditure in Dar es Salaam is between 1.5 and 2.5 times higher than elsewhere in Tanzania, and a much smaller proportion of people are classified as living in absolute poverty.[46] However, close to half of the working age population of the city is officially unemployed.[47] Informal industries, including minibus driving, street trading and urban agriculture, are important sources of livelihood for the city's poorer residents.

## Mobility in Dar es Salaam

### On the road to development

Traveling by road is the only way to get around in Dar es Salaam. But the city's roads offer chaotic and poorly planned conditions for pedestrians, drivers and public transport users. Pedestrian journeys account for nearly half of all trips within the city, as walking remains the transport choice for the city's poorest residents.[48] However, there are few safe road-crossing facilities and hardly any street lighting. Footpaths are often taken over by parking or street traders, and bicycle paths are nonexistent.

Some 70% of motorized journeys in Dar es Salaam are by public transportation. In common with most African cities, small-scale private sector operators provide virtually all public transportation. In Dar es Salaam this takes the form of 9,000 "dala-dala" minibuses that operate on semi-fixed routes, as well as taxicabs that make point-to-point journeys.[49] But the sector is fragmented and undercapitalized, and vehicles are often overloaded and driven dangerously. The service offered is poor due to overcrowding, particularly during peak hours, reckless driving, route shortening, harassment of women and school children and polluting vehicles. It is estimated that only 30% of dala-dalas are roadworthy.

Dar es Salaam has the highest rate of vehicle ownership of any city in Tanzania, although it is low by international standards. Ownership increased from 2% to 6% of households between 1991 and 2001.[50] In middle-income suburbs, as many as 60% of households own cars while in poorer areas the proportion is much lower.[51] Bicycle ownership, by comparison, is less prevalent than in other cities – with only 12% of the city's households owning a bicycle (compared to 34% of urban households nationally). However, human powered transportation remains important for small traders.[52]

Despite the relatively low rate of motorization, congestion is already a problem, particularly during peak hours. Minibuses, cars, handcarts and peddled carts share the roadway, causing accidents and impeding the traffic flow. In the heart of the city, busy roads and junctions are further constricted by new buildings, informal developments, parking and street traders. It is not unusual for people to have to travel for two to four hours each day to get to their place of work or study.

### Health risks

Although overall vehicular air pollution in Dar es Salaam is lower than in other African cities such as Nairobi, air pollution is worsening. For those living or working near congested roads, air pollution is a serious problem. The situation is exacerbated by the vehicle stock consisting predominantly of old, imported vehicles for which genuine spare parts are often unavailable. There are no mandatory vehicle tests and the country has a poor maintenance culture. Traffic congestion and illegal adulteration of some fuels with kerosene further contribute to the problem.

Although the physical condition of the main arterial routes is relatively good, over 95% of roads in the city have no functioning storm water drainage, and only one quarter are paved.[53] In wet weather they pool with mud and water, making driving hazardous and slow and providing an ideal breeding ground for malaria-carrying mosquitoes. In dry weather clouds of choking dust blow up from the road's surface.

The number of road accidents and road deaths both appear to be rising and it is estimated that 8% of deaths in hospitals are caused by road accidents. Private cars and dala-dalas are most often involved, with pedestrians and cyclists accounting for 59% of fatalities.[54] Risky behavior by both drivers, passengers and other road users, poor road infrastructure, badly maintained vehicles and lax enforcement of traffic rules are the main contributory factors. The overcrowding of public service vehicles also contributes to injury and mortality risks. Road accidents cost the country 3.4% of GDP.[55]

# Dar es Salaam mobility

### Public and paratransit transport
Privately operated minibuses:
9,000 dala-dalas in Dar es Salaam

### Road network
Total network is 2,005 km including 421 km paved roads.

### Vehicle ownership
16 per 1,000 people (National level)

### Trip frequency
4 trips/day/person (2007)

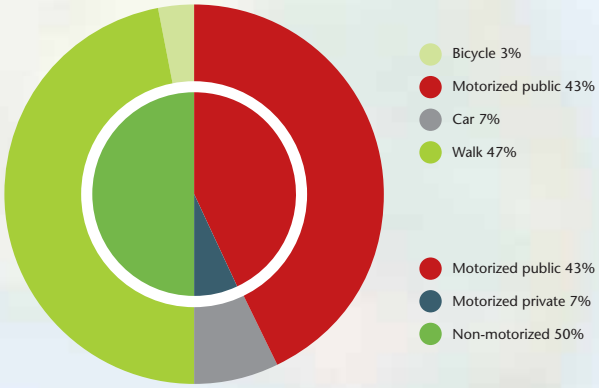
### Fatalities
0.126 per 1,000 people (2002)

### Characteristics of trip length/trip time
The data for average trip length and trip time are not available.

### Expenditure on transport
In 2001 9.7% of household spending was on transportation, compared to 1.2% in 1995.

### Public transport basic fares
1 dala-dala ride = 250 Tanzanian shilling (US$ 0.19) – maximum fare supported by the government for the Ubungo to city center route (8 km)

Figure 13: Transport modal shares (Dar es Salaam)




Source: World Bank data

## Low mobility and poverty

The poorest city dwellers suffer disproportionately both from the negative impacts of transportation, such as pollution and road accidents, and from a lack of effective and affordable transportation. Their main modes of transport - walking and dala-dala - leave them most vulnerable to injury and crime. Low-income households can spend up to 45% of their income on public transport, while many simply cannot afford the fare.[56]

Dar es Salaam residents take on average four trips per day, with half of these on foot. Low mobility particularly affects residents of the city's informal settlements, where a lack of planning and investment means that roads are either non-existent or are flooded in wet weather. Without road access, these residential areas are cut off from sanitary waste disposal, policing and other public services, and people find it hard to get to work or to markets.

Vulnerable travelers, including women, the elderly and the disabled, are also disadvantaged by the cut and thrust of dala-dala transportation. Women and students are often harassed or discriminated against on public service vehicles and there is a lack of user-friendly facilities for the disabled.[57]

## Transport links to the region

To understand the role of Dar es Salaam as a hub it is necessary to appreciate the wider region.

In the hinterland of Tanzania, despite fertile soil and a favorable climate, farmers are among the poorest in the world, with two out of five people in the countryside classified as being so poor that they cannot meet their basic needs. Transport bottlenecks cut off fertile regions from export outlets and raise input costs, compounding the problems of inefficient marketing and post-harvest storage. Only 38% of the rural population has reliable access to transport, and the average distance to public transport is 54 km in rural areas.[58] This has had a significant

impact: households within 100 meters of an all-weather road with access to a bus service earn one third more than the rural average.[59] Poor transportation contributes both to low farm gate prices and high costs for urban consumers.

Furthermore, there are the neighboring land-locked countries of Malawi, Zambia, Democratic Republic of Congo, Rwanda, Burundi, and Uganda for which Dar es Salaam is one of very few ocean import/export hubs.

The road and rail routes to both the hinterland and the neighboring land-locked countries that run out of Dar es Salaam include marine crossings of inland lakes. The development potential of these inland areas is hampered by poor road and rail infrastructure and a lack of integration between the seaport, rail, road and lake transportation.

As with most African countries, Tanzania's transport corridors have developed from a colonial transport system of feeder roads and railway lines designed to carry commodities from the rural hinterland to European ports. When Tanzania gained independence it expected to build up a more integrated transport network to serve

national development needs. However, the transport system has remained stagnant due to a lack of investment and policies aimed at protecting uncompetitive state railways rather than promoting competitive integrated road and rail services.[60]

Tanzania's road network carries 70% of the country's freight and 90% of its passenger traffic. It is a relatively sparse and largely unpaved network of 85,000 km spread across nearly 900,000 km$^2$ (neighboring Kenya, by comparison is nearly 40% smaller, but has twice this amount of roadways). The railway is relatively extensive but inefficient. The tracks and bridges are affected by floods during the rainy season, while the wagons and locomotives are inadequate and very old. Rolling stock cannot be interchanged between the two systems as they run on different gauges, although there is now a trans-shipment yard to enable freight containers to be transferred between the two. Passenger numbers are stagnant, and freight tonnage has been falling in recent years, leaving the railways operating well below their potential capacity.

Dar es Salaam port has 11 berths, of which 8 are for break bulk and 3 for containers, as well as an oil jetty able to handle tankers of up to 40,000 dry weight tonnages. Container traffic is rising, but the port has struggled to catch up with its rival Mombasa. Container handling is only available at the port and some railheads. Therefore, most containers are transported inland by truck, are unloaded and return empty to the port.[61]

Figure 14: Transport corridors in Tanzania


High levels of bureaucracy both at international borders and internally (for example in the management of weighbridges) lead to higher costs. Import and export procedures have improved significantly in recent years, cutting the time for exports to 24 days and imports to 30 days. This is significantly better than both neighboring Kenya and the regional average. However, in comparison with the most successful trading nations, which have turnaround times of less than 6 days each way, Tanzania still has a long way to go to streamline trade procedures at its borders.[62]

*"Transport integration needs stability and political will to succeed. Regional leaders need to work together."*

*(Participant, Dar es Salaam dialogue, 3 April 2007)*

## Governance for mobility

The transport sector in Tanzania falls under the mandate of several departments. The Ministry of Infrastructure Development is responsible for transport development policy and for trunk and regional roads. Local authorities under the Ministry of Regional Administration and Local Government are responsible for the district, urban and feeder roads. The Ministry of Home Affairs is responsible for road traffic and safety regulations.

Since the mid-1980s the government of Tanzania has pulled out of transport business operations to take a more hands-off role focused on setting strategic development targets, implementing regulations and monitoring and evaluation. As part of this approach, the government has rationalized and streamlined the institutional framework for management of transport infrastructure and services into autonomous executive agencies. These include the Tanzania Ports Authority, the Tanzania Airport Authority and the Tanzania National Roads Agency (TANROADS), which manages, develops and maintains trunk and regional roads. A National Road Board guides TANROADS activities with representation from the private sector, road users and the government. The Surface and Marine Transport Regulatory Authority is responsible for the licensing of public transport operators, and sets rules and fares for their operation.

The Dar es Salaam city government is split into a number of levels, from the regional administration headed by the Regional Commissioner to the City Council administration headed by the Mayor, and finally to three Municipal Councils each headed by a District Commissioner.

The primary responsibility for mobility rests with the City and Municipal authorities who are responsible for planning and development control, local roads, drainage and waste management. The City Council coordinates crosscutting issues including transportation and planning, but each Municipal Council provides direct services in terms of road development and maintenance, waste, urban development, education and information and communications technology (ICT) development.

Tanzania's government recognizes that transport is critical to the development of prosperous agriculture, manufacturing, mining and tourism enterprises. The country needs a modernized transport system to facilitate regional as well as global trade, industrial upgrading and urban development. This requires efficient logistics, facilities for containerized shipping and inter-modal transfers, better storage and customs procedures, as well as linkages between urban industrial and commercial development

and freight transport facilities and regional integration.[63]

The government has therefore set a goal to provide reliable road access to 95% of the rural population, with all trunk and regional roads in at least fair condition by 2015 and improved efficiency in ports and airports to support economic development.[64] Together with international donors and investors it has embarked on a major road and rail transport infrastructure development program. By 2006, 85% of trunk and regional roads, and 47% of district, urban and feeder roads were reported to be in good or fair condition. Nevertheless, more than 80,000 km of roadway remains unpaved, making traveling difficult in wet weather.[65]

The National Transport Policy (NTP) put in place in 2003 puts emphasis on efficiency, effectiveness, competition, affordable services and environmental preservation. Elements of the policy that are particularly relevant for urban transport include:

- Improving the capacity and quality of the public transport network in urban centers
- Establishing alternative public transport networks, using rail and water
- Ensuring the public transportation system is affordable to low-income people
- Ensuring urban transport is sustainable and environmentally friendly
- Strengthening the systems for driver education and regulation.

The NTP also recognizes the importance of land-use planning in addressing urban transport problems. It aims to ensure that facilities such as light industries and schools are located within or close to residential neighborhoods and to develop transport infrastructure hand in hand with municipal planning. It advocates for the development of ring roads to divert traffic away from city centers, the promotion of public transport and the development of rail and water transport wherever possible to complement road transport.

The NTP highlights the need for more effective freight transport and improved transport corridors. It seeks to harmonize and coordinate road, waterway and rail policy, regulation and procedures with neighboring countries and to encourage private sector investment.

## Towards solutions

As indicated above, Tanzania's mobility challenges are recognized by its government, its businesses and its citizens. The Tanzanian national government and the city of Dar es Salaam are taking a number of steps to address the mobility deficit.

### National infrastructure improvements

Together with international donors and investors, Tanzania has embarked on a major road and rail transport infrastructure development program, the objective of which is to open up the country to economic development and to provide reliable communication between different regions and efficient transport for passengers and goods. Attention is particularly focused on improving transport along Tanzania's four key transport corridors. Each corridor is served by a committee that seeks to coordinate and attract investment both in transport infrastructure and in industry and to facilitate trade by reducing the difficulties of border crossings and inter-modal transfers. However, the transport corridor developments remain under-funded.

TANROADS has undertaken a major road maintenance and upgrading program, in particular targeting the central transport corridor road connecting Dar es Salaam with the administrative capital Dodoma and the landlocked countries of Rwanda and Burundi.

The Tanzania Ports Authority is promoting a US$ 44 million project to upgrade the port to take larger vessels and handle growing volumes of oil products.

Successful concessioning of the Dar es Salaam container terminal to a private company has been instrumental in achieving efficiency improvements and growing shipment volumes. But its performance also depends on improvements to the rail network serving it. The CEO of the container port stated: "*The problem we face in Tanzania is that the development of our business is being held back because outside the port, the road and rail infrastructure is so poor*".[66]

The government has entered a joint venture with RITES (a public sector undertaking of Indian Railways) for one of its national railway lines and is attempting to do likewise with other parties for the other (which is described as being "at the brink of collapse"[67]).

### Dar es Salaam city planning

The growth of the city of Dar es Salaam has not followed any coordinated, long-term strategic plan. As a consequence, there is a mismatch between people, infrastructure, amenities and employment opportunities. Municipal land management practices, largely inherited from the colonial systems, have been unable to cope with the rapid urbanization of the country. The city suffers from poor land-use planning controls, with a high percentage of the population living in unplanned and poorly served informal settlements

along the arterial roads while most services and jobs are situated in the central business district. The City Council has initiated an integrated transport program to improve mobility in the city. Important elements are increasing private sector investment in the transport system and increasing the capacity of the municipality to plan, manage and regulate its public transport system. The principles of integrated city and transport planning advocated by the NTP have been taken up in Dar es Salaam's Master Plan, but the question remains as to whether they will be successfully implemented.

## Public transport improvement

The Dar es Salaam City Council also has plans to introduce high-capacity modern buses, bus stops and ticketing systems to enable modal integration and improved facilities for non-motorized travel. Central to this vision is the much vaunted and long awaited Dar es Salaam Rapid Transit (see Box 4). The city faces a number of challenges in implementing its bus rapid transit (BRT) plans. Securing the finance and capacity to develop the system are obviously crucial. But also critical will be dealing with the poor culture of traffic regulation enforcement in the city; without improvement this will cause problems for the bus-only lanes of the BRT system. From a development point of view, a major challenge for the new BRT system will be to ensure that it is affordable and addresses its impact on dala-dala passengers and drivers. Dala-dalas provide livelihoods to an estimated 31,000 people, and even once the BRT system is operational dala-dalas will continue to be the main public transport mode.

## Driver education and regulatory enforcement

Education campaigns are being undertaken around road safety and environmental controls and the Tanzanian police force is working to improve the quality of driver education, with mandatory training, a revised curriculum and the import of dual control instruction vehicles.[71] The police force also plans to introduce computerized driving licenses in a bid to eradicate fake driving licenses and poor driver training. However, while these initiatives focus on improving driver behavior, very little is being done to put systems for vehicle inspection in place despite its potential to reduce pollution, improve safety and mitigate congestion.

## Coordination

Bringing together the diverse actors involved in enabling mobility in Tanzania in the dialogue did not reveal any new problems, or a completely novel set of solutions. It did, however, advance the crucial recognition that Tanzania's mobility challenges require coordinated action between infrastructure and planning departments, between transport modes as well as ICT solutions, across international borders and between the public and private sectors.

A number of priorities were identified for improving transportation in the city, for example widening some main roads and improving feeder roads, improving public transport, improving road and vehicle maintenance and traffic management. Better enforcement of traffic rules and campaigns to improve driver behavior were also called for. However, participants recognized the need for a wider, development focused approach to transportation in the city in order to improve access to services and safety for all citizens and road users. Suggestions included decentralizing industry and services away from the city center and ensuring user-friendly transport facilities for vulnerable groups including children, the elderly and the disabled.

*"The Minister has created a policy and investment framework for transportation and infrastructure development – now expect the business community to look for the investment opportunities that make sense for them."*

*(Participant, Dar es Salaam dialogue, 3 April 2007)*

**Box 4: DART – Dar es Salaam Rapid Transit**

The bus rapid transit (BRT) system pioneered by cities such as Curitiba in Brazil and Bogota in Colombia combines the exclusive right-of-way, punctuality, frequency and prepay ticketing of a metro service with the low construction and maintenance costs of a bus system. It is increasingly recognized as one of the most cost-effective solutions to providing high-quality, low-cost urban public transport.

In 2003, the Dar es Salaam City Council announced its ambition to develop a BRT system. At the time this would have made it the first of its kind in Africa. The World Bank awarded the city US$ 1 million in April 2005 to finance detailed design and planning, and the United Nations Environment Program and the Institute for Transportation and Development Policy (ITDP) have provided support.[68]

The proposed Dar es Salaam Rapid Transit (DART) system would not replace dala-dalas but would carry around 200,000 people each day, representing 20% of daily bus trips in the city. The system is planned to include a 100-km network of busways, with segregated and priority bus lanes and boarding stations using over 1,000 high-capacity, low-emissions buses and 600-800 feeder buses.

The government has taken some steps towards implementing the plan, expanding and improving major roads into the city and agreeing regional tariff reductions for bus imports. However, full-scale construction has already been put off several times, as a recent report in the Tanzanian Guardian complained: "As it sounds, it is now more than three years since it was made public, and not a single rapid bus is on the road."[69]

Current indications are that Phase 1 implementation will go ahead in 2009/10.[70]

Participants agreed that more political will is needed to enable greater mobility opportunities within the region in order to enable economic development and social progress. The development of regional transport corridors was supported as a useful lever for this. Developing these corridors to their full potential will require improving the linkages between transportation modes and treating transport corridors as total logistics systems replacing and upgrading rail networks with a single standard gauge and reducing congestion in the port of Dar es Salaam. The key priorities identified were to improve legal and institutional frameworks, to reduce complexity and bureaucracy and to eliminate corrupt practices to create a conducive environment to attract more foreign direct investment.

Common themes that stood out from the discussion at both city, national and regional levels were the need to:

- **Make institutions effective** – The best technical solutions to mobility challenges can be undermined, by excessive bureaucracy, corruption and organizational territorialism or by a lack of resources and professional capacity. In the case of Tanzania, poor coordination and limited resources for investment in housing, roads, transport services and traffic safety have prevented effective planning, implementation or ongoing maintenance. The development of effective and coordinated institutions to manage, plan and regulate municipal and regional transport is therefore critical.

- **Develop an integrated approach to mobility for development** – Improving mobility, whether at the city, national or regional level, enables people and goods to get from where they are to where they need to be. This is much broader than simply improving transport infrastructure or facilitating the movement of vehicles. It involves an integrated approach to planning and infrastructure development, building and maintenance, safety and training, transport, logistics and ICT provision. Prioritizing mobility for development will mean making sure that the needs of vulnerable transport users such as students, older people and the disabled are considered, ensuring that the needs of non-motorized transport users are given as much importance as vehicles and redressing the balance between investment in urban and rural mobility. It also means developing effective and efficient mobility solutions that link different transport modes and integrate communication and transportation.

- **Mobilize the private sector** – Private sector capital, management and expertise have been critical to achieving improvements in the performance of road, port and air transport operations to date. However, challenges still hindering investment in Tanzania are an unreliable power supply, ambiguous administrative procedures and a weak financial sector with high interest rates. Key challenges for Tanzania are not just how to attract international investment to enable higher standards, but also how to increase stronger involvement by local entrepreneurs, both in public transport and in infrastructure maintenance.

*"The private sector should be the engine of growth in Tanzania, providing the wagons and the goods, while the government provides the rail lines and the roads."*

*(Participant, Dar es Salaam dialogue, 3 April 2007)*

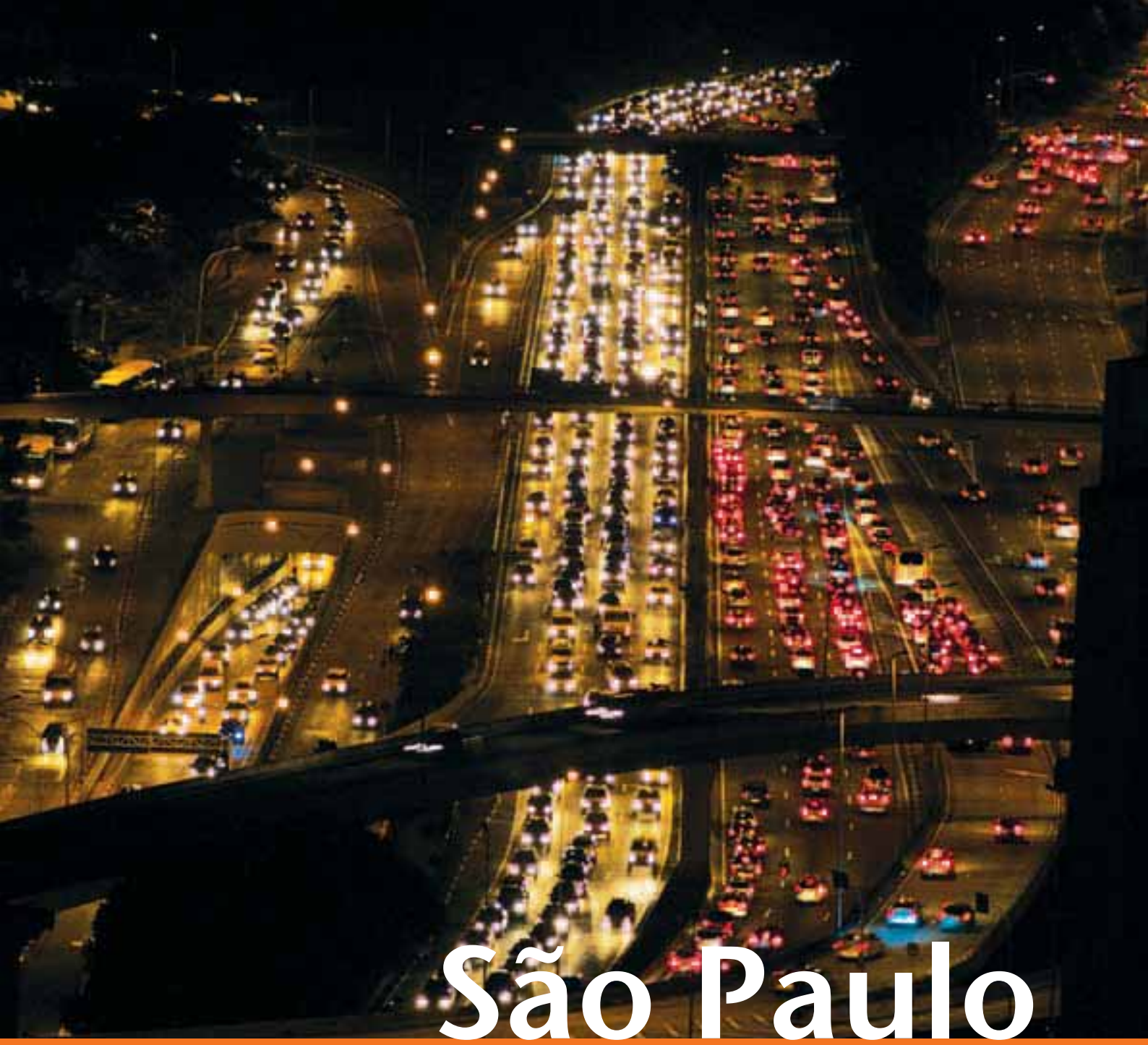
## Summary

Dar es Salaam has grown rapidly without a forward-looking unified city plan and with low levels of infrastructure investment. The city has grown much faster than its infrastructure – a situation that is not only increasingly detrimental to the lives of Dar es Salaam residents but also threatens to hamper national and regional economic development. Large numbers live in informal settlements and are poorly served by roads, public transport, water or utilities. The city's roads are chaotic and poorly planned for pedestrians, drivers and public transport users and, despite the relatively low rate of motorization, congestion, accidents and pollution are growing problems.

The poorest city dwellers suffer disproportionately both from the negative impacts of transportation and from a lack of effective and affordable transportation. Vulnerable travelers including women, the elderly and the disabled are particularly disadvantaged by the lack of mobility opportunities. However, rural residents face even more severe mobility problems, with lack of all-weather roads and transportation standing in the way of access to markets, education and health services.

At a national level, the railways, ports and transport corridors and local roads are recognized as being inadequate and a key barrier to trade and economic development. This is being addressed through a program of rehabilitation, upgrading and maintenance, through privatization and donor funding. There is potential for Tanzania's road, rail and shipping networks to become economic development corridors, not only shifting goods and produce across Tanzania and to and from neighboring countries, but bringing access to markets, and social and industrial development to those living along the corridors. However, to date the corridor projects have been under-resourced.

Participants in the dialogue agreed that mobility in Dar es Salaam is the backbone of its economic growth, and is critical to all sectors. They recognized that past mobility investments have fallen short of needs and agreed that the current poor state of infrastructure, lax enforcement of regulations and lack of planning are critical factors holding the city and the country back. And they identified a number of ways to improve the situation, through an overall development approach to the city's mobility situation in order to facilitate access to transport services to all citizens.



# São Paulo

## Brazil

## São Paulo snapshot

São Paulo is the industrial and financial center of Brazil, and one of the largest cities in the world. Despite its extensive bus network and efficient metro system, public transport use is falling and car use is rising. Congestion was recently rated the number one common concern of São Paulo citizens, and is responsible for economic losses estimated at US$ 2.4 billion per year. The mayor and the city's highest earners have taken to traveling across the city by helicopter. Meanwhile, those on the ground face what have been called the world's worst traffic jams, with tailbacks up to 200 km during rush hour.

On 15 May 2008, a wide ranging group of stakeholders came together in a dialogue in São Paulo, Brazil. Co-hosted by Conselho Empresarial Brasileiro para o Desenvolvimento Sustentável (the WBCSD partner organization in Brazil), participants from businesses that provide and depend on mobility services, NGOs, regulators and government bodies, discussed the mobility challenges that São Paulo and other cities in Brazil are facing. The discussion focused on three issues key questions:

- Can São Paulo avoid permanent grid-lock?
- Is the mobility system in São Paulo adequately addressing the mobility needs of all citizens?
- What more can be done to reduce the adverse health and environmental impacts from transportation in São Paulo?[71]

*"We have to reinvent the city to create areas where people are closer to what they need."*

*(Participant, São Paulo dialogue, 15 May 2008)*

*Note: This chapter is based on the background report written by Engenharia de Tráfego e de Transportes S/C Ltda (TTC), as well as on the discussions at the São Paulo dialogue. Access the full São Paulo background report on www.wbcsd.org/web/m4dev.htm*

## City of hopes, city of fears

São Paulo's population more than doubled every 20 years throughout the twentieth century; a population boom with which urban planners have struggled to keep up. More recently, population growth has slowed from a high of 4.5% each year during the 1970s to 1.3% today.[72]

The city of São Paulo covers 1,500 km$^2$ and is relatively dense. Unlike Rio de Janeiro, urban growth is not constrained by the ocean or mountains and therefore the São Paulo Metropolitan Region (SPMR) has spread out to cover over 8,000 km$^2$, resulting in massive destruction of the Atlantic Rainforest green belt surrounding the city. Since 1980, the city has transformed itself from a manufacturing center into a service metropolis linking Brazil to the global economy. It is both a financial capital, home to most of the foreign companies and banks in the country and an important maritime hub. Through the ports of Santos and São Sebastião, the metropolitan region handles nearly one-quarter of Brazilian foreign trade.

Regional GDP per capita is around US$ 9,000, with services contributing 72% of economic activity. However, inequality is high, and nearly three out of five people in the metropolitan region earn less than half of this amount. At the last census in 2000, 14% of residents were considered to be living in poverty (compared to 33% in Brazil as a whole). However, most households now have access to public services including electricity, garbage collection and water. Some 90% have access to telephone services and 82% to sewage services.

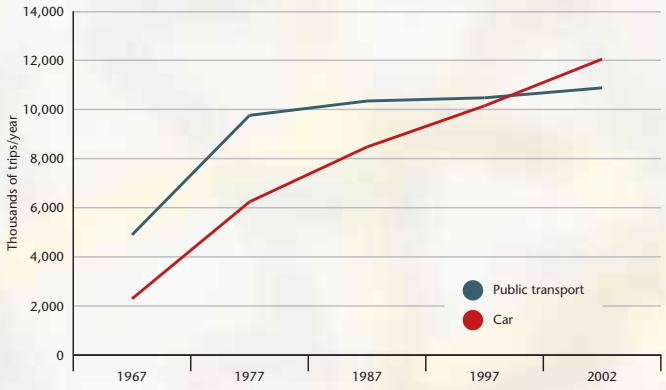
São Paulo is a city segregated by walls and security equipment and by widely divergent incomes and opportunities. A survey by the government in 2007 found that residents in the most affluent districts of the city enjoyed a quality of life (as measured by the UN Human Development Index) in line with Sweden and Canada, while those in the poorest districts were in line with Mongolia and Guyana. The city's neighborhoods have seen a number of shifts as manufacturing has given way to services and new formal and informal developments have expanded. Inner-city slum tenements and favelas around the city's periphery house the poorest social groups, while the better off live closer to the city center or in gated communities in the suburbs. In the last twenty years the density of the central district has fallen from 18,000 to 11,000 residents/km$^2$, while the densest peripheral districts have risen from 13,000 to 21,000 residents/km$^2$. The population of central neighborhoods is still falling while peripheral neighborhoods continue to grow at rates of up to 3% per year.[73]

Despite recent reported decreases in crime throughout São Paulo, crime and fear of crime remain a critical factor in this city where murder, rape, kidnappings, armed assaults and burglaries have become a fact of life.[74]

## Mobility in São Paulo

In the last few decades, São Paulo, like other major Brazilian cities, has seen a rapid expansion in automobile ownership and use. There were over 8 million registered vehicles in the SPMR in 2007, amounting to 314 cars and 45 motorcycles per 1,000 residents. Private motorized trips (by car, motorcycle and taxi) have doubled over the past thirty years and São Paulo has become the first city in Brazil where private vehicle trips have overtaken public transport (see Figure 15).

Figure 15: Changes in car and public transport trips (1967-2002)




Source: Companhia do Metropolitano de São Paulo (CMSP, 1998 and 2002)

Overall mobility has remained fairly stable at a little over 2 trips per person per day since the late 1970s (although the level of mobility dipped to 1.8 trips per day during Brazil's economic crisis in the late 1980s and early 1990s). However, high-income groups take more than twice as many trips as low-income groups. The poorest walk or travel by the antiquated suburban rail service, those on middle incomes take the bus, while those on higher incomes travel on the modern but modest metro system or by private vehicle. Trips are concentrated in the city's core area, where most high-income residents live and where most jobs are found.

Walking has always been a very important way of traveling in São Paulo and still accounts for more than one-third of all trips. In fact, walking trips have risen over the past few decades as the transition to a post-industrial city has meant a shift towards more informal sector and service jobs, often in sub-centers of the city, closer to people's homes. However, bicycle use has always been very small, accounting for around 1% of all trips in 1997.

*"There are few bicycle lanes and no secure bicycle parking – you have to be brave to ride a bike to work in São Paulo."*

*(Participant, São Paulo dialogue, 15 May 2008)*

Although two-wheelers make up a relatively smaller proportion of the vehicle fleet than in many other major cities in the developing world, motorcycle use has recently become more popular in São Paulo, and throughout Brazil. Between 1997 and 2006, the number of motorcycles in the city increased from 140,000 to 455,000. A significant number of these motorcycles are used by "Motoboys", São Paulo's army of motorcycle dispatch riders who deliver the documents that keep Brazil's financial capital ticking (see Box 5).

# São Paulo mobility

## Public and paratransit transport

Rail: 6 lines, 262 km
Bus: 14,000 buses and microbuses (city of São Paulo), 101 km of bus lanes/corridors
Subway: 4 lines, 61 km

## Road network

Total network is 45,453 km

## Vehicle ownership (2007)

Automobiles: 314 per 1,000 people
Motorcycles: 45 per 1,000 people

## Trip frequency

2.1 trips/day/person (2002)

## Fatalities

0.141 per 1,000 people (2005, city of São Paulo)

## Characteristics of trip length/trip time

Trip time for motorized travel is 44 minutes. Cars: 27, Buses: 57, Bus-rail combined: 77, Bus-metro combined: 93 minutes.

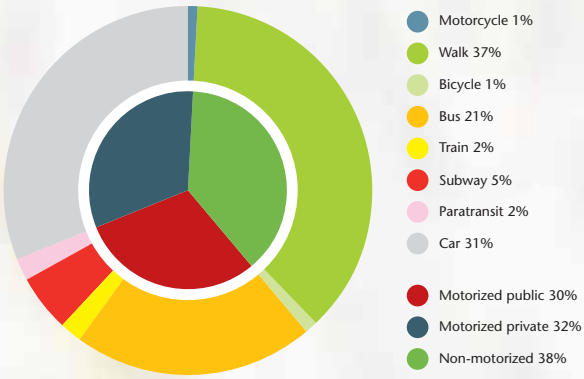
## Expenditure on transport

58% of people in SPMR earn less than US$ 350 a month. Public transport has become increasingly more expensive. The bus fare doubled excluding inflation between 1977 and 1997.

## Public transport basic fares

Metro: 2.4 R$ (Reais)
Bus: 2.3 R$ (up to 3 free connections, valid 2 hours)
Bus-metro combined ticket: 4.2 R$

Figure 16: Transport modal shares (São Paulo, 2002)




Source: CMSP, 2002

NB: All data are for São Paulo Metropolitan Region (SPMR) unless otherwise stated.

**Box 5: São Paulo's Motoboys[75]**

"Motoboys" are crucial to São Paulo's economy, delivering contracts, plans and pizzas across the city's commercial and financial districts. No one is sure of their exact numbers, but estimates range from 120,000 to 200,000.

The Motoboys, mainly young, poorly educated men from the slums around São Paulo, are self-employed or work for small dispatch agencies. Competing on speed in the congested city, they zigzag among the traffic, risking both their own safety and that of any pedestrians that get in their way. It is dangerous work. In 2006, some 380 Motoboys were killed and 9,000 injured, according to the Brazilian Motorcyclists Association.

Motorcyclists are loosely regulated and the Motoboys are reviled for kicking cars, breaking side-view mirrors and getting into arguments and fights with other road users.

São Paulo is now moving towards stronger regulation of motorcyclists, both for their own safety and to tackle the rising problem of criminals using motorcycles as getaway vehicles. Higher mandatory insurance, requirements to wear protective gear, a ban on carrying passengers, driving in the express lane, and driving between lanes of traffic are all being trialed.

Some, such as Aldemir Martins de Freitas, president of the Union of Motorbike Workers of São Paulo, have welcomed the move: "This is a historic moment for our profession. We want to stop being just a bunch of people and to be recognized." But others, such as dispatch rider Benjamin de Souza, have protested against the planned measures, seeing them as a threat to their livelihoods and a symptom of Brazil's social divide. "Society denies us support," he says. "They don't want to share space with bikers, who are poor."

## Enough buses for Belgium

São Paulo's bus services expanded rapidly in the 1960s and 1970s and now carry more than 10 million people each day, which is more than the entire population of Belgium. São Paulo's busways were some of the first to be implemented in the world, and the city boasts the longest network of exclusive bus lanes worldwide. With over 26,000 buses, 1,908 lines and 34 transfer stations, the city is said to have the world's most complex bus system. The extensive bus system provides almost universal access throughout the metropolitan region through a network of metropolitan, local and intercity services.

The buses themselves are only the most visible part of a vast operation that includes computer simulations, Global Positioning System (GPS) monitoring and an electronic payment system. Bus travel remains the main mode of public transport, carrying one in five people on their daily journeys. However, both the absolute number of passengers and the proportion of the trips made by bus are falling.

The bus network has a wide reach, but services can be irregular, unreliable and uncomfortable. Bus operators are awarded fixed contracts by city transport regulators and have little incentive for competition or innovation within the system. With tight fare controls and high inflation rates, they have resorted to cutting services in order to remain profitable.

Paratransit in the form of unlicensed minivans are also a significant provider of mobility services in many of Brazil's cities. These trips are not included in official statistics but have risen to become a significant presence in São Paulo, Rio and elsewhere. Some vans serve routes that compete directly with formal bus or rail routes, others serve areas previously underserved by transit facilities or act as feeder services to other formal modes.[76]

The subway and suburban rail carry a smaller number of passengers, but both are rising. The subway system, made up of 101 trains, carries 3 million passengers a day. The system opened in 1974 and now accounts for 5% of trips. It offers high-quality service but does not have a widespread reach and is poorly integrated with railways.

The suburban railway system, made up of 248 trains, carries 1.5 million passengers, or 2% of trips, and is used by the poorest of São Paulo's commuters. Until 1993, most of the suburban railway system was controlled by the federal railway company. Differences in objectives and goals, coupled with political and corporate conflicts between federal, state and city priorities, have led to low service levels and poor public confidence in the service. However, the municipal government is now committed to investing in improving and expanding the service.

Security concerns and declining speed and quality of public transport contribute to the widespread belief that public transport is a "second best" solution for people who cannot afford an automobile.

At the same time, the very poorest citizens are often unable to afford public transport, which has become more expensive in recent years. The fastest rise was between 1977 and 1997 when, allowing for general inflation, the real cost of a bus fare doubled and the train fare increased by a factor of 3.5. Between 1997 and 2002, the real cost of public transport journeys increased by a further 14%. A bus

journey is now more than twice the direct cost of an equivalent motorcycle trip and only one-third less than the petrol and parking costs for a lone car driver.[77] While senior citizens, students and many people working for large firms or the public sector receive free or discounted travel passes and disabled citizens are able to use a free dial-a-ride service, rising public transit fares remain a problem for people on low incomes who fall outside these schemes. Workers in the informal sector, in particular, do not receive any concessions.

*"People sleep on the streets downtown in São Paulo Monday to Friday because they have no money to go home."*

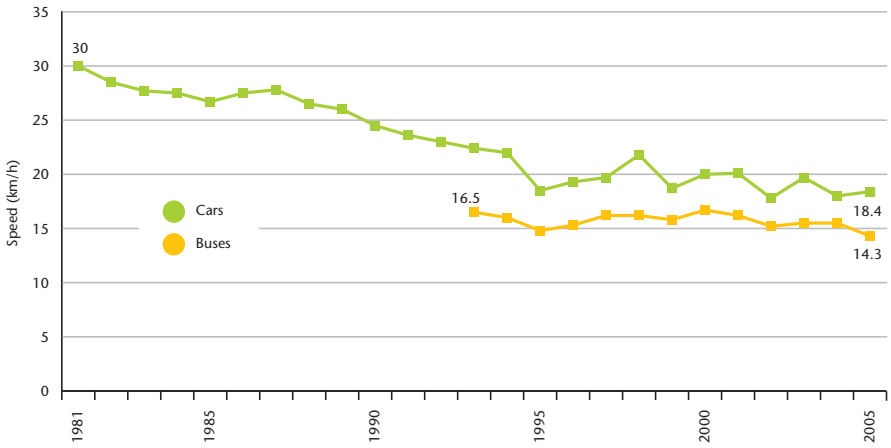
*(Participant, São Paulo dialogue, 15 May 2008)*

## "The World's Worst Traffic Jams"

The city government has already invested US$ 3 billion in new roads, overpasses and tunnels, but this has not allowed them to keep up with growing demand and congestion is a serious problem. While automobile speeds in the main arterial system increased from 25 km/h in the late 1970s to 28 km/h in the 1980s, they fell back to less than 20 km/h by the 1990s (see Figure 17).[78] São Paulo residents complain that they suffer "the world's worst traffic jams". Tailbacks in the afternoon rush hour increased from 60 km at the end of the 1980s to more than 100 km in the 90s and are still rising; a peak of over 200 km of congestion was recorded in 2007.[79]

The congestion affects all travelers, with buses traveling even more slowly than private cars. Despite the world's longest bus network, only 3% of the network operates on dedicated bus lanes and most buses have to travel on increasingly congested narrow streets. The optimum bus speed, given adequate management, is 25 km/h; in São Paulo bus speeds average 14.5 km/h. *"It's a nightmare. It's getting to the point where I can't take the stress anymore,"* says a cleaning lady who takes three buses to work. São Paulo state's transportation secretariat estimated that gridlock costs the city's economy at least 4.1 billion reais (US$ 2.4 billion) a year in lost productivity. The punishing commute eats into people's productivity and sense of well-being and leaves them angry, exhausted and depressed. *"I feel useless, like I am a prisoner,"* says one architect who spends between two and three hours each day going to and from work. *"I could be at the gym, studying, at home relaxing. But instead I am stressed and frustrated."* Freight transport also contributes to congestion. Trucks account for 27% of trips made each day in São Paulo state, mainly making journeys between factories and warehouses within the metropolitan region. Because the city lacks a full ring road, cargo trucks have to make their way on city roads to reach ports and other regional destinations.

Figure 17: Traffic speeds on main arterials in the city of São Paulo (1981-2005)




Source: Cia de Engenharia de Tráfego (CET, 2006)

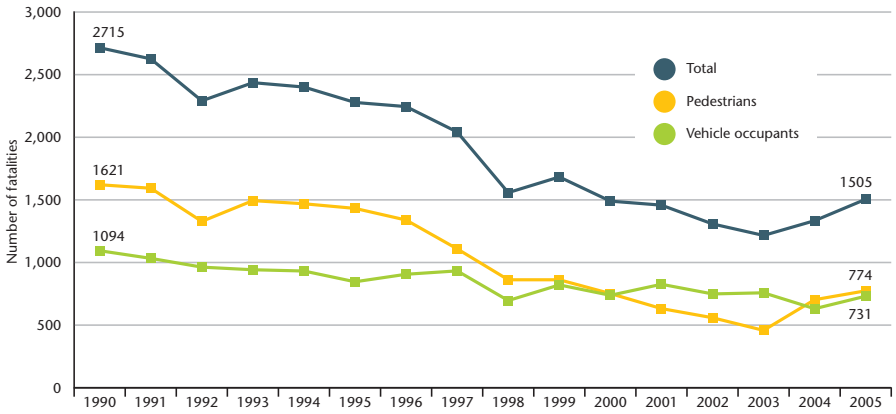
Inefficient logistic processes and chaotically distributed cargo storage add to congestion. Nearly 46% of all vehicles in circulation travel empty.

## Health risks

Throughout the 1980s and 1990s, the city of São Paulo had some of the highest traffic accident figures among large cities in the developing world, with over six deaths each day. In the past decade, the introduction of a national traffic code, speed regulation enforcement, road design, signage and the compulsory use of seat belts and helmets have reduced death rates to around four per day (see Figure 18).

The majority of victims are pedestrians, while motorcyclists and bicycle riders are also extremely vulnerable. Motorcyclists are responsible for around

Figure 18: Traffic fatalities in the city of São Paulo (1990-2005)



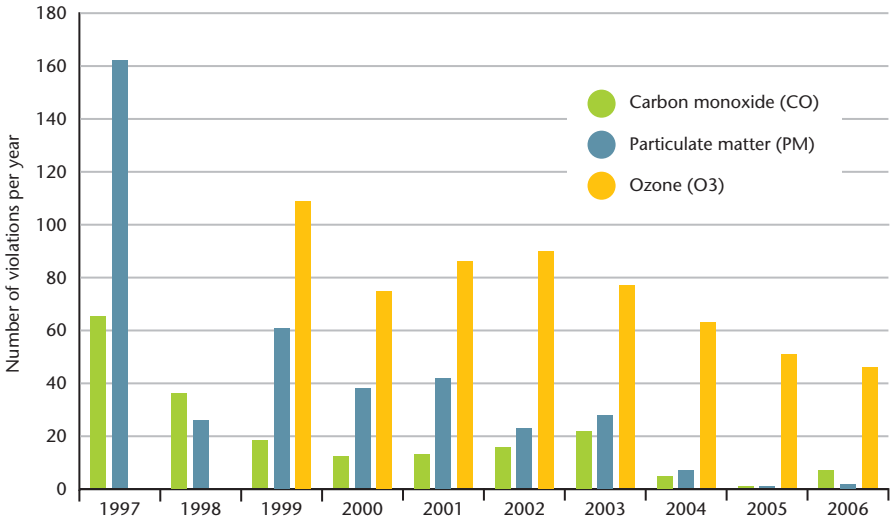

Source: CET, 2007

10% of traffic flow, but more than 20% of accident victims. Cyclists are rare on the roads, but make up 6% of fatalities (see Figure 19).

São Paulo is considered to have moderate air pollution compared to other megacities.[80] The National Program for Motor Vehicle Pollution Control (PROCONVE) has succeeded in improving vehicle emissions, resulting in a continuous improvement in the air quality over the past decade despite rising vehicle numbers. In 1997, particulate matter (PM) was above acceptable levels for nearly half the year. By 2006, this had been reduced to just a few days and since 2004, yearly PM air concentration averages have been below the Brazilian standard (see Figure 20). Nitrogen oxide (NOx) emissions from light-duty vehicles are now reasonably under control, although emissions from heavy-duty diesel-fueled vehicles are only gradually being reduced.

Measured and projected emission levels based on current trends and policies in place show that while light-duty vehicles were once responsible for the majority of carbon monoxide (CO) and volatile organic compound (VOC) emissions, these are now being brought under control. However, other pollutant sources are growing in importance. Motorcycles have become increasingly popular in São Paulo and are contributing a growing share to VOC and particulate emissions, as well as the majority of CO. Heavy-duty trucks contribute the majority of NOx and particulate emissions.

Figure 20: Air quality monitoring in São Paulo State (1997-2006)

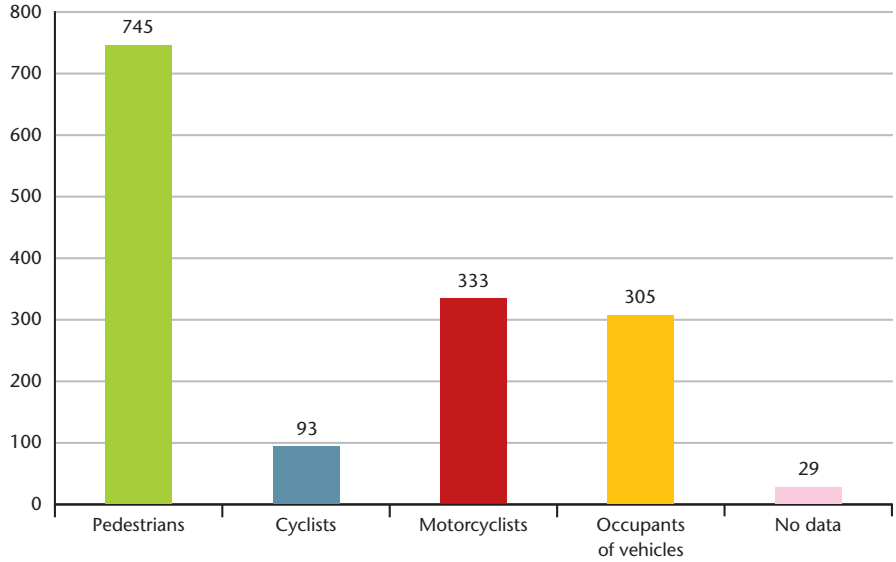



Source: Environ Mentality, São Paulo State Environment Agency (CETESB)[81]

Crime and violence also affect the quality of life for São Paulo's commuters. People stuck in traffic are vulnerable to assailants on motorcycles who can easily escape the scene. Local newspapers often report shootings and fist fights over traffic disputes, as well as armed attacks on motorists. Armor plating and bullet proof glass are popular among those who can afford to upgrade the security of their vehicles, while the very rich simply by-pass the streets altogether and commute by helicopter – São Paulo's private fleet is second only to New York's.

Public transport passengers are vulnerable to robbery both on their way to the bus stop, while waiting and even on board buses. According to passenger surveys carried out in 2007, the highest priority for passengers was not "arriving faster at my destination" (22%) or "spending less on public transport" (20%), but "greater personal security against thefts and muggings" (31%). In 2000 there were over 10,000 bus hold-ups, targeting both bus drivers and passengers for money and valuables.

Figure 19: Traffic fatalities in the city of São Paulo by type (2005)




Source: CET, 2007

## Governing mobility

Transportation in São Paulo is governed by a complex web of federal, state and city responsibilities. There is no overall coordinating body and together these agencies struggle to provide adequate services to meet the city's growing demand for mobility and to address the congestion problem.

Brazil's federal government defines traffic regulations and fuel quality standards, approves new fuel and vehicle innovations and sets requirements for public services delivered at city and state levels. It is also responsible for airports and ports, interstate train and bus systems, federal railway and highway systems. State governments are responsible for state highways and railways, intercity and long-distance bus

systems, and for intercity transportation. City governments are in charge of public transportation and traffic within their own geographical limits.

Municipal authorities have the greatest authority for transportation, and now also traffic planning, inspection and policing. All cities with more than 20,000 inhabitants are required to develop an Urban Master Plan. In practice, however, transport, traffic management, road building and urban planning are rarely coordinated. Community consultation is still infrequent but improving as concern about the state of the urban environment rises along with the Brazilian experience of democratic participation.

Most Brazilian cities feature a transport, traffic or public roads department, but seldom an urban planning department. Urban development in Brazilian cities takes place under little regulation, responding only to the market valuation of land. In medium-sized cities, public transportation is usually managed directly by mayors and their technical staff. However, these activities are normally carried out separately from activities connected with traffic and are usually included in a set of activities related to the transportation system.

In large cities, the complexity of transport and traffic issues tends to generate better coordination between both areas, although they tend to remain deficient and detached from other areas in charge of investments in the transportation system, such as road and urban planning departments. In the city of São Paulo itself, urban and transport issues are handled by three different departments: urban planning, transportation and roadways, with each tending to work separately.

Public transport services in the SPMR are regulated by the 39 municipalities that generally oversee their own local bus transportation systems, and by the Metropolitan Transportation Department of the São Paulo State government, which provides train, subway and intercity bus services through separate agencies. Within metropolitan regions such as São Paulo, there are frequent conflicts between metropolitan and local agencies, where transport issues such as the regulation of intercity bus lines spill over political boundaries or where resources and responsibilities are not aligned.

Most city governments contract private public transport operators to operate their services. Contracts are based on fixed routes, timetables, vehicles, tariffs and overall operational conditions. Few cities have permanent methods of interacting with system users to hear their opinions, and private operators have no incentive to innovate.

The main set of federal government projects related to Brazil's infrastructure, including transportation, is under the Growth Acceleration Plan (PAC). Launched in 2007, PAC provides for a total infrastructure investment of R$ 504 billion from 2007 through 2010, R$ 58 billion of which is for land transportation (including urban transportation), airports and ports. Total PAC investments projected for 2007 were R$ 112 billion. However, the actual investment made in PAC projects in 2007 reached R$ 16 billion, only 14% of the total.

The main public policy vehicle for improving mobility in São Paulo is the Urban Transport Integrated Plan (PITU) developed by the State of São Paulo. It is a set of public transportation and roadway infrastructure proposals aimed at improving the mobility of citizens in the SPMR by integrating transportation planning and city planning. It hopes to promote the emergence of new job-dense areas outside the city's center.

The plan envisions an ideal 2025 city where public transportation ridership increases to 60%, low-income people double the average number of daily trips they can afford, and average traffic speeds increase by 20%. It plans for US$ 20 billion in investment and calls for a significant expansion in all types of transportation infrastructure.

However, at the federal, state and municipal levels, political and spending priorities still tend to be skewed towards higher earners. Consequently, roads receive higher spending and more subsidies than public transportation, and within the public transportation system planned spending is concentrated on the high status metro rather than either the train or bus system.

## Towards solutions

Addressing São Paulo's mobility challenges includes a complex mix of actions by city, state and federal governments and by private sector investors and operators. However, participants in the dialogue were concerned that the current levels of investment, political will and institutional capacity are not sufficient to effectively tackle the city's mobility challenges. They also agreed that investments tended to disproportionately address the mobility needs of the middle-income over lower-income groups and the elderly.

The city has made some progress in reducing the burden of pollution and road accidents through regulation of fuels and vehicles, and through better enforcement of traffic regulations. However, it has not found an effective way of tackling the congestion that threatens the city with gridlock.

### Cleaner, greener fuels and vehicles

In 1986 the National Environmental Council (CONAMA) created the Brazilian Motor Vehicle Air Pollution Control Program (PROCONVE), which established emissions limits based on

European and American legislation. By 1997, regulatory requirements had reached 95% emissions reduction in new vehicles. A similar program has been introduced to reduce emissions by motorbikes and two-wheelers.

However, while PROCONVE is improving the performance of new vehicles, it does not address pollution from those already on the road. An estimated 70% emissions arise from just 20% of vehicles: those that are poorly maintained or have been modified. A few cities in Brazil, most notably Rio, have implemented vehicle inspection and maintenance programs to identify these vehicles, but the city of São Paulo only just began inspections in 2008, monitoring and screening high-emitting vehicles using remote sensing devices. There is also a national program (CONPET) that provides assessments, on a voluntary basis, for drivers of haulage vehicles (see Box 6).

Brazil was the first country to successfully implement large-scale replacement of gasoline with ethanol through its PROÁLCOOL program (see Box 7). The program supports Brazil's goal of fuel independence and is now being hailed as a major contributor towards reducing greenhouse gas emissions as ethanol use lowers pump-to-wheel $CO_2$ emissions. However, the overall balance of environmental impacts is not yet clear. Some 75% of Brazilian $CO_2$ emissions are from deforestation and cattle faming, and although sugar cane is not grown in the Amazon region, there are concerns that expansion of cane growing to meet fuel demand may create pressure to expand into virgin lands elsewhere. A recent study by the OECD concludes that *"the overall impact of cane expansion on greenhouse gas emissions is difficult to determine."*[82]

Demand for diesel oil is much larger than both demand for gasoline or ethanol. This unbalances the refining process and has made it difficult to improve the country's diesel oil quality. The country is now experimenting with the adoption of biodiesel. The program is at an initial stage with about 3% of biodiesel in the diesel-oil mixture.

## Cutting congestion

Congestion was recently rated the number one concern of São Paulo citizens, and is responsible for economic losses estimated at US$ 2.4 billion per year. The city has invested US$ 3 billion in new roads, overpasses and tunnels, at times accounting for up to 27% of the city's annual budget, but this has not been able to keep up with growing demand.

**Box 6: CONPET – Rationalizing fuel and energy use**

The Brazilian National Energy Ministry's CONPET program (national program for the rationalization of the use of oil and natural gas derivatives) aims to rationalize fuel and energy use. It is managed by PETROBRAS, the Brazilian oil company. Focusing on improving the environmental impacts of diesel vehicles, it is working with over 2,000 transportation haulage firms as well as self-employed truck drivers. Drivers are provided with on-the-spot assessments of vehicle emissions and fuel quality and receive guidance on how to improve the performance of their vehicle, reducing operational costs and emissions.

**Box 7: PROÁLCOOL and PROCONVE – Reducing oil dependence and emissions**

The growth in both freight and personal motorization in São Paulo and across Brazil has led to growing energy demand by the transport sector. Brazil has long used renewable energy from hydroelectric power plants. Following the 1975 oil crisis, the Brazilian government set up the PROÁLCOOL ethanol fuel program to create a viable sugar-cane based ethanol alternative to gasoline.

The policy required close coordination between the Ministry of Agriculture and sugarcane planters, the Ministry of Science and Technology and research centers, the Ministry of Industry and Commerce, the automobile industry, the Ministry of Mines and Energy, PETROBRAS, the fuel distributors and the gas stations, the Ministries of Finance and Planning, the Ministry of Environment and automobile owners.

The first step was the addition of 20% ethanol to Brazilian gas, which could be used without a noticeable difference to fuel consumption. In the early 1980s, automotive manufacturers began producing engines that could operate more efficiently on the 20% ethanol-gas mixture, as well as the first full pure ethanol engines.

However, in the 1990s, with the decline of the PROÁLCOOL program cheap oil prices and ethanol shortages caused consumers to switch back to gasoline, and those with pure ethanol engines were left stranded.

Today most light duty vehicles in Brazil have flex fuel engines that can use both fuels, enabling consumers to choose which fuel to use without running the risk of their vehicles being devalued due to shortages of ethanol supply. The country is also a major exporter of flex-fuel vehicles.

Figure 21: São Paulo's "rodizio" system

Since 1996 São Paulo has operated the "rodizio" system (see Figure 21), which prohibits vehicles from traveling on the major streets during rush hour once a week (license plates ending 1 and 2 on Mondays, 3 and 4 on Tuesdays and so on). In its early stages it successfully reduced the number of vehicles in circulation by 12%. However, people get around the restriction by borrowing or purchasing a second car or simply choosing to drive illegally. This increases the cost and inconvenience for travelers, while failing to generate public funds to invest in transport improvements. As the overall fleet size has increased, congestion levels have now risen way beyond 1996 levels (although without the "rodizio" they might be even higher).

São Paulo is also trying to reduce the contribution of freight transport to congestion in a number of ways. Trucks are now banned from passing through the city center during the daytime, and those making deliveries into the area have to meet vehicle size and pollution control standards. Under the PAC, São Paulo is to receive investment for a ring road and a cargo railway bypass. The ring road will link the major regional highways out of São Paulo, allowing cargo and passenger traffic to bypass the city. It will be operated as a private concession with toll-road sections. Several large supermarket chains, retail networks and consumer goods manufacturers are also involved in developing distribution centers to rationalize cargo distribution along major regional highways and around the ring road. A pipeline is also being constructed to carry ethanol, currently hauled by truck, across the state to the port of Santos.

*"We need a change of mindset so that public road space is regarded a scarce public good. But if there are restrictions put on road use, you also need an alternative – both the carrot and stick are important."*

*(Participant, São Paulo dialogue, 15 May 2008)*

The city is also considering an urban toll but there is concern that public transport does not have sufficient capacity to take up the expected demand and currently there is limited stakeholder support for the measure. Congestion charging is often discussed, but has not been embraced by the city's administration.

## Improving public transport

Improving public transport and tempting people back to using it is a key part of the city's strategy for tackling congestion. Between 2002 and 2004 the city restructured its bus system with new busways: the development of the "passa-rápido", or fast lane, system (see Box 8).

In 2004, the city introduced the "bilhete único" (see Figure 22), or one ticket, payment card. It allows users to store money and to make stops and transfers between buses (and more recently metro trains) for a single fare. The system is convenient for passengers and also makes revenue division between the dozen private bus operators easier and less open to fraud. It makes the "chained" trips and multiple errands of city life more affordable and has enabled users to eliminate money concerns from their choice of routes and transfers. Following implementation, many users changed their routes to better suit their needs; the number of daily passengers rose by 13% while the number of transfers almost quadrupled.

Figure 22: The "bilhete único" – one ticket


**Box 8: The fast lane – Reforming São Paulo's bus system**

São Paulo was one of the early pioneers of busway development, perhaps best known for the 15-km long Nove de Julio busway on which convoys of buses move up to 20,000 passengers per hour in each direction. However, although efficient in moving people, this system was unpopular for its negative visual impacts on the street scene and on commerce, and thus was not expanded beyond a few corridors. Instead São Paulo developed a complex network of conventional buses competing for road space with other vehicles.

By 2001 this situation had declined towards failure, with a slow and unreliable bus system and the number of public transport trips falling. The city administration has been working to reform the city's bus services, introducing electronic payment cards and a new type of busway: the "passa-rápido", or fast lane. It aimed to be less intrusive than the earlier system while still carrying large numbers of passengers.

The fast lane for buses is a mixture of bus rapid transit (BRT)-style dedicated busways down the middle of major roads, bus lanes at the side of some roads and even an elevated busway. In addition to these structural changes, bus routes have been organized into a more efficient network with high-capacity coaches on the main routes and microbuses as feeders to busways, subways and train lines. However, bus ridership continues to fall, and the city has committed to further investment to improve all its forms of mass transit.

The SPMR has recently invested in 110 km of exclusive bus lanes. Under the PITU 2025 project, the SPMR plans to upgrade and expand the subway and metropolitan train network and expand the city's BRT network along new transport corridors. Most resources will go into extending the subway network from 60 km to 168 km and the rail system from 270 km to 372 km. The bus system, which will continue to be the city's largest transit mode, will have an additional 366 km of dedicated lanes and 40 new transfer terminals. The whole São Paulo bus fleet is currently being equipped with a vehicle position monitoring system to enable improved operational line management and user information at bus stops. At major bus stops closed-circuit television (CCTV) enables central controllers to keep track of passenger and vehicle flows. The city is also working to make its public transport fully accessible for people with disabilities in line with federal government requirements.


Participants in the dialogue stressed that the problem of congestion will not be solved by just creating more road space and they welcomed the renewed municipal focus on improving public transport and managing demand for personal motorized vehicles. Participants also stressed the need for an integrated approach to urban and transport planning that brings people and activities closer together, reducing trip lengths and enabling the safe use of non-motorized modes.

There was general agreement that the service levels for public transport need to be significantly improved. However, it was also recognized that this presented a dilemma: better quality may lead to higher ticket prices. Some measures, such as more bus-only lanes, however, could save money by reducing the idling time and the number of buses required to deliver the service. The single ticket initiative was universally agreed to have made a significant improvement in affordability and use of public transport.

Participants agreed that attracting the inhabitants of São Paulo onto public transport is not just dependent on solving the technical challenges of improving the quality, reliability and frequency of services, but also requires a change in mind set: firstly that road space is regarded a scarce public good and secondly that public transport is seen as a viable alternative to personal vehicles among the middle class. Congestion charging may be one measure that could help to create this change. Participants pointed out that this approach is meeting a lot of resistance and that congestion charging requires a balanced approach. The main issue is finding an appropriate financial model that effectively contributes to public transport improvement and road safety through adequate reinvestment of the taxes generated. It was also stressed that any congestion charging solution would need to address the risk of entrenching social exclusion by developing service and pricing policies that enable access by all social classes.

Several participants discussed the practical and cultural barriers to bicycling in São Paulo, including security concerns and lack of bicycle lanes and secure bicycle parking. It was pointed out that the federal government's "Bicycle for Brazil" policy that is targeting investment in infrastructure for bikes will be rolled out in São Paulo in the future.

## Public-private partnerships

Governments around the world facing the challenge of developing and maintaining transport infrastructure are held back by the limitations of public sector budgets and management capacity. Between the established options of traditional public procurement or outright privatization public-private partnerships (PPPs) have emerged as a mechanism to overcome this gap (see Box 9).

Brazil is one of the few countries in Latin America to set up a legal and regulatory PPP-framework to promote long-term private sector investments in infrastructure. The federal road concession program started in 1995

### Box 9: Public-private partnerships

Public-private partnerships (PPPs), in which a consortium of private building, maintenance, finance and operating companies contract with governments to build and operate long-term transport projects, are increasingly popular. They:

- Attract new sources of private sector investment, taking spending out of the political cycle and enabling projects to be developed that would not otherwise be possible
- Free up the public sector to focus on outcomes
- Shift construction and maintenance risk to the private sector and give them incentives to deliver projects on time and on budget
- Enable cost savings and service improvements through innovation in design and customer service and better asset management.

Critics of the private provision of infrastructure argue that PPPs deliver high profits to the private sector at the expense of less affordable services for users. While it is certainly true that PPPs provide access to new sources of finance, ultimately it is taxpayers and users who must pay for infrastructure improvements. However, effective PPPs do not just shift projects off the public balance sheet, but deliver them with greater efficiency. Achieving this depends on realistic project assumptions and rigorous competitive processes. The OECD and the International Transport Forum offer the following recommendations:

- Ensure adequate cost-benefit analysis at the planning stage with a thorough examination of demand
- Bundle together responsibilities for construction and maintenance so that long-term maintenance is not overlooked
- Ensure strong competition during tendering processes
- Ensure that quality and innovation, not just lowest price, are included in assessments of value for money of bids
- Take care to allocate risk appropriately
- Be realistic about project planning and how infrastructure services are paid for.[83]

with the concessioning of five federal highway segments totaling over 800 km. The largest of these was the Via Dutra highway between São Paulo and Rio de Janeiro (see Box 10).

Following these early road concessioning projects, the Brazilian government approved a new PPP-law to encourage further local and foreign private sector investment in transport and other infrastructure. The legislation aims to provide reassurance to private investors that PPPs will follow market rules and that contracts will be honored over many years and changes of political administration. To secure the public sector's credibility as an investment partner, the legislation provides for the use of market tools such as guarantee funds and multi-sourcing through several banks, and gives investors the security of an arbitration mechanism and foreclosable collateral. In addition, the new framework broadens the scope of PPP agreements from those financed directly by tolls and fares to those which would sell services to the state.[85]

Uptake has been slow at the federal level, but the concept of PPPs in Brazil has been taken up by a number of state, and now also municipal, governments keen to overcome infrastructure bottlenecks caused by a shortage of available public sector finance. In São Paulo, both the new subway line number 4 and the Rodanel ring road are being constructed and operated through PPP arrangements.

### Box 10: Novadutra – Pioneering public-private partnership

The Via Dutra between Brazil's two major metropolises, São Paulo and Rio, is the busiest interstate highway in Latin America and perhaps the most important economic corridor in Brazil. But by the 1990s it had become a pothole ridden, accident prone, highly congested obstacle to development. In one year alone 3,300 people were injured and over 500 killed along its route.

In March 1996, following a competitive tendering process, the concession to upgrade, maintain and collect tolls on the road was officially granted to CCR, a consortium including Andrade Gutierrez, Camargo Correa, Serveng-Civilsan and Brisa. With an investment estimated at R$ 717 million for the following 25 years, there was a lot of work to be done. It was almost like building a new road from scratch.

As a result of the private concession, traffic volumes have risen considerably (98% from 1996 to 2007), fatality rates have come down (they fell from 481 in 1997 to 246 in 2007), the quality of service provided has gone up, average travel times have come down, and community awareness of road safety issues has gone up significantly.[84]

## Summary

The São Paulo Metropolitan Region is the most important economic power house in Brazil. The city of São Paulo is also one of the world's largest mega-cities but it is struggling to meet the mobility needs of its citizens in a sustainable way. Much needs to be done to close the mobility opportunity divide between the low-income segments and the relatively well served middle- and high-income groups.

In the last few decades, São Paulo, like other major Brazilian cities, has seen a rapid expansion in automobile ownership and use. Despite having an extensive bus system and a well-established metro, public transport use is falling while the price, particularly for the metro, is prohibitive for the low-income segment.

Congestion is a major concern for citizens and expectations are high that the city, state and federal governments can find innovative ways to mitigate this, through road and public transport system construction and innovation and through the mobilization of private sector investment. The city has also made some efforts at transport demand management through its "rodizio" system, but is now struggling to control the growth of private vehicles on the road. Infrastructure for non-motorized transport is not well developed and pedestrians' needs are poorly addressed.

The dialogue participants stated that the environmental and health impacts of transportation tend to be accepted as part of life in the city and do not tend to get as much attention as congestion problems, either from São Paulo citizens or municipal government. Vehicle inspection coupled with enforcement was identified as one area that could be improved significantly, benefiting both the environment and congestion due to broken down vehicles.

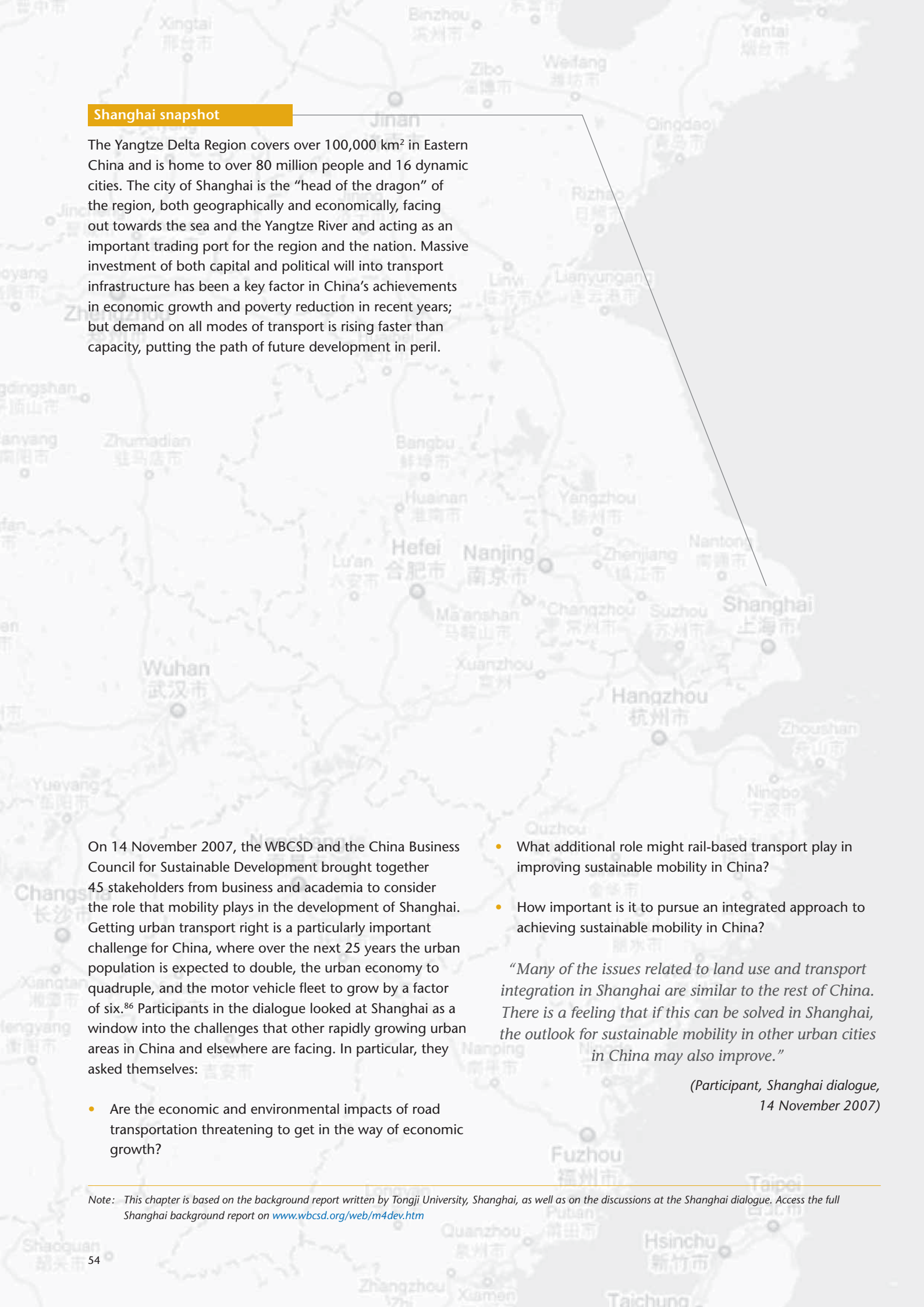
It is also clear that the move away from collective transportation onto motorcycles and cars comes at a cost of greater energy and resource use, exposure to the uncertainties of international oil markets and potentially higher $CO_2$ emissions. Brazil has pioneered the use of biofuels among light-duty vehicles, but it faces further challenges to ensure that transport fuels are environmentally sustainable across the full range of vehicles on the road.

# Shanghai

China

## Shanghai snapshot

The Yangtze Delta Region covers over 100,000 km$^2$ in Eastern China and is home to over 80 million people and 16 dynamic cities. The city of Shanghai is the "head of the dragon" of the region, both geographically and economically, facing out towards the sea and the Yangtze River and acting as an important trading port for the region and the nation. Massive investment of both capital and political will into transport infrastructure has been a key factor in China's achievements in economic growth and poverty reduction in recent years; but demand on all modes of transport is rising faster than capacity, putting the path of future development in peril.




On 14 November 2007, the WBCSD and the China Business Council for Sustainable Development brought together 45 stakeholders from business and academia to consider the role that mobility plays in the development of Shanghai. Getting urban transport right is a particularly important challenge for China, where over the next 25 years the urban population is expected to double, the urban economy to quadruple, and the motor vehicle fleet to grow by a factor of six.[86] Participants in the dialogue looked at Shanghai as a window into the challenges that other rapidly growing urban areas in China and elsewhere are facing. In particular, they asked themselves:

- Are the economic and environmental impacts of road transportation threatening to get in the way of economic growth?
- What additional role might rail-based transport play in improving sustainable mobility in China?
- How important is it to pursue an integrated approach to achieving sustainable mobility in China?

*"Many of the issues related to land use and transport integration in Shanghai are similar to the rest of China. There is a feeling that if this can be solved in Shanghai, the outlook for sustainable mobility in other urban cities in China may also improve."*

*(Participant, Shanghai dialogue, 14 November 2007)*

*Note: This chapter is based on the background report written by Tongji University, Shanghai, as well as on the discussions at the Shanghai dialogue. Access the full Shanghai background report on www.wbcsd.org/web/m4dev.htm*

## Rapid growth, grand plans and deep pockets

Over the past twenty years, China has experienced economic development and urbanization on a scale and at a speed never before seen in human history: 150-200 million farmers have migrated to the cities in what has been called "the world's largest ever peacetime migration."[87] In the decade up to 2004 per capita GDP grew at more than 7% annually, while the proportion of the population living below the poverty line fell from 64% to 10%.[88]

Shanghai and the wider Yangtze Delta Region (YDR) has been the power house of China's economic growth and a gateway to international trade. While the region is home to 6% of China's population it generates nearly 20% of GDP and is responsible for 20% of intercity passenger trips and 10% of freight movement. Between 1990 and 2000, imports through Shanghai's ports tripled and exports grew five-fold. With China joining the World Trade Organization, Shanghai has become a favorite base for foreign companies: over half of the world's top 100 multinational corporations are now represented here.

The population of Shanghai has grown from around 8 million in 1990 to around 17 million today. This includes around 3 million internal migrants who are excluded from official resident status by China's "Hukou" household registration system. While population growth has now tailed off somewhat, Shanghai's economy is continuing to boom.

Shanghai's growth is not only a product of economic liberalization and the innate potential of its location and industrial base. It has also been made possible through massive investment in infrastructure within the city and the construction of passenger and freight transport systems.

> *"I am unaware of any place in human history that has built so much road infrastructure in such a short period of time."*
>
> *(Participant, Shanghai dialogue, 14 November 2007)*

Over the past two decades, tower-blocks, expressways, metro lines and bridges have transformed the landscape from a dense but low-rise city to one that is growing both upwards and outwards in clusters of skyscrapers, suburbs and satellite towns. Farmland across the Huangpu River has been linked to the city by bridges and tunnels to create the Pudong financial and commercial district and a regional highway network has been developed.

Before the 1990s Shanghai's development focused on satellite cities, and most people continued to live in compact, high-density areas within walking or cycling distance of workplaces and facilities.[89] Since then, Shanghai has expanded outwards, integrating these centers into the bounds of its "megacity" and filling the gaps with new industrial sites, mass housing estates and exclusive suburbs. Urbanized areas spill over municipal boundaries. Housing space per capita has more than doubled, but despite this, nearly half of households still experience overcrowding and a further 16% suffer from severe overcrowding.

To reduce density and release value from government land, Shanghai's municipal government has now drawn up a massive plan to build by 2010 "One New City and Nine New Towns" with a combined population of 5.4 million, as well as 60 new small towns with populations of around 50,000 each. Every one of the nine new towns is designed to resemble the typical city of a different European country. At present these towns lack transport links to Shanghai; however, while these links will develop, the plan is for them to become self-sufficient cities where people can live, work and shop without having to commute to central Shanghai.

At present, the YDR, especially Shanghai, is in a key period of development. The global downturn, the increasing shortage of land resources, the rise of production prices and enterprise costs, transport congestion and resource constraints are key challenges. The region hopes to continue to drive China's economic development by raising innovation capabilities, continuing to reform the economy, integrating regional infrastructure and prioritizing sustainability.

# Mobility in Shanghai

## Mobilizing markets

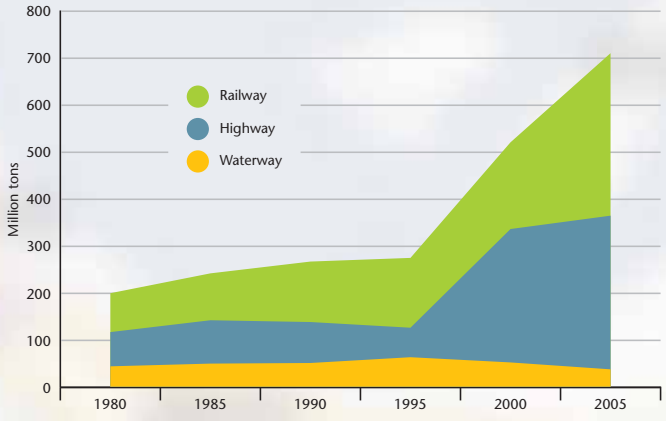
*"It is hard to imagine economic growth without transport."*

*(Participant, Shanghai dialogue, 14 November 2007)*

The YDR is one of the busiest logistics centers in China, with transport by road, rail, sea and air. Shanghai is at the core of the regional highway network with four corridors forming the major traffic arteries within the region; it is also a major international port, which in 2006 handled 12% of China's total port cargo and 23% of its international containers.

Shanghai has experienced massive growth in goods movement over the past 25 years. Total freight traffic in 2005 was 3.6 times what it was in 1980. Railroad freight tonnage increased for the first 15 years, but has fallen by 40% since 1995. Highway traffic is 4.5 times what it was in 1995 and ocean shipping is more than nine times its 1980 level (see Figure 23).

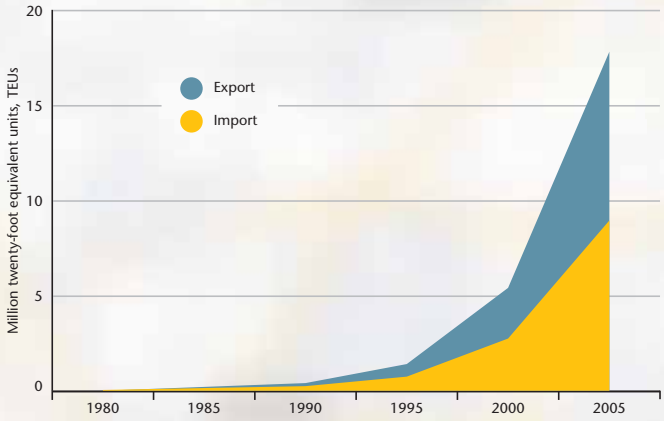
Figure 23: Shanghai freight traffic




Source: Shanghai statistical yearbook, 2007

The growth in the number of containers passing through Shanghai has been phenomenal – from virtually none in 1980 to over 18 million in 2005 (see Figure 24). Most of these containers move to and from Shanghai's ports by truck, contributing to congestion and emissions.[90]

Figure 24: International container throughput of Shanghai ports




Source: Shanghai statistical yearbook, 2007

This growth in freight transport has put pressure on the region's infrastructure. From 2001 to 2005, highway mileage increased from 108,900 km to 137,800 km, but geographical limitations make it very difficult to provide enough traffic lanes to match the demand, and freeways in the region become crowded soon after opening.

## City on the move

Shanghai used to be a cycling city where people lived within a short distance from their work and the street scene was dominated by bicycles. While Shanghai's city center remains dense, suburban growth and industrial relocation have created long commuting distances for many workers. The Shanghai government's transport strategy is to switch people from bicycles to public transport.

However, many of Shanghai's residents have other ideas and are seeking solutions that combine the affordable, door-to-door personal mobility they were used to as cyclists with the speed and distances required for trips across the new Shanghai. Car ownership has been rising by over 20% a year for the past ten years.

# Shanghai mobility

### Public and paratransit transport
Rail network: 270 km
Buses: 18,000 buses (1.2 million seats and 948 lines)
Metro: 5 lines, 148 km (+ plans for 6 more lines)
Taxis: 45,000 taxis

### Road network
Total network is 12,227 km in the central city with 8,110 km of highway in the Shanghai region.

### Vehicle ownership (2007)
Automobiles: 39 per 1,000 people
Motorcycles: 68 per 1,000 people

### Trip frequency
2.2 trips/day/person

### Fatalities
0.09 per 1,000 people (2006)

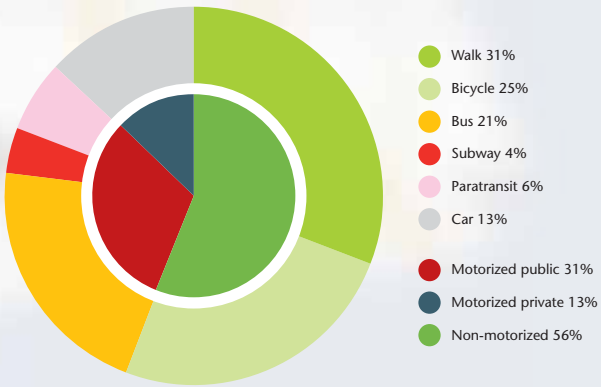
### Characteristics of trip length/trip time
For commuting, the average trip length is 6.9 km (2004).
Trip times vary by mode: Bus: 56 minutes,
Metro: 70 minutes, Car: 41 minutes, Taxi: 32 minutes,
Bicycle: 22 minutes, E-bike/Gas-moped: 24 minutes ,
Motorcycle: 21 minutes, Foot: 17 minutes.

### Expenditure on transport*
2006: 2,333 Yuan/capita, 15.8% of total expenditure (compared with 3% in 1990). Average wage in Shanghai is 29,569 Yuan (2006).

### Public transport basic fares
Bus: 2 Yuan with air conditioning, 1 Yuan with no air conditioning for city center (zonal + distance)
Metro: 3 Yuan for first 6 km, then 1 yuan for any additional 10 km

*Expenditure on transport and communication

Figure 25: Transport modal shares (Shanghai, 2004)




Source: Tongji University

### Box 11: Electric bikes

Electric bikes range from traditional pedal bicycles with the addition of an electric motor to larger electric powered scooters, styled like motorbikes. They can be charged using any standard electrical outlet. In China, e-bikes can be ridden in bicycle lanes without a driver's license, vehicle registration or helmet.

E-bikes are becoming increasingly popular in China, expanding more rapidly than any other mode in the last five to seven years. Some 40,000 e-bikes were produced in 1998; by 2005 the number had risen to 10 million. It is estimated that 16 million to 18 million electric bicycles were bought in 2007 and sales are expected to reach 25 million to 30 million in 2008.

E-bikes are cheap to own and operate, provide flexible personal mobility and are quiet and non-polluting. They are energy efficient but contribute significantly to lead pollution from their heavy batteries, as well as congestion, accidents and injuries. Their quiet operation can make them a danger to cyclists and pedestrians, as well as other e-bike riders.

Several cities have attempted to or have successfully banned e-bikes, including Beijing and Guangzhou. Other cities are trying to limit the bikes' speed and size, and may soon require licenses to use them. Shanghai has taken a more positive view of e-bikes, seeing them as a potential solution to problems of poor air quality and personal mobility opportunity.[91]

### Box 12: Car sharing – Logical yet illegal

The concept of car sharing, where drivers drop their neighbors off at their workplaces, is becoming more and more popular in cities like Beijing, Shanghai and Shenzhen. Internet forums and websites dedicated to the idea have also emerged. These services map out the best route connecting each destination and enable strangers to link up to get to work.

The main participants are young white-collar workers who take on passengers to offset the cost of driver's insurance, maintenance and running costs. As one driver who earns US$ 60 each month from car sharing with two neighbors told the Seattle Times *"I felt it was a waste of money driving to work alone. Now, with my car-sharing group, I can save money, and have a bit of company at the same time."*[92]

At present car sharing is not recognized or encouraged. It is seen as an unauthorized commercial transport business and a front for outlaw cab services. State-run news media have carried numerous declarations from officials saying car pooling is illegal if the driver receives payment.[93]

Electric bicycles are also increasingly popular, providing affordable door-to-door mobility over longer distances than pedal cycles. They are officially classified as "non-motorized", although users often remove the pedals and the most powerful bikes can travel at speeds of up to 60 km/hour (see Box 11).

Car sharing schemes are also emerging as another way to make personal motorized travel affordable (see Box 12).

Through this combination of motorized public transport and private vehicles, Shanghai residents are taking more and longer trips. Between 1995 and 2004 the average trip rate increased from 1.9 to 2.2 trips per person per day, while trip length grew from 4.5 km to 6.9 km. Trips by private motorized vehicle in Shanghai increased from 7% to 15% and by public transport from 20% to 24%, while the proportion of bicycle trips in the city dropped from 42% to 28%. Nevertheless, pedestrian and bicycle traffic remains high, accounting for 54% of total trips and enabling low-paid employees to get to work at an acceptable time and monetary cost.

Increasing affluence and rural-urban migration has also led to greater demand for out of town travel. Intercity highway traffic increased ten-fold and air passenger transportation quadrupled between 1995 and 2006. People are also spending an increasing proportion of their income on transportation, rising from 3% in 1990 to nearly 15% in 2007.[94]

Heavy investment in transport infrastructure has enabled these changes in mobility. Determined to avoid the problems of traffic congestion and pollution that afflict so many cities, Shanghai's government sought to divert travelers under, over and around the city center through spectacular bridges, elevated highways, spiraling junctions, orbital ring roads and a new subway system. An extensive freeway network connecting suburbs to each other and to the central city has been constructed (see Box 13). At the same time, Shanghai has made substantial progress in the planning, construction and management of public transport. Residents travel in more comfort and make transfers with greater convenience, and public transport ridership is increasing.

Buses provide the main public transport mode in the city. There are 43 public transport operating companies running 18,000 buses and trolleys with 1.2 million seats on 948 lines. The local buses serve 7.48 million passengers each day. There are now also five metro lines in Shanghai with 68 stations and a total operating length of 147.9 km, carrying 1.63 million passengers daily, and the city has plans to build a further six lines. Motor taxis have replaced pedicabs as Shanghai's main paratransit mode and 45,000 registered taxies carry a further 2.96 million passengers.

The railway is the backbone of intercity transport for Shanghai, carrying around 50% of intercity passengers; however, while railway mileage per person in Shanghai is only one-third of the national average, the lines

**Box 13: Shanghai's expressways**

The urban expressway system of "three rings and ten radial roads", finished in 2004, forms the backbone of road transport in Shanghai. It cost nearly 20 billon Yuan to build, razing and moving buildings to allow 6-lane highways to cut through the city's dense neighborhoods and across the Huangpu and Suzhou Rivers.

By the end of 2005, the total city road mileage in Shanghai had reached 12,227 km, up 84% from 2000; the road area was 209.4 $m^2$, up 157% from 2000.

The integrated system of arterial roads and expressways is designed to offer the flexible, speedy, door-to-door service that a modern service city and trade port needs. The target for the expressway network was "15-30-60": connecting all major industrial and market areas to the expressway within 15 minutes, peripheral cities and industrial zones to the city center in 30 minutes and any point to another within the network in 60 minutes or less.

The expressways have played a critical role in keeping this massive city moving. They have enabled road freight to travel through the city, benefiting economic growth and enabling goods and services to reach its growing population. However, the benefit of rapid personal travel has mainly accrued to a minority of Shanghai's population with the means for private vehicle travel, often at the expense of facilities for other residents. Bicycles are banned from all bridges and major roads to improve traffic flow, and the construction of elevated expressways has segregated neighborhoods and communities.

are already running at capacity. The operating track mileage of the railway has hardly increased in the last 15 years, and the railway ran at a deficit from 1997 to 2005. Aviation and waterway transportation have been improved and extended.

## Growing pains

Shanghai boasts the world's longest bridge, its most extensive bus system, and the first commercial maglev train, to name but a few of its exceptional claims. However, this city of superlatives is in danger of climbing up the league table of the world's biggest traffic jams, worst air pollution and most dangerous roads.

The growing gap between mobility demand and supply is largely the result of a city that has become the victim of its own success, and has grown more rapidly than either its infrastructure or its institutions can cope with. Transport demand within Shanghai's city center and outside of the central city is increasing. Motorized travel is increasing even more dramatically; the growth rate of motorized trips is far ahead of that of the personal trips. The original blueprints for Shanghai's road network were prepared on the basis that the city would reach the two million car mark in 2020. In fact, that figure was reached in

2004. As the chief engineer of the city's Urban Planning Administration Bureau, admitted: "*The development of Shanghai has been beyond our imagination.*"[95] A number of key bottlenecks have emerged:

- **The squeeze on road space** – Private car ownership is growing rapidly, but had only reached one vehicle for every thirty-six people by 2004. Even at this level the squeeze on road space in Shanghai's dense core and its busy highways is already acute. New highways fill up with traffic as fast as they are built, while efforts to separate fast and slow moving traffic tend to marginalize the city's bicycle riders. The number of bicycle lanes has been reduced, forcing bicycle riders to ride on sidewalks.

  Because of its geographical location, Shanghai can only connect with the other parts of mainland China through the Shanghai-Nanjing corridor in the northwest and Shanghai-Hangzhou corridor in the southwest. Two enormous bridges are under construction as a new gateway to the north via Nantong and to the south via Ningbo. However, expansion of the existing highways is unlikely to meet the huge demand for sustainable mobility due to high traffic concentrations on several corridors that pass through densely populated areas.

- **The squeeze on rail capacity** – In China the railway system generally caters for long distance service designed for inter-province travel. There is a lack of high-speed train service within the 50 to 300 km range. Railways are controlled nationally and have tended to prioritize national energy needs and the transport of coal over the transport of either passengers or commercial cargo. Shanghai's two external rail routes, Shanghai-Nanjing and Shanghai-Hangzhou, cannot meet personal travel requirements during peak times such as festivals and holidays. Their cargo transport facilities cannot meet the new cargo transport demand and suburban rail links are virtually nonexistent. Transport problems hit the headlines in the run up to Chinese New Year 2008,

but less dramatic demonstrations of the rail system straining at capacity are evident in the crowded and slow trains of an overburdened intercity railway system.

*"The Ministry of Railways was set up to deal primarily with freight. They are therefore set up with the capacity and culture to shift tons of coal across the country, but not to deal with the demands of metropolitan rail transport."*

*(Participant, Shanghai dialogue, 14 November 2007)*

- **The stretch on transport governance capacity** – The Shanghai Municipal Government exercises the functions of both a city and a province (or state) and has a governmental unit focused specifically on its urbanized areas. However, it does not have an overall regional transport authority able to oversee multi-modal integration or coordination between transport and land-use planning. Divergent and conflicting institutional priorities often get in the way; for example, the income generation opportunities of urban land over fringe rural land make it harder to ensure that the city expands in a measured and controlled way.

*"There is a need to develop a regional planning authority for Shanghai as the old institutional boundaries do not adequately cover the current realities of the economic area and are not really working anymore."*

*(Participant, Shanghai dialogue, 14 November 2007)*

- **The stretch on fuel resources** – The YDR is an area short on energy and resources. While Shanghai's primary and secondary industries are becoming more energy efficient with greater added value for every unit of energy used, energy consumption per unit of added value in the transport, storage and post industries increased by 2% over 2005, directly leading to an increase in energy consumption per unit of value added in the tertiary industry in 2006. Absolute rises in transport demand, as well as mode shifts from rail to road, are major drivers of China's rapidly growing oil demand. Over a decade China has gone from being a net exporter of oil to importing around one-third of the oil it consumes, a figure that is forecast to continue rising.[96]

Mobility issues, of course, are only one aspect of Shanghai's growing pains, but they are increasingly causing problems for the people and businesses of Shanghai:

- **Congestion** – As fast as Shanghai's infrastructure develops, demand rises faster. Traffic congestion has become a serious problem both in the city and in its regional highway network, despite relatively low levels of vehicle ownership by international standards. During rush hours, 60% of the intersections in the city center are congested. Average traffic speeds in the core of the city are 14-16 km/h, rising to 20-25 km/h in the outer areas and newly developed Pudong area.[97] In rush hours, about 42% of arterial roads in the center of the west part of Shanghai are congested. Drivers are frustrated to find their new vehicles stuck in traffic, while pedestrians and cyclists face longer, more dangerous and more polluted trips.

- **Air pollution** – Pollution resulting from vehicle emissions in the city center is becoming more and more serious. Air quality measurements at 16 out of the 18 survey stations

along Shanghai's major roads reveal nitrogen oxide (NOx) pollution levels above national standards, 12 stations also record CO levels that breach national standards. Data show that $CO_2$ emissions reached 150 million tons in 2004, 20 million tons more than in 2000. It is estimated that 86% of $CO_2$ and 81% of NOx are from urban vehicle emissions in Shanghai.

- **Accidents** – During the 1980s and 1990s road related deaths and accidents increased along with the growing number of cars on the road. Following the introduction of a traffic accident surveillance system in 2002, traffic safety measures have been gradually strengthened and the number of reported deaths and injuries from road traffic accidents in Shanghai has decreased in recent years.

## Life in the slow lane

While mobility opportunities in Shanghai have increased through major public infrastructure investments, the largest benefit has accrued to the minority of Shanghai's population with the means for private vehicle travel, often to the detriment of facilities for other residents. Bicycles are banned from all bridges and major roads to improve traffic flow, and new urban districts such as the Pudong are not built to be pedestrian friendly. The minimum two-way ticket by metro costs nearly one-fifth of the daily wages for low-income workers, making it unaffordable for many.

High-income residents traveling mainly by car and metro can make the trip from home to downtown within 30 minutes, while low-income residents

tend to walk, cycle or ride the bus and pay the price of a much longer journey time. Individuals from lower income households also take far fewer trips each day than do individuals from higher income households. Transport connections serving the central city's commercial districts and affluent suburbs are much better than those connecting poorer residential areas and labor-intensive manufacturing zones.

Low-income people suffer more from pollution, accidents, noise, land appropriation and neighborhoods divided by busy roads. Cyclists, pedestrians and motorcyclists are particularly vulnerable to fatalities and injuries on the roads, while the families of deceased rural migrants are entitled to lower rates of compensation than those of registered urban residents. With residential areas developing along the main transport axis, low-income families are being squeezed out by higher earning residents to areas with poorer transportation.

While a lack of transportation is not the only factor forcing social stratification in Shanghai, the lack of mobility opportunities certainly contributes to making life harder. Migrant workers suffer from a lack of affordable transportation options. Temporary residents make up nearly one-quarter of Shanghai's population but take only 8% of the personal trips in the city each day. Low-income workers escaping from the cramped housing conditions of Shanghai's dense core too often find themselves resettled in "transport deserts" on the periphery where buses are few, full and far between.

## Governing for mobility

The Shanghai Municipality covers an area of 6,341 km$^2$, more than four times larger than Greater London, and includes both urban and agricultural land within its boundaries. As a centrally administered municipality, the city is directly under the central government and its mayor has the same rank as a provincial governor. Effectively, Shanghai is a city state, with many of the powers of central government at its disposal. The city is a powerful political force, and over the last few decades has produced many of the country's senior leaders. However, recently the national authorities have sought to reign in Shanghai's level of autonomy and power.

Shanghai has no governmental unit focused specifically on its urbanized areas. Dialogue participants recognized this as a key obstacle to effective planning and transport integration.

The Shanghai Urban Planning Bureau is charged with guiding development across the municipality to realize the goal of economic, social and environmental development. It formulates and implements urban planning policies, local laws and regulations and develops and monitors the city's master plan. In May 2001, the state council approved the new master plan (1999-2020). The vision is for Shanghai to compete as a world economic center, world financial center, world trade center and world shipping center, and urban planning focuses on meeting these goals.

Economic cooperation within the region is organized through the Regional Economic Coordinating Meeting of the YDR, which has established a YDR Urban Economic Coordinating Office. Based in Shanghai, this Office is an executive department responsible for the coordination, organization and improvement of the regional economic cooperation in the YDR.

Transportation is managed by a number of different agencies at provincial, regional and municipal levels, and there is no single transport coordination body. Aviation and railways are managed by corresponding regional organizations, while highway and water transport are administrated by provincial transport organizations. The Shanghai Railway Bureau is in charge of the regional railway network. The Shanghai Municipal Port Authority is in charge of the port and shipping. The Road Administration Department of Shanghai is responsible for road construction and supervision, industry management, property protection, highway toll collection, maintenance and management of municipal highways. Urban transport management in Shanghai involves several organizations, including the Urban Transport Bureau, Urban Planning Bureau, Urban Construction and Transport Committee, Municipal Engineering Administration Bureau, Traffic Police and Headquarters of Police Security Bureau.

Recognizing that a coordinated approach is needed to meet the transport demands of Shanghai's growing population and economy, the Shanghai Metropolitan Transport White Paper was produced in 2002. It is the first comprehensive transport plan for the city (indeed, the first of its kind in China) and it outlines current and future transportation needs and sets objectives and actions for city planners and managers.

The overall goal was to "provide accessible, safe, comfortable and clean transport services" and the white paper sets out objectives for roads, waterways, transit hubs, railway, metro, buses and parking.

The plan adopts a "public transport first" policy, and calls for the number of trips per day in the city by public transport to increase from 21% in 2000 to 35% city-wide and 50% in the central business district by 2020. Shanghai plans to invest 110 billion Yuan in public transport, including bus, metro and bus rapid transit (BRT) services, with the target of enabling travel between any two points in the central city within one hour. Shanghai will also gradually introduce an exclusive bus lane system.

Shanghai has recognized the need for institutional reform to push forward its ambitious plans for infrastructure development. In April 2000, the government carried out the reform of the metro system, which needed

to attract financing at nearly 1.5% of GDP in order to expand. The Shanghai Metro Line Construction Co., Shanghai Modern Rail Transit Co. Ltd, Shanghai Metro Incorporation and The Shentong Group were set up to construct, manage, supervise and provide finance for the metro. However, while this helped to solve the financing issue, new problems appeared, such as poor safety and supervision of the metro system, different ticket systems and inconvenient metro transfers. Therefore, the Shanghai Metro Line Company merged into the Shentong Group in 2004, only four years after the reform.

## Towards solutions

Although construction of Shanghai regional and urban transport infrastructure has achieved great success, the imbalance between transport demand and supply is causing growing pains for the city and region. Shanghai is continuing to strengthen the construction of key transport infrastructure, but the main efforts will be put on mass-capacity transport modes, and the Shanghai government has instigated many transport demand management policies.

### Infrastructure development and planning

The Shanghai government has made massive investments of both capital and political will into transport infrastructure and public transport systems over the past ten years, investing an average of 2.9% of its GDP. It set in motion the building boom by leasing state-owned land to foreign investors, which enabled rapid property development and provided funds for public infrastructure works. A former mayor of Shanghai commented: If the city had not been able to raise funds through land leasing,

its urban renewal projects would have taken 100 years instead of 10.[98]

By the end of 2005, the total mileage of city roads in Shanghai had reached 12,227 km, up 84% from 2000. The government is accelerating the construction of high-capacity roads and constructing arterial freight transport networks to connecting ports, airports, railway hubs, and logistics parks and advanced manufacturing estates. The city is also concentrating on public transport, with 44% of the investment going towards the metro, in line with the policy of encouraging public transport in the city center and adopting motorization in suburban areas. Improvements to the quantity and quality of intercity passenger rail transport are also planned. However, the infrastructure of sidewalks and bike lanes is receiving much less attention than the rest of the transport system, despite their environmental sustainability and significant contribution to city travel.

Shanghai's lack of deep water port facilities is also recognized as a problem and the city is now building a new 50-berth deep water port on the Yangshang Islands. The port will be connected by an 8-lane, 30-km bridge to a new town in Shanghai's Nanhui District, which will be its principle logistics facility. The development of the logistics center linked to the new port will enable containers to go by rail to the port and should help alleviate some of the freight bottlenecks. Railway freight transportation lines, such as the Pudong railway, are also under construction.

Shanghai's urban planning control system is strong at preparing detailed plans for polycentric urban development connected by transportation networks into a larger, ordered urban system. However, as in other cities, grand plans do not always turn out as expected. Master plans for compact urban nodes connected through transportation networks to form a larger, ordered system are often derailed by market forces. Lower land costs (and often lower costs of regulatory compliance) in non-central areas and on the peripheries of nodes result in the suburbanized corridor and cluster pattern of development common to many metropolitan regions around the world.[99] Planned and actual growth patterns in Shanghai often show little correspondence.

Economic linkages in Shanghai and its region go well beyond the administrative boundaries of urban and transport bodies. Participants in the stakeholder dialogue called for a single administrative authority for transportation and urban planning in the region in order to more effectively coordinate planning and transport across road, rail, metro and waterways. They also stressed the need for greater land-use control, particularly in suburban areas, and called for the reintegration of transport and suburban planning. They also recommended greater focus on the construction of transport hubs to facilitate more efficient mode shifting for public transport. Stakeholders in the dialogue felt that energy efficiency and environmental concerns should take higher priority in planning for both passenger and freight mobility.

### Transport demand management

Chinese cities are investing heavily in infrastructure but this is not keeping up with demand no matter how many roads are built. Constraints on the number of motorized road vehicles are already in place with a strategy of shifting travelers to public transport.

The government aims to shift commuters from long-distance bicycle rides onto public transport in

order to improve traffic conditions, reserving bicycles for shorter trips and for connecting to public transport. Dialogue participants were concerned that this was not the best overall solution and that more focus should be placed on infrastructure for non-motorized transport in future plans, particularly for short distance trips.

The Shanghai government has taken a number of steps to control burgeoning demand for personal motorized transportation:

- **License plate auctioning** – Since 1994, license plates for private cars in Shanghai have only been available by auction. The license is valid for life once it is purchased and can be transferred to other people. Between 5,000 and 7,000 new license tags are issued each month, with successful bidding prices as high as 50,000 Yuan. The monthly availability of new licenses is adjusted according to urban transport status and purchase prices of licenses. The auction policy of license tags has restrained the increase in car ownership in Shanghai, achieving for example a lower motorization rate than Beijing. Although the city implements policies such as travel limits on non-local licensed vehicles during rush hours on elevated expressways, people are increasingly buying non-local licenses, diverting funding for road building and maintenance to other districts.

- **Parking charges** – Shanghai guides the planning, construction and management of its parking facilities by area. The specific measures are that the central business district provide few parking spaces and charge a higher price to discourage vehicles from entering the area. The restrictions progressively lessen outside of the district. In the peripheral area the policy focuses on solving the parking requirements in residential areas and in encouraging public transport use through "park and ride" facilities beside transport hubs.

- **Motorcycle limitation** – Motorcycles are more affordable than cars and more flexible than public transport. However, the city government is concerned because motorcycles contribute to pollution and disturb transport flow. They have implemented policies to strengthen regulations and reduce the use of motorcycles. In the city center the only two-wheeled vehicles allowed to operate are liquefied petroleum gas scooters, e-bikes and bicycles. Controls on license plates are also being introduced.

Shanghai has had some success in managing transport demand growth. However, the license auction system does not provide incentives to purchase more efficient cars and has led to growth in "non-local" licenses purchased by the Shanghai population, and hence less revenue for the municipal government. As a result the dialogue participants recommended that some new approaches be introduced, such as road congestion charging and fuel taxes. They also called for more investment to improve the walking and bicycling environment and for stronger environmental controls and incentives.

The city government has invested in improved traffic management, with a closed-circuit television (CCTV) system and traffic counting loops, improved traffic regulation enforcement and upgraded intersections to help speed up traffic. However, other traffic management measures, such as the flexible working hours, reversible traffic lanes and intelligent transportation system-enabled information have not been deployed.

Participants in the stakeholder dialogue felt that the expanding urban area and the mobility demands of an increasingly affluent population are endangering the mobility situation in Shanghai and that more effective traffic demand management approaches are now needed. However, they feared that the situation has not yet become serious enough to drive an institutional response. Participants felt that unless these "early warning" signals were heeded, significant economic decline would provide a more painful signal that cannot be ignored.

## Environmental controls

On 1 October 1997, unleaded gasoline for motor vehicles was promoted in Shanghai. On 1 July 1999, the European I emission standards for light vehicles was implemented, two years ahead of schedule. In 1998, taxis began to run on liquefied petroleum gas (LPG) and the use of compressed natural gas (CNG) was promoted on buses. The use of low-olefin unleaded petrol was promoted for motorized vehicles in March 2000 ahead of national implementation. On 1 March 2003, the European II emission standard for motorized vehicles was implemented in the city.

According to new regulations implemented in the city center since 15 February 2006, high-polluting vehicles (i.e., those not meeting European I emission standards) that have not received "the green license" are restricted on the elevated expressways. This restriction was extended to the surface roads within the inner-ring road on 1 October 2006.

## Citizen road safety education

A number of the participating companies highlighted the steps that they have taken to support road safety education in Shanghai and other cities and provinces in China (see Box 14).

### Box 14: Supporting road safety education in China

During 2007, General Motors (GM) China participated in the opening of the First United Nations Global Road Safety Week, China Region. GM organized a fleet of 10 Chevrolet vehicles to accompany a tour through Shanghai, Beijing and other major cities. This involved public education covering elementary, middle, high school and university students on road safety, recruitment of road safety volunteers, and support of joint action to reduce traffic hazards and to ensure safety inside and outside of cars. It also involved the support of joint efforts to improve road infrastructure and emergency rescue systems and to better understand the critical role of personal responsibility in reducing traffic accidents.

During 2008, GM sponsored the China Child & Family Road Safety Education Program with the China National Care for Children Committee and the National Women Federation. The program, conducted in elementary schools in Beijing, Qingdao and Tianjin, targeted 200,000 families.

Toyota conducted Toyota Driver Communication, a 4-day hands-on safe driving course in Beijing in October 2005 and in Guangzhou in November 2006. Approximately 200 people responsible for safety management at taxi companies and driving schools participated. With the cooperation of the Ministry of Public Security of each city, participants were taught how to conduct vehicle inspections prior to operation and safe driving, confirming blind spots, emergency braking on slippery road surfaces, and other topics concerning driving skills for avoiding accidents. The programs were conducted by veteran instructors who teach the same course in Japan.

Michelin has distributed 50,000 copies of a guide to safe driving and has produced a weekly television program giving advice on driving safety. This program was broadcast in six provinces and was watched by 5 million viewers.

## Summary

**Take a dense city with winding lanes, bursting with people, and on the brink of suburban industrial development and mass vehicle ownership, and you have the sort of dilemma facing many city planners in the developing world. This was the situation facing Shanghai's city government in the early 1990s as it embarked on its hugely ambitious plans to redevelop the city.**

**The huge investments in transportation are only possible with the Shanghai government playing an active role and the involvement of the private sector. This has paid off in kick-starting the city's economic boom and in improvements in the livelihood and welfare of millions. Shanghai has a well-developed transport system that is expanding all the time. The level of integration between mobility modes is the best of all the four cities we studied. Nevertheless, the poorest sectors of society have paid the greatest cost for Shanghai's urban development, in terms of negative transport impacts, while receiving fewer benefits.**

**The critical questions now are how the growing use of private road vehicles can be reconciled with viable high-speed public transport and continued support for non-motorized travel, and how mobility improvements can be delivered equitably across the widening income gap. The city is still in flux and the future of Shanghai's physical structure will not only be strongly influenced by its transport system, but also by land-use planning.**

# What we have learned

The WBCSD *Mobility 2030* report proposed seven goals to help move society toward sustainable mobility. Here we use five of these goals, as well as some of the related indicators, as an organizing framework to summarize what we have learned from the dialogues and background reports in the four cities. The goals we use are the following:

1) Preserve and enhance mobility opportunities available to the general population
2) Narrow "mobility opportunity divides"
3) Reduce road vehicle-related deaths and injuries
4) Mitigate congestion
5) Eliminate transport-related emissions of conventional pollutants as a significant public health concern.

With respect to some goals, we identify special challenges that were highlighted at the dialogues. We also identify opportunities to use new technologies. And we relay cautions that were reported concerning unintended consequences of some actions that have been undertaken.

At the end of the section, we discuss several important institutional challenges that the dialogues indicated are adversely impacting one or more of the cities' ability to plan, finance, construct and maintain their transportation infrastructure.

## Preserve and enhance mobility opportunities available to the general population

Preserving and enhancing mobility opportunities available to the general population was identified as an overriding goal in each dialogue. Information presented at the dialogues and in the background reports suggests that there has been some improvement in the range of mobility opportunities available to the general population. But this improvement has required the expenditure of huge sums of public money. It also has required more of the cities' space to be used for roads and other transport infrastructure. City residents also have seen the share of family budgets devoted to mobility activities increasing in each of the cities. Finally, average travel speed has been decreasing and travel times have been increasing for many residents, especially those with lower incomes.

In Bangalore, Shanghai and São Paulo, preserving and enhancing the mobility opportunities available to the general population generally has meant: constructing more and better roads (especially expressways and "ring roads") to accommodate the growing number of personal motorized vehicles; and constructing or expanding metro systems to speed the journeys of relatively affluent inhabitants. However, this has proved to be extremely expensive. Given restricted municipal budgets and aid from higher levels of government, this has meant that the public resources for improving and maintaining other means of transport (including non-motorized transport) have often been quite limited. For example, in São Paulo's Urban Transport Integrated Plan 2025, metro expansion, suburban rail expansion, and the integration of the metro and suburban rail and metro systems are slated to receive 92.5% of the public transport investment forecast for the period 2007-2010. Buses, the mode currently responsible for 76% of all trips by public transport in São Paulo, will receive only 7.5%.

### Access to the means of personal mobility

*Definition of indicator: "The percentage of households having access to motorized personal vehicles plus the percentage of households located within a certain distance of public transport of a given minimum quality."*

As each city has expanded in area, access has become more of a problem, especially for the poor and disadvantaged. Wealthier residents have acquired motorcycles or scooters (especially in Bangalore) and/or automobiles and light trucks (especially in Shanghai and São Paulo). Indeed, personal motorized vehicle ownership levels by the wealthier residents in these three cities may be approaching Western European levels.

However, public transport remains a major – and sometimes the overwhelmingly dominant provider of personal mobility in each city: the public transport share of all motorized trips ranges from 45% in São Paulo to 71% in Dar es Salaam. In Bangalore, São Paulo, and Shanghai "public transport" presently consists primarily of conventional buses operating over fixed routes on the same streets used by other vehicular

*Note: While our original research set out to study people and freight mobility, and in spite of the impact of freight movement on urban mobility and emissions, the focus of participants in each of the stakeholder dialogues was overwhelmingly on people transport over freight transport. The emphasis on personal mobility is therefore reflected in this report. Furthermore, the lack of consistency and quality of the data collected makes it difficult to draw valid comparisons between the cities. Additional information on the goals and indicators used in this section, as well as information on the goals and indicators not discussed in the body of this section, is supplied in an electronic appendix, see: www.wbcsd.org/web/m4dev.htm*

*All indicators are defined in WBCSD (2004), Mobility 2030.*

(and sometimes pedestrian) traffic. As the cities expand and as motorized vehicular traffic increases, these conventional bus systems are becoming increasingly stressed. Significant portions of each of the four cities, especially those parts in which informal settlements are concentrated, are poorly served by existing conventional bus systems.

In Bangalore and Dar es Salaam, "informal" paratransit is an important provider of access. Indeed, in the latter public transport currently is being provided almost exclusively by approximately 9,000 privately-owned and operated minibuses known as *dala dalas*. While they reach almost every part of the city and are relatively affordable, they are unsafe and unreliable. Harassment of women and children passengers is reported to be a major problem. Bangalore has 92,000 three-wheeled auto-rickshaws that provide a low-cost and flexible supplement to the local bus system. But safety is also a problem with these vehicles. They are not crashworthy and they typically carry loads beyond (sometimes far beyond) their design limits. Neither the Shanghai nor the São Paulo dialogues identified similar "informal" paratransit systems playing a significant role in providing accessibility in those cities. But Shanghai has 45,000 "registered taxis", which carry almost 3 million passengers each day – more than the metro system.[100]

Three of the four cities (Dar es Salaam is the exception) are planning to rely on new or expanded metro systems to improve accessibility. Bangalore's system is just being constructed and São Paulo's is being expanded. Shanghai's program of metro construction is the most extensive. By 2012, Shanghai is scheduled to have 13 metro lines with a total length of up to 510 km. That would make it the longest "rapid transit" system in the world.[101] The metro system is intended to form the "backbone" of Shanghai's public transport system, carrying 40% of daily passengers. However, the coverage of even this greatly expanded metro system is not likely to be dense enough to provide many of the city's residents with direct access to the metro. For many, access will be by bus. Shanghai plans to expand its bus system and to integrate it with the metro. The plan is that by 2010, all suburban residents will be within 0.5 km of a bus stop and that they will be able to access the metro network without having to transfer.

Dar es Salaam is attempting to implement a bus rapid transit (BRT) system. The long-term plan calls for the BRT to be implemented in six phases. However, only the first phase is being constructed, and even it has had to be cut back due to lack of financing. This reduced first phase is scheduled to begin operating in 2009. It is designed to replace approximately 2,000 *dala dalas* operating over 48 routes with 120 trunk and 120 feeder buses operating over exclusive bus lanes.

Though consistent and reliable data are difficult to obtain, it is apparent that non-motorized modes still provide a major share of personal mobility in each city. In Shanghai in 2004, trips by foot and by bicycle accounted for 31% and 25% of the daily total, compared to 31% and 33% respectively in 1995. In São Paulo in 2002, 37% of daily trips were by foot and 1% were classified as "other" (which we assume includes trips by bicycle).

### Impact on public revenues and expenditures

*Definition of indicator: "The level and change in level of public capital and operating expenditures for providing transportation services and transportation infrastructure. This includes 'launching aid', public infrastructure capital, operating subsidies, revenues collected by government from transport operations and user fees, and reduction in other government outlays due to the quantity and quality of transport services."*

Expenditures for the construction and maintenance of road infrastructure and of public transport systems (including both dedicated infrastructure and the vehicles used to provide public transport) represent a substantial financial burden for each of the four cities. Between 1967 and 1977, 27% of the budget of the city of São Paulo was used for road construction. In Shanghai, investment in transport infrastructure has absorbed an average of about 3% of the city's GDP over the last decade. We have seen no figures on transport-related spending by the government of Dar es Salaam, but we understand that the city cannot afford to support transportation without help from external donors such as The World Bank. Indeed, the Tanzanian Ministry of Infrastructure Development estimates that about 70% of financing for infrastructure in Tanzania is provided by international donors.

In some cases, higher levels of government have agreed to provide a share of the necessary funds. But even in such cases, local governments must contribute a large share. India's Jawaharlal Nehru National Urban Renewal Mission (JNNURM), launched in December 2005, and planned to last seven years works with cities such as Bangalore to produce and fund projects designed to improve infrastructure and governance as well as improve basic services to the urban poor.

To participate, each city must develop a city development plan identifying the projects it wishes to undertake. If it is approved, 35% of the cost of these projects will be financed by the Government of India, 15% by the government of the state (in Bangalore's case, the government of Karnataka), and 50% by the local government. The JNNURM is designed to supplement projects already being undertaken by the city. In Bangalore's case, these "already being undertaken" projects include its metro-rail system, its new international airport and its program of constructing "flyovers" to ease road congestion.

One challenge for cash-strapped city governments is to balance the attractiveness of being able to tap private sector resources and know-how for transportation infrastructure projects against the constraints imposed by the need for private firms to make a profit on such projects. São Paulo is constructing a ring road to allow traffic to bypass the city. The first section has been completed. The city plans to finance additional sections of the road by privatizing the part(s) already operating. Specifically, it intends to require the winning bidder to contribute R$ 2 billion to the next stage of construction and to bear part of the cost of improving certain "underused" roads to speed traffic through the city. Since the winning bidder will need to maintain the existing road as well as carry out these additional obligations, the tolls set for use of the road will need to be high enough to cover all these costs plus return a profit.

The same applies to privately financed transport-related investment in the other cities. Financing was provided by the government at the outset of Shanghai's metro construction. However, as the cost of construction grew dramatically, a private company, the Shentong Group, was set up to finance, own and manage the metro system. Three companies were established to undertake the construction.

The Shanghai metro system is intended to be profitable. This means that its fare receipts (plus any operating subsidies that Shanghai might provide to lower the cost of travel to different individuals or groups) must cover the cost of construction, the interest on the bonds issued to finance the construction, and also permit the stockholders of the Shentong Group and related companies to earn at least a normal rate of return. To do so, these fares may put the cost of metro ridership well beyond the reach of a large share of the inhabitants of Shanghai.

## The challenge of maintaining infrastructure once it has been built

The importance of providing funds for the proper maintenance of transportation infrastructure cannot be over-emphasized. There is a propensity to fund capital expenditure but not ongoing upkeep. As a result, infrastructure deteriorates rapidly once it has been put into service. Probably the most striking examples of this were raised in the Dar es Salaam dialogue. The Bangalore dialogue also cited poor maintenance (as well as poor construction) as a major problem throughout India.

## Transportation-related land use

*Definition of indicator: "The amount (or share) of land devoted to transportation activities."*

As transportation-related infrastructure grows, the amount of each city's land devoted to this activity rises. The amount of land devoted to roads was highlighted as a major concern in both Bangalore and Shanghai. In the former, "transportation" accounts for 8% of the city's land area. In the latter, the area covered by roads has grown from 18 $km^2$ in 1990 to 209 $km^2$ in 2005. The area taken up by roads in Dar es Salaam is not known, but there seems to be less concern with the amount of land roads are occupying than with the urgent need for more roads to improve the population's access to mobility.

## Financial outlay required of users[102]

*Definition of indicator: "Share of individual (or family) budget devoted to personal travel."*

Outlays on personal transport as a percentage of the average household's total consumption expenditures appear to be rising everywhere. In São Paulo, for example, public transport became increasingly expensive, especially in the period from 1987 to 1997. Adjusting for inflation, the bus fare doubled between 1977 and 1997. The train fare for the very poor people increased by a factor of 3.5. Between 1997 and 2002, public transport fares increased an additional 14%, adjusting for inflation. There has been an increase in the share of the population engaged in "informal" economic activity. These individuals are not eligible to receive the heavily subsidized travel passes provided by employers.

In Shanghai, transport's share of people's income rose from 3% in 1990 to nearly 15% in 2007. The composition of transportation expenditure has changed significantly. In 1990, almost 90% of all transport spending was "traffic fees", which

we believe to be expenditure on public transport (including taxis). Between 1990 and 2000, that category grew from 2.4% to 4% of total consumption expenditure. However, it has remained at about 4% since that time. In contrast, the other major category of transportation expenditure, "all other transportation", which we believe to be expenditure on private transportation such as bicycles, automobiles and motorcycles, has increased more than ten-fold, from 0.2% in 1990 to 5.5% in 2006. Household expenditure on transportation varies widely by household income, ranging from 4.1% of total per capita expenditure for the "low-income" household category to 16.8% for the high-income household category. But nearly all of the variation across household income categories in 2006 was due to the variation in the category of "total less traffic fees". We believe that this reflects the growing use of private motorized vehicles among Shanghai's higher income households.

## Travel time

*Definition of indicator: "Average time required from origin to destination, including all switches of vehicle/mode and all 'waiting' time."*

In each city, individuals in high-income households are believed not only to enjoy a wider range of mobility options but also to be able to reach their chosen destinations more quickly than lower income individuals who depend more on public transport (especially buses). Trips by public transport, especially those requiring one or more transfers en route, typically require more time (often more than double) than the time required to make the same trip by car, taxi or motorcycle.

Yet data for São Paulo indicates that there is little variation across income classes in average travel time per trip. This reflects decisions that people make about where they live and where they work. Travel time depends not only on vehicle speed and the number of connections one must make but also on how far one must travel. In Bangalore and Shanghai, wealthier citizens are moving to the rapidly growing suburbs. They use the newly constructed expressways (or, in Shanghai, the metro) to reach the city center relatively quickly.

## The challenge of assuring adequate goods mobility

Though both the dialogues and the background papers concentrated overwhelmingly on personal mobility, it was recognized in each city that preserving and enhancing goods mobility is an essential element of the sustainable mobility equation. Goods mobility is a major enabler of economic growth and rising living standards. But it is also a major contributor to "conventional" and greenhouse gas emissions, energy use, traffic noise, and accidents.

Goods movement into, out of, within and through each of the four cities represents a significant share of total mobility activity. This is especially true of the two port cities – Dar es Salaam and Shanghai. São Paulo, being both Brazil's largest city and the hub of Brazilian manufacturing activity, also experiences a great deal of goods traffic.

Most goods are carried by truck. Brazil and Tanzania make extremely limited use of railways. India and China ship a significant amount of raw materials by rail and, in the case of China, by inland waterway, but in both Shanghai and Bangalore, manufactured goods, foodstuffs, and other non-bulk commodities move largely by truck.

The detailed data on truck movements in São Paulo provided in the background report illustrates the role that trucks play in rapidly-growing cities in the developing world. Trucks account for 27% of the goods and passenger trips made each day in São Paulo state. Most of these truck trips (73%) originate and terminate entirely within the state. Only 11% of truck trips originate or terminate outside São Paulo State, and only 1% both originate *and* terminate outside (i.e., pass through) the state. The fleets owned by the companies manufacturing the cargo account for 48% of the estimated cargo trips, while 52% belong to hauling companies and self-employed individuals. Nearly 46% of all vehicles in circulation travel empty.[103] Transport hauling companies have a higher percentage of vehicles filled (1.3 loaded vehicles for every empty vehicle) than self-employed drivers (the rate is 1.12) and companies that haul their own cargoes (the rate is 1.11).

São Paulo is trying to reduce truck traffic in a number of ways. It is building two freight "ring railways" that will permit freight trains to transit the São Paulo Metropolitan Region without having to use the tracks of the suburban passenger rail system. The city also limits truck traffic in the center. Restricted structural roads ban truck traffic during certain times of the day according to local regulations based on traffic characteristics such as fast or arterial traffic, tunnels,

*Note: Very little data was available on freight movements. Nevertheless, based upon the data we were able to obtain, we feel comfortable in reaching the following conclusions.*

overpasses and bridges. The maximum circulation restriction zone consists of city areas that concentrate a large amount of business activities in trade and services.

In Shanghai, commercial freight trucks accounted for approximately half of all motorized vehicles in 1995, but between 10% and 25% in 2004.[104] Average daily mileage per truck in 1995 was just about the same as average daily mileage per passenger vehicle (52 km vs. 51 km).[105] However, in 2004, the average truck traveled 75 km while the average passenger vehicle traveled 55 km. This implies that while in 1995, trucks and passenger vehicles generated about the same number of vehicle miles (6.2 million per day), by 2004 daily truck vehicle miles had approximately doubled (to 13.5 million per day) passenger vehicle miles (excluding motorcycles) had grown 4.4 times, to 27.3 million miles per day.

## Information technology: Opportunity to facilitate new and improve the efficiency of existing mobility systems

The growth of information technology in developing countries is so rapid that the potential of this technology to enhance sustainable mobility in these countries needs to be explored in depth.

The most dramatic growth is in the availability of cell phone technology. In Shanghai the number of mobile phones owned per 100 individuals reached 88.7 in 2006, up from 64.2 in 2003. In São Paulo, 44.5% of the population aged 10 and above reported owning a cell phone for personal use in 2005.[106] Cell phone ownership in Bangalore was reported at 18% in August 2007, with the number of mobile phone subscribers having grown from 127,000 in 2000 to 3.9 million in 2006.

Cell phones can allow people to learn about potential business opportunities.[107] They can prevent "wasted" trips to closed stores and offices and even eliminate the need for certain trips by permitting transactions to be conducted entirely over the phone. They can improve the attractiveness of public transport by providing users with information about expected waiting time and traffic conditions.

Internet access is also becoming more widespread in the developing world as cell phones are rapidly becoming the principal way to access the Internet. In São Paulo, 34% of individuals surveyed in 2005 reported that they had internet access. In the other cities we studied, Internet use is far less widespread. Shanghai reports that in 2006, 5% of households used the Internet. In Karnataka (the state in which Bangalore is located), approximately 1% of the population was identified as "Internet users" in 2006. In Tanzania, the corresponding figure for 2004 was 0.88%.

The technologies that enable low-cost, multi-function cell phones and the tremendous information-handling capabilities of the Internet are also key to energy-efficient, lower-polluting road vehicles and to the collection of capabilities known as Intelligent Transport Systems (ITS). With computers on the vehicle and/or incorporated into the road infrastructure, car navigation systems can show the shortest direction to one's destination, help monitor (and even predict) congestion, report accidents promptly, and show the availability of parking places.

While much of the technology has been developed and deployed in more developed countries, it is beginning to be deployed in developing countries. The São Paulo report identifies several initiatives being taken to improve the use of the urban street network.[108] It reports that the Brazilian National Traffic Department recently approved the implementation of a National Automatic Vehicle Identification System and began distributing free labels to the whole domestic fleet, starting with new vehicles. The report states that this is likely to increase the use of ITS substantially, since vehicles circulating in the city will be fitted with "electronic identification labels". Traffic agencies are expected to install aerials in strategic sites to monitor vehicle flow, thereby enabling vehicle license and registration inspection, inspection of cargo vehicles and prevention of cargo theft, urban mobility improvement policies, traffic and transportation management, and actions geared to increasing public security.[109]

Given its status as the "Silicon Valley of India", it is not surprising that Bangalore is attempting to take the lead in India in implementing ITS technologies in its transportation system. For example, Bangalore's bus system, the BMTC, installed satellite-tracking technology in its vehicles beginning in 2000, the first system to do so. Initially BMTC adopted off-line GPS technology on 200 vehicles. In January 2007 it placed orders for the supply and operation of electronic display boards for a passenger information system with a Bangalore-based information technology firm on a build, own, operate and transfer basis. According to a BMTC official, deliveries began in February 2008. The BMTC is also integrating its passenger information system and interactive voice response system services to cater to the increase of

passenger inflow as the BMTC aims to increase the passenger load by 10%. In the future, the commuter will be able to obtain information about the arrival of the bus of their choice on their mobile phone. Apart from reducing private vehicle congestion on roads (due to specific information on the arrival of buses), the passenger information system is expected to increase the use of public transport due to reliable information.[110]

Information technology could help enable the "informal" paratransit vehicles in Bangalore to complement, rather than compete with, the city's public transport system. At present, these vehicles provide inexpensive, flexible mobility services, but they are unsafe and polluting. They are seen as a threat to "conventional" bus-based public transport systems since they drain some of the traffic volume that is needed to enable these bus-based systems to operate profitably. If the paratransit vehicles could become feeder systems for upgraded express bus systems, if the safety performance of the vehicles could be improved and their emissions reduced, they could be turned into significant assets.

Information technology can also contribute to improved goods mobility by helping to reduce truck traffic and to make truck operations more efficient. The percentage of trucks running empty suggests that opportunities for backhaul are not being exploited. Experience in the US since trucking deregulation suggests that the percentage of backhauls can be increased substantially, and having trucks equipped with radios or cell phones and GPS makes backhauls easier to arrange.[111] Transportation companies specializing in package delivery can optimize the routes traveled by their vehicles dynamically, reducing distances traveled and saving fuel.[112] Equipping trucks with GPS can also lower cargo theft – a significant problem in Brazil.

## Narrow "mobility opportunity divides"

*Mobility 2030* defines the "mobility opportunity divide" as the difference that exists in the ability of different groups of people to move freely, gain access, communicate, trade and establish relationships. At least three distinct types of mobility opportunity divide can be identified. The first is reflected in differences in mobility opportunities available to the *average* resident of developing countries compared to the *average* resident of developed countries. The second is reflected in differences in mobility opportunities available to the *average urban resident* compared to the *average rural resident*. The third is reflected in differences in mobility opportunities available to different groups (e.g., people of different income levels, the elderly, the disabled, etc.) *within* the urban areas. While all three types of mobility divide were referred to in the dialogues and in the background reports, mobility divides of the third type received by far the most attention. We will limit our discussion in this section to this type.

### The magnitude of the mobility opportunity divide within each of the four cities

A starting point for evaluating the magnitude of the mobility opportunity divide within a city is to understand the degree of income inequality in the city. A recently released report by UN Habitat provides Gini coefficients (a standard measure of income inequality) for over 80 developing-country cities, among them Dar es Salaam, São Paulo, and Shanghai.[113] According to the report, São Paulo has by far the most unequal income distribution of the three: its Gini coefficient is 0.61; Dar es Salaam's is 0.36; and Shanghai's is 0.32.

Not surprisingly, therefore, in São Paulo higher income individuals make substantially more trips per day than lower income individuals. Moreover, in 2002, 74% of the daily trips made by higher-income individuals were by private vehicle, 15% were non-motorized, and 11% were by public transport. In contrast, 63% of the trips made by lower-income individuals were by foot or bicycle, 28% were by public transport, and 10% were made by private vehicle.

Though income inequality is much lower in Shanghai, differences in mobility opportunity across income levels are also quite important. In the periphery of Shanghai (the city's fastest growing districts), low-income residents tend to walk or take the bus. High-income residents tend to drive or take the metro. Not surprisingly given this difference in modes used, the trips by the high-income residents tend to take less time than the trips by the low-income residents. Some 65% of the high-income respondents reported spending less than 30 minutes on a trip from the periphery to the central area; only 7% reported spending more than one hour. In contrast, only 33% of the low-income residents reported spending less than 30 minutes on such a trip, while 27% reported spending more than 60 minutes. This also helps to explain why the Shanghai suburbs are disproportionately populated by higher income families.

### Efforts to provide special fares for lower-income and disadvantaged individuals

While the data are not conclusive, we believe that the weight of evidence suggests that in *each* of the four cities, the mobility opportunity divide between rich and poor is substantial and widening. While mobility opportunities for the *average* inhabitant of each city may be improving, for lower-income residents they are either not improving as quickly or are declining. In part this is due to the growth in the geographic area of each city. In the past, it was probably possible to reach most parts of these cities by foot, bicycle or bus within a relatively short period of time. This is no longer the case. Those residents who can afford a car or motorcycle or who have easy access to the metro systems in those cities that have them find that their mobility opportunities have been enhanced, sometimes quite substantially. But those who must walk, ride bicycles or take conventional buses traveling on increasingly congested city streets are seeing their mobility opportunities deteriorate.

Governments in each city have been experimenting with ways of making public transport more affordable to school children, the elderly, and the poor. São Paulo has instituted a "single ticket" system that allows free transfer among public transport modes. And in June 2007, Shanghai implemented "preferential ticket prices for transfer" on all of the 396 bus lines within the inner ring. Bangalore appears to have the most comprehensive system of subsidized fares. It spends R$ 700 million per year subsidizing bus passes for special categories of people traveling in the city. Besides daily, weekly and monthly passes for all passengers there are special passes for the senior citizens (the elderly), the disabled, journalists, fire fighters, family members who are successors of freedom fighters (from the war of independence against the British), policemen, students, etc. Even so, bus travel is too expensive for many of the city's poor. In Bangalore, nearly 50% of households have a salary of approximately US$ 123 per month. For these people, transportation absorbs nearly 24% of household income.[114] Even in Shanghai, the minimum two-way ticket on the metro costs 18% of the daily income of low-income people.

### An unintended side effect of providing lower fares for special groups

The efforts to help special groups obtain affordable transportation sometimes have unintended consequences. Dar es Salaam City Council sets the fare rate for *dala dala* passengers, with children entitled to a reduced fare that is less than half the price of an adult ticket. However, the city government does not provide a subsidy to cover lost revenues, and it is reported that *dala dala* drivers refuse to accept school children in place of full-fare passengers. This has made it even more difficult for children to get to school on time.

## Reduce road vehicle-related deaths and injuries

At each dialogue, major concern was expressed about the high levels of road vehicle-related deaths and injuries, especially the fact that the majority of victims tend to be pedestrians and bicyclists. In Bangalore and São Paulo, special concern was expressed about the fact that a growing number of motorcyclists are being killed and injured each year.

### Safety

*Definition of indicator: "The probability that an individual will be killed or injured in an accident while using a mobility system, and the total number of deaths and serious injuries (expressed as DALY – disability-adjusted life years) per year by category (air transport, automobile, truck, bus, moped, bicycle, pedestrian, etc.)."*

Each city suffers from a high number of transport-related deaths and injuries, with pedestrians, bicyclists, and riders of motorcycles and scooters as principal victims. Statistics for Shanghai and São Paulo show total traffic-related deaths and injuries declining, but the data are considered somewhat unreliable, so it is difficult to be certain of the trends. In São Paulo, deaths of motorcyclists and their passengers have increased to the point where they now exceed deaths of car drivers and occupants, even though the number of passenger cars exceeds the number of motorcycles by a ratio of approximately 7 to 1. Inexperienced drivers and pedestrians not used to dealing with motorized traffic are identified as major contributors to the high casualty rates in Bangalore and Shanghai. Pedestrians and bicyclists are poorly served in both cities: sidewalks are often nonexistent or are obstructed, forcing pedestrians onto roads crowded with motorized vehicles. Bicycle lanes are extremely rare. Intersections are poorly controlled.

### Personal security

*Definition of indicator: "For individuals, the probability that one will be harassed, robbed, or physically assaulted during a journey. For society, the total number of incidents (perhaps weighted by severity)."*

Theft and harassment of women and children was highlighted as a problem in Dar es Salaam. However, personal security

on public transport systems appears to be an important issue everywhere. In São Paulo, "greater personal security against thefts and muggings" ranked as the most important concern in a recent passenger survey, exceeding even concerns about service quality and cost.

### Actions and concerns

Death and injury rates seem to be reducing in São Paulo and Shanghai, although there was little discussion of the reasons for these reductions in either the reports or dialogues. In contrast, death and injury levels appear to be increasing in both Bangalore and Dar es Salaam.

Some of the actions being taken by cities to improve road infrastructure (e.g., road widening) may actually be harming the safety of pedestrians and bicyclists. Sidewalks, already scarce in cities like Bangalore, are being appropriated for roads, forcing pedestrians to compete with cars.

There is general agreement that drivers need to be educated about how to drive more safely and responsibly. Recent articles in the popular press in India[115] and China[116] have described how poor driver training is – when it is received at all. Pedestrians need to be educated about how to avoid cars, trucks, buses and motorcycles.

In some cities, traffic police are seen to be unfair, arbitrary and open to bribery. This makes it much more difficult to persuade drivers, bicyclists and pedestrians to obey traffic laws.

These aspects of the road safety problem clearly need to be tackled more aggressively.

## Mitigate congestion

Each city reports major, and growing, problems with traffic congestion. Traffic control at key intersections is an issue everywhere. So is the lack of sidewalks and capacity to accommodate "slow" traffic. Heavy goods vehicle traffic is also seen as an important factor contributing to congestion.

### Reliability

*Definition of indicator: For personal mobility, "the variability in door-to-door travel time for a 'typical' mobility user"; for goods mobility, "the variability in origin-to-destination time for 'typical' shipments of different times."*

The mobility systems used by relatively wealthier residents allow them to travel faster and tend to be more reliable. Lower income residents either walk, ride bicycles, or rely on buses and paratransit. Bangalore, Shanghai and São Paulo each have experimented with dedicated bus lanes as a way of speeding up bus travel. But in each city, the bus lanes are said to be poorly enforced.

In Bangalore, many of the major roads are carrying several times the amount of traffic for which they were designed. A survey prepared as part of the Environmental Income Statement for the proposed Bangalore subway reviewed conditions on 25 major roads. This review found that at peak periods, the roads were carrying from 2.7 to 5.8 times their "practical capacity".[117] In Dar es Salaam, poor roads and poor traffic control at major intersections mean that it can take hours for people to travel from the suburbs to the city center. In São Paulo, traffic speeds for cars on main arterials have dropped from 30 km/h in 1981 to 18 km/h in 2005, while traffic speeds for buses have dropped from 17 km/h to 14.5 km/h over the same period. As a result of Shanghai's recently built system of expressways, the area from which an individual in a car can reach the downtown area in one hour has expanded substantially. But congestion is still considered a problem. In rush hours, about 42% of arterial roads in the center of the west part of Shanghai are congested.

### Efforts by some cities to limit the availability and/or use of private cars

Shanghai and São Paulo are trying to limit congestion (and pollution) by controlling the ownership (Shanghai) and use (São Paulo) of private cars. Shanghai has copied Singapore's policy of limiting the number of car licenses issued and auctioning off this limited supply of licenses. As a result of this policy, per capita ownership of cars is considerably lower in Shanghai than, for example, Beijing. São Paulo has copied Mexico City's policy of restricting the number of days that any one car can circulate in the city. Up to 20% of the fleet (based on license plate numbers) is prohibited from circulating each day of the week. Originally this is estimated to have reduced the number of vehicles circulating by 12%. However, over time, the impact on traffic has declined to about 7%.

### Favoring public transport over private transport – policies versus reality

In principle, each city has a policy of favoring public transport over private transport, and each is in the process of upgrading its public transport systems – both measures being intended to help reduce traffic congestion. Each of the cities is facing the question of whether its upgraded public transport systems will be able to compete successfully with

"informal" systems (such as the *dala dalas* in Dar es Salaam) or privately owned vehicles.

### The limited impact of road network expansion on congestion reduction

At each of the dialogues, skepticism was expressed about whether road expansion will indeed reduce congestion. There was discussion of using congestion pricing (as in Singapore), limitations on parking, and other policies to discourage private road-vehicle use.

## Eliminate transport-related emissions of conventional pollutants as a significant public health concern

Each city is trying to reduce those transport-related conventional emissions that are perceived as having at present the greatest adverse impact on the health and welfare of its citizens. Dar es Salaam is focusing on eliminating lead from gasoline and reducing dust from roads. Other transport-related emissions are of secondary concern at this point. Shanghai, Bangalore, and São Paulo are requiring the installation of emissions control equipment designed to reduce emissions of carbon monoxide (CO), nitrogen oxide (NOx), sulphur oxide (SOx), and unburned hydrocarbons from various categories of road vehicles, though the stringency of the controls being implemented lags somewhat behind that of those being implemented in Europe, the United States or Japan.

The only city for which we could obtain detailed information on transportation-related emissions data is São Paulo. The four figures below, taken from the background report show historical (1980-2006) and projected (2007-2030) emissions of CO, unburned hydrocarbons (measured as volatile organic compounds, or VOCs), NOx, and particulate matter ($PM_{10}$)[118] for light-duty vehicles, motorcycles, and heavy vehicles.[119]

The patterns of emissions displayed in the following figures are similar to those we have seen in studies tracking the evolution of various emissions over time in the US and the EU. Different vehicle types account for the majority of different pollutants at different times, reflecting both the share of each vehicle type in the total vehicle fleet, the average intensity of use of each vehicle type, and the timing of introduction of emissions standards applying to different vehicle types.

Figure 26: CO emissions in São Paulo (1980-2030)

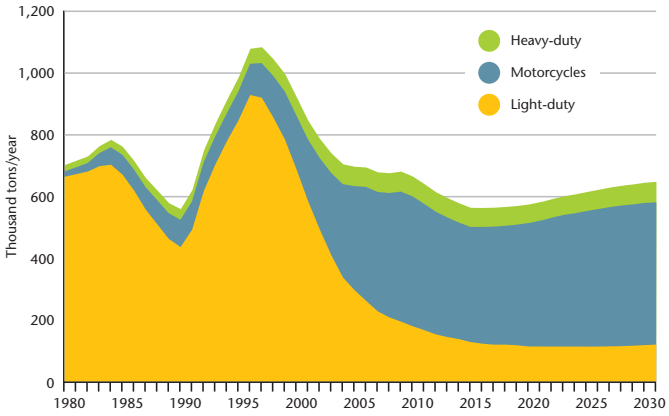



Figure 27: VOC emissions in São Paulo (1980-2030)

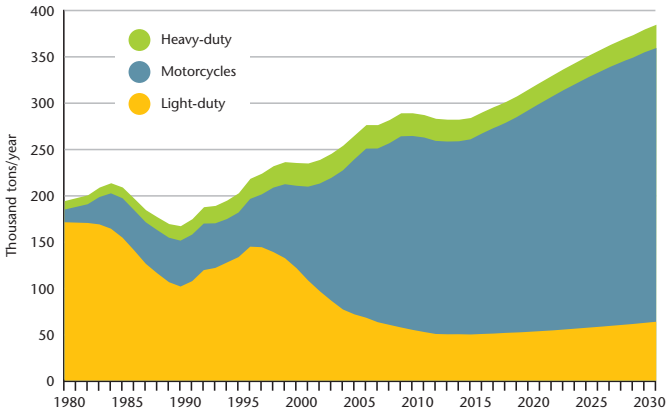



Figure 28: NOx emissions in São Paulo (1980-2030)

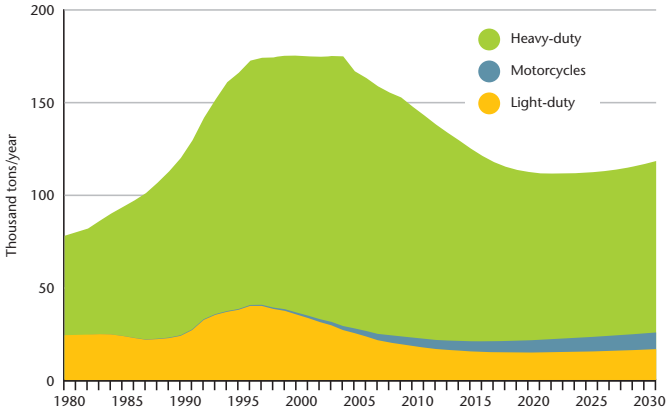
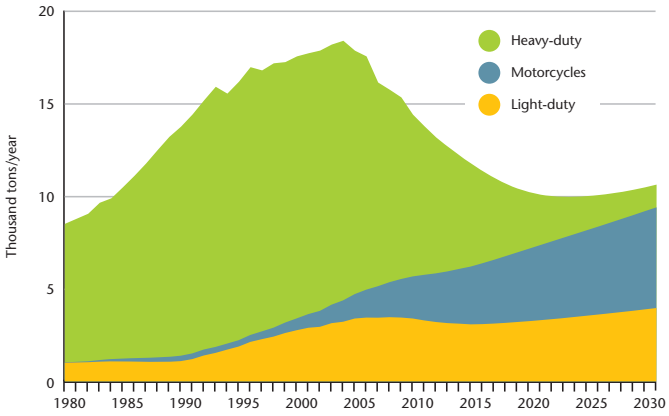


Figure 29: Particulate matter emissions in São Paulo (1980-2030)




In São Paulo, light-duty vehicles were once responsible for the majority of CO and VOC emissions, but they have decreased due to the requirement that the vehicles be equipped with pollution controls. The increase in CO and VOC emissions after the mid-1990s reflects the sharp growth in the number of motorcycles during this period. They are powered by two-stroke engines that have oil added to their gasoline. NOx and PM emissions are primarily the responsibility of heavy-duty trucks. The observed patterns help explain why Shanghai has banned motorcycles and why Bangalore has pressed hard to have its auto-rickshaws converted to compressed natural gas. Motorcycles with two-stroke engines are extremely important sources of CO and VOC emissions. The patterns also show why diesel-powered trucks have been the target of increased controls. They are the principal source of NOx and PM emissions.

Going forward, emissions of CO, NOx and PM are projected to decline through about 2020, with emissions from light-duty vehicles becoming a relatively minor share of the total by this time. Carbon monoxide, unburned hydrocarbons and PM emissions from motorcycles and NOx emissions from heavy-duty vehicles appear to present a continuing problem throughout the period given the emissions standards now in effect or scheduled to be implemented.

We do not have comparable data for the three other cities.[120] However, it is our understanding that although reductions from current emissions levels may occur over the next couple of decades for several pollutants, none of the four cities is expected fully to meet the goal of *eliminating* transport-related conventional emissions as a significant public health concern in the foreseeable future. As the data for São Paulo show, growth in transport activity will offset the impact of the newly required emissions reduction equipment, and the effectiveness of that equipment will deteriorate without aggressive and effective programs of inspection and maintenance.[121] Additional controls beyond those already planned will be necessary if the goal is to be met. Cities also might consider introducing programs to encourage the scrapping of older vehicles to eliminate the more polluting vehicles from the fleet. In some cases, it might be desirable to retrofit existing vehicles to enable them to use other fuels.

The São Paulo report draws the following conclusions concerning priorities for controlling transport-related emissions in the future:

a) Motorcycles are the main focus of efforts to control CO; for other vehicles the emphasis is on the development of technology
b) Control of VOC emitted by type of vehicle depends essentially on significant restrictions applied to motorcycles, as well as on the continuity of control requirements for automobiles
c) NOx limits for heavy duty vehicles should be strongly reduced, whereas for the remaining types of vehicles maintaining the already established strategies should be sufficient
d) As of 2015, control strategies for PM emissions will have to be extended to light duty vehicles and motorcycles, and it is essential to maintain the already established requirements for heavy duty vehicles.[122]

## The prospects for mobility becoming sustainable in the four cities

In each of the background reports and dialogues it was emphatically concluded that at present mobility in the city in question is unsustainable. Indeed, in at least a couple of the dialogues, the consensus was that, on balance, the situation was deteriorating rather than improving. While this may have been an overly pessimistic assessment, it nevertheless reflects the immense mobility challenges being faced by these cities.

There seemed to be a reasonably good understanding of what might be required. The pessimism was based on a general lack of confidence that the cities were capable of mounting adequate responses. Five major reasons expressed for this lack of confidence were: (1) difficulty in securing adequate stakeholder support, (2) challenges relating to governance and policies, (3) limits on governments' capacity to plan effectively, (4) limits on governments' capacity to implement, and (5) limits on governments' capacity to finance and maintain mobility investments.

## Stakeholder support

*"Stakeholder support" here refers to the extent to which policy-makers, citizens and business are aligned on the mobility priorities in each city. It also includes the extent to which the appropriate policy-makers at the municipal, state, national and (possibly) international level are aligned to support action. Lack of such support can prevent needed projects from being carried out.*

With the JNNURM, the Indian government has recognized that infrastructure in its cities needs to improve significantly. However, this commitment seems to break down at the city level, where there is little evidence that the future projects are being developed in line with the National Urban Transport Policy vision. The majority of the population is concerned about the worsening congestion and destruction of green space to make way for more roads. They do not seem especially concerned about traffic safety despite the high accident rate. For business, the deterioration of the mobility situation in the city is a major cause for concern. A 2003 survey of 1,855 manufacturing firms in 40 cities across twelve states in India conducted for The World Bank and the International Finance Corporation revealed that the highest number of respondents identified the state of Karnataka (where Bangalore is located) as a location where transport was considered to be a "major-to-severe" bottleneck to growth.[123]

In Tanzania there is recognition at the highest level of government that the mobility systems in Dar es Salaam and in the country as a whole need to improve substantially. At the municipal level the previous mayor was instrumental in getting the bus rapid transit (BRT) system approved. The majority of the population uses non-motorized modes, so they are less likely to benefit from future investments in roads and would see other basic needs as more pressing for the government to address than mobility. Indeed a challenge for the new BRT system will be to ensure it is affordable for the majority of the population. The problem is further compounded by the fact that the vast majority of the poor in Dar es Salaam live in unplanned settlements that are badly served by all forms of services including transportation. The extent to which these people really have a voice in future investment priorities is a cause for concern. The private sector is perhaps the most vocal in its demands to improve the transportation systems, particularly the quality of the existing systems as well as the intermodal linkages to allow freight to move more efficiently into and across the country.

Congestion is a high profile issue in São Paulo and is clearly on the agenda of the municipal government, the media and the public. The dialogue discussion indicated that it is increasingly recognized that congestion cannot be solved simply by road building. Strong support was expressed for improving public transport, and there was some acceptance of the need for more traffic demand management. It was felt that there is less political and public will to solve the problem of affordability and accessibility of transportation for the poor. This is reflected in investment patterns that are not publicly disclosed and disproportionately focus on transport modes used by higher income segments, such as private vehicles and the metro. There also was general agreement that there is little public or political will to address the environmental and health impacts of transportation in the city.

The Brazilian federal government recently established the Ministry of Cities but it remains to be seen if this can really drive change at the municipal level. The government has implemented far-reaching polices on biofuels although these have had more to do with energy security than reducing vehicle emissions. Diesel fuel standards have lagged behind. At state level, municipal transportation is not prioritized, with many examples of budgets being approved but funds not being released.

In Brazil, community participation in discussing and proposing actions is still rather infrequent in terms of a formal commitment between government and society, although the last decade saw considerable growth in this relationship. This growth is connected both with the deterioration of the urban environment – increasing societal concerns – and the strengthening of Brazilian democracy, which included new social groups into formal discussions about policy decisions.

In the Yangtze River Delta and Shanghai, both the provincial and municipal governments have long recognized the importance of a well functioning mobility system to enable economic growth and social progress. This recognition has been backed by huge investments in transportation infrastructure over the last 20 years. However, there is also a growing recognition by all stakeholders that supply is not keeping up with demand and that continued economic growth and quality of life are at risk if solutions to the current mobility challenges are not found. There is also evidence that the low-income segment of the population is benefiting least from the investments and is most exposed to the negative impacts from transportation. It is not clear that they have a voice in the prioritization of future plans.

## Governance and policies

*"Governance and policies" here refers to the extent to which the policy frameworks and governance structure at the municipal, state and national levels are conducive to achieving sustainable mobility.*

According to the Bangalore report, "…though the JNNURM is a well-intentioned program, the City Development Plan (CDP) formulated under this plan fails to address certain very important issues, which are critical from the viewpoint of sustainability. [These include:] (1) The emphasis is purely on physical infrastructure expansion while sustainability (social, environmental and economic) is not addressed; (2) Key areas like environmental protection, addressing the mobility divide, transport energy issues, policy instruments to manage travel demand, etc. are not adequately addressed; (3) Mechanisms to integrate identified initiatives under JNNURM with other national/state level policies and plans like NUTP, are not clearly spelt out in the program; (4) There is no thrust or provision for 'inclusive planning and growth'; (5) Impacts of the kind of transport development outlined on other areas have not been addressed."[124]

At the dialogue, it was recommended to create a unified metropolitan transport authority to bring all the various municipal functions related to mobility under one umbrella. The creation of a consultative body with representatives from business and civil society was seen as additional to this.

In Tanzania the National Transport Policy (NTP) is the main policy instrument. The dialogue indicated that while institutions are in place to deliver this, there is limited integration and coordination between them. Concerns were expressed that the NTP has placed too much focus on road transportation in and around cities rather than on the most efficient means to transport people and goods from place to place where public transport, inter-modality and rural to urban connectivity would get greater attention. This is particularly important for the vast number of people who do not use motorized transport as well as the poorly connected rural areas that receive little investment compared to urban areas.

The São Paulo report states that at the national level in Brazil there is little focus on the public policies, coordination and funding mechanisms needed to support developments in the urban transport sector. Responsibility for governing urban transport is largely devolved to the municipal level, but without the requisite control of funding. As in many megacities, the boundaries of political responsibility do not match up with the boundaries of the functional city. There is no overall transport authority for the São Paulo region and among the existing network of government agencies involved with mobility at each city level in the region, there is little cooperation and integration on crosscutting issues. The long duration of the planning and implementation cycle for urban development and transportation investments is also at odds with the considerably shorter political terms, giving limited continuity in plans from one political term to the next.[125]

## Capacity to plan effectively

*"Capacity to plan effectively" here refers to more than just the ability of city planners to produce plans. It also requires that mobility and land-use planning be appropriately integrated. This includes, for example, measures to maintain higher density living to support the necessary access levels on public transportation, and actions to revive city centers to mitigate some of the urban sprawl that would otherwise increase trip distance.*

In Bangalore, the lack of coordination and integrated planning is severely impacting the use of land. Trees and green space in the city are being removed to make way for more roads and the suburbs are developing with little thought as to how to best serve these areas with public transport. As noted above, the mobility projects in Bangalore are not in line with India's vision for its cities as expressed in the National Urban Transportation Plan.

Dar es Salaam suffers from extremely poor land-use planning controls with a high percentage of the population living in unplanned and poorly served informal settlements along the arterial roads. This coupled with a population growth rate in excess of 4% per year (mainly to the informal settlements) makes any improvement in this situation extremely difficult.

Tanzania's NTP is intended to address urban transport problems related to land-use planning. Presently, land-use planning is not done in such a way that it locates industries and social amenities in residential areas. Most of these services are situated in the central business district. In view of the identified transport bottlenecks related to land-use planning, the plan provides the following policy directions: facilities such as light industries, schools, business and shopping centers, markets and other services to be located within or close to residential neighborhoods in order to reduce the number of trips in urban areas; the provision of necessary transport infrastructure to meet present and future needs should be based on city, municipal and town master plans.

Most Brazilian cities feature a transport, traffic or public roads department, but seldom an urban planning department. Generally urban development in Brazilian cities takes place with limited control, under poor regulations, if at all, and subject to market laws that govern the value of land and accessibility levels. In medium-sized cities, public transportation is usually managed directly by mayors and their technical staff. However, these activities are normally carried out separately from activities connected with traffic. In large cities, the complexity of transport and traffic issues tends to generate better coordination between both these areas, although they are often still detached from other areas of investments in the transportation system, such as road and urban planning departments.

The São Paulo Metropolitan Region has prioritized the following areas to mitigate congestion: infrastructure investments; improved use of roadway systems; improvements and incentives towards the use of public transport; and actions to decongest and organize the flow of freight. There is little evidence that activities are planned to improve accessibility for the low-income segment.

Dialogue participants recognized that the old institutional boundaries in Shanghai do not adequately cover the current realities of the economic area and are not really working. They recommended the creation of a regional planning authority for Shanghai: *"The planning authority needs to be sized appropriately to the mobility issues they are trying to solve."*

A 2007 study compared planned Shanghai growth patterns with actual growth patterns and found little correspondence. The following institutional issues were highlighted to explain this:

- Misalignment of functional responsibilities, revenue assignments and expenditure responsibilities among municipal, district and town governments
- Perverse fiscal incentives – the declining fiscal capacities of sub-municipal governments forces one-time sales of land-use lease rights; no land-based recurring revenues
- Subsidization and land conversion controls distort real estate markets
- System of property rights mitigates economies of scale and constricts land supply
- Planning process cannot keep up with the pace of change
- There are no explicit, codified mandates for metropolitan management, including suburban areas.[126]

The Shanghai report concludes that one disappointing feature of Shanghai's plans (and actual growth patterns) is that low-income households tend to be displaced as new infrastructure is developed and as the land prices go up. They also tend to be disproportionately affected by the negative impacts of transportation.[127]

According to the report, the urban planning control system, generally speaking, is working well to control unplanned and low-density development. However, industrial land development in suburban Shanghai is scattered. The report recommends that regulation be strengthened to encourage mixed-use land development at a relatively high density in order to promote public transport and reduce travel demands. It also recommends that suburban development be focused on the strategy of "urban development guided by public transport", guaranteeing the land reserved for public transport interchange facilities and enhancing the capacity of transfer facilities to encourage new development along public transport corridors.[128]

The report states that with the high building density and heavy traffic, the city center is heavily polluted along major traffic routes. It raises a concern that the decline of environmental quality may impact people's desire to continue living in the city center. Controls on vehicle emissions and guarantees for the quality of city center should be very important.[129]

## Capacity to implement

*"Capacity to implement" here refers to the extent to which the necessary human capacities are in place to successfully implement policies on the ground. This includes the necessary skills and experience to plan, execute and operate major infrastructure investments or approaches that may be new to the particular location.*

In a 2003 World Bank/IFC survey on India, "skills shortages" were considered a barrier to growth. Karnataka, the state within which Bangalore is located, led the list with 23% of respondents reporting that skills shortages were a barrier to growth.[130]

Throughout India road building practices do not appear to be adequately controlled; roads deteriorate rapidly once put in place. This is compounded by insufficient truck inspection, with overloading being a major cause of road deterioration. There also appears to be limited coordination between the different institutions resulting in a lack of integrated plans for the use of urban space in Bangalore.

The government of Tanzania has still not implemented the Dar es Salaam BRT system although some steps have been taken to expand some major roads to accommodate it and there has been an agreement on tariff reduction for bus imports. The main reason cited for delay is the identification of a contractor to manage the project and carry out the work.

A 2008 study identified some of the institutional challenges:

- Thus far the planning agency personnel have changed three times
- The project was shifted from control of the Dar es Salaam City Council to the national government, undermining the ability to build local capacity to design and manage the system
- There is no familiarity with complex transit system operational control and no modern local bus corporations
- The legal and regulatory framework is weak.

According to the study, further political issues relating to bus procurement and the status of the *dala dalas* must be dealt with for the project to work:

- The government must enforce the removal of competing *dala dala* routes on the trunk route
- Fares must be adjusted for inflation; this must be protected in operating contracts
- Value-added, custom and excise taxes must be waived on the importation of buses
- The bus type must be kept as specified in the business model
- Below-commercial interest rates must be available from export credit agencies for bus procurement; this probably will require a partial government guarantee on the loan.[131]

Many of the large infrastructure projects in Tanzania are being developed by and manned with overseas labor. There is a need to build construction and maintenance capability within the country.

São Paulo has strong institutional capacity in fuel and vehicle innovation and in public transport engineering and management, both in the public and private sector. However, in some cases this is held back by contracting and coordination mechanisms. For example the contracting process for public transport creates a monopoly situation where the bus companies do not compete with each other and have little incentive to improve service levels. In other cases institutional boundaries prevent collaboration between different public agencies. The development of the "single ticket" achieved the significant feat of bringing together all key players in public transportation and demonstrated the benefits of integrated working. Traffic and licensing enforcement, which had been weak when carried out at the state level, has now been transferred to municipal authorities and is becoming stronger. Urban planning capacity and integration within the regional and city governments remains relatively weak.

There is no evidence that Shanghai has any significant issues related to implementation capacity. The challenge in the future will be to maintain the capacity for implementation across administrative boundaries as the scale of the mobility issues that are being addressed continue to expand beyond existing boundaries.

## Capacity to finance

*"Capacity to finance" here refers to the extent to which the necessary finances are available and can be disbursed to fund existing and future necessary mobility investments. It also implies that funds are available to maintain capital assets once they have been put in place.*

Historically, Bangalore has seriously underinvested in the provision of mobility systems and services in the city. There is evidence that this may change in the future but it is also clear that there is a lot of catching up to do compared to other world cities with Bangalore's levels of economic activity. In the current Investment Plan for Transport Infrastructure in Bangalore (2006-12 Period), 52% of the total future investments are to cover the capital, operation and maintenance expenses for road transportation. The remaining 48% are allocated to public transport, land acquisition, transit centers and other operation and maintenance costs. There is no investment earmarked for pedestrian and non-motorized transport infrastructure.

Financial capacity is the biggest challenge facing Dar es Salaam as it struggles to improve its transportation infrastructure as well as deal with other pressing human needs. As a result, and despite the good intentions of the various ministries to invest in infrastructure, financial constraints continue to limit transport infrastructure development in the city and in the country in general. The budget allocated for development/capital spending has always fallen short of needs, including that for the rehabilitation and maintenance of existing infrastructure. Estimates by the Ministry of Infrastructure Development show that about 70% of financing for infrastructure is provided by international donors.

While São Paulo plans to make significant investments in transport infrastructure and public transportation, this is not yet at a level sufficient to solve the challenge it faces. Brazilian cities are extremely dependent on external funding from federal government and international finance agencies, with only one-third of their funds being self-generated. The main set of federal government projects related to Brazil's infrastructure, including transportation, is under the Growth Acceleration Plan. Launched in 2007, the plan provides for a total infrastructure investment of R$ 504 billion from 2007 through 2010, R$ 58 billion of which is for land transportation (including urban transportation), airports and ports. Total investments projected for 2007 were R$ 112 billion. However, the actual investment made in projects in 2007 reached R$ 16 billion, only 14% of the estimated total.

Historically the Yangtze Delta Region and Shanghai authorities have invested heavily in transport infrastructure – investing anywhere between 2% and 4% of GDP in transportation infrastructure and services every year since 1996. In the future more focus will be placed on the construction of public transport and investment will be prioritized to realize more metro construction during the Eleventh Five-year Plan.

Increasingly, the private sector is seen as a source of funding for roads and railways but there is reluctance due to uncertainties and pressure on expected returns. As a result new development projects in the urban transportation area such as bus corridors, terminals, subway and railway systems do not always succeed in finding an interested private enterprise to provide funds.

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No study limited to just four cities can claim to provide a complete picture of the mobility challenges faced by rapidly growing, developing country urban areas and how they are responding to these challenges. But we believe that our study of these four particular cities – ranging in population from 3 to 20 million, in area from 800 to 6,300 $km^2$, in motorized vehicle ownership per 1,000 persons of less than 20 to more than 350, and in length of urban road networks from 2,000 to 45,000 km – is helpful in identifying issues to which business, government and individuals need to pay attention.

As the cities strive to improve the mobility for their citizens, each one is aware of the disparities in mobility opportunity that exist between citizens of different income levels. All are trying to address these disparities, though with different degrees of urgency and with different degrees of success. Each city is trying to tackle the growing transport congestion it faces. Each is spending considerable sums (relative to resources) in trying to build its way out of trouble, through increasing the number and quality of roads and/or through enlarging and improving the quality, safety and attractiveness of its public transport system. However, no city has yet found "the answer" to the congestion problem.

Each city is trying to reduce those forms of conventional transport-related emissions that are deemed to be most important to its citizens. However, efforts to reduce pollution on a per-vehicle basis through stricter controls over vehicles and fuels are being offset by growth in the total volume of transport activity. Without further tightening of emissions standards in the future it will be difficult for the four cities to fully eliminate transport-related conventional emissions as a significant public health concern in the foreseeable future.

There are, of course, other transport-related issues of concern to these cities. There is growing awareness of the importance of global climate change and of transport's contribution to it. In some cases, the cities are taking steps that may, over time, contribute to a reduction in greenhouse gas emissions by transportation activities within their jurisdictions. They are also aware of transport's annoyances – such as noise. But dealing with these annoyances clearly has a lower priority than the impossible-to-ignore problems of providing mobility to all.

Several institutional conditions are impacting the cities' ability to deal with their transportation challenges. We want to stress that there is no one set of institutional conditions that is necessary to achieve sustainable mobility. The assessments provided here are, by definition, subjective ones based on the views and experiences of WBCSD member companies involved in this work. As such, they should be treated as one set of opinions that may prove useful in framing a debate on the way forward at each location. Each city will have to find its own path that takes into account the socio-economic conditions that exist today as well as the political, historical and cultural dimensions that make it unique.

# Conclusion

Bringing together diverse mobility sector businesses, the Mobility for Development project has provided a valuable opportunity to debate the state of mobility in four rapidly developing cities. The aim was to raise awareness about the role of mobility in driving economic development, to develop a better understanding of the sustainable mobility challenges in rapidly growing cities in the developing world, and to investigate ways to narrow the "mobility opportunity divide" and to mitigate negative transport impacts.

## The importance of mobility as a driver of development

Mobility is essential for the economic and social advancement of developing countries.

**Mobility enables economic growth and human development** – The efficient movement of people and goods opens up opportunities for broad economic development, unlocking resources, promoting competition and enabling people to access markets and jobs, health and education services, leading to improved living conditions. Each of the four cities has experienced rapid urban and economic growth, accompanied by rapid growth in the number of vehicles, both passenger and freight, public and private.

**Mobility enables regional integration and growth in trade** – Shanghai, Dar es Salaam and São Paulo as major regional transport hubs connect ports, cities and rural hinterlands; and in each of these cities expanding road, rail and port capacity has been crucial to economic dynamism. In Bangalore economic growth has been driven by a different form of mobility – global connectivity through telephone and high-speed Internet has crucially enabled the growth of the information technology services industry, which in turn has led to growth of local supporting industries and services.

**Mobility enables successful urbanization** – While there is considerable debate over the dividing line between beneficial decentralization and damaging sprawl, urban growth is critical to development, and transportation to facilitate access is crucial to functioning, livable cities. The growth in motorized transportation has enabled all cities to grow, in some cases to megacity proportions, absorbing migrants from the countryside in search of a better life and alleviating overcrowding in dense city-center neighborhoods.

**Well functioning mobility systems enable cities to attract talent and investment** – In Bangalore, São Paulo and Shanghai, attracting international investors was crucial to the city's strategy for trade, innovation and employment growth. No doubt in time this will also apply to Dar es Salaam. Well functioning mobility systems are an important factor in maintaining these cities' attractiveness as a base for international companies and internationally mobile talent. Accessible green spaces and cultural facilities, vibrant streets and safe neighborhoods are important both for attracting investors and visitors, as well as for the quality of life of residents.

**Mobility providers create employment** – In each city, the mobility sector plays a crucial role in providing jobs for an expanding workforce. While in Shanghai the burgeoning auto industry is a major employer, in Bangalore and Dar es Salaam, the informal paratransit service sector is a significant source of employment.

## Sustainable mobility challenges

Rapidly developing cities face serious mobility problems. As cities grow larger their infrastructure, including road, rail and public transport systems, as well as traffic controls and regulatory institutions are failing to keep up with the mobility needs of growing and increasingly diverse populations.

**Congestion threatens economic competitiveness** – Congestion and under-capacity of roads, railways and ports lead to higher distribution time and costs for goods transportation and lost worker productivity due to longer commutes, and cities and regions become less attractive to new business. In Bangalore, the once-spacious garden city that attracted investors has found its reputation suffering from problems of poor infrastructure and destruction of its tree-lined avenues to accommodate wider roads and traffic congestion. São Paulo too has found that its position as national power-house is being threatened by congestion problems.

**Environmental and traffic safety problems threaten health and quality of life** – Traffic accidents not only bring suffering and loss of life and talents, but also hinder economic development. In every city, traffic safety and local pollution are critical concerns. Across India it has been estimated that road traffic accidents are responsible for economic losses equal to 3% of GDP every year.

**Energy intensive patterns of development and transportation threaten sustainability** – Transport is responsible for a significant and growing proportion of energy use and greenhouse gas emissions. Energy security is already a concern, and while developing countries do not currently

have obligations to reduce emissions, it is clear that achieving atmospheric stabilization will require that economic growth be de-linked from rising emissions. Cities that have been built around energy-intensive models of development will have a harder time adjusting.

Institutional barriers and obstacles can be as serious as flooded roads and potholes in preventing effective mobility:

**Absent or poorly implemented urban planning** exacerbates mobility problems by enabling a pattern of low-density suburban development, which makes it difficult for public transport to compete with private vehicles. Municipal boundaries that no longer align with the reality of urban development make integration of transport and urban planning impossible.

**The absence of cross-border cooperation on transport and trade** mean that poor networks, high freight operating costs, and transit charges and border delays and taxes prevent regional transport corridors from contributing more strongly to development.

**Provision of public transport is struggling** to meet the needs and aspirations of growing numbers of people. As the cities expand and as motorized traffic increases, conventional bus systems are becoming increasingly stressed. A lack of effective competition, poor multi-modal integration and the tension between improving services and maintaining affordability are just some of the factors leading public transport to under-perform on safety, comfort, convenience, punctuality and cost effectiveness.

**Mobility opportunity gaps threaten inclusive development.** Not everyone is benefiting from enhanced mobility, and for many the situation is getting worse. There is a widening mobility opportunity gap between urban and rural areas and between higher and lower income households within cities. Low-income areas are often poorly served by public transport, while motorization and sprawl mean that pedestrians, cyclists and public transport passengers face heightened pollution and accident risk, further distances to travel, higher fares and longer waits for buses. In Shanghai a two-way metro ticket would eat up nearly one-fifth of the daily income for low-paid workers, making it unaffordable for many. In Dar es Salaam three-quarters of the city's population lives in unplanned settlements, where lack of planning and investment means that roads are either non-existent or are flooded in wet weather.

**Mobility developments can make the situation worse for the poor, the non-motorized and the vulnerable.** The needs of pedestrians, cyclists, and vulnerable citizens including women, children and the disabled are rarely reflected by planners' priorities. Transport service improvements often mean that the poor are priced out, not only by fare increases but also by rent increases in areas with better transport links.

## Towards solutions

**The integration of different transport modes** is crucial to ensure access to mobility opportunities for a wider population. Public transport systems (bus, metro etc.) should be coordinated in terms of tariff structures, inter-connectivity and scheduling. Intelligent transportation systems can help integrate paratransit providers into the public transport services network. Policies to make transport affordable for low-income populations or special groups need to take into consideration and try to avoid unintended consequences (such as passengers with subsidized tickets not being accepted by paratransit service providers as in the case of Dar es Salaam).

**Public-private partnerships**, if well planned and executed, can help governments attract private sector investment for projects that would otherwise not be possible. They can shift construction and maintenance risk to the private sector and enable cost savings and service improvement, freeing up the public sector to focus on outcomes.

There are no easy answers. As the experience of the four cities highlights, it is much easier to assess the problem than it is to implement effective solutions. Nevertheless, the transition towards sustainable mobility must be made, and can be most effectively pursued through smart and timely decisions and action by all stakeholders, including contributions by international business.

Ultimately, the case for sustainable mobility is part of the broader case for markets, opportunities and the benefits of urbanization and economic integration to be extended throughout the world. Unless the populations of the world's fast growing developing regions can be brought into the global market, at least half of the world's future population could still be living in poverty in 2050. This level of inequity represents an enormous risk to global stability, and a lost opportunity for business to create new markets.

# Key messages to stakeholders

**The problems of unsustainable mobility are becoming critical obstacles to development.** Decisions made now about urban development will affect how easily problems can be dealt with for a long time in the future. We believe there is an opportunity to leapfrog the unsustainable patterns of mobility that have been developed by many cities worldwide.

**Sustainable mobility needs comprehensive, integrated planning.** Sustainable mobility cannot be achieved through concentration on one transport mode alone, but by a combination of transport modes that enhance and safeguard quality of life and ensure that people and goods are able to move around efficiently. Cities need to prioritize sustainable development goals and citizens' quality of life in planning mobility solutions, rather than responding to the needs of only one group or the lure of a "silver bullet" transport solution.

Transit-oriented design, transport demand management, integration of paratransit modes and provision for safe and comfortable non-motorized travel including footpaths, sidewalks, crossings and bike tracks are key elements that will need to be considered, alongside effective raising of finance for major infrastructure development and long-term maintenance. Intelligent transportation systems can contribute to reducing congestion and to enabling the integration of paratransit service providers into the public transport system.

**Stakeholder collaboration is indispensable to achieving sustainable mobility.** Finding sustainable solutions requires that all stakeholders approach the challenge with commitment, passion and intelligence, and with the foresight and open minds necessary to learn from and work with others. All stakeholders, including the non-motorized, vulnerable road users, women, the aged and children, need to be considered in mobility planning. This requires education and capacity building as well as opportunities for citizens to express their opinions in the planning process and through their everyday mobility choices.

**We can learn from history and from each other.** Although there are no universal solutions for sustainable mobility, there are common issues shared between the cities studied and with others around the world. While the path to resolving challenges is particular to each city, depending on their stage of development and degree of prosperity, cities can nevertheless benefit from the experiences – both good and bad – of other cities, and apply what they have learned to their local situation.*

## Messages for business

**The role of business is to provide innovative products and services** that create value for an expanding number of customers. Developing technologies and transport systems that provide efficient, safe and clean transport infrastructure and services goes a long way towards fulfilling human development needs in more sustainable ways. Long-term business viability depends on the ability to respond to changes in the way people use mobility and to balance this with limits in terms of space and other resources.

**Business can reduce the mobility-related impacts of its own operations**, taking site and sourcing decisions and investments in logistics and employee transportation into consideration. Business investment in sustainable mobility can reduce transportation costs, improve the efficiency of supply and distribution chains and reduce lost time and security issues affecting the work force as a result of transport-related problems.

**Business has to engage with other stakeholders from the earliest stage of mass-motorization** to promote collaboration towards common sustainable development goals. In particular, business should urge and support government actions towards an integrated and inclusive approach to urban land-use and transport planning and educate, empower and provide incentives to citizens to take up safe, more efficient and less environmentally damaging mobility opportunities. Business can share good practices and learning and provide input to government on the relevant technical aspects of transportation, emissions control and safety policies.

* Appendix 1 lists a number of examples of mobility solutions from cities around the world and provides links to further information to facilitate learning from experience. It can also be accessed directly on www.wbcsd.org/web/m4dev.htm

## Messages for governments

**Take an integrated and inclusive approach to urban land-use and transport planning.** In setting policy for transport systems, urban planning, regulation and financing, national, regional and local governments should prioritize sustainable economic growth and quality of life improvements. Urban regions should consider setting up a single, accountable agency to coordinate action on mobility, to facilitate inter-modal integration and to monitor and share comprehensive data on the mobility situation.

**Learn from other cities.** Recognize the need for new thinking on urban planning and mobility to avoid developing cities that use ever more resources, including land, materials, energy, time and money, to sustain. Get involved in regional and global learning networks, such as the C40 Cities Climate Leadership Group, the Plus Network on sustainable cities and others.

**Ensure mechanisms for stakeholder education and collaboration.** Work with local and international business, civil society organizations and community groups, environment, development and mobility experts to develop mobility plans and strategies. Educate citizens on mobility issues and skills, in particular prioritizing key groups including children, new drivers, city migrants and paratransit service providers.

**Align incentives with goals for sustainability.** Establishing long-term institutional frameworks is crucial to enabling business investment. Public-private partnerships offer a key tool to facilitate infrastructure delivery. By making good use of proven delivery models, as well as learning from cases of failure, public-private partnerships can align private incentives with public goals. Care must be taken in awarding contracts and concessions for public services to ensure that the terms are sustainable, fair and efficient and that social goals and commercial concerns can be reconciled. Financing needs to consider ongoing maintenance and capital expenditure, and care needs to be taken to ensure that the poor are not overlooked.

**Provide incentives to individuals to make safer, more efficient and less environmentally damaging transport and travel choices**, for example through education and traffic regulation and enforcement and the use of intelligent transport systems, fuel taxes, tolls, congestion charging, park and ride facilities and parking regulations, and through the provision of safe, comfortable, attractive and competitive public transport services.

**Build effective capacity to implement national and regional policies, regulations and urban plans.** It is critical that plans be supported by the capacity to promote, implement, enforce and finance them. Stakeholders such as development agencies, research institutions and civil society organizations have key roles to play in this respect, providing expertise, information and capacity building for citizens and their public institutions.

## Messages for citizens

**Each citizen has a role to play in sustainable mobility.** Individual choices are critical. Citizens must be able to make sound decisions, both in their daily mobility choices and in informing political and business decision-makers, that reflect the broader impacts of mobility on their health, on their environment and on the development of their city and nation. Education and empowerment of citizens are required to allow people to adapt to new opportunities and risks and to become safer and more eco-efficient transport users.

*Sustainable mobility will require changes in people and goods transport systems and how society uses them. We believe that sustainable mobility can be achieved in ways that expand opportunities and freedom of choice for citizens of the developing world, and that improve quality of life and safeguard the environment.*

# Appendix 1: Learning from other cities

The report concludes that, although there are no universal solutions for sustainable mobility, there are common issues shared between the cities studied and with others around the world. Each of the conclusions and key messages that we have taken away from our study of these four cities is also reinforced by the experience of other cities.

This appendix therefore highlights some examples and experiences that relate to our key messages and that we hope will provide useful learning and models for others facing similar challenges. These are just a few examples out of many, and while we recognize that several of the projects highlighted are relatively high cost and may be beyond the financial reach of some developing nations, we believe that sharing learning can help to support all nations' and cities' progress and effective action towards sustainable mobility.

## Comprehensive integrated planning

**Message: Sustainable mobility depends on comprehensive integrated planning of mobility systems**.

The Brazilian city of **Curitiba** has been pioneering integrated urban planning since the 1960s in order to accommodate rapid growth while reducing congestion, preserving the local environment and providing easily accessible and affordable public transit. The city's master plan enables coordination between land usage strategy and development of road networks and public transportation systems. One of the good examples is the well-coordinated bus system linked with the city's land-use master plan.[132]
More information: www.embarq.org/en/city/curitiba-brazil

**Greater Nottingham**, in the UK, is determined to develop a more prosperous, cleaner, safer city through a land-use and transportation strategy that focuses on improving access to jobs and services, improving public transport, tackling congestion, reducing air pollution and improving road safety while contributing to local regeneration and quality of life. Greater Nottingham traffic growth has been contained to less than 1% over the last 5 years (compared to 4% on average for urban roads in Great Britain), while public transport has increased by 8% – the highest rate of any of the UK's major cities. The city authorities work with employers and schools to develop travel plans and are now developing a workplace parking levy scheme both to raise money to support public transport investment and to reduce congestion by daily commuters.
More information: www.nottinghamcity.gov.uk/transport_and_streets/transport_planning[133]

During the 1960s the City of **Freiburg** in Germany recognized that rapid motorization was leading to congestion, environmental problems and weakening economic growth. It therefore developed a "global transport concept" for socially, environmentally and economically sustainable urban transport, including establishing bicycle lanes, banning traffic from the city center, introducing Germany's first transferable flat-rate travel card, and building a city and suburban railway, calming traffic through the design of public spaces and speed limits, concentrating traffic and improving roads, controlling parking and promoting public transport.
More information: www.unep.org/OurPlanet/imgversn/121/bohme.html, www.freiburg.de/servlet/PB/menu/1199159/index.html (in German)

**Message: Balance development of public and private transportation services**

China's first BRT system was established in **Xiamen** in 2008. It differs from "traditional" BRT systems in that it crosses the downtown area on an elevated roadway. It offers punctual, air-conditioned, and relatively low-cost travel on its three lines and the system has proved popular with the citizens in the city.
More Information: www.sutp.org/ , www.chinabrt.org/en/cities/xiamen.aspx

Notorious for having some of the worst traffic congestion in the world in its capital, **Bangkok**, the Thai government developed the light rail "Skytrain" in 1999. As the train cars are air-conditioned and punctual, and the stations connect directly to movie theaters, department stores and commercial centers, it is favorably accepted as a convenient system by citizens. On the other hand, there have been concerns that the Skytrain mainly links some high-income areas and inner city commercial districts, and does not provide services for residential populations in the large settlements. Ticket prices marginalize many and traffic congestion remains a problem in the city.
More information: www.geo.umu.se/VG_uppsatser/BengtssonM.pdf

The **Cairo** metro in Egypt is Africa's only fully fledged metro system. It runs on two lines of nearly 63 km and carries more than 2 million passengers per day, around a quarter of public transport trips in the city. The construction of the metro line has not increased the rate of public transport use,

but has allowed the transport system to cope with the city's population growth. Metro fares are around double those of buses, but remain relatively affordable compared to average incomes, and are subsidized for students and public sector workers. The service allow users to make a significant time savings and is popular.[134]
More information: www.thredbo.itls.usyd.edu.au/downloads/thredbo6_papers/thredbo6-theme3-Bahgat-El-Tony-El-Mahdi-Boshra-Abbas-Fattah-Al-Keelany-White.pdf

Home to some 18 million people – and 6 million cars – **Mexico City** is one of the largest and most congested cities in the world. Public transport has been provided by uncomfortable, unsafe and slow paratransit microbuses, encouraging people to travel by private car as soon as they could afford to. City officials realized that the key to solving the twin problems of congestion and air pollution was improving public transport and making it a viable alternative to growing car use. Working with CTS-México – a Mexican non-governmental organization staffed with transport engineers, urban planners and policy experts, they developed the Metrobus, a 20 km BRT line with 36 stations running along the center of one of the city's busiest avenues. The Metrobus replaced 350 microbuses with 98 low-pollution BRT buses and cut travel time in half. Paratransit operators have been incorporated into the scheme with former microbus owners organized into a privately-owned company that share the cost of the new articulated buses, and now contributes to operating the service. Mexico City's mayor now wants to see nine more such corridors installed before the end of his term.
More information: www.embarq.org/en/project/mexico-city-metrobus, www.worldchanging.com/archives//007510.html

**Message: Use information technology to reduce congestion and integrate paratransit providers (intelligent transport systems)**
A project is going on in **Japan** to improve road traffic safety and urban transportation and establish efficient distribution systems, by developing and promoting the use of information and communication technology and intelligent transportation systems to connect people, road infrastructures and vehicles as a united system.[135]
More information: www.cao.go.jp/innovation/en/pdf/innovation25_interim_full.pdf

The City of **Gothenburg** in Sweden sought to increase the opportunities for mobility of citizens in rural and urban areas through the provision of integrated demand responsive transport services and to find new ways for disabled and elderly people and others with barriers to travel, to gain access to transport. Their solution was FlexRoute a demand-responsive bus service with flexible services routes, which is coordinated by automated telephone booking.
More Information: www.rec.org/REC/Programs/Telematics/CAPE/goodpractice/trnsprt/doc/GOTHENBURG.doc

Public light buses are a popular form of paratransit in **Hong Kong**. Most of the vehicles are individually owned and operate through a combination of commercial flexibility and government regulation. These light buses supplement railway and public bus services acting as feeders, serving areas where patronage is not high enough for provision of services by mass carriers and providing extra capacity. Fleet sizes are controlled by licensing with buses licensed as either green (scheduled) or red (unscheduled) buses, and required to meet basic environmental and safety standards. In recent years the majority of buses have converted to LPG.[136]

Micro- and mini-buses provide paratransit services in **Jakarta**, Indonesia. They have been integrated with other vehicles by limiting low-speed and capacity vehicles to narrow roads in marginal areas of the city, and by regulating vehicle conditions, fares and time schedules.[137]

**Message: Apply transportation demand management and ensure efficient inter-modal transfers**
Stuttgart 21 is a project to reconstruct **Stuttgart** central rail station in Germany underground in order to transform its platforms into "through platforms" from "bay platforms". The plan includes surface and underground lines connecting the station in Stuttgart's enclosed central valley with existing railway and underground lines and also incorporates redevelopment of the central part of the city (on 100 ha of land that will be freed up). The city hopes that by enlarging the city center it will be able to reduce the pressure of urbanization and the consumption of land on the outskirts of the town.
More information: www.cfit.gov.uk/docs/2001/ebp/ebp/stage2/index.htm , aspdin.wifa.uni-leipzig.de/institut/lacer/lacer02/l02_39.pdf

**Barcelona**, Spain has sought to enable easier inter-modal transfers through the development of park-and-ride facilities and by integrating ticketing including all modes of public transport and parking, covering the whole of the metropolitan area. At the same time the city has regulated on-street parking and expanded pedestrian priority roads

in the city center in order to encourage a modal shift from traveling by car to using public transportation or walking.
More information: www.cfit.gov.uk/docs/2001/ebp/ebp/stage2/index.htm

## Governance and effective institutions

**Message: Stakeholder collaboration is absolutely indispensable in striving to achieve sustainability mobility**

In the **Philippines**, the role of **non-government organizations** has been significant in the advocacy of various issues including the promotion of clean-air and air-quality awareness. The Partnership for Clean Air is a multi-sectoral coalition composed of civil society organizations, government agencies, academic institutions and other private organizations with the purpose of increasing public awareness. Examples of such activities include reporting polluting vehicles and providing economical driver training for bus companies.[138]
More information: www.cleanairnet.org/caiasia/1412/propertyvalue-26873.html

In **Thailand** the **government, industry and academia** are working together to develop and implement leading-edge technologies. They plan to evaluate and support the commercialization of intelligent transport systems in Thailand, such as traffic signal controls and the collection of traffic information from GPS-equipped vehicles, while ensuring a balance between supply and demand that addresses regional needs. Thailand's ultimate goal is to build a transportation environment in which everyone can enjoy the benefits of freedom of mobility.
More information: its.in.th, wiki.nectec.or.th/its

In **Buenos Aires** a history of non-coordination between different modes of public transit meant that the city found it politically impossible to pass a law to form a metropolitan transportation planning organization. Recognizing the seriousness of the problem, the city successfully procured a loan from the International Monetary Fund to build cooperative relationships between transportation stakeholders through small "bottom-up" projects.[139]

The Toyota Technical Education Program (T-TEP) is a **collaboration between the company and local educational institutions** to support education for vehicles after-sales services worldwide in order to foster human resource development. T-TEP's curriculum covers the same basic skills and know-how acquired by maintenance and repair personnel at Toyota and Lexus dealers. Toyota Motor Italy (TMI) helped establish T-TEP curricula at 16 professional and technical schools as of March 2006. T-TEP schools target local automotive companies, and some graduates find work at Italy's Toyota and Lexus dealers. Furthermore, the presence of well-equipped T-TEP schools throughout the country allows TMI to bring its training to its dealers in each region. When a new Toyota or Lexus model appears, TMI conducts special training sessions to familiarize dealers' personnel. Mutual collaboration creates valuable opportunities for each. Toyota companies contribute to automotive vocational training in countries around the world for the purpose of the T-TEP program to help fortify technical education.
More information: www.toyota.co.jp/en/social_contribution/neighbors/neighbors_vol_3e.pdf (English), www.toyota.co.jp/jp/social_contribution/neighbors/neighbors_vol_3j.pdf (Japanese)

In **England** a system of **local transport plans (LTPs)** has been introduced in which the central government provides guidance and budgetary support to local authorities with regards to the national targets and priorities for sustainable transport, while giving the discretion to them to implement according to the local situation. LTPs use an output-oriented approach, for example reviewing the amount of subsidies when the plan does not match the targeted results. Local transport authorities prepare five-year plans that they present to the central government. These plans outline the current baseline with regard to transport, accessibility and pollution, set challenging but achievable objectives and a program for achieving these objectives, and solicit necessary funding from the treasury. The aim of the process is to ensure that transport planning is evidence-based and aligned with national goals for economic development, social inclusion, and environmental and health considerations
More information: www.dft.gov.uk/pgr/regional/ltp/guidance/fltp

It is **governments' responsibility to set appropriate fuel, environmental and safety standards**, while **consumers are responsible for maintaining vehicles** in accordance with these new standards and maintenance guidelines. Air quality in **Dalian**, China has improved through the adoption of measures such as prohibition of lead petrol enforced through roadside inspections, and an inspection and maintenance system to get rid of vehicles that are past their lifespan, with a certificate system for enforcement: a "green mark" is given to vehicles that pass inspections.[140]
More information: www.ejtir.tbm.tudelft.nl/issues/2004_01/pdf/2004_01_02.pdf

**Message: We can learn from history and from each other**

**Tokadai City**, a bedroom suburb near Nagoya, Japan, developed a new transportation system. However, the new transportation system was discontinued after 15 years because of a lack of connections to other lines bound for Nagoya city center[141] as well as an overestimated forecast by city planners of 54,000 resident citizens by the end of the century, when actually the population reached less than half that total. As a result, the line recovered only about a third of its operating costs.[142]

More information: www.city.komaki.aichi.jp/contents/01021210.html (Japanese only), www.apta.com/services/intnatl/intfocus/asiastudy.cfm

# Appendix 2: Resources

## Mobility and development

www.worldbank.org/transport – The **World Bank Portal on Transport** provides access to World Bank research on all aspects of transport for development.

www.itdp.org – The **Institute for Transportation and Development Policy**, a US-based NGO, promotes environmentally sustainable and equitable transportation policies and projects worldwide. Website includes details of learning from ITDP's programs in Asia, Africa and Latin America and an information center including documents and whitepapers, its Sustainable Transport magazine and other resources for sustainable transport.

www.gtkp.com – The **Global Transport Knowledge Partnership** sponsored by the UK government agency DFID, involves global organizations, local policy-makers, experts and interested users in working to make effective use of international transport knowledge. The gTKP offers free access to sector experts and best practice knowledge on seven themes in road transport, including environment and climate change, finance, governance, road safety, rural transport, social development and urban transportation.

www.internationaltransportforum.org – The **International Transport Forum**, hosted by the OECD is a global platform and meeting place at the highest level for transport, logistics and mobility. Its founding member countries include all the OECD members, as well as many countries in Central and Eastern Europe. In addition, China, India and Brazil are being invited to participate in the Forum.

## Sustainable urban transport

www.sutp.org – The **GTZ Sustainable Urban Transport Project** is a partnership between the German Technical Cooperation (GTZ), the Bangkok Metropolitan Administration (BMA), CITYNET and the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), which aims to help developing world cities achieve their sustainable transport goals, through the dissemination of information about international experience and targeted work with particular cities. The website includes the Sourcebook on Sustainable Urban Transport which covers key areas of a sustainable transport policy

www.embarq.org, www.thecityfix.com – **Embarq** is a not-for-profit program of the World Resources Institute. EMBARQ works with cities in the developing world to catalyze and help implement sustainable solutions to the problems of urban mobility. Website includes news and learning from EMBARQ's Centers for Sustainable Transport in Mexico, Brazil, India, Turkey and the Andes, as well as the Sustainable Mobility magazine and City Fix blog.

www.cities-for-mobility.net – **Cities for Mobility** is a global network of cities on questions of urban mobility.

www.iea.org – In 2002-2004 the **IEA** collaborated with the WBCSD on the Sustainable Mobility Project (SMP) which resulted in the *Mobility 2030* report of the WBCSD published in 2004. A foundation for the analysis in this project was the SMP model, developed at the IEA. After the completion of the project, several of the companies involved (BP, Honda, Nissan, Shell, StatoilHydro and Toyota) continued working with the IEA and in 2004 started the **Mobility Modelling** (MoMo) effort, allowing the Agency to further develop the SMP model into what is now called the "MoMo model". This has contributed to ongoing improvements in the IEA's ability to characterize and project transport sector activity, efficiency and energy use around the world. The project is expected to continue, with ongoing efforts to improve data and modeling capability, particularly with respect to developing countries.

## Sustainable cities

sustainablecities.net/plusnetwork – **Sustainable Cities – Plus Network** is a peer learning network involving over 30 cities, regions and associations dedicated to considering the long-term impacts of current decisions. The goal is to use integrated long-term planning to guide immediate actions so as to move cities and communities on the path to sustainability.

www.c40cities.org – **The C40 Large Cities Climate Leadership Group** is a group of cities that have pledged to reduce carbon emissions and increase energy efficiency in large cities across the world. Their website shares best practices across a number of issues, including transportation.

www.iclei.org – **ICLEI – Local Governments for Sustainability** is an international association of local governments as well as national and regional local government organizations that have made a commitment to sustainable development. ICLEI provides technical consulting, training and information services to build capacity, share knowledge and support local government in the implementation of sustainable development at the local level.

www.citynet-ap.org – **CITYNET** is a Network of Local Authorities that Promotes Sustainable Urban Improvement Initiatives in the Asia-Pacific.

www.sustainablecitiesnet.com – **Sustainable Cities** is a network and communication system to deliver information, to connect people and projects, to accelerate the transformation of cities across the world.

## Specific issues

www.cleanairnet.org – The **Clean Air Initiative** advances innovative ways to improve air quality in cities by sharing knowledge and experiences through partnerships in selected regions of the world. It brings together expertise in urban development, transport, energy reform, environmental management and environmental health.

www.grsproadsafety.org – The **Global Road Safety Partnership** brings together governments and governmental agencies, the private sector and civil society organizations to address road safety issues in low and middle-income countries. The GRSP provides advice on good practice and facilitates projects in a growing number of countries.

www.vtpi.org/tdm – The Victoria Transport Policy Institute's **Transportation Demand Management Encyclopedia** aims to provide a comprehensive source of information about innovative management solutions to transportation problems.

www.ecomobility.org – **The Global Alliance for Ecomobility** focuses on all aspects of non-motorized transport.

info.worldbank.org/etools/PPPI-Portal – The World Bank Institute's **Global Public-private Partnership in Infrastructure Web Portal** provides a resource library of publications, reports, and papers related to public-private partnerships in infrastructure.

www.ppiaf.org – The **Public-private Infrastructure Advisory Facility** helps developing countries improve their infrastructure by offering technical assistance and identifying disseminating and sharing best practices around public-private partnerships in infrastructure in developing countries.

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## About the WBCSD

The World Business Council for Sustainable Development (WBCSD) brings together some 200 international companies in a shared commitment to sustainable development through economic growth, ecological balance and social progress. Our members are drawn from more than 37 countries and 22 major industrial sectors. We also benefit from a global network of 58 national and regional business councils and partner organizations.

Our **mission** is to provide business leadership as a catalyst for change toward sustainable development, and to support the business license to operate, innovate and grow in a world increasingly shaped by sustainable development issues.

Our **objectives** include:

- *Business Leadership* – to be a leading business advocate on sustainable development;
- *Policy Development* – to help develop policies that create framework conditions for the business contribution to sustainable development;
- *The Business Case* – to develop and promote the business case for sustainable development;
- *Best Practice* – to demonstrate the business contribution to sustainable development and share best practices among members;
- *Global Outreach* – to contribute to a sustainable future for developing nations and nations in transition.

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Through its Development Focus Area, the WBCSD is seeking to:

- Help companies develop their understanding of how global development issues affect them, generate learning and document good practice case studies of how companies tackle specific development challenges
- Work with companies, Regional Network partners and other development partners to broker inclusive business solutions that are good for business and good for development and provide companies with guides and tools that help them align their business ventures with the needs of society
- Advocate for framework conditions that create an enabling investment environment for business to increase its contribution to sustainable development, through working with policy-makers and other stakeholders

### Development Focus Area Core Team

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### Disclaimer

This report is released in the name of the WBCSD. Like other WBCSD reports, it is the result of a collaborative effort by members of the secretariat and executives from several member companies. A wide range of members reviewed drafts, thereby ensuring that the document broadly represents the majority view of the WBCSD membership. It does not mean, however, that every member company agrees with every word.

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