PLANNING AND DESIGN FOR SUSTAINABLE URBAN MOBILITY

GLOBAL REPORT ON HUMAN SETTLEMENTS 2013

UN HABITAT
FOR A BETTER URBAN FUTURE

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FOREWORD

For more than half a century, most countries have experienced rapid urban growth and increased use of motor vehicles. This has led to urban sprawl and even higher demand for motorized travel with a range of environmental, social and economic consequences.

Urban transport is a significant source of greenhouse gas emissions and a cause of ill-health due to air and noise pollution. The traffic congestion created by unsustainable transportation systems is responsible for significant economic and productivity costs for commuters and goods transporters.

These challenges are most pronounced in developing country cities. It is here that approximately 90 per cent of global population growth will occur in the coming decades. These cities are already struggling to meet increasing demand for investment in transportation. That is why my Five-year Action Agenda, launched in January 2012, highlights urban transport – with a focus on pollution and congestion – as a core area for advancing sustainable development.

This year's edition of the UN-Habitat *Global Report on Human Settlements* provides guidance on developing sustainable urban transportation systems. The report outlines trends and conditions and reviews a range of responses to urban transport challenges worldwide. The report also analyses the relationship between urban form and mobility, and calls for a future with more compact and efficient cities. It highlights the role of urban planning in developing sustainable cities where non-motorized travel and public transport are the preferred modes of transport.

I commend this report to all involved in developing sustainable cities and urban transport systems. Success in this area is essential for creating more equitable, healthy and productive urban living environments that benefit both people and the planet.

Ban Ki-moon
Secretary-General
United Nations

INTRODUCTION

Urban transport systems worldwide are faced by a multitude of challenges. In most cities, the economic dimensions of such challenges tend to receive most attention. The traffic gridlocks experienced on city roads and highways have been the basis for the development of most urban transportation strategies and policies. The solution prescribed in most of these has been to build more infrastructures for cars, with a limited number of cities improving public transport systems in a sustainable manner.

However, the transportation sector is also responsible for a number of other challenges that do not necessarily get solved by the construction of new infrastructure. It is, for example, responsible for a large proportion of the greenhouse gas emissions that lead to climate change. Furthermore, road traffic accidents are among the main causes of premature deaths in most countries and cities. Likewise, the health effects of noise and air pollution caused by motorized vehicles are a major cause for concern. In some cities, the physical separation of residential areas from places of employment, markets, schools and health services force many urban residents to spend increasing amounts of time, and as much as a third (and sometimes even more) of their income, on public transport.

While those among the urban populace that have access to a private car, or can afford to make regular use of public transport, see traffic jams and congestion as a major concern; this is a marginal issue for people living in 'transport poverty'. Their only affordable option for urban transportation is their own feet. Persons with low household incomes – but also others, including many women, and vulnerable groups such as the young, the elderly, the disabled, and ethnic and other minorities – form the bulk of those characterized as living in transport poverty.

Thus, when the Secretary-General of the United Nations launched his '5-year action agenda' in January 2012, he identified sustainable transportation as one of the major building blocks of sustainable development. In particular, he stressed the need for urgent action to develop more sustainable urban 'transport systems that can address rising congestion and pollution'. He noted that action was required by a range of actors, including 'aviation, marine, ferry, rail, road and urban public transport providers, along with Governments and investors'.

Planning and Design for Sustainable Urban Mobility: Global Report on Human Settlements 2013 seeks to highlight the transportation challenges experienced in cities all over the world, and identifies examples of good practice from specific cities of how to address such challenges. The report also provides recommendations on how national, provincial and local governments and other stakeholders can develop more sustainable urban futures through improved planning and design of urban transport systems.

The report argues that the development of sustainable urban transport systems requires a conceptual leap. The purpose of 'transportation' and 'mobility' is to gain access to destinations, activities, services and goods. Thus, ***access*** is the ultimate objective of all transportation (save a small portion of recreational mobility). The construction of more roads for low-income cities and countries is paramount to create the conditions to design effective transport solutions. However, urban planning and design for these cities and others in the medium and high income brackets is crucial to reduce distances and increase accessibility to enhancing sustainable urban transport solutions. If city residents can achieve access without having to travel at all (for instance through telecommuting), through more efficient travel (online shopping or car-sharing), or by travelling shorter distances, this will contribute to reducing some of the challenges currently posed by urban transport. Thus, urban planning and design should focus on how to bring people and places together, by creating cities that focus on accessibility, rather than simply increasing the length of urban transport infrastructure or increasing the movement of people or goods.

The issue of urban form and functionality of the city is therefore a major focus of this report. Not only should urban planning focus on increased population densities; cities should also encourage the development of mixed-use areas. This implies a shift away from strict zoning regulations that have led to a physical separation of activities and functions, and thus an increased need for travel. Instead, cities should be built around the concept of 'streets', which can serve as the focus for building liveable communities. Cities should therefore encourage mixed land-use, both in terms of functions (i.e. residential, commercial, manufacturing, service functions and recreational) and in terms of social composition (i.e. with neighbourhoods containing a mixture of different income and social groups).

Such developments also have the potential to make better use of existing transport infrastructure. Most of today's cities have been built as 'zoned' cities, which tends to make rather inefficient use of their infrastructure; as 'everyone' is travelling in the same direction at the same time. In such cities, each morning is characterized by (often severe) traffic jams on roads and congestion on public transport services leading from residential areas to places of work. At the same time, however, the roads, buses and trains going in the opposite direction are empty. In the afternoon the situation is the opposite. Thus, the infrastructure in such cities is operating at half capacity only, despite congestion. In contrast, in cities characterized by 'mixed land-use' (such as Stockholm, Sweden), traffic flows are multidirectional – thus making more efficient use of the infrastructure – as residential areas and places of work are more evenly distributed across the urban landscape.

Furthermore, the report argues with strong empirical information that increased sustainability of urban passenger transport systems can be achieved through modal shifts – by increasing the modal share of public transport and non-motorized transport modes (walking and bicycling), and by reducing private motorized transport. Again, an enhanced focus on urban planning and design is required, to ensure that cities are built to encourage environmentally sustainable transportation modes. While encouraging a shift to non-motorized transport modes, however, the report acknowledges that such modes are best suited for local travel and that motorized transport (in particular public transport) has an important role while travelling longer distances. However, in many (if not most) countries there is a considerable stigma against public transport. The private car is often seen as the most desirable travel option. There is thus a need to enhance the ***acceptability*** of public transport systems. More needs to be done to increase reliability and efficiency of public transport services and to make these services more secure and safe.

The report also notes that most trips involve a combination of several modes of transport. Thus, modal integration is stressed as a major component of any urban mobility strategy. For example, the construction of a high-capacity public transport system needs to be integrated with other forms of public transport, as well as with other modes. Such integration with various 'feeder services' is crucial to ensure that metros, light rail and bus rapid transit (BRT) systems can fully utilize their potential as a 'high-capacity' public transport modes. It is therefore essential that planners take into account how users (or goods) travel the 'last (or first) mile' of any trip. By way of an example, it is not much use to live 'within walking distance' of a metro (or BRT) station, if this implies crossing a busy eight-lane highway without a pedestrian crossing, or if one is unable to walk to the station (due to disability, or lack of personal security). Likewise, it is unlikely that urban residents will make use of metros (and BRTs), if the nearest station is located beyond walking distance, and there is no public transport 'feeder' services providing access to these stations or no secure parking options for private vehicles near the stations.

Yet, it is important to note that considerable investments are still required in urban transportation infrastructure in most cities, and particularly in developing countries. City authorities should ensure that such investments are made where they are most needed. They should also make sure that they are commensurate with their financial, institutional and technical capacities. In many cities of developing countries, large proportions of the population cannot afford to pay the fare required to use public transport, or to buy a bicycle. Others may find these modes of transport affordable, but choose not to use them as they find the safety and security of public transport to be inadequate (due to sexual harassment or other forms of criminal behaviour), and/or the roads to be unsafe for bicycle use or walking (due to lack of appropriate infrastructure). Investment in infrastructure for non-motorized transport or affordable (and acceptable) public transport systems is a more equitable (and sustainable) use of scarce funds.

However, many cities and metropolitan areas, all around the world, experience considerable institutional, regulatory and governance problems when trying to address urban mobility challenges. In many cases national, regional and local institutions may be missing or their responsibilities may be overlapping, and even in conflict with each other. To address such concerns, the report notes that it is essential that all stakeholders in urban transport – including all levels of government, transport providers and operators, the private sector, and civil society (including transport users) – are engaged in the governance and development of urban mobility systems.

To ensure effective integration of transportation and urban development policies, it is essential that urban transportation and land-use policies are fully integrated. Such integration is required at all geographic scales. At the micro level, much is to be gained from advancing the model of 'complete streets'; an acknowledgement that streets serve numerous purposes, not just moving cars and trucks. At the macro level, there is considerable scope for cross-subsidies between different parts of the urban mobility system, including through value-capture mechanisms which ensure that increased land and property values (generated by the development of high-capacity public transport systems) benefits the city at large, and the wider metropolitan region, rather than private sector actors alone.

Planning and Design for Sustainable Urban Mobility: Global Report on Human Settlements 2013 is released at a time when the challenges of urban transportation demands are greater than ever. This is particularly the case in developing countries where populations (and the number of motorized vehicles) are growing at rates where urban infrastructure investments are unable to keep pace. I believe this report will serve as a starting point to guide local authorities and other stakeholders to address the challenges faced by urban transportation systems all over the world. The report provides some thought-provoking insights on how to build the cities of the future in such a manner that the ultimate goal of urban transport – namely enhanced access to destinations, activities, services and goods – takes precedence over ever-increasing calls for increased urban mobility.

Dr Joan Clos
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1 The HS-Net Advisory Board consists of experienced researchers in the human settlements field, selected to represent the various geographical regions of the world. The primary role of the Advisory Board is to advise UN-Habitat on the substantive content and organization of the Global Report on Human Settlements.

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LIST OF ACRONYMS AND ABBREVIATIONS

£	Sterling pound
€	Euro
ADB	Asian Development Bank
BRT	bus rapid transit
CBD	central business district
CO_2	carbon dioxide
CNG	compressed natural gas
dB(A)	decibel
EU	European Union
GDP	gross domestic product
HIV/AIDS	human immunodeficiency virus infection/acquired immunodeficiency syndrome
km^2	square kilometre
MTA	Metropolitan Transportation Authority (New York, US)
MTRC	Mass Transit Railway Corporation (Hong Kong, China)
NGO	non-governmental organization
NIMBY	not-in-my-backyard
NMT	non-motorized transport
NO_x	Nitrogen oxides
OECD	Organisation for Economic Co-operation and Development
PPP	purchasing power parity
RMB	Chinese renminbi (yuan)
SAR	Special administrative region (of China; used about Hong Kong and Macao)
SUV	sports utility vehicle
TfL	Transport for London (UK)
TOD	transit-oriented development
UITP	International Association of Public Transport
UK	United Kingdom of Great Britain and Northern Ireland
UNDP	United Nations Development Programme
US	United States of America
US$	US dollar
VKT	vehicle-kilometres travelled
WHO	World Health Organization

CHAPTER

1

THE URBAN MOBILITY CHALLENGE

Hyper-mobility – the notion that more travel at faster speeds covering longer distances generates greater economic prosperity – seems to be a distinguishing feature of urban areas, where more than half of the world's population currently reside. By 2005, approximately 7.5 billion trips were made each day in cities worldwide.[1] In 2050, there may be three to four times as many passenger-kilometres travelled as in the year 2000, infrastructure and energy prices permitting.[2] Freight movement could also rise more than threefold during the same period.[3] Mobility flows have become a key dynamic of urbanization, with the associated infrastructure invariably constituting the backbone of urban form. Yet, despite the increasing level of urban mobility worldwide, access to places, activities and services has become increasingly difficult. Not only is it less convenient – in terms of time, cost and comfort – to access locations in cities, but the very process of moving around in cities generates a number of negative externalities. Accordingly, many of the world's cities face an unprecedented accessibility crisis, and are characterized by unsustainable mobility systems.

This report examines the state of urban mobility in different parts of the world. It explores the linkages between urban form and mobility systems, with a view to determining the essential conditions for promoting the sustainable movement of people and goods in urban settings. This introductory chapter reviews key issues and concerns of urban mobility and provides a framework for the content of the rest of the report. It outlines development trends impacting on urban mobility and then discusses urban mobility issues of the twenty-first century, including the challenges of fostering sustainable mobility.

Current urbanization patterns are causing unprecedented challenges to urban mobility systems, particularly in developing countries. While these areas accounted for less than 40 per cent of the global population growth in the early 1970s, this share has now increased to 86 per cent, and is projected to increase to more than 100 per cent within the next 15 years, as the world's rural population starts to contract. What is perhaps even more striking is the regional patterns of urban population growth. Figure 1.1 shows how an increasing share of this growth is projected to occur in Africa (19 per cent of total annual growth today, compared to 43 per cent in 2045), while the combined annual urban population increase in developed countries, China, Latin America and the Caribbean is projected to decrease from 46 per cent of the total today to 11 per cent in 2045. Thus, it is the world's poorest regions that will experience the greatest urban population increase. These are the regions that will face the greatest challenges in terms of coping with increasing demands for improved transport infrastructure. In fact, projections indicate that Africa will account for less than 5 per cent of the global investments in transport infrastructure during the next few decades (see Table 8.2).

Despite the increasing level of urban mobility worldwide, access to places, activities and services has become increasingly difficult

A major point of departure for this report is that sustainable mobility extends beyond technicalities of increasing speed and improving the effectiveness and efficiency of transport systems, to include demand-oriented measures (e.g. promoting walking and cycling, and reducing the need to travel), with the latter representing a pivotal factor in achieving relevant progress. It suggests that the prevailing challenges of urban mobility are consequences of the preoccupation with the means of mobility rather than its end – which is the ***realization of accessibility***.

This first chapter of the report starts with a discussion of the need to focus on access as the basis for urban mobility planning. It urges urban planners and decision-makers to move away from a 'transport bias' in urban mobility planning, towards a focus on the human right to equitable access to opportunities. This is followed by a brief analysis of global conditions and trends with respect to the urban movement of people and goods. The last part of the chapter provides a brief discussion of the social, environmental, economic and institutional dimensions of sustainability in urban mobility systems.

Sustainable mobility extends beyond technicalities of increasing speed and improving the effectiveness and efficiency of transport systems, to include demand-oriented measures

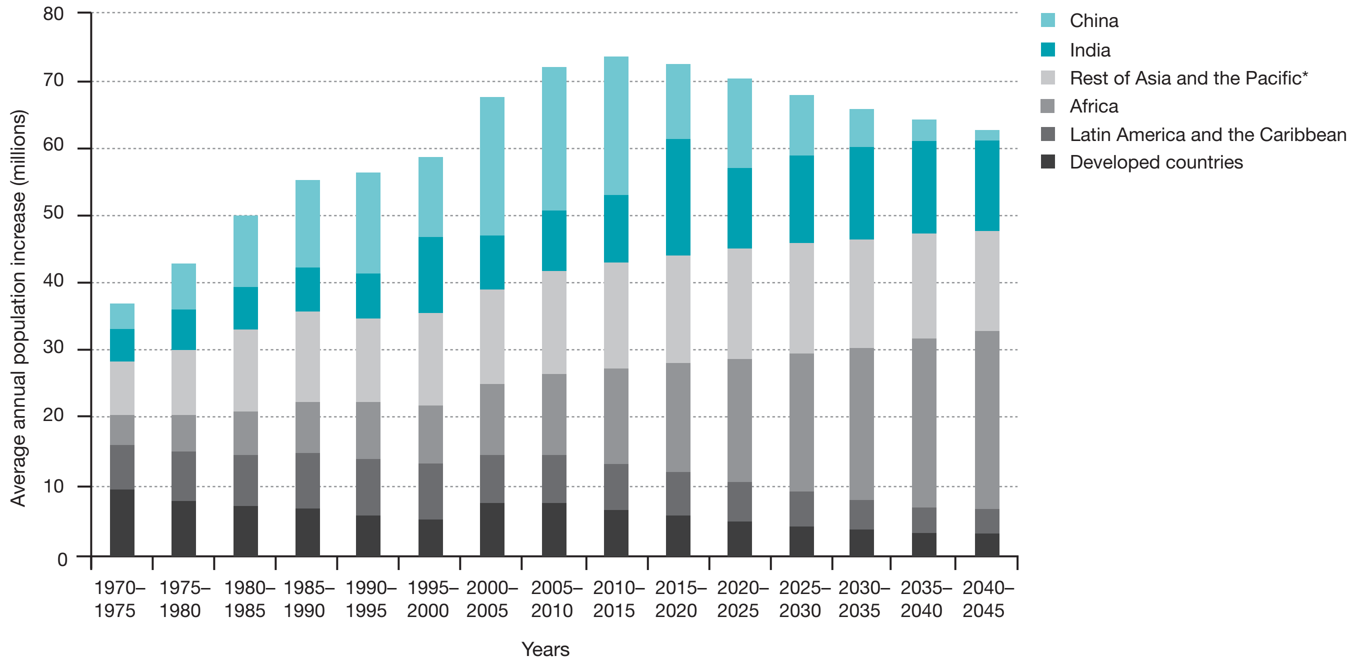


Figure 1.1

Average annual urban population increase, by region (1970–2045)

Note: *The 'rest of Asia and the Pacific' includes all countries in this region except: Australia, China, India, Israel, Japan and New Zealand.

Source: UN, 2012a.

ACCESSIBILITY IS AT THE CORE OF URBAN MOBILITY

In directing attention beyond transport and mobility, and giving prominence to the aspect of accessibility, this report calls for a paradigm shift in transport policy. This alternative approach emphasizes the need to reduce the global preoccupation on mobility enhancement and infrastructure expansion. 'This kind of transportation planning has been implicated in problems of environmental degradation and social isolation.' However, 'most fundamentally, a focus on mobility as a transportation-policy goal neglects the consensus view that the vast majority of trips are not taken for the sake of movement per se, but in order to reach destinations, or more broadly, to meet needs.'[4]

This report calls for a paradigm shift in transport policy

While the speed and efficiency of travel are important, more critical however, is the ease of reaching those destinations in terms of proximity, convenience as well as positive externalities. Transport and mobility as derived demands are treated as means for enabling people to access other people and places. Reducing the need for such demands and minimizing travel time also entails optimizing the value of being at the destination. 'Mobility is thus properly viewed as a means to the greater end of accessibility.' Nonetheless, it is not the only means to this end: 'accessibility can be enhanced through proximity', as well as 'electronic connectivity'.[5] As a result, enhancing accessibility places human and spatial dimensions at the core of sustainable mobility.

While the speed and efficiency of travel are important, more critical however, is the ease of reaching those destinations in terms of proximity, convenience as well as positive externalities

This focus on accessibility emphasizes the need for a holistic and integrated approach to sustainable urban mobility. It establishes a link between urban form (in terms of shape, structure, function as well as demographics) and urban transportation systems. Particular attention is given to the urban form's potential to support the increased proximity of places and functions, thus minimizing the need for extended movement. Land-use planning ensures the proximity and compactness of locations, and diversifies functions, so as to cater to a variety of needs.

The accessibility focus for sustainable mobility also entails paying due consideration to the built form of the city, particularly the optimization of urban density and the fostering of a sense of place. The combination of high-density settlements, strong sense of place and mixed-used functions not only minimize the need for extended movement, but also enhance economies of agglomeration and encourage non-motorized mobility. Furthermore, appropriate design and layout of streets and neighbourhoods, proper allowance for building configuration and density, and streamlined arrangement of arterial streets and roads, should also be taken into account. The backbone of accessibility-based urban mobility is public transport, particularly high-capacity public transport systems that are well integrated in a multi-nodal arrangement.

The bottom line for accessibility is not the hardware; rather it is the quality and efficiency of reaching destinations whose distances are reduced. Equally important is the affordability and inclusiveness in using the provided facilities. Sustainable mobility is thus determined by the degree to which the city as a whole is accessible to all its residents, including low-income earners, the elderly, the young, the disabled, as well as women with children. Furthermore, transport interventions should be explicitly targeted to prevent negative outcomes. By permitting high levels of innovative services and giving priority to public and non-motorized transport, the need for private cars is reduced. Strategies to change public attitudes and encourage sustainable forms of mobility thus have a key role to play.

This alternative approach also brings to the fore the human rights dimension of sustainable mobility: 'the right to mobility is universal to all human beings, and is essential for the effective practical realisation of most other basic human rights'.[6] Beyond the policy implications of such a profound acknowledgement, the observation also has an important bearing on this report. Recognizing mobility as an entitlement – i.e. to access destinations, functions or services – implies a focus on people, and underscores the need to pay attention to the obstacles that prevent them from reaching destinations. Consequently, mobility is not only a matter of developing transport infrastructure and services, but also of overcoming the social, economic, political and physical constraints to movement. These constraints are influenced by factors such as: class, gender relations, poverty, physical disabilities, affordability, etc. Mobility is thus about granting access to opportunities and empowering people to fully exercise their human rights.

Thus, associating sustainable mobility with human rights takes it beyond the realm of functionality and economic justification. Instead it places the issue at the same level as other essential elements required for the full realization of human rights. Indeed, there is a general consensus that all the political, social, cultural and economic rights cannot be realized without the component of accessibility (and thus equitable mobility). The underlying premise – within a human rights perspective – is that mobility is not simply about reaching destinations; in the final analysis, it is about accessing opportunities. In this regard – and acknowledging that access is a tacit right that all human beings are entitled to – there is a need to ensure that any constraints to enjoying this fundamental entitlement are removed.

This report illustrates the contextual circumstances of urban mobility challenges, which have restricted access to cities by various social groups. Working towards sustainable mobility, renewed efforts within and between governments, are essential in ensuring that solutions are inclusive, participatory, and that all budgetary and resource implications meet the needs of all citizens.

THE TRANSPORT BIAS OF MOBILITY

In many cities of the world, the equation of 'mobility' with 'transportation' has fostered a tendency towards increasing motorization, and a propensity to expand the network of urban roads. Highway structures, including viaducts and flyovers, tunnels and foot-bridges have become standard features of the modern city and urban landscape. Encouraging this whole process is the excessive sectorization of transportation planning and management. Apart from causing a spiral of negative externalities, this approach further distorts the urban form and severely undermines the environmental, social and economic sustainability of cities. A major missing link which this report underscores is that sustainable mobility entails – and indeed requires – a closer connection between transport and land-use planning.

Mobility is not only a matter of developing transport infrastructure and services, but also of overcoming the social, economic, political and physical constraints to movement

Globally, the transport bias of urban mobility is demonstrated by the dominance of motorization, and particularly private motor vehicles as the preferred means of mobility. In 2010, there were more than 1 billion motor vehicles worldwide (excluding two-wheelers).[7] Based on data from 2005, nearly half of all urban trips were made by private motorized modes, a figure that continues to climb.[8] By 2010, developed countries had, on average, ten times as many motor vehicles (excluding two-wheelers) per capita as developing ones.[9]

In many cities of the world, the equation of 'mobility' with 'transportation' has fostered a tendency towards increasing motorization, and a propensity to expand the network of urban roads

Meteoric increases in the number of motor vehicles in developing countries mean that a redistribution of the 'global travel pie' is unfolding. By 2035, the number of light-duty motor vehicles – cars, sports utility vehicles (SUVs), light trucks and mini-vans – is projected to reach nearly 1.6 billion (Figure 1.2). The majority of these will be found in developing countries, especially China, India and other Asian countries. China alone is projected to have approximately 350 million private cars by 2035, nearly ten times as many as they had in 2008.[10] In some rapidly emerging economies such as India, the number of cars, trucks, and motorized two-wheelers on city streets is growing at a rate of more than 20 per cent annually.[11] Mexico City's car population is increasing faster than its human population – two new cars enter into circulation every time a child is born.[12] In India, private vehicle growth exceeds population gains by a factor of three.[13]

Globally, the transport bias of urban mobility is demonstrated by the dominance of . . . private motor vehicles

The extent of global motorization is a major cause for the increasing trends in energy use and carbon emissions worldwide. This has fuelled low-density development and sprawling urban forms, which have gradually increased the dependence on motorized transport. Furthermore, government policies in the United States (US) have contributed towards shaping car-dependent settlement patterns. Following the Second World War, the US government invested heavily in high-capacity highways and freeways and subsidized home mortgages, while most of its European counterparts channelled funds into development of urban rail systems, and social and market-rate housing near public transport stops.[14]

The extent of global motorization is a major cause for the increasing trends in energy use and carbon emissions worldwide

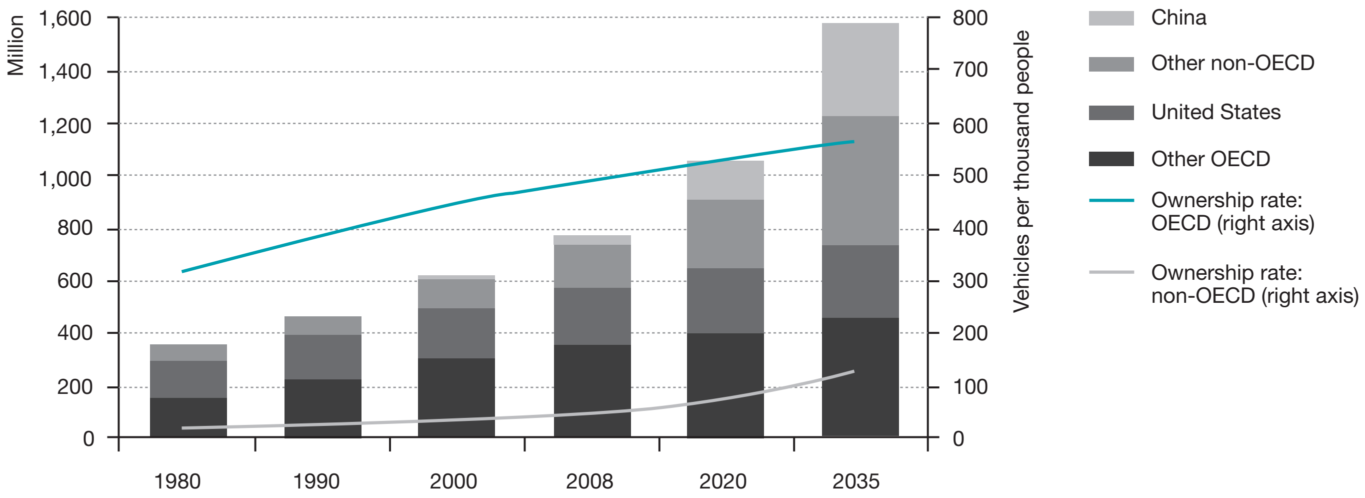


Figure 1.2

Passenger light-duty vehicle fleet and ownership rates by region, estimates and projections (1980–2035)

Source: IEA, 2010.

However, global motorization explains only part of the increasing energy use and greenhouse gas emissions worldwide. Other contributing factors relate to economic growth and rising incomes, especially in developing countries. From 2002 to 2007, China's per capita incomes almost doubled, and car ownership nearly tripled.[15] Car dependency is also served by a cultural and commercial system, which promotes the car as a symbol of status and personal freedom. Therefore, many developing countries perceive motorization as a condition for development. Conversely, evidence from an analysis of the relationship between car use and gross domestic product (GDP) per capita levels between 1970 and 2008 in eight developed countries shows that travel distances by cars may have peaked and that further increases in GDP per capita are unlikely to lead to increased travel distances.[16] Another recent study found that the annual increase in car use per capita in developed countries fell from 4.2 per cent in the 1960s, to 2.3 per cent in the 1990s, to 0.5 per cent from 2000 to 2010.[17] Saturation occurs partly because the amount of additional wealth that people choose to spend on travel is reduced when incomes reach a certain point.[18] In the US, for instance, households earning US$50,000 per year averaged more kilometres of vehicle travel in 2009 than households with twice as much annual income.[19] Moreover, factors such as shrinking city sizes and lifestyle changes are contributing to levelling off of car ownership and usage in developed countries. Furthermore, increasingly ageing populations further contribute to the stabilization of motorization rates.[20]

Factors such as shrinking city sizes and lifestyle changes are contributing to levelling off of car ownership and usage in developed countries

In many transitional countries, the shift to capitalist economies has been accompanied by an explosive growth in the number of freight vehicles, particularly trucks. From 1993 to 2009, truck traffic grew by 165 per cent in Poland, 213 per cent in Croatia, and 247 per cent in the Czech Republic.[21] Many trucks are old and are kept running for longer than the manufacturer's estimated lifetime, aggravating energy requirements, local environmental problems and carbon emissions. In Asia's rapidly industrializing cities, globalization and consumerism have given rise to a wide variety of freight-carrying modes – trucks, pickup vans, trailers, ropeways and railways that coexist with non-motorized modes such as cycle rickshaws, animal-powered carts and head-loading. For every truck in Delhi, India, there are about five feeder informal motorized goods vehicles, five non-motorized vehicles and five to ten head-loaders.[22]

Another feature of the transport bias has been heavy investments in infrastructure

Another feature of the transport bias has been heavy investments in infrastructure. In China, for example, the total length of urban roads more than doubled in the 13-year period between 1990 and 2003.[23] During the same period, the total area allocated to roads more than tripled.[24] Similarly, in Nairobi, Kenya, a total of 143 kilometres of urban roads was either newly constructed or rehabilitated for a total cost of US$537.8 million between 2008 and 2012.[25] This is a substantial amount for a young African economy, and was invested mainly to increase traffic flows and to enable faster mobility. In European countries, road infrastructure accounted for more than two-thirds of infrastructure investments in the transport sector between 1995 and 2010 (Figure 1.3).

The global expansion of mobility encompasses great innovations that have linked transportation with intelligent communication systems, transforming the way in which people organize their travel and communication considerably. The interplay of these systems has redefined the core of social interaction and urban life.[26] Accordingly, the evolving transport system of the last century is firmly rooted in a number of key components including motorized modes, oil industry, consumerist lifestyles, global procurement of oil, spatial and infrastructure planning, urban and street design and societal values that embrace mobility as part of what constitutes high quality of life standards.[27]

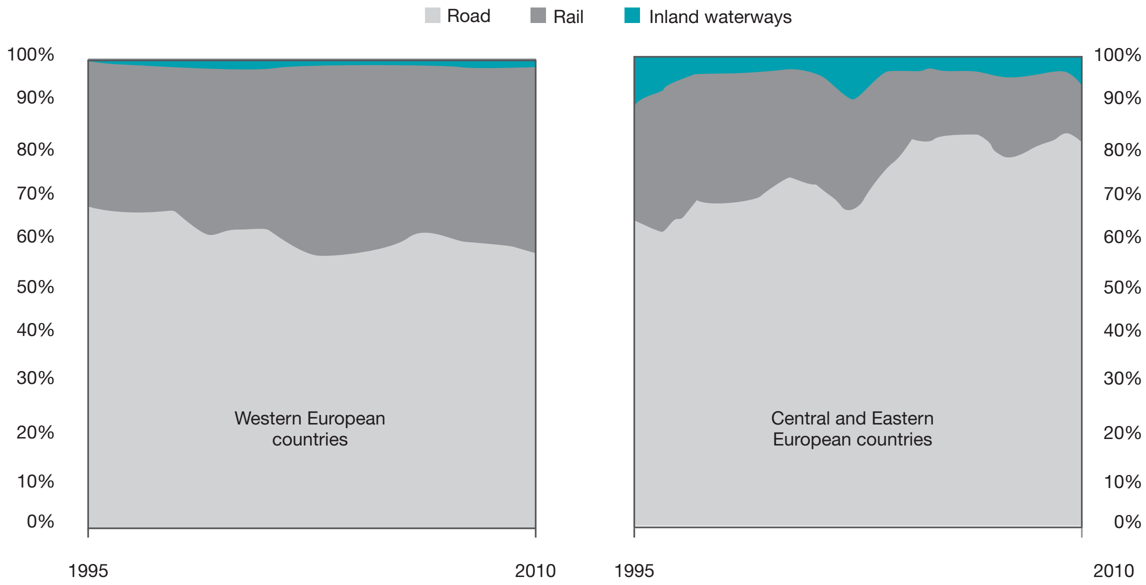


Figure 1.3

Transportation infrastructure investments by mode, Europe (1995–2010)

Source: Based on ITF, 2012.

SOME OF THE FORCES PROMOTING THE TRANSPORT BIAS

The rapid motorization of many of the world's cities is further compounded by expanding globalization, rising trade flows and incomes, leading to an enhanced demand for personal mobility. In many parts of the world, and particularly in developing countries, the private car has become a status symbol, depicting affluence and success in life. A prime example is the largely unregulated large-scale importation of used vehicles to developing countries. Evidence suggests that over 80 per cent of the vehicle stock in Peru was originally imported as used vehicles from the US or Japan.[28] Similarly, in many African countries, import-liberalization policies introduced during the 1990s made it easier and cheaper for households to buy second-hand vehicles imported from overseas.

A number of influential converging factors – such as economic policies that maintain fuel subsidies and planning practices that incentivize suburban residential developments, large malls and retail centres with extensive parking – all play a role in increasing motorization. The suburban development that supported the car culture allowed people to live in low-density residential areas that, although requiring a longer commute, were cheaper in terms of land prices. Some examples include the rise of new 'urban villages' such as Mahindra World City in Chennai (India), Gurgaon satellite town near Delhi (India) and Tlajomulco in the urban agglomeration of Guadalajara (Mexico). Similarly, in Metro Manila, the Philippines, new settlements described as 'exurbia' have emerged during the last two decades, including Bulacan, Pampanga, Rizal, Quezon, Cavite, Laguna and Batangas, all of which have been converted into gated communities and sustained by dependence on car-based transportation.[29] It should also be mentioned that between 1970 and 1990, Los Angeles, US, sprawled an additional 1020 square kilometres, during which time the population increased by 3.1 million residents.[30]

Such planning choices ensured that the car became an essential part of most people's transportation needs. In many instances, governments at all levels have also accelerated sprawl by building more roads to the urban fringe. For example, despite having only 10 per cent more freeway kilometres, Chicago has more than twice as many residents as Houston. The increasing trend to build more roads in Houston has encouraged development to shift to newer areas, with minimal bus service. This has reinforced the vicious circle of car dependency, where the new roads develop their own congestion problems. In 1999 alone, Houstonians lost 36 hours per person as a result of traffic congestion, more than commuters in all but three other American cities (Los Angeles, San Francisco and Dallas).[31]

The fragmentation and sectoral-ization of the management of urban development in many parts of the world is also reinforcing the dominance of the traditional 'transport bias' in urban mobility systems

The fragmentation and sectoralization of the management of urban development in many parts of the world is also reinforcing the dominance of the traditional 'transport bias' in urban mobility systems. Much has been documented about the proliferation of institutions in both developed and developing countries.[32] The poor linkage between land-use and transport planning has encouraged the tendency towards increased transport investments. The latter delivers immediate visible infrastructural outputs – with direct outcomes and impacts – benefiting a range of interests and having higher political pay-off, at least in the short run.

Beyond the strategic and economic dynamics within countries, global forces in much of the second half of the twentieth century fostered a spatial pattern that provided a justification for the traditional transport bias of urban mobility systems. The 'Fordist' pattern of accumulation – which prevailed after the Second World War – promoted a distinct spatial urban landscape and system of governance, which was hierarchical and highly fragmented. The core–periphery delineation was replicated across all levels, with a set of cities acquiring the status of global centres for driving the system of globalization. At the city level, the centrality of manufacturing and trading was facilitated through spatial segregation and by maximizing the economies of urbanization.[33] Towards the last quarter of the twentieth century, greenfield land, suburban housing and urban infrastructural investments became the avenues for illicit wealth generation that caused the global financial crisis. In many parts of Europe, the US and Latin America there are swaths of real estate spread out in the suburban areas and exurban regions that were part of such schemes. The highways and boulevards leading to these sites further enhanced the motorization trend.[34]

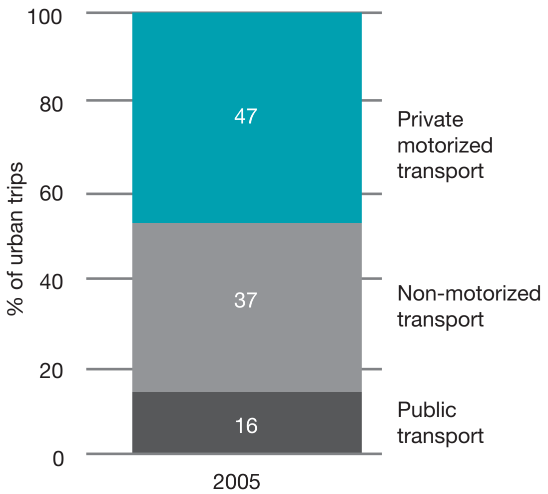
The 'Fordist' pattern of accumulation – which prevailed after the Second World War – promoted a distinct spatial urban landscape and system of governance, which was hierarchical and highly fragmented

It has been estimated that between 1950 and 2005, raw material extraction (biomass, fossil-energy carriers, ores and industrial minerals, construction minerals) increased from 10 to 60 billion metric tonnes, excluding water and land resources.[35] The most significant increase came from the extraction of construction materials and ores/industrial minerals. In 1900, biomass accounted for almost 75 per cent of total material use; however its share had dropped to only one-third by 2005, indicating that the global economy has gradually reduced its dependence on renewable materials (i.e. biomass) and increased its dependence on finite mineral resources, which cannot be replaced.[36] While demand was increasing, for a long time prices were also declining, thus encouraging increased dependence on the finite resources, including, in this case, motorization as the dominant mode of mobility.

Figure 1.4

Modal splits of urban trips (2005)

Source: Pourbaix, 2012.



TRENDS AND CONDITIONS IN TRANSPORT-ORIENTED MOBILITY SYSTEMS

This section provides an overview of global trends and conditions, with transport as the main focus of improving mobility and enabling access. It examines formal and informal modes of transport, including walking and cycling. Furthermore, the implications of rapid motorization on economic performance and social equity in cities are discussed. An overview of the alternative to transport-oriented mobility will be provided in chapters 5 to 8; specifically, the components of an accessibility-based sustainable mobility.

Varying but declining dominance of public transport

In 2005, 16 per cent of all trips in urban areas worldwide were by some form of public transport (i.e. formal, institutionally recognized services, such as buses and rail-based public transport) (Figure 1.4). The role of public transport in individual cities varies widely, accounting for 45 per cent of urban trips in some cities of Eastern Europe and Asia, 10 to 20 per cent in much of Western Europe and Latin America, and less than 5 per cent in North America and Sub-Saharan Africa.[37] In 2001, more than half of all mechanized trips (i.e. excluding walking) in Hong Kong and Eastern European cities (such as Bucharest, Romania; Moscow, Russia; and Warsaw, Poland) were by public transport, compared to an average of about 25 per cent for Western European cities, and less than 10 per cent in the high-income, car-oriented cities of Dubai (United Arab Emirates), Melbourne (Australia) and Chicago (US). However even within Western Europe, the role of public transport varies sharply, capturing more than a third of all mechanized trips in rail-served cities such as Berlin (Germany), Helsinki (Finland), Lisbon (Portugal) and Vienna (Austria) and fewer than 10 per cent of mechanized trips in European cities such as Ghent (Belgium), Lille (France) and Glasgow (UK).[38]

In cities of developing countries, the role of public transport varies markedly, particularly among African cities. Only a handful of Sub-Saharan Africa cities (such as Addis Ababa, Ethiopia; Abidjan, Côte d'Ivoire; and Ouagadougou, Burkina Faso) have reasonably well-developed, institutionalized public bus services that account for 25 to 35 per cent of all motorized trips.[39] Most other parts of Sub-Saharan Africa are characterized by private paratransit and informal operators, with local buses serving only a small fraction of trips, if any. In fact, in most of Sub-Saharan Africa, and poorer parts of South and Southeast Asia, government-sponsored public transport services are either inadequate or non-existent.[40] However, in North Africa, many cities have well-developed public transport systems, including formal buses and informal shared taxis, and rail-based modes. In Egypt for example, Cairo's metro has been operational and expanding since 1987. Similarly, a modern light rail system in Tunis, Tunisia, has been successfully operating since the early 1990s. In Cairo, public transport (formal and informal) accounts for more than 75 per cent of daily motorized trips.[41]

In South-Eastern Asia, conventional 50-passenger buses are the workhorse of the public transport networks of most cities. In Bangkok, Thailand, 50 per cent of passenger trips are by bus, rising to 75 per cent during peak hours.[42] In Eastern Asia, buses serve slightly larger shares of mechanized trips than metros in Taipei, China (14.4 versus 12.9 per cent) and Shanghai, China (12.9 per cent versus 5.7 per cent); whereas metros are more dominant in Hong Kong, China (35.5 per cent of mechanized trips); Seoul, Republic of Korea (34.8 per cent); and greater Tokyo, Japan (57 per cent).[43] Throughout Latin America, buses dominate, even in rail-served cities such as São Paulo (Brazil), Santiago (Chile) and Buenos Aires (Argentina). As noted in Chapter 3, the world's most extensive bus rapid transit (BRT) networks are currently found in Latin America, where a total of 18 cities currently have some form of BRT system.[44]

Despite growing concerns over energy supplies, climate change and access for the poor, public transport's modal share of trips is expected to decline over the next decade in all world regions. If recent trends continue, the number of trips made by public transport will increase by around 30 per cent between 2005 and 2025, an estimate that is far less than the 80 per cent growth in trips by private motorized vehicles over the same period.[45] In recent years, public transport's downward spiral has been most pronounced in Eastern Europe. The transition to capitalist economies has brought with it substantial public transport services cuts and disinvestments – the same kind of vicious cycle that has marginalized public transport in more advanced economies.

The declining market share of trips served by public transport is cause for concern since they are the most efficient forms of motorized mobility, particularly for low-income earners. The low and decreasing role of public transport renders it even more complicated to foster an effective linkage between land-use and transport planning. More effort is devoted to control and regulation of the private and informal sector operators whose main motivation is increasing profit.

Informality

Worldwide, the informal transport sector provides much-needed (and much-valued) mobility, particularly for the poor. The lack of affordable and accessible public transport systems in developing countries has led to the proliferation of informal operators, such as private microbus and minibus services. These modes help fill service gaps but can also worsen traffic congestion and air quality. In some settings, informal carriers are the only forms of public transport available. In India, for example, only about 100 of the more than 5000 cities and towns have formal public transport systems. Accordingly, conventional public transport has been replaced by more ubiquitous but less affordable paratransit such as motorcycle taxis, rickshaws, *jeepneys* and *jitneys*.[46]

Since cities in poorer countries seldom have the institutional and financial capacity to increase and sustain public transport systems – and private firms typically lack the capital and incentive to provide comprehensive transport systems – small, private and informal systems prevail. Like many market-based solutions, they provide a service that must be filled, but not without compromises to the environment and lack of service to those who are marginalized or live in less profit-rich locations.[47] These are called informal public transport or paratransit, because they serve the public and are essentially providing a public good.

Non-motorized transport

Non-motorized transportation is often the dominant mode of urban mobility when public transport services are poor and incomes are low. In 2005, about 37 per cent of urban trips worldwide were made by foot or bicycle, which are the two major modes of urban non-motorized transport (Figure 1.4). For very short trips, walking is the main mode of transport in both developed and developing countries. The modal share of walking can be very high. In African cities, walking accounts for 30–35 per cent of all trips. In Dakar (Senegal) and Douala (Cameroon) the share is much higher, at over 60 per cent.[48] Evidence shows that non-motorized transport is an important component in poorer and smaller cities, capturing as much as 90 per cent of all person-trips.[49] Furthermore, in densely packed urban centres, non-motorized transport provides access to places that motorized modes cannot reach, and is often the fastest means of getting around. In South Asia's densest, most congested cities, more than half of all passenger and goods trips are by foot, bicycles or rickshaw.[50]

Walking is often ***the*** only form of transport for the very poor, when weather and topography permit. Many people in developing countries are 'captive walkers', meaning that they walk because they cannot afford an alternative. For them, having a well-connected and safe pedestrian environment is critical to meeting their daily needs.[51] As the least costly form of mobility, walking allows the very poor to reduce their daily expenses, and thus has significant poverty impacts. The most visible indicator

Public transport's modal share of trips is expected to decline over the next decade in all world regions

The declining market share of . . . public transport is cause for concern since [it is] the most efficient [form] of motorized mobility, particularly for low-income earners

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Many people in developing countries are 'captive walkers', meaning that they walk because they cannot afford an alternative

of poverty in many cities, particularly in developing countries, is the presence of slums and squatter communities. Spatially, the field of movement in these slums is very restricted, with such limitations constraining income and employment opportunities for the urban poor. As a result, the affected population is forced to restrict their travel to essential trips related to work, education and shopping.

In pursuit of transport policies reflecting sustainable mobility, the promotion of walking and cycling is very important. The bicycle is by far the most energy-effective means of passenger transport and offers a relatively inexpensive means of improving the accessibility of poor people. In developed countries, bicycles are commonly used as a feeder mode to public transport services. A well-known example is the Netherlands, where bicycles are used for more than 40 per cent of trips in some cities.[52] Historically, bicycles are particularly important in Chinese cities.[53] Non-motorized transport shares are highest in smaller Chinese cities, in the ranges of 70 to 80 per cent.[54]

Traffic congestion is an undesirable by-product of widespread mobility in cities worldwide, and a major factor in restricting access in cities

Bicycles serve relatively small shares of person trips in many major African cities, however, cycling is popular in smaller and secondary cities.[55] Dangerous and crowded roads, and the absence of protected lanes, have discouraged cycling in many African cities.[56] Still, bicycles can be an important source of economic livelihoods, as evidenced in Kisumu, Kenya, where bicycle-taxis (*bodaboda*) ferry commuters across town at half the price of a *matatu* ride or in Bukoba, Tanzania, where some residents carry passengers or haul goods on their *esekidos* to supplement their wages.[57]

In Bangladesh, India, Pakistan and Sri Lanka, bicycles serve as 'mass transport' in the form of cycle rickshaws, serving mostly women and children. In Dhaka, Bangladesh, around 40 per cent of school trips are by rickshaw.[58] Also, rickshaw pulling often offers an entry point into the labour market for unskilled rural migrants to the cities of South Asia. In Dhaka, 20 per cent of the population, or 2.5 million people, rely on rickshaw pulling for their livelihood, directly or indirectly.[59] This notwithstanding, rickshaws are banned from Dhaka's main roads for slowing motorized traffic, and the view of some public officials is that they detract from the city's image as a modern metropolis.

Traffic congestion is a major indication of the disjuncture between land-use planning and transport systems

Traffic congestion

Traffic congestion is an undesirable by-product of widespread mobility in cities worldwide, and a major factor in restricting access in cities. A recent global study of 20 major cities revealed that traffic congestion levels markedly worsened between 2007 and 2010.[60] Motorists in Moscow, Russia, reported an average daily delay of two and a half hours.[61] With a 24 per cent annual growth rate in the number of registered motor vehicles, traffic conditions are deteriorating most rapidly in Beijing, China.[62] In mid-2010, an 'epic' 100-kilometre, 9-day traffic jam was reported in China's Heibei Province – along a freeway that feeds into Beijing.[63] The growing popularity of helicopters is partly a response to the rising congestion problem in Latin American cities such as Mexico City (Mexico), Santiago (Chile) and São Paulo (Brazil).[64]

Congestion has widespread impacts on the urban quality of life, consumption of fossil fuels, air pollution and economic growth and prosperity. World Bank studies from the 1990s estimated that traffic congestion lowered the GDP of cities by some 3–6 per cent, with the higher value applying mostly to rapidly growing cities (e.g. places with busy port traffic, reliance on just-in-time inventorying and manufacturing, and other time-sensitive activities).[65] Time losses from traffic congestion are estimated to cost the equivalent of 2 per cent of GDP in Europe and 2–5 per cent in Asia.[66] The hidden external costs of traffic congestion in Metro Manila (the Philippines), Dakar (Senegal) and Abidjan (Côte d'Ivoire) have been pegged at nearly 5 per cent of those cities' GDPs.[67] Such costs not only exact a burden on the present generation, but also commit future generations to long-term debts, which can eventually slow global growth.

Traffic congestion is a major indication of the disjuncture between land-use planning and transport systems. It not only exposes the limitation of a transport-oriented bias to mobility, but it also reveals the efficiency of land-use systems in a given city. Limited road capacity, in the face of growing demand for motorized mobility, partly explains deteriorating traffic conditions. In general, the percentage of the total land area devoted to streets[68] in developing-country cities is considerably lower than in the cities of developed countries.[69] In India, the annual growth rate in traffic during the 1990s was around 5 per cent in Mumbai, 7 per cent in Chennai and 10 per cent in Delhi. However, none of these cities have expanded their road supply by even 1 per cent annually.[70]

In most developing-country cities, the inadequate quantity and structure of road infrastructure is often associated with rapid population growth. For instance, Nairobi, Kenya – a city with approximately 3.5 million inhabitants – has a shortage of collector streets and major thoroughfares to serve traffic demands, compared to developed-country cities of a similar size. The city's arterials are mostly radial and the lack of circumferential roads force-funnels many peripheral trips through the central business district, with widespread effects on traffic flows.[71] Central Bangkok, Thailand, has a fishbone street pattern, featuring narrow local streets that channel most motorized trips onto oversaturated thoroughfares. The absence of many collector-distributor roads has contributed to inefficient patterns of traffic flows.[72]

Congested road infrastructure in developing countries, is further exacerbated by forms of encroachment onto the carriageway, or excessive provisions for local access. The most common forms of encroachment are caused by street hawkers and informal transport operators, which combine to block the smooth flow of traffic. In Sub-Saharan Africa, street vendors occupy around a third of road space in crowded cities.[73] A further congestion-related problem is the absence of traffic management in many developing countries. Phnom Penh, Cambodia – a city of nearly 2 million inhabitants – has 864 kilometres of roads, but just 36 traffic signals.[74] In Lebanon, congestion is made worse by inadequate road signage, a failure to manage limited supplies of parking and a culture of aggressive, unruly driving.[75]

Freight movements can also contribute to congestion. In most poor countries, the goods-movement sector lacks basic infrastructure, such as freight terminals, warehousing, parking and staging areas, freight-forwarding centres and other logistical needs. Few developing-country cities specifically plan for freight movements, thus a haphazard, dysfunctional arrangement of urban logistics is often the rule. An example is Lomé, Togo, where the absence of a bypass road around the city causes trucks to leave the port and head directly into the core of the city.[76] Heavy trucks contribute to (and suffer from) poor-quality roads – because wear-and-tear exponentially rises with the dead-axle weight of a vehicle (e.g. one heavily loaded truck can inflict as much road damage as 10,000 passing cars).[77] Consequently, road decay worsens congestion and increases the operating costs.

SUSTAINABILITY CHALLENGES OF URBAN MOBILITY

Building on the seminal Brundtland Report of 1987,[78] a sustainable urban mobility system is one that satisfies current mobility needs of cities without compromising the ability of future generations to meet their own needs.[79] The idea of sustainability in urban mobility has moved beyond a focus on ecology and the natural environment to also include social, economic and institutional dimensions. Furthermore, it has moved beyond the preoccupation with movement and flows within urban settings to looking at enhancing proximity in space. A holistic and integrated approach to urban land-use and transport planning and investment is needed if urban areas are to become socially, environmentally and economically sustainable.

Accordingly, four pillars of sustainability are considered in the review and analysis of urban mobility in this report; namely the ***social***, ***environmental***, ***economic*** and ***institutional*** dimensions. These are not separate or isolated, as there are important synergies and co-benefits. For instance, pursuing economic sustainability can also confer environmental benefits, such as instituting taxation policies that also conserve energy. In the early 2000s, Japan phased in reduced ownership taxes on fuel-efficient vehicles by 25 to 50 per cent and imposed higher charges on large-engine vehicles, including vehicles that were more than ten years of age.[80] While regulatory and fiscal instruments can be used to promote urban sustainability, as mentioned earlier, the most effective mechanism is the effective utilization of the planning process.

Few developing-country cities specifically plan for freight movements, thus a haphazard, dysfunctional arrangement of urban logistics is often the rule

Integration of land-use and transport planning

As pointed out in the preceding sections, the ultimate goal of mobility is the capacity to traverse urban space. Relationships between locations, as well as impediments and conveniences between them, are critical in determining the ease and convenience of accessing them. The development of a sustainable transportation system starts with the organization of urban space. The main objective is to reduce the need for mobility by reducing the number of trips and length of travel distance. As a result, urban density is optimized and functionality of urban places enhanced. Sustainability entails a shift of emphasis from transportation to people and places. In operational terms, it still calls for improvement in transportation systems and even advocates for innovations in other modes of communication, while giving emphasis to streamlining space utilization in its relationship with people.

The development of a sustainable transportation system starts with the organization of urban space. The main objective is to reduce the need for mobility by reducing the number of trips and length of travel distance

Neglecting the connection between land use and mobility has created the urban sprawl evidenced in most cities today. During the period since the Second World War, the urban land area in developed countries has doubled, while it has grown by a factor of five in developing countries.[81] From 1995 to 2005, 85 per cent of the 78 largest cities in developed countries experienced a faster growth in their suburban areas than their urban cores.[82] In Europe, studies of land-cover changes reveal that cities in Estonia, Latvia, Croatia, Slovakia, Poland, Hungary and Bulgaria are experiencing the most sprawl.[83]

Neglecting the connection between land use and mobility has created the urban sprawl evidenced in most cities today

In many developing countries, urban sprawl comprises of two main contrasting types of development in the same city. The first is characterized by large peri-urban areas with informal and illegal patterns of land use. This is combined with a lack of infrastructure, public facilities and basic services, and is often accompanied by little or no public transport and by inadequate access roads. The other is a form of 'suburban sprawl' in which residential zones for high- and middle-income groups and highly valued commercial and retail complexes are well connected for private motorized vehicles rather than by public transport.

The urban form – emerging either from a haphazard process of locating settlements and activities, or from strategically planned intervention – makes a big difference in mobility systems

In the absence of regulatory controls and far-sighted urban planning, the pace of sprawl will most likely accelerate. Spread-out patterns of growth not only increase the dependence on the private car, but also consume farmland and open space, threaten estuaries and natural habitats, and burden municipal treasuries with the high costs of expanding urban infrastructure and services.

Land-use planning also entails paying attention to the multiple scales of urban mobility. It traverses from the regional and metropolitan levels, through the city linkages and down to the neighbourhood and street level. The urban form – emerging either from a haphazard process of locating settlements and activities, or from strategically planned intervention – makes a big difference in mobility systems. Similarly, the design of streets and neighbourhood blocks promotes a sense of place and determines the accessibility of such neighbourhoods. The very physical configuration of the street may either encourage or discourage walking and bicycling. Key considerations for sustainable mobility include the pattern of street arrangement, the length of blocks and the relationship of buildings to pathways, stations and central places.

The percentage of urban land allocated to streets is one of the factors that influence the level of connectivity within urban areas. Another factor is how appropriately the streets are laid out to cater for the various mobility modes used within the city. A study found that a large number of cities in developing countries have low percentages of urban land allocated to streets; for example, 6 per cent in Bangui (Central African Republic), 6.1 per cent in Yerevan (Armenia), 11.1 per cent in Accra (Ghana) and 12.3 per cent in Ouagadougou (Burkina Faso).[84] This is despite the fact that these cities are experiencing rapid rates of urbanization, a phenomenon which is poised to impact on their mobility and hence levels of accessibility. The same study found that cities in developed countries had significantly higher percentages of land allocated to streets, the average rate being 29 per cent.[85] The linkages between urban land allocated to streets and the planning of accessible cities are discussed further in Chapter 5.

Urban transport is socially sustainable when mobility benefits are equally and fairly distributed, with few if any inequalities in access to transport infrastructure and services based on income, social and physical differences

Land-use and transport planning have been called for and to some extent addressed since the 1970s. Nevertheless, a persisting challenge remains the application of integrated land-use and transport planning in practice, as well as dealing with existing transport infrastructure and land-use patterns that cannot always be easily changed, particularly in old middle-size or larger cities. Accordingly, research needs to be directed to such pragmatic issues. It is in making such critical decisions with respect to places and people that the pillars and principles of sustainability can be operationalized.

Social dimensions

Urban transport is socially sustainable when mobility benefits are equally and fairly distributed, with few if any inequalities in access to transport infrastructure and services based on income, social and physical differences (including gender, ethnicity, age or disabilities). Social sustainability is rooted in the principle of accessibility wherein equality exists among all groups in terms of access to basic goods, services and activities – such as work, education, medical care, shopping, socializing – and to enable people to participate in civic life. It recognizes the critical importance of mobility and accessibility in fully enjoying human rights.

As earlier indicated, one important aspect of accessibility is the affordability of transport modes. Affordable transportation means that people, including those with low incomes, can afford access to basic services and activities (healthcare, shopping, school, work and social activities) without budget strain. For many urban dwellers in developing countries, the availability of reliable and affordable public transport services can be the difference between being integrated into the economic and social life of a city or not. Unaffordable mobility prevents the urban poor from breaking out of the shackles of inter-generational poverty. Furthermore, exorbitant expenditures on public transport take money away from other essential needs, such as food, health care, education and shelter.

Where governments are unable to construct and subsidize public transport services, travellers often have to pay large, sometimes exorbitant, shares of their incomes to private, often informal, paratransit operators. Setting prices at whatever amount the market will bear, informal operators invariably charge more per kilometre travelled than publicly supported ones. In the poor informal housing settlements on the outskirts of Mexico City – beyond the service jurisdiction of the city's metro system – residents sometimes take two to three separate *collectivos* (shared-ride taxis and microbuses) to reach a metro terminal that provides low-cost connections to the city and job opportunities.[86] Travel can consume 25 per cent or more of daily wages.[87] Time costs can also be exorbitant: 20 per cent of workers in Mexico City spend more than three hours travelling to and from work each day.[88] Studies show that taking a series of informal minibuses and motorized tricycles to and from work can cost 20 to 25 per cent of daily wages in rapidly growing cities such as Delhi (India), Buenos Aires (Argentina) and Manila (the Philippines), and as much as 30 per cent in Nairobi (Kenya), Pretoria (South Africa) and Dar es Salaam (Tanzania).[89]

Social sustainability also has gender, age and disability dimensions. A majority of women in many parts of the world are less likely to have access to individual means of transport, be they cars or bikes: in Bamako (Mali), 87 per cent of women versus 57 per cent of men walk for virtually all trips; in Chennai (India), 83 versus 63 per cent; and in Chengdu (China), 59 versus 39 per cent.[90] In addition, women often create complex trip chains – e.g. taking children to school followed by shopping and other errands – so as to make traditional fixed-route bus services impractical, forcing them to rely on more expensive door-to-door services (whether by private car in developed countries or by rickshaws, bicycles, motorcycle taxis in poorer countries). Other transport-related burdens faced by women are: lack of pavements and safe crosswalks; sexual harassment in overcrowded buses; and personal security threats from unlighted streets and public transport stops.

In many developed countries, the elderly and disabled have statutory rights that guarantee equal and full accessibility to public facilities like pavements, rail-based public transport and buses, such as legislated in the Americans with Disabilities Act in the US. Few developing countries provide such protection, or design streets and transport infrastructure, to enable access for the elderly and disabled. Young people constitute a group at further risk of transport disadvantage. In Sub-Saharan Africa, school-age children and youth often walk long distances, along congested corridors, to reach schools, exposing them to accident risks and all sorts of hardships and deprivations.[91]

Safety is a crucial aspect of a high-quality urban mobility system. It includes the safety of infrastructures and of the rolling stock, as well as citizen's safety in reaching the system (e.g. walking from home to the bus stop). Road accidents have become a global pandemic. Each year, around 1.2 million people are killed and a further 20–50 million injured in road traffic accidents worldwide.[92] Road crashes result in economic costs of up to 3 per cent of GDP.[93] The vast majority of road traffic accident deaths (more than 90 per cent) occur in developing countries,[94] despite these countries accounting for only 33 per cent of the world's motor vehicles.[95] Road safety levels differ sharply between developing and developed countries and the gap is widening. In the latter part of the twentieth century, road accident fatalities fell in developed countries but rose sharply elsewhere – e.g. 300 per cent increase from 1980 to 2000 in Africa.[96] The World Health Organization (WHO) predicts road traffic deaths in low-income countries will more than double between 2005 and 2030, while they are expected to fall in wealthier nations.[97] Rapid urbanization, greater reliance on motorized transport to move people and goods, growing income disparities and lax enforcement of traffic laws, are among the factors that account for rising road traffic crashes and fatalities.[98]

Environmental dimensions

Many of the environmental challenges in the urban transport sector are rooted in its reliance on the non-renewable fossil fuel to propel private motor vehicles. The share of the world's oil consumption accounted for by transportation increased from 45.4 per cent in 1973 to 61.5 per cent in 2010, with the sector expected to continue to sustain the increasing demands for oil (Figure 1.5). World reserves of conventional oil exceed what has been used to date, but with rapid motorization, many observers believe it is unlikely that this energy source will last beyond the mid-century mark.[99] As demand for transportation fuels rises, prices increase.[100] End consumers have to cope with a rise in prices of petrol and diesel fuels for motorized travel.

Rising greenhouse gas emissions and global temperatures underscore the urgency of weaning the transport sector from its dependency on oil and automobility. Globally, 13 per cent of all greenhouse gas emissions come from the transport sector and three-quarters of this is caused by road transport.[101] By 2050, global carbon dioxide (CO_2) emissions from motor vehicle use could be three times as large as they were in 2010.[102] The transport sector's footprint, however, varies widely across

Many of the environmental challenges in the urban transport sector are rooted in its reliance on the non-renewable fossil fuel to propel private motor vehicles

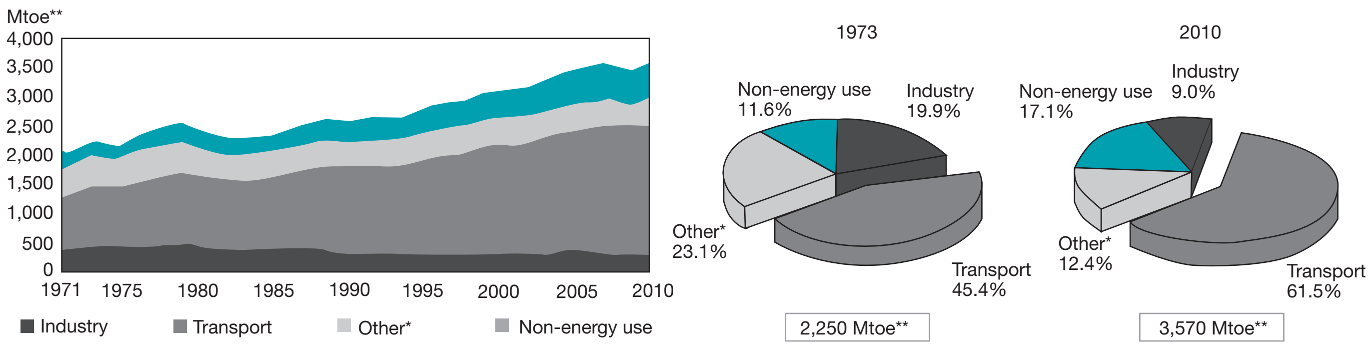
Rising greenhouse gas emissions and global temperatures underscore the urgency of weaning the transport sector from its dependency on oil and automobility

Figure 1.5

World oil consumption by sector

Notes: *: Includes agriculture, commercial and public services, residential, and non-specified other; **: million tonnes of oil equivalent.

Source: IEA, 2012b.



cities, accounting for 11 per cent of greenhouse gas emissions in Shanghai and Beijing (China), 20 per cent in New York City (US) and London (UK), 35 per cent in Rio de Janeiro (Brazil) and Mexico City, 45 per cent in Houston and Atlanta (US), and 60 per cent in São Paulo (Brazil).[103] Levels of energy consumption for transport vary significantly even among cities with similar GDPs, depending on urban form, financing and taxation policies, and the quality and affordability of alternative modes. As urban form gets more compact and dense, CO_2 emissions from transport decline. For instance, Austria's urban areas are more than four times denser than Australia's, and generate only 60 per cent of the amount of CO_2 per capita that Australia's urban areas generate.[104] Mode share is also an important factor: energy consumption levels decrease as the share of trips on public transport and non-motorized modes increases. In 2007, per capita energy consumption in the transport sector was more than three times higher in the US than in Japan and Germany.[105] This is partly explained by the modal share in these countries; in Japan, for example, 40 per cent of all urban motorized trips are made by public transport, compared to only 4 per cent in the US.[106] Indeed, greenhouse gas emissions per passenger of public transport (bus, rail and trams) is about one-twelfth that of the car.[107]

The urban transport sector is economically sustainable when resources are efficiently used and distributed to maximize the benefits and minimize the external costs of mobility

The urban transport sector is also a major source of air and noise pollution, with serious public health impacts. Long-term repeated exposure to high levels of ozone and particulates can diminish lung functions and trigger asthma and other respiratory illnesses.

Economic dimensions

The urban transport sector is economically sustainable when resources are efficiently used and distributed to maximize the benefits and minimize the external costs of mobility. This safeguards investments in and maintenance of transport infrastructure and assets. The translation of investments into walkways, bikeways, railways and roadways creates jobs, encourages business expansion and increases economic output. Increasingly, the litmus test of cost-effective transport infrastructure is whether the project is 'bankable' – capable of attracting loans and private investors.

Translating visions and plans for sustainable urban mobility depends on the presence of supportive and nurturing governance, as well as sound institutional and regulatory structures

Urban transport infrastructure is expensive. It can consume a large share of the public budget in emerging economies. In Ho Chi Minh City, Viet Nam, a US$5 billion subway is currently under construction and in Jakarta, Indonesia, a new ring road is expected to cost a similar amount.[108] Crafting reliable and equitable funding programmes for transport infrastructure that reward efficient and sustainable behaviour remains a formidable challenge.

Public transport often faces serious fiscal challenges. Almost universally, public transport systems rely on public subsidies. Cities that finance the costs of public transport operations can face severe fiscal burdens. Experiences show that in many cases operating subsidies are used to finance higher worker compensation and benefit packages, without commensurate improvements in public transport services.[109] In developing countries, cities without adequate fiscal resources end up relying on informal sector operators to fill the gaps. Lower-income cities that borrow funds in foreign currency to build transport infrastructure also face the risk of having to pay back loans with devalued local currency.

Another fiscal challenge cities face worldwide is paying for ongoing road maintenance and expansion. Taxes on fuels are usually the primary means of funding road infrastructure. However, increased fuel economy, combined with travel saturation, has reduced such revenues in developed countries. For example, fuel economy improvements in France that reduce CO_2 emissions of the average diesel car from 160 to 130 grams per kilometre, have at the same time dramatically reduced government revenues.[110] This has called for a shift to kilometre-based taxes, something which is now possible given technological advances such as global positioning systems (GPS) and radio frequency identification devices.

Institutional and governance dimensions

Translating visions and plans for sustainable urban mobility depends on the presence of supportive and nurturing governance, as well as sound institutional and regulatory structures. The ability to manage and respond to escalating demands for urban travel – i.e. to plan, predict, foresee, preserve rights-of-way, build, operate and maintain facilities – is often limited in developing countries. The lack of adequate institutional capacity – whether in the form of a trained and educated civil-service talent pool, or a transparent and largely corruption-free procurement process for providing transport infrastructure and services – poses immense challenges in advancing sustainable urban transport.

Institutional fragmentation undermines the ability to coordinate urban transportation services.[111] Separating urban sector functions into different organizations – each with its own boards, staff, budgets and by-laws – often translates into unisectoral actions and missed opportunities, such as the failure to site new housing projects near BRT stations. Multiple public transport service providers can mean uncoordinated bus and rail schedules, multiple fare payments (which increase user costs) and facility designs that are poorly integrated. In addition, bloated bureaucracies are notorious for waste and delays in the deployment of urban transport projects.

Another institutional void is the minimal involvement of citizens and broad-based community interests in the planning and design of urban transport facilities and services. Decision-making needs to be more inclusive, transparent and democratic. Decentralizing decision-making ensures greater voice and legitimacy to non-governmental organizations (NGOs) and civil society.

Lack of capacity for strategic planning and coordination is a major problem in many cities of the world, particularly in developing countries. Institutions rarely have sufficient time or funds to expand transport infrastructure fast enough to accommodate travel demands. The ability to advance sustainable mobility programmes or introduce efficient pricing schemes presumes something that rarely exists – a well-managed transport authority that sets clear and measurable objectives and rigorously appraises the expenditure of funds in a transparent and accountable manner.[112] Often, the mechanisms for coordinated multi-sectoral planning are either weak or absent. Understanding the linkage between land-use and urban transport planning is important for the multiplicity of actors, levels and institutions involved.

CONCLUDING REMARKS AND STRUCTURE OF THE REPORT

This chapter has provided an overview of the implications of the unfolding events of rapid urbanization, hyper-mobility and the health and climate hazards associated with car-dependent cities – all of which are inextricably linked. During the past 100 years, the structural foundations for today's urban mobility systems were derived from developmental circumstances, when resources were cheap, urban populations were low and modes of communication were limited. However, while the global trends discussed in this chapter pose uncertainties and risks, there are also unprecedented opportunities for advancing sustainable urban mobility.

In order to become more sustainable, cities should be more compact, encourage mixed land use and prioritize sustainable modes of mobility such as public and non-motorized transport. Furthermore, urban mobility systems need to be inclusive, providing mobility opportunities for all. Improved urban planning will be critical toward designing and retrofitting cities to better accommodate sustainable modes. Compact, mixed-use cities with high-quality pedestrian and cycling infrastructure, combined with policy measures that charge the true social cost of using private motorized vehicles, offer the best hope of increasing the modal shares of sustainable modes of mobility.

A paradigm shift is also needed in how transport users think about transportation and its relationship to the city. Of particular significance is the need for government institutions and planning processes to emphasize accessibility over mobility. Furthermore, policies to encourage sustainable urban mobility should take into account social, environmental, economic as well as institutional dimensions of sustainability. This calls for a more holistic and inclusive framework for the planning, design and provision of urban mobility systems and services. Accordingly, translating visions and plans for sustainable urban transport futures depends on the presence of a supportive governance and regulatory structure.

The following nine chapters of this report analyse global trends, conditions and policy responses with respect to urban mobility. They investigate the connection between transport and various aspects of urban form, and suggest measures towards the promotion of sustainable mobility. The discussion in the next three chapters focuses on trends and conditions with respect to the two main categories of urban transport: passenger transport in Chapters 2 and 3 and goods transport in Chapter 4. The evidence presented in these chapters shows that, urban transport policy and planning challenges in developing countries and countries with economies in transition differ significantly from those found in the urban areas of developed countries; as do the resources and institutional frameworks at the disposal of policy-makers and planners. Notwithstanding, the best choice of policy responses will also vary within each region and even within countries.

Chapter 5 serves as the anchor of this report, exposing the basis of the prevailing anomalies and opportunities for corrective intervention. It looks at the interrelation between mobility and the spatial structure of the city, while stressing the need to reconfigure urban form to enhance accessibility. The importance of integrating transport and land-use planning is emphasized while the underlying principles of sustainable development provide the normative framework for change. The policy implications discussed in Chapter 5 lay the ground for the subsequent discussion in Chapters 6 to 9, which focus on the social, environmental, economic and institutional dimensions of sustainable mobility. Chapter 10 concludes the report and presents policy recommendations on how to enhance the sustainability of urban mobility systems.

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NOTES

1 Pourbaix, 2012.
2 ITF, 2011.
3 ITF, 2011.
4 SMART, 2008, p2.
5 SMART, 2008, p2.
6 CEMR, 2007, Preamble.
7 See Table 2.3.
8 Pourbaix, 2011.
9 See Table 2.3.
10 IEA, 2010.
11 Pan, 2011; Tiwari, 2011.
12 Jirón, 2011.
13 Jain, 2011; World Bank, 2011b.
14 Altshuler, 1979; Pucher and Lefevre, 1996.
15 Kutzbach, 2010.
16 See Figure 2.12 (and Figure 8.1).
17 Newman and Kenworthy, 2011b.
18 Millard-Ball and Schipper, 2010; ITF, 2011.
19 ITF, 2011.
20 ITF, 2011
21 Suchorzewski, 2011.
22 Jain, 2011.
23 From 95,000 in 1990 to 208,000 kilometres in 2003 (Wenhua, 2005).
24 From 892 million square metres in 1990 to 3156.5 million square metres in 2003 (Wenhua, 2005).
25 New African, 2012.
26 Sheller and Urry, 2003
27 Urry, 2004.
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29 Alcazaren, 2004.
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31 Lewyn, 2003.
32 In varying degrees an observation made by the Governor of New York resonates for many cities in the world. He said that 'the simple truth is that New York's State and local governments have become too big, too expensive, and too ineffective. In fact, there now are more than 1,000 State agencies – an ever proliferating tangle of boards, commissions, councils, departments, divisions, offices, task forces and public authorities. Likewise, New York's antiquated system of local government today consists of more than 10,500 governmental entities. This oversized and inefficient bureaucracy is a luxury taxpayers cannot afford' (Cuomo, 2010, p61).
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56 Pedankur, 2005.
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65 Kessides, 1993; World Bank, 1994; World Bank, 2002a.
66 London European Partnership for Transport, 2011.
67 Chin, 2011; UITP, 2011b.
68 For the purpose of this report, the term 'streets' includes all categories of road infrastructure, including arterial highways, primary and secondary roads, as well as bikepaths and footpaths.
69 Vasconcellos, 2001; see also UN-Habitat, 2013b.
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71 Gonzales et al, 2009.
72 Cervero, 1991.
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85 UN-Habitat, 2013b; see also Vasconcellos, 2001.
86 Cervero, 1998.
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88 World Bank, 2009b.
89 Ferrarazzo and Arauz, 2000; Kaltheier, 2002; Carruthers et al, 2005.
90 Peters, 2011.
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CHAPTER

2

THE STATE OF URBAN PASSENGER TRANSPORT

In a world that is predominantly urban, the ability of people to move within cities to access jobs, services and amenities is a critical driver of sustainability. Indeed, access to affordable, safe and environmentally friendly means of transport is a prerequisite for the wellbeing of urban dwellers as well as for the balanced functioning and prosperity of cities. While progress has been made in this respect, considerable challenges remain in widening the accessibility of sustainable transport in cities across the world. While developing countries are disproportionately shouldering an overwhelming share of the urban transport challenges, developed countries also face their own array of difficulties, compounded currently by undercurrents of global financial uncertainty.

This chapter provides an overview of the state of urban passenger transport globally, focusing on four key modes of transport namely non-motorized transport (NMT), formal public transport, informal (motorized) transport and private motorized transport (Box 2.1). Goods movement in urban areas is covered in Chapter 4, given its unique and crucial yet often overlooked role. The four modes of passenger transport are reviewed here in the context of developed and developing countries, illustrating extensive variation in trends and conditions, and thus accessibility (as elaborated in Chapter 1). The impacts of these trends and conditions are highlighted briefly as a precursor to a more detailed review of the same in Chapters 6, 7 and 8.

This review illustrates the central role of NMT in developing countries and a growing interest in these modes in developed countries. Formal public transport has varying levels of importance within, and/or between, cities of both developing and developed countries. Informal transport, although playing a limited role in developed countries, is found to be the principal transport mode in developing countries, to the extent that in some it is being co-opted as part of formal public transport provision. Thereafter, the enormous growth in private motorized transport in many developing countries is reviewed, as are the patterns of dependence on this mode in developed countries. Importantly, also, the chapter considers the critical role of integration across different modes of transport in cities, and highlights experiences of cities that have invested in intermodality.

The trends and conditions of urban transport described in this chapter have been directly

In a world that is predominantly urban, the ability of people to move within cities to access jobs, services and amenities is a critical driver of sustainability

Box 2.1 Modes of urban transport

Non-motorized transport refers to the transportation of passengers via human or animal powered means including bicycles, rickshaws, pedicabs, animal-drawn carts and walking. With animal power being largely a rural feature, the focus in this report is on human-powered modes (bicycles, cycle rickshaws) and walking.

Formal public transport services are those available to the public for payment, run on specified routes to timetables with set fares, and within the context of this report, in an urban area. They may be operated by public or private organizations and cover a wide range of modes, namely bus, light rail (tramways and street cars), metros, suburban rail, as well as waterborne transport (ferries, boats).

Informal (motorized) transport (also referred to as 'paratransit') relies on privately owned vehicles whose operators often lack necessary permits or do not meet requirements for vehicle size, insurance coverage or driver standards. Even if some operators are fully licensed, they may deviate from routes or charge unauthorized higher fares, as a result of which they are considered informal.

Private motorized transport involves vehicles that are powered by an engine and are used by individuals or private companies to transport passengers. Light-duty vehicles (cars, SUVs, light trucks and mini-vans) and two- or three-wheelers remain the key modes of private motorized transport in urban areas.

influenced by land-use and urban planning decisions taken at neighbourhood, local and regional levels (Chapter 5), resulting in particular urban forms and functionality that hinder or facilitate accessibility. In turn, transport investments and policies have influenced the development of urban form and functionality in particular ways, thereby impacting on access to mobility. The interaction between the development of urban spatial patterns and transport is thus a key factor shaping accessibility in cities both in physical and socioeconomic terms.

NON-MOTORIZED TRANSPORT

This section highlights the trends and conditions of NMT around the world, including the provision of appropriate infrastructure, as well as the related benefits and challenges. Globally, walking and bicycling are the dominant modes of NMT. Yet, the needs of NMT users are often ignored, while pedestrians and cyclists together form a significant fraction of traffic accident victims. Most cities do not have dedicated infrastructure, and even if some European cities have been remodelled to become pedestrian and bicycle friendly, NMT users typically negotiate hostile urban environments. In London, UK, for instance, many cyclists are killed annually by turning trucks, despite the presence of bicycle lanes.

Walking is the principal means of transportation in cities of developing countries . . . not by choice, but rather driven by the lack of affordable and accessible alternatives

Developing countries

NMT is the principal mode of transportation in most cities of developing countries, particularly Africa and Asia (Figure 2.1). In Dakar (Senegal), for instance, walking and cycling accounts for 71 per cent of trips while in Douala (Cameroon) it accounts for 60 per cent. In Asia, the combined average share of cycling and walking in Chinese cities, for instance, is 65 per cent.[1] Beijing, for instance, has a combined modal share of walking and cycling of 53 per cent. In Indian cities (such as Ahmedabad, Bangalore, Delhi and Mumbai) walking and cycling account for about a third of all trips. In Latin America, walking and cycling constitute more than one-third of the trips in cities such as Santiago, Chile (37 per cent), Rio de Janeiro, Brazil (37 per cent) and Guadalajara, Mexico (39 per cent), but are less significant in others such as Buenos Aires, Argentina (9 per cent), La Paz, Bolivia (10 per cent) and Caracas, Venezuela (18 per cent).[2]

In recent years, there has been a decline in cycling in some Asian cities [due] to rising incomes and concomitant motorization, as well as changing social perceptions

Walking is the principal means of transportation in cities of developing countries. This is largely not by choice, but rather driven by the lack of affordable and accessible alternatives, with most pedestrians belonging to lower income groups.[3] Among low-income groups in Santiago (Chile), NMT provides a modal share of over 50 per cent, compared to only 10 per cent among high-income groups.[4] In Kenya, the majority of Nairobi's slum inhabitants walk as they cannot afford motorized transport.[5] On average, walking accounts for a significant proportion of trips in African cities, and is particularly common among women and children.[6]

Cycling caters for the mobility needs of considerable numbers of urban dwellers in developing-country cities, especially in Asia. In mainland China, bicycle ownership is much higher than in other Asian countries, with an estimated 600 million bicycles.[7] In India, household bicycle ownership rates are high in cities such as Delhi (38 per cent), Ahmedabad (54 per cent) and Chandigarh (63 per cent).[8] This is reflected in the relatively higher modal share of cycling in these cities – Delhi (12 per cent) and Ahmedabad (14 per cent). In some Asian countries with relatively higher incomes, however, the modal share of cycling is much lower, such as in Singapore (1.6 per cent of work trips),[9] the Republic of Korea (1.2 per cent)[10] and Hong Kong SAR (0.5 per cent).[11]

In recent years, there has been a decline in cycling in some Asian cities. This has been attributed to rising incomes and concomitant motorization, as well as changing social perceptions, which tends to see cycling as a means of transport for the poor. India is a case in point where bicycle modal shares declined from 30 per cent in 1994 to 11 per cent in 2008.[12] Numbers also decreased in China, particularly in big cities.[13]

In African cities, cycling plays a comparatively limited role, accounting for less than 3 per cent of total trips in capital cities such as Bamako (Mali), Dakar (Senegal), Harare (Zimbabwe), Nairobi (Kenya) and Niamey (Niger). Cycling appears to be more popular in smaller and secondary cities such as Morogoro (Tanzania) and Eldoret (Kenya) where it constitutes 23 per cent and 12 per cent of total trips, respectively.[14] In Latin America, cycling makes up only a small share of total transport trips, with bicycle use being more in intermediate sized cities than in larger ones. For example, while in Curico (Chile) the modal share is 9 per cent, the average share across Chile is under 2 per cent.[15]

The three-wheeled rickshaw is a popular type of urban transport in Asia, especially in Cambodia, Indonesia, Myanmar, Thailand, the Philippines and Viet Nam. Known as pedicabs (*padyak*) in Metro Manila (the Philippines), they are able to operate in narrow alleys, walkways and other areas which are impenetrable by other modes such as *jeepneys* (converted jeep taxis) and buses. In Bandung (Indonesia), pedicabs known as *becaks* make up 33 per cent of all trips.[16] In contrast, cycle rickshaws are uncommon in Africa, although they did exist in the 1990s in Kigali (Rwanda) and Bujumbura (Burundi).[17] The use of tricycles however has been met with mixed

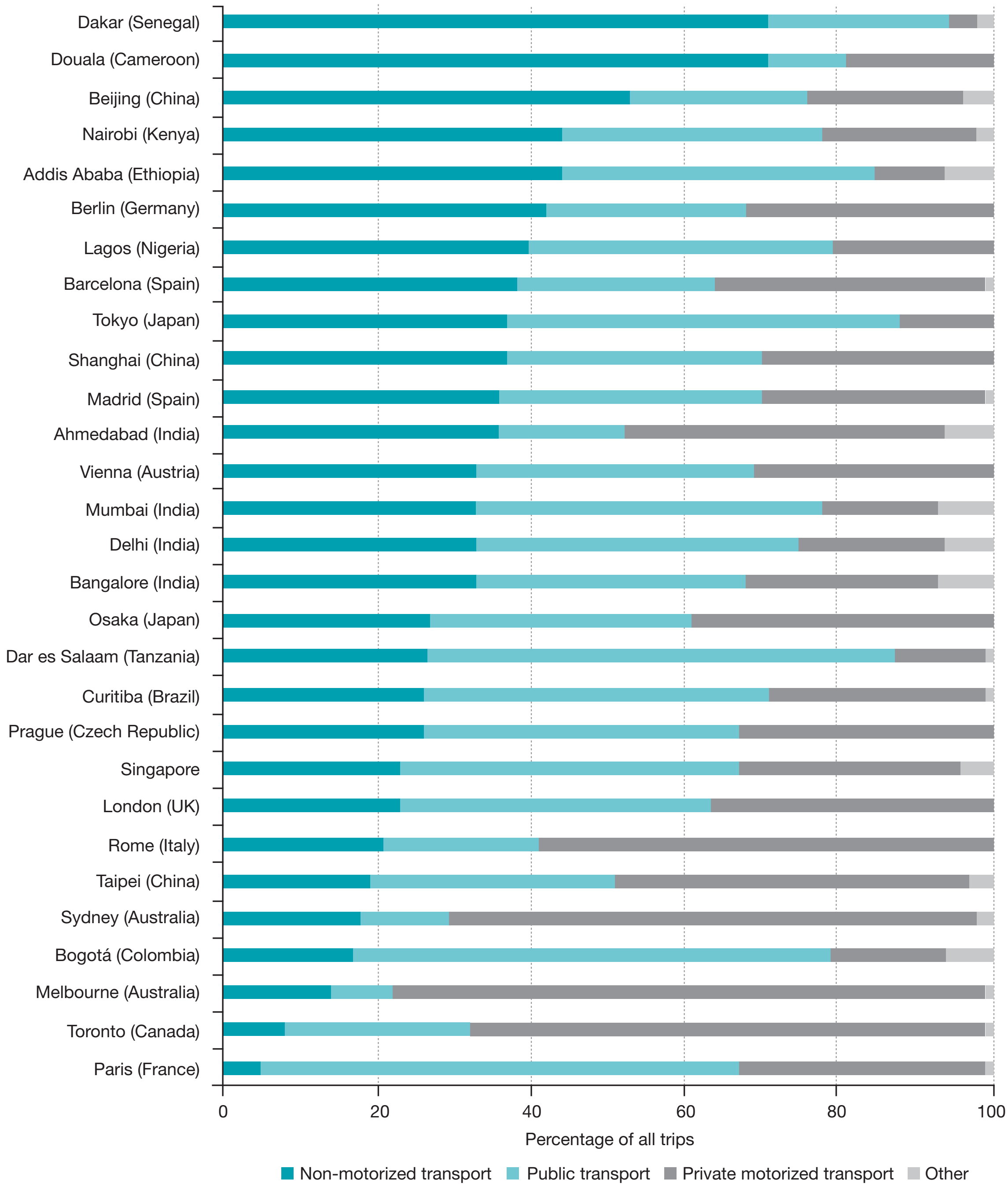


Figure 2.1

Urban travel modal shares in selected cities

Sources: LTA Academy, 2011; UITP and UATP, 2010.

reactions by city authorities in several Asian countries. Jakarta (Indonesia) banned *becaks* in the 1970s considering them obsolete, unsafe and hindering traffic flow, while Viet Nam banned tricycles in 2008.[18] In Mandalay (Myanmar), use in the central business district is limited to daytime.[19] The city of Udon Thani (Thailand), by contrast, is actively promoting cycle rickshaws as an alternative to cars.[20]

Developed countries

The proportion of non-motorized trips varies greatly in developed countries, with walking and cycling making up less than an eighth of daily trips in car-dependent countries such as Australia, Canada and the US, and over 20 per cent in most European countries. The share of journeys on foot is higher in European countries, but less than in Australia, Canada and the US (Figure 2.2).

Bicycle ownership is high in Western Europe, especially in the Netherlands, Germany and Denmark (Figure 2.3). This has been attributed to the transport and land-use policies introduced since the mid-1970s in these countries in favour of NMT and public transport facilities rather than motorized transport. The ratio of bicycles to inhabitants is lower in other European countries such as Hungary and France, as well as in the US and Canada. Cycling

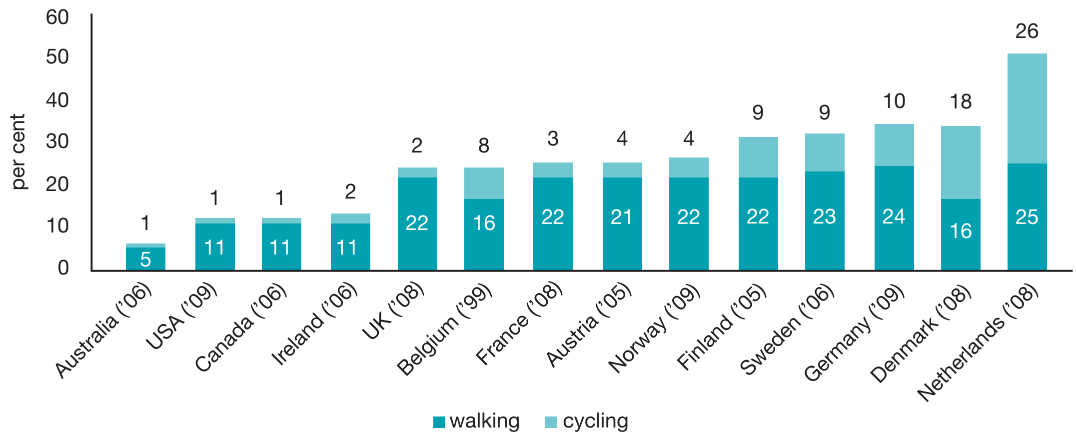


Figure 2.2

Cycling and walking share of daily trips in Europe, North America and Australia (1999–2009)

Source: Buehler and Pucher, 2012a.

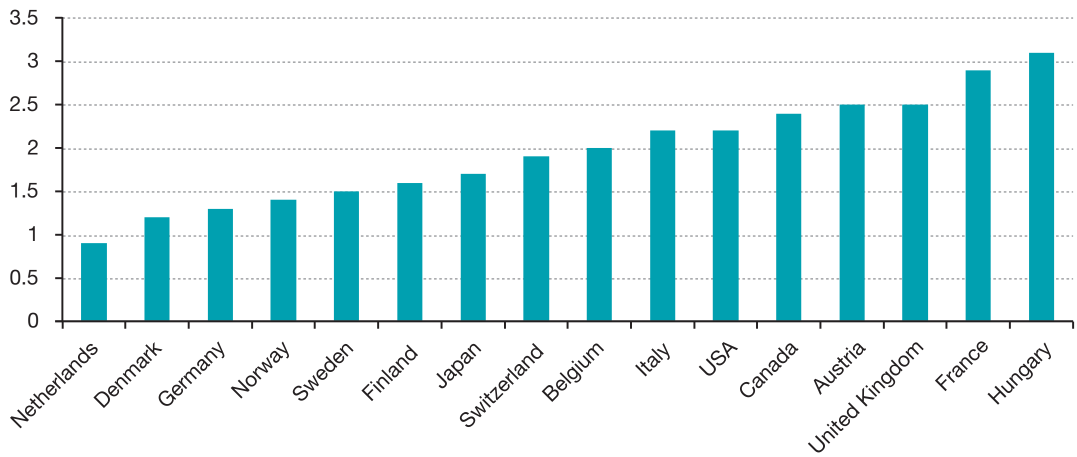


Figure 2.3

Number of inhabitants per bicycle, developed countries

Source: BOVAG-RAI Mobility Foundation, 2009.

in the US is mostly for recreational and fitness purposes, whereas in Europe it is a key means of movement for utilitarian purposes.[21]

A recent trend with respect to NMT in developed-country cities has been the increasing popularity of three-wheeled pedicabs. For instance, annual trips by such pedicabs have been estimated at 1 million in London (UK) and 250,000 in Berlin (Germany).[22] Nevertheless, this mode of transport is still insignificant in the cities of developed countries.

Generally, developing-country cities have poor quality infrastructure for NMT. Dedicated corridors are largely absent

Infrastructure for non-motorized transport

Generally, developing-country cities have poor quality infrastructure for NMT. Dedicated corridors are largely absent and, where they exist, they are often at the risk of being encroached upon for commercial purposes or used for the perennial widening of motorized carriageways.[23] Poor lighting, absence of footpaths and overcrowding make walking unsafe in these countries.[24] Furthermore, limited speed enforcement does little to deter high traffic speeds. In the absence of segregated NMT infrastructure, the dangers poised by speeding vehicles result in low cycling rates.[25] The general lack of provision and maintenance of NMT facilities in cities of developing countries is primarily a problem of financing. Such facilities are not considered to be 'revenue-generating' and private investors and international lending agencies are thus not keen to finance such expenditures. Furthermore, the costs of such NMT facilities are often considered to be beyond city capabilities.[26] However, as discussed later in this report, the result of this is that public expenditures tend to focus on provision of infrastructure for the small minority that can afford to own a private car, in effect subsidizing the wealthiest road users.

Poor lighting, absence of footpaths and over crowding make walking unsafe in [developing] countries

Across Africa, provision for segregated infrastructure for NMT is limited. In Nairobi (Kenya), 95 per cent of roads have high pedestrian flows but only 20 per cent have pedestrian footpaths,[27] while in Kampala (Uganda) more than 60 per cent of road networks have no footpath segregated from motorized traffic. In Lagos (Nigeria), NMT space is inadequately protected.[28] There are some exceptions, however, such as Ouagadougou (Burkina Faso), where dedicated lanes were built in the 1980s. Unfortunately, these lanes have become unsafe due to the encroachment by high-speed motorcycles.[29]

NMT infrastructure conditions in most Asian cities are similarly inadequate. Out of the transport-related projects approved under India's Jawaharlal Nehru National Urban Renewal Mission, only 2.2 per

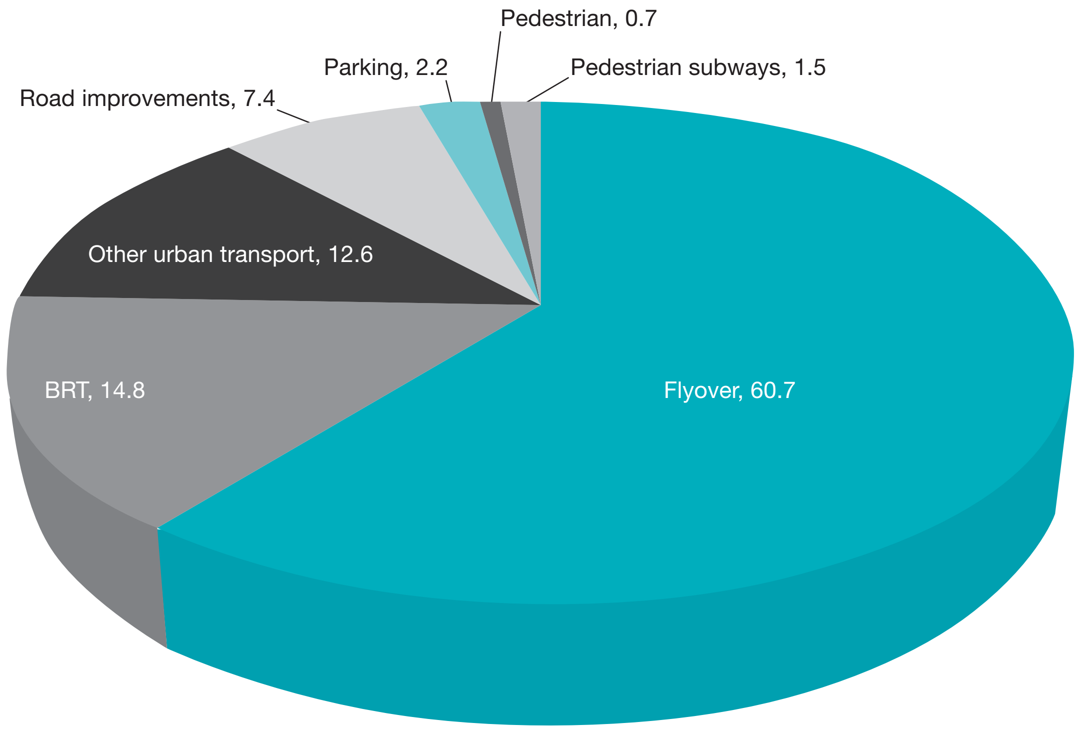


Figure 2.4

Transport investments in Indian cities under the Jawaharlal Nehru National Urban Renewal Mission (by December 2011) (percentages)

Source: Manchala and Vagvala, 2012.

cent focused on pedestrian infrastructure (Figure 2.4). The majority of the roads in Delhi (India) do not have pavements and those that exist are often unusable.[30] Some Chinese cities, by contrast, have excellent bicycle infrastructure. In the recent past, however, these have been invaded by electric bikes.[31] The elimination or narrowing of sidewalks to accommodate more car lanes in Chinese cities has also been reported.[32]

Infrastructure for NMT in some Latin American cities is also in poor repair. For instance, in Cali, Colombia, sidewalks are barely sufficient for one person, poorly maintained, blocked by construction waste, parked vehicles or informal vendors, and have open sewerages. Car access ramps often discriminate against the disabled, persons with high-heeled shoes and baby carriages (mostly women), while a lack of lighting encourages the pedestrian use of car lanes, and contributes to increased fear of muggings. Furthermore, a significant proportion of roads (30 per cent) are unpaved; pedestrians and cyclists are exposed to dust, mud and air pollution.[33]

However, encouraging measures to enhance NMT infrastructure have been observed in some developing countries. In Colombia, for example, Bogotá's *CicloRuta* – a 340-kilometre bicycle path that is connected to BRT routes, parks and community centres – has registered considerable achievements and resulted in a doubling of the proportion of the population that used bikes between 2000 and 2007.[34] The Republic of Korea's Bicycle Master Plan intends to build 30,000 kilometres of bike-ways (primarily for recreational purposes) and increase the modal share of cycling to 10 per cent by the end of 2019.[35] In China, policies to promote NMT include planned bicycle networks and parking at public transport stations in Beijing to increase ridership.[36] Some have also adopted bicycle sharing systems where bicycles are made available for shared use to individuals on a very short-term basis. The Chinese cities of Wuhan and Hangzhou have the largest bike sharing systems in the world, with some 90,000 and 40,000 bikes, respectively.[37]

The Chinese cities of Wuhan and Hangzhou have the largest bike sharing systems in the world, with some 90,000 and 40,000 bikes, respectively

In developed countries, pedestrian infrastructure has rapidly improved in recent decades with a number of Western European cities investing heavily in pedestrian areas and dedicated lanes. In Germany and the Netherlands, there have been extensive efforts to improve infrastructure for both walking and cycling, with bike paths and lanes more than doubling in the Netherlands and tripling in Germany between the late 1970s and mid-1990s (Box 2.2). In contrast, investments to improve infrastructure for walking and cycling in the US have been comparatively limited.[38]

An increasingly important approach in Western Europe has been the integration of NMT and motorized travel through urban design to enhance the safety and quality of street space for pedestrians and cyclists. Neighbourhood streets have been redesigned in numerous cities in the UK, Denmark, Sweden, German and the Netherlands to create 'home zones' accessible to cars, bicyclists and pedestrians on equal terms, resulting in a significant

Box 2.2 An exercise in cycle-friendly design

In Houten – a new town in the Netherlands designed in the early 1970s – cycle routes, with adjoining walkways, form the backbone of the town plan. The town consists of a number of neighbourhoods, each connected to the railway station and the adjoining town centre by tree-like systems of direct cycle routes. Cars can enter each neighbourhood by way of an access road from a ring road that encircles the town. Access roads are split up as soon as they enter the neighbourhood, keeping the car traffic volume within the neighbourhood low and therefore compatible with the needs of ordinary, human-powered road users of all ages. Streets are designed to keep speeds low (30 kilometres per hour or less) while cars going from one neighbourhood to another, or from a residential area to the town centre, have to return to the ring road on the edge of town. This makes the cycle route shorter than the motorized route for virtually every trip, and as a result, cycling and walking account for a larger share of the modal split within the town.

Source: Foletta and Field, 2011.

increase in NMT use, enhancing urban landscape aesthetics and boosting the social function of public spaces.[39]

In the absence of strong policy support for NMT, the requisite infrastructure is not created

In general, with competition for space, speed and infrastructure, cyclists and pedestrians are disadvantaged in most cities globally. Although NMT sustains and complements public transport as a key feeder service, it is seldom integrated with it and receives rare media coverage.[40] In the absence of strong policy support for NMT, the requisite infrastructure is not created, resulting in a more hostile environment with higher rates of fatal accidents and an overall decline in cycling. This downward trend is enhanced by the fact that most NMT users, at least in developing countries, use NMT due to the lack of affordable alternatives; they are captive low-income users. There is thus a social stigma against using NMT as it is seen as the travel mode of the poor.

The use of NMT in cities generates numerous social, economic and environmental benefits

Impacts of non-motorized transport

The use of NMT in cities generates numerous social, economic and environmental benefits (Table 2.1).[41] Indeed, the existing evidence has consistently shown that the benefits of expanding NMT use outweigh the related costs by large margins. For instance, in Amsterdam (the Netherlands) the overall benefit–cost ratio of improving bicycle infrastructure was estimated to be 1.5:1 while similar calculations for Delhi (India) and Bogotá (Colombia) estimated the ratio to be 20:1 and 7:1, respectively.[42]

A major advantage of NMT is that it reduces energy consumption, greenhouse gas emissions and pollution (air, water and noise) substantially, as it does not rely on fossil fuels unlike other modes of transport in cities (see Chapter 7). Furthermore, as NMT requires significantly less road space and parking, it enables the preservation of natural habitats and open spaces. Cycling and walking can also directly provide the daily physical activity required for a healthy lifestyle. Negative health impacts have been observed where the share of NMT in urban areas is encroached by motorization.

Importantly also, the movement of passengers through NMT supports urban livelihoods in developing-country cities. For instance, 20 per cent of the population in Dhaka, Bangladesh, rely on rickshaw pulling for their livelihood,[43] while figures of 5–10 per cent have been reported in the Indian cities of Kolkata, Chennai, Delhi and Hyderabad. This source of livelihood is particularly important in smaller cities with limited public transport services and narrow streets.

Yet, despite generating enormous benefits in cities, NMT is constrained in a number of ways. Perhaps most critical is the risk of injury, with pedestrians and cyclists constituting more than 27 per cent of those killed in road traffic accidents globally, rising to a third in low- and middle-income countries.[44] Globally, 400,000 pedestrians are killed annually and vulnerability is accentuated in specific regions such as Africa where 38 per cent of those killed in traffic accidents are pedestrians.[45]

NMT faces the added challenge of being marginalized in urban planning and investments, partly due to an absence of adequate information and data. External loan financing in many developing countries tends to favour large projects, metro systems and BRT systems. Data on NMT are also often under-presented in transport data, resulting in low

Table 2.1
Non-motorized transport benefits

User benefits:	Increased user convenience, comfort, safety, accessibility and enjoyment as well as savings from reduced vehicle ownership and use.
Equity objectives:	Benefits economically, socially or physically disadvantaged people.
Congestion reduction:	Reduced traffic congestion from private cars on congested roadways.
Roadway and parking cost savings:	Reduced roadway and parking construction, maintenance and operating costs.
Energy conservation:	Economic and environmental benefits from reduced energy consumption.
Pollution reduction:	Economic and environmental benefits from reduced air, noise and water pollution.
Land-use impacts:	Encourages more accessible, compact, mixed, infill development (smart growth).
Improved productivity:	Increased economic productivity by improving accessibility and reducing costs.

Source: Adapted from Litman, 2013.

planning priority given the reliance of policy-making on mobility data.[46] Pedestrians and cyclists may thus be easily overlooked in planning at the expense of motorized transport.

Related to the above, the negative public image of NMT, especially in developing countries, is an additional factor in its neglect in planning.[47] Among users themselves the stigma of poverty leads many to shift to motorized transport when their incomes rise. For authorities, development and modernity is associated with technology and motorized transport. Promotion of NMT may thus not be considered commensurate with development.

FORMAL PUBLIC TRANSPORT

This section reviews the trends and conditions of public transport globally. The discussion focuses on services which can be considered as formal according to the way they are organized or operated to maintain a level of service, quality, routes, timetables and fare structures. High-capacity public transport services by bus or rail – which has significant potential to enhance urban accessibility in developed and developing countries alike – are examined in greater detail in Chapter 3, while informal transport is reviewed separately later in this chapter.

Overall, the growth of public transport in some cities of developed countries and stagnation and decline in cities of developing countries is highlighted, noting the consequences of restricted financial investments. The environmental, social and economic benefits of public transport are outlined, while the desirability of attracting choice riders to public transport is discussed together with experiences and challenges of achieving this.

Developing countries

The modal share of public transport has decreased or stagnated in most developing-country cities, and few efficient formal public transport systems remain. Public transport is typically operated by a growing number of entrepreneurial individuals or small/medium-sized companies, but with low investment and minimal public support. Public transport in these cites has been characterized by weak regulation, scarcity in supply, poor quality and the predominance of informal sector operators. Subsequent formalization occasionally occurs through aid-financing arrangements, for instance through trust funds guaranteeing credit lines for vehicle purchase, as in Dakar (Senegal), Johannesburg (South Africa) and Lagos (Nigeria).[48]

Some encouraging trends have, however, been observed. In Africa, BRT systems have been introduced in Lagos (Nigeria) and Johannesburg (South Africa), generating substantial benefits for residents.[49] BRT lines are under construction or planned in other African cities such as Dar es Salaam (Tanzania), Accra (Ghana) and Kampala (Uganda). The supply of public transport services is also increasing in North Africa, with light rail and tram systems available in Cairo, Casablanca, Rabat, Algiers and Tunis. Metro systems are now servicing the population in Cairo (Egypt) and Dubai (United Arab Emirates).[50] Perhaps most notable are China's growing investments in metro and BRT systems, servicing millions of passengers in urban areas.

Latin America has relatively good formalized public transport with stronger institutions in planning and management, while the private sector plays an increasingly important role in cities such as Montevideo (Uruguay), Bogotá (Colombia) and Rio de Janeiro (Brazil). A growing number of urban BRT systems in Brazil, Chile, Ecuador, Peru and Venezuela have expanded public transport services significantly.

Beyond mainstream formal public transport services, a number of other modes exist in developing-country cities, depending on the context-specific nature of transport challenges and opportunities. Waterborne transport also serves a number of cities in developing countries. In Mombasa (Kenya), the Likoni ferry crossing serves over 200,000 passengers and 3500 vehicles daily.[51] The Chao Phraya express-boat company in Bangkok (Thailand) transports 11 million passengers annually.[52] In Colombia, Medellin's aerial cable car (Metrocables) moves up to 3000 passengers per hour and has been hailed as an innovative and high-impact solution that has dramatically transformed access to public transport for inhabitants of informal settlements built on steeply sloping terrain and hillsides.[53]

Developed countries

Most cities in developed countries are maintaining or increasing the market share of formal public transport. In North America and Western Europe, the annual number of public transport passengers has been increasing since the 1960s and 1970s, despite rising car ownership and suburban sprawl.[54] Yet, this overall increase masks differences between and within cities (or countries), as well as the low growth of public transport relative to other modes of transport.

Levels of public transport use per capita range from highs of 237 trips per person annually in Switzerland to only 24 trips per capita annually in the US.[55] Although North America's public transport ridership is slowly growing – especially light rail and quality bus services in cities that have invested in public transport (Toronto, Edmonton and Vancouver in Canada and Portland in the US)[56] – the modal share of public transport remains marginal in comparison

Data on NMT are also often under-presented in transport data, resulting in low planning priority given the reliance of policy-making on mobility data

The modal share of public transport has decreased or stagnated in most developing-country cities, and few efficient formal public transport systems remain

Latin America has relatively good formalized public transport with stronger institutions in planning and management, while the private sector plays an increasingly important role

Figure 2.5

Percentage of daily trips by public transport, selected cities in Europe, US and Australia (2001 data)

Source: UITP, 2006.

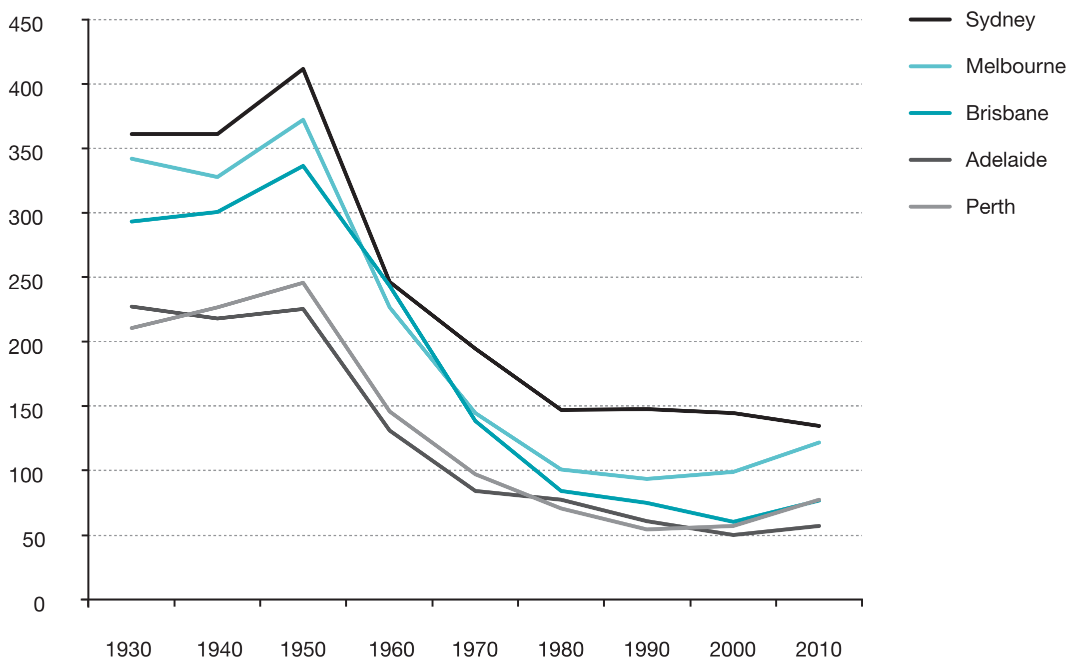
to European countries. A significant proportion of the daily trips in European cities like Vienna (Austria) and Helsinki (Finland) are by public transport, but far less so in Melbourne (Australia) and Chicago (US) (Figure 2.5). The dramatic overall decline in the importance of public transport in Australia since the first half of the last decade has been attributed to increased motorization (Figure 2.6).

Good service provision and quality infrastructure in many European cities allow public transport to be a lifestyle choice, enjoying increased patronage, especially for short inner-city trips, although constraints for women, children and the elderly have been noted. In Vienna, Austria, for instance, 96 per cent of residents live within walking distance of a public transport stop, formal public transport use is high, and the city is consistently rated highly for quality of life.[57] In Europe, there are 45 metro systems transporting 9.9 billion passengers annually while 189 light rail and tramways transport 10.4

Figure 2.6

Annual public transport passenger trips per capita, Australia (1930–2010)

Source: Cosgrove, 2011.



billion passengers annually.[58] Tramway use is seeing a revival in developed-country cities, especially in France, Spain, Portugal and the UK, but also in North America and Australia. Globally, the number of cities with trams had risen to 400 in 2011(compared to 300 in 1980), and another 100 systems were under construction or being planned.[59] In Eastern European countries the use of public transport remains much higher than in the rest of Europe, despite the debilitating effects of the end of communism on public transport services and use. Nevertheless, the dense urban rail and trolleybus systems created by the centralized socialist economies have been largely neglected and dilapidated amid rapid motorization and urban sprawl.[60]

In terms of the regulatory aspects of public transport provision, there has been a notable global shift from publicly owned provision to a privately owned market-driven approach since the 1980s (Table 2.2). A separation of organizer, operator and infrastructure functions has occurred such that public authorities now oversee, rather than organize or deliver, public transport. In the European Union (EU) for instance, there has been a strong drive for the deregulation of transport provision. One of the earliest experiences, which would later influence the rest of Europe, was the deregulation of the public transport market in the UK,[61] with private operators now providing more than 80 per cent of bus services outside London, leading to both improvements and setbacks.[62]

Despite some notable achievements in the expansion of public transport services, the wider picture is fragmented, with disparity in provision between regions and countries, and between capitals and non-capital cities. There are limited statistics on public transport operations in cities of developing countries, making comparison difficult.

In terms of the regulatory aspects of public transport provision, there has been a notable global shift from publicly owned provision to a privately owned market-driven approach since the 1980s

Table 2.2

Global overview of structure of formal public transport

Region	Trends	Regime	Comment
Western Europe *Average market share:* 15–20% *High share cities, e.g.:* Zurich, Switzerland 44% Vienna, Austria, 37%	Stagnation or slight growth in market share. Growth in trip numbers. Decrease in suburban areas.	Liberalization. Increasing competition. Cities often regulated or run by multi-modal public monopolies. Consolidation of major players.	Improved fare box recovery, reduced subsidies. Tension between authorities and operators may detract from social objectives.
Transitional European countries *Average market share:* 50% *High share cities, e.g.:* Warsaw, Poland, 69% but declining	Strong reduction in market share.	Deep reform, introduction of competition, separation of organization and operations. Private sector interest emerging.	Great financial stress, low quality, poor image.
North America *Average market share:* Low	Stagnation or slight growth in market share. Growth in trip numbers.	Publicly operated, federal support for infrastructure, local tax co-funding. Some recent private sector involvement.	Slow service delivery improvements in some places. Deficient fare box recovery. Serious financial stress.
High-income Asian countries (Japan, Singapore, Hong Kong) *Average market share:* 70–90%	Continued investment, expansion and more transport demand measures being put into place.	Mainly private operations. Competitive market. Local private players.	Some operators becoming global players. Some major private sector international groups moving in.
Emerging Asian countries (e.g. India, China, Republic of Korea)	Strong investment in public transport.	Reform to public sector. Introduction of new regimes.	Reform, increased financial incentives, improvement hampered by political interests.
Low-income Asian countries (e.g. Philippines, Indonesia, Malaysia) *Average market share:* Very low (data difficult to obtain)	Loss of market share. Losing ground to informal sector.	Weak and floundering public sector. Few private operators outside informal sector.	Renewed political interest but progress slow.
Middle East and North Africa *Average market share:* Almost zero.	Strong political support. Slow change in perception from low class to lifestyle choice.	Mainly private operations with regulation from newly created bodies.	Ambitious integrated networks being rapidly implemented.
Sub-Saharan Africa *Average market share:* <5%	Almost complete absence of formal public transport.	Informal and ad hoc. Often lacking minimum quality and infrastructure. Quality can be associated with switch to formal.	Public transport dominated by informal sector. New emerging systems include inclusion of the informal sector.
Latin America *Average market share:* 70% but declining.	Losing market share with growing car affordability. Significant interest.	Mainly private companies. Strong private owner associations.	Interesting new models and examples emerging that are appropriate for South/South transfer.

Source: Heather Allen, International Association of Public Transport, September 2011.

Infrastructure for public transport

Globally, there has been a lack of adequate investment in public transport.[63] In most developing countries, urban public transport infrastructure is far from adequate and in poor condition.[64] The existing infrastructure is often derelict and poorly maintained, which in turn compromises not only the quality of service, but also the health and safety of passengers. Previously subsidized public transport services have also been scaled back or discontinued amid policies of liberalization and economic reform in some developing countries. In Africa, publicly owned and managed public transport entities were disbanded in the 1990s owing largely to structural adjustment policies, leading to years of neglect since then and the dominance of informal transport operations.[65]

In most developing countries, urban public transport infrastructure is far from adequate and in poor condition

The provision of public transport infrastructure is comparatively better in cities in some key emerging markets, such as South Africa and Brazil

Investments required for urban public transport services can be prohibitively high for developing countries, as in the case of rail-based transport that costs millions of dollars per kilometre.[66] Furthermore, the spending on roads for private motorized transport remains far higher than on dedicated public transport infrastructure in developing countries (see for example the case of Africa in Figure 2.7). Much of the overseas development assistance received by developing countries has focused on road building, although this approach is now slowly changing in favour of investments in more socially sustainable modes.

The provision of public transport infrastructure is comparatively better in cities in some key emerging markets, such as South Africa and Brazil (Figure 2.8). The increased availability of bus transport services in most metropolitan areas of India – as a result of measures taken under the Jawaharlal Nehru National Urban Renewal Mission – has been noted, but the services remain unreliable, time-consuming and overcrowded.[67] The hosting of international events has also driven major public transport investments in cities such as Johannesburg (World Cup, 2010), Beijing (Olympics, 2008), Shanghai (World Expo, 2010), Delhi (Commonwealth Games, 2010) and Rio de Janeiro (World Cup, 2014).[68]

In contrast, many cities of developed countries have seen investment and improving services,[69] increasingly through public–private partnerships. During the 1990s average investment remained at 0.45–0.5 per cent of urban area GDP, with the higher levels in Madrid (Spain), Lisbon (Portugal), London (UK), Berlin (Germany), Vienna (Austria), Oslo (Norway), Prague (Czech Republic) and Lille (France).[70] Investment was also sustained in high-income Asian countries, particularly in Singapore, Tokyo (Japan) and Hong Kong (China).[71]

Impacts of formal public transport

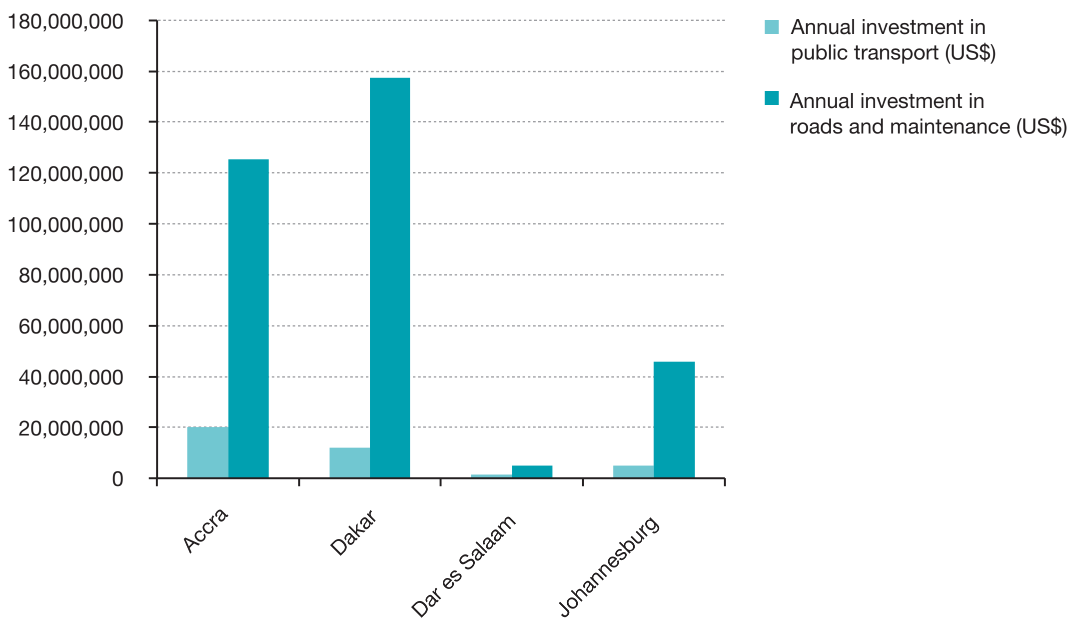
Public transport systems significantly influence the economic, environmental and social fabric of urban life in positive ways, and form a key prerequisite for the sustainable city of the twenty-first century. This mode of transport moves more people with fewer vehicles, less energy and smaller space consumption. Notable among positive environmental impacts are lower emissions of airborne pollutants and greenhouse gases (see Chapter 7).

The economic benefits of public transport investment include both direct job creation and indirect support of manufacturing, construction and other economic activities. An investment of US$1 billion in public transportation supports 36,000 local jobs in the US.[72] People living near public transport services work more days annually than those without such access, while public transport com-

Figure 2.7

Transport investments in Africa (2008)

Source: UITP and UATP, 2010.



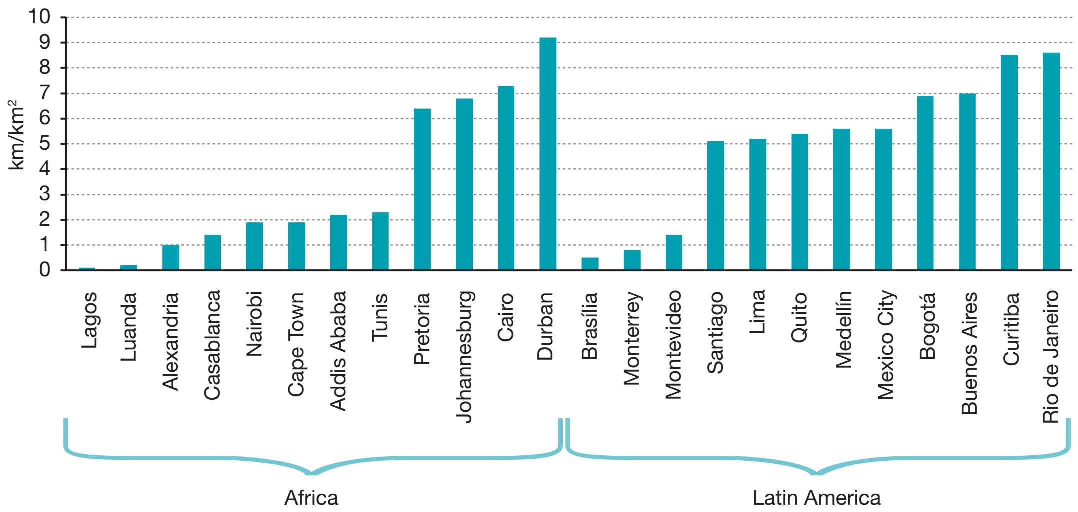


Figure 2.8

Length of public transport networks, selected cities in Africa and Latin America

Note: Includes dedicated public and private bus routes, in kilometres per square kilometres of city area.

Sources: EIU and Siemens AG, 2010 and 2011.

muters often report that they would not continue in current jobs, or would earn less, without public transport services.[73] A UK Government study showed that 13 per cent of respondents had not applied for a particular job in the previous 12 months due to transport problems.[74] Furthermore, the economic benefit of a modal shift to public transport can be substantial. In the US, it has been estimated that the annual economic savings to consumers would exceed the cost of strategies to encourage such a shift by approximately US$112 billion.[75]

Public transport investments via subsidies can have a broad effect. Subsidized student and school-child use (e.g. low-priced student tickets in Western Europe) can provide guaranteed revenues on uneconomic routes, as in the case of Germany.[76] In the US, many universities provide reduced-fare tickets. Salt Lake City's TRAX light rail system in this way serves the University of Utah with 45,000 travellers a week, or 33 per cent of total travel to the campus.[77]

In social terms, access to jobs, education, health services and other facilities is increased by public transport provision; these are central to social inclusion for the disadvantaged. Furthermore, public transportation also supports community cohesion by increasing the quantity and quality of interactions between people.[78] For the youth, public transport offers a means of travelling independently, and in some cases this can delay the desire (or need) to drive private motorized vehicles.

Public transport tends to increase physical activity as most trips include walking or cycling links.[79] Users average about three times as much walking as people who rely on private cars, nearly achieving the 22 daily minutes of moderate physical activity considered necessary for health reasons.[80] Public transport passengers also have about one-tenth the fatality rate of car occupants and, in terms of risks to other road users, public transport causes less than half the number of deaths per passenger-kilometre compared to private cars.[81]

The economic benefit of a modal shift to public transport can be substantial

The limited availability of financial resources for the provision of public transport services is a key constraint. Often, only a fraction of the necessary improvements can be implemented from the public purse. This has ramifications for both service levels and quality. Under such circumstances, retaining existing public transport customers, while gaining new ones, becomes particularly difficult. Projections on future population growth and motorized travel amid a lack of road capacity, suggest that if public transport does not double its modal share, many cities may well grind to a halt.

The challenge is to convert congestion into public transport riders, and overcome dependency on private cars. Yet, an important precursor to increasing such ridership is the provision of high-quality services, as clients value aspects such as connectivity and coordination of services, while flexibility and trip-chaining is also important, particularly for women.[82] Qualitative factors such as convenience, comfort, security and prestige are valued more highly than is assumed by a conventional focus on quantitative factors such as speed and price.[83] Focusing investments on improving quality of services may thus be even more effective than eliminating public transport fares (Box 2.3).

Projections on future population growth and motorized travel amid a lack of road capacity, suggest that if public transport does not double its modal share, many cities may well grind to a halt

Security and safety concerns are a barrier for public transport use by children, women and the elderly (see Chapter 6). overcrowding can expose travellers to undesirable behaviour in fellow passengers, and some cities do offer segregation of services such as in Mexico City (Mexico), Tehran (Iran) and Dubai (United Arab Emirates), where there are designated women's areas on public transport. Also, although children and youth are high user groups, keeping these as choice riders as they get older is not easy if public transport is low quality and perceived as old fashioned.[84]

Box 2.3 Zero-fare public transport?

Would zero-fare public transport systems 'even the playing field' and encourage travellers to shift from cars to public transport? Would free public transport be good for society, particularly lower-income or disadvantaged people?

Concession fares are an example of addressing these social objectives through partial subsidy. In a zero-fare public transport system the entire cost of the system is subsidized. The passenger does not directly pay for the trip, the most obvious result being that people are more likely to use public transport, as has been the case in Hasselt, a small city in Belgium. A similar system associated with tourism is in place in Melbourne, Australia. In Tallinn, Estonia, zero-fare public transport for all its 420,000 inhabitants on all public transport services run by the city from 1 January 2013 is expected to significantly increase ridership.

However, meeting dramatically increased demand in large systems would require considerable capital investment. If funds were instead used to increase service levels, perhaps new passengers may be attracted while maintaining income from existing passengers. The income from new passengers may then at least partially offset the costs of the improved service.

Sources: Brown et al, 2001; van Goeverden et al, 2006; Royal Institute of Technology, 2012.

The value of expanding public transport services to enhance accessible mobility in cities is unquestionable. Urban planning and land-use policies – together with transport demand and fiscal measures – can encourage a shift in transport behaviour towards public transport. Authorities in many cities may, however, lack the resources and institutional capacity necessary to coordinate land-use and transport planning so that they generate such a modal transition.

Urban planning and land-use policies – together with transport demand and fiscal measures – can encourage a shift in transport behaviour towards public transport

INFORMAL TRANSPORT

The informal sector – a term describing small-scale economic activity and unregulated employment – supplies small-vehicle, low-performance services that fill the niche between formal taxis and conventional 50-passenger capacity buses.[85] This section examines the conditions of informal transport globally, illustrating the dominance of this mode in developing countries. Informal transport is often the only accessible means available in many of the world's poorest cities. Although it provides important benefits to the urban poor, informal transport contributes significantly to congestion, air and noise pollution and traffic accidents. The role of informal transport in complementing formal transport and in generating broader social benefit is considered together with the costs entailed.

Informal transport is firmly entrenched in developing-country cities, often accounting for over half of all motorized trips

Developing countries

Informal transport is firmly entrenched in developing-country cities, often accounting for over half of all motorized trips. In Africa, private carriers dominate, mainly minibuses and shared taxis with schedules and fares varying with demand, routes being semi-fixed and stopping points unregulated. The City of Nairobi (Kenya) has the world's highest per capita use of informal transport with *matatu* minibuses providing 662 trips per inhabitant per year, three-quarters of public transport trips and 36 per cent of traffic volumes. In Harare, Zimbabwe, minibuses serve around 90 per cent of the market.[86] In Algiers (Algeria) the modal share for taxis and minibuses is 56 per cent of motorized trips,[87] while in Greater Cairo, Egypt, informal shared taxis increased their modal share (of motorized trips) from 6 per cent in 1987 to 37 per cent in 2001, and this has since risen even higher.[88]

In Lagos (Nigeria) the public-sector bus company failed under the weight of low fares and unsustainable subsidies, its mobility role taken over by *danfos*, midi-buses providing frequent and affordable services, but characterized by overcrowding and aggressive driving.[89] A fast growing informal mode is motorcycle taxis, with 60,000 of them in Cotonou (Benin) accounting for one-quarter of all trips.[90] In Kampala, Uganda, residents resort to *boda boda* motorcycle taxis, despite fares being four to six times higher than regular taxis.[91] The lower investments required from operators of informal transport services are a key incentive for entry into this sector.

Formal public transport is often absent in many Asian cities. In Istanbul, Turkey, an estimated 5000 illegal taxis were in operation by the year 2000.[92] In Sana'a, Yemen, public transport is almost entirely reliant on informally operated vehicles, often old and poorly maintained, posing safety, health and congestion challenges for the city.[93] Minibuses and microbuses serve 5–10 per cent of all trips in Thailand and Indonesia. Informal vehicles, dominated by the colourful *jeepneys* (converted US army jeeps) provide as many as half of all trips in the Philippines.[94] While NMT serves short-distance trips in Jakarta, Indonesia, motorcycle taxis (*ojeks*) cover longer distances. Hybrid, three-wheeled motor-taxis, *bajas*, provide comfort more akin to a private car, while larger three-wheeled *bemos* carry up to eight passengers, and *mikrolets* and minibuses carry 10 to 25 passengers.[95] The rapid expansion in auto-rickshaws has been observed in numerous Asian and African cities in recent years (Box 2.4).

Informal transport is a predominant mode in most of Latin America, with the proliferation of vans and minibuses fuelled by a lowering of import tariffs and the inability of public transport to meet transport demand. A flood of 10 to 15 passenger vans in the 1990s displaced *pirate* buses in Rio de Janeiro, while today an estimated 15,000 unlicensed vans operate in São Paulo.[96] The use of unlicensed vans in Brazil is also tied to perceived arduous and overreaching registration procedures. In Santiago, Chile,

Box 2.4 Auto-rickshaws: Taxis for the poor and middle class

An auto-rickshaw or three-wheeler (variously known as *tuk-tuk*, *trishaw*, *autorick*, *chakda*, *vikram*, *tempo*, *bajaj*, *tricycle*, *baby taxi*, etc.) is a popular way to get around in many developing countries. These motorized versions of the traditional rickshaw flourish in Bangladesh, Cambodia, Egypt, Ethiopia, Guatemala, India, Laos, Pakistan, the Philippines, Sri Lanka, Sudan and Thailand. In many Indian and Pakistani cities, motorcycle rickshaws – usually called *phat-phati*, *chand gari* (moon car) or *qingqi* (after the Chinese company) – also populate city streets. In Afghanistan, auto-rickshaw use is growing at 10 to 20 per cent per year in many cities. Auto-rickshaws are also an important source of employment, providing as much as 15 per cent of total urban jobs in some Asian cities.

Because two-stroke engines that power most auto-rickshaws are noisy and emit high levels of air emissions, local governments in India and Pakistan have in recent years required that older models be replaced by cleaner and quieter three-wheelers, powered by compressed natural gas.

Sources: Cervero, 2000; Jain, 2011.

some 30,000 pirate taxis ply the streets. In Kingston, Jamaica, private station-wagons (called *robots*) poach customers from public operators by running ahead of buses.[97] In Mexico City, around half of the mini-bus operators are not legitimately licensed or insured. Smaller door-to-door carriers concentrate on out-lying markets, such as in Bogotá, Colombia, where *tricimobiles* in peripheral informal settlements serve short trips of 1–2 kilometres at low costs (less than US$0.50 per trip).[98] Because of rapid motorization, however, informal carriers are increasingly viewed as major contributors to worsening traffic congestion.

Informal transport operators in developing countries serve not only low-income markets but also middle-income choice consumers looking for convenience (e.g. door-to-door, taxi-like services).[99] Low-income users also seek service quality, as in the case of Uzbekistan, the Kyrgyz Republic and Brazilian cities where surveys show that the poor are willing to pay more for better services.[100] Furthermore, there are notable gender and age differences in the use of informal transport in cities, with minibuses catering to larger volume, longer distance trips, generally serving male customers. Motorcycle taxis often cater to a younger crowd. Nearly two-thirds of the motorcycle-taxi passengers in Bangkok, Thailand, are aged 16–25 years.[101]

Generally, the role of informal transport appears to decline as cities in developing countries become wealthier. For instance, the market share of informal transport in nine cities in Sub-Saharan Africa shows a negative correlation with local GDP per capita levels (Figure 2.9). This inverse relationship between wealth and informal transport can at times prompt public authorities to ban them in the hope of conveying a modern image.

Informal transport services are nowhere near as vertically organized as formal services. Often, individual owner-operators provide the service, and the sector is normally held together in a loose horizontal fashion, dependent upon inter-personal and inter-operator linkages and fellowship among stakeholders (Box 2.5).

Some developing countries attempt to regulate market entry, vehicle and driver fitness and service practices with respect to informal transport. For example, in Nairobi, Kenya, the Ministry of Transport enforced that all seats be fitted with seatbelts in minibuses, while standing is no longer permitted on larger buses.[102] Red plates distinguish the 55,000 legitimate shared-ride taxis of Beirut, Lebanon, although around 40 per cent of the plates are forged.[103] However, circumvention of such regulations is widespread and enforcement is often hampered. Thus, in many poorer countries, governments acquiesce to self-regulation and self-policing of informal transport. Indeed, many informal operators often form route associations to minimize collectively damaging behaviour and to increase ridership and profits.

Informal transport operators in developing countries serve not only low-income markets but also middle-income choice consumers looking for convenience (e.g. door-to-door, taxi-like services)

Generally, the role of informal transport appears to decline as cities in developing countries become wealthier

Box 2.5 Minibus operators in Kampala (Uganda) and Nairobi (Kenya)

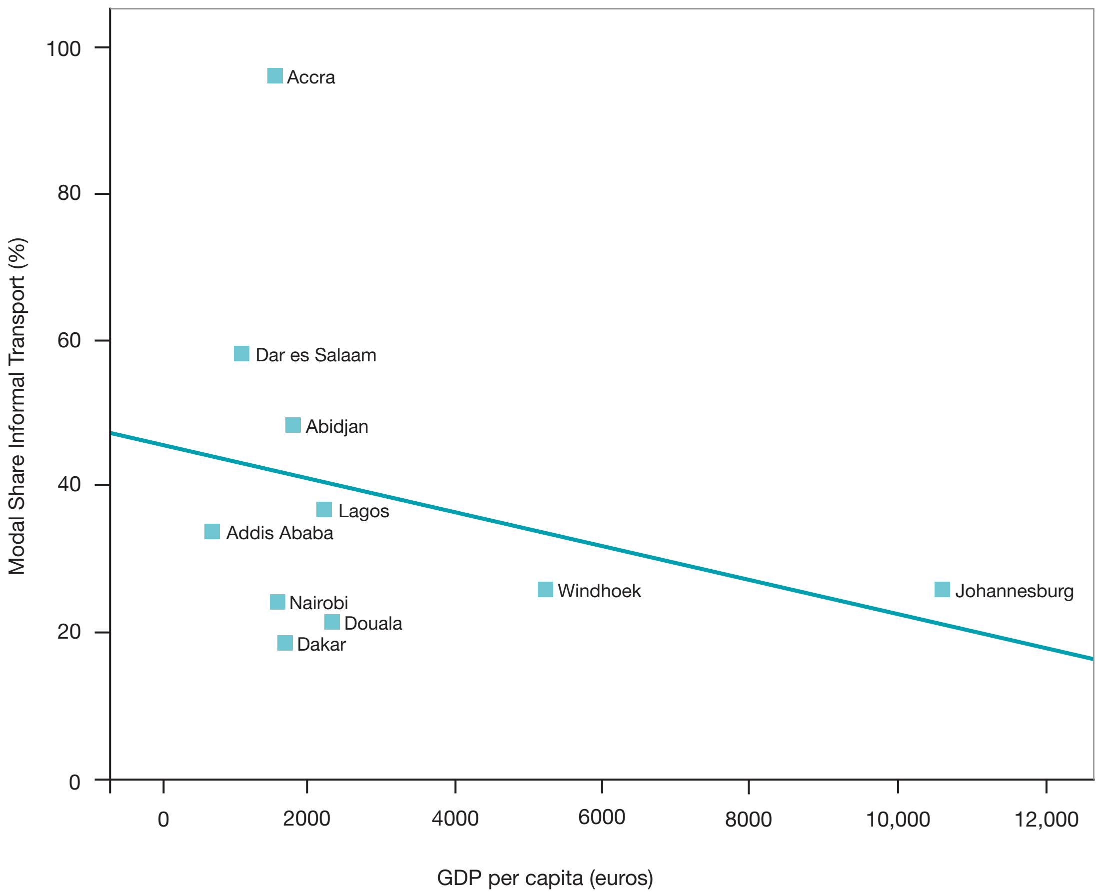
In Kampala and Nairobi, it is normal for minibus owners to be investors rather than owner-drivers. Most owners have less than four vehicles. They usually hire out their minibuses for a daily fee to a principal driver, who may in turn employ a second driver and one or more conductors. The driver keeps the revenue collected but is responsible for paying the costs of fuel, use of the minibus terminals, the wages of any second driver and conductors, as well as any fines extorted from him by the police or the route associations. Drivers work very long hours, with shifts averaging more than 12 hours a day, usually for six or seven days a week, although actual driving hours are normally seven to eight hours. So as to maximize the revenue from each trip, the minibus driver will not normally leave the terminal until the vehicle is full. This means that at off-peak times vehicles wait very long times at the terminal.

Sources: Gleave et al, 2005; Pirie, 2011.

Figure 2.9

Informal transport market share and GDP per capita in ten selected cities in Africa

Source: UITP, 2010.



Deliberate re-regulation of public transport has . . . been observed in some developing countries

Deliberate re-regulation of public transport has also been observed in some developing countries. Responding to faltering public bus services, the local government of Kingston, Jamaica, opened the marketplace to private service providers in the 1990s, only to experience a deluge of illegal minibus operators who flagrantly violated traffic rules. A single government-controlled bus company was consequently reintroduced, although illegal minibuses still persist. In Dakar, Senegal, re-regulation similarly followed the declining quality of private paratransit services. With the help of overseas development assistance, an organizing authority was created and resourced to upgrade the minibus fleet and grant tightly controlled concessions to private companies. In Nairobi, Kenya, *matatu* minibuses are being phased out in the central business district in favour of larger vehicles (25 seats and more), operated by larger, more closely regulated owner-driver 'societies'.

Paratransit offers distinct service advantages, and in most developing countries – where formal public transport is limited or non-existent – it is often the only dependable service available

Developed countries

Many cities of developed countries also have informal transport services, often as niche markets for immigrants from countries with a legacy of informal transport. Some car-owning lower income families also supplement their income by operating 'under the radar'.[104] Unlicensed illegal limousine services may poach unsuspecting visitors leaving airports. In Miami and New York (US), informal services thrive as trusted and familiar alternatives to city services, particularly in areas with dense neighbourhoods of people with similar cultural backgrounds, high levels of immigrants and non-native speakers. Over 5000 illegal vans and private cars are estimated to roam the streets of Manhattan and Brooklyn.[105] Other examples include the 'black cabs' of Belfast (UK) and the 'little Cuba cabs' of Miami (US) operating in low-income neighbourhoods ignored and sometimes redlined by authorized operators.

In Eastern Europe, informal transport began to play an increasingly important role in the 1990s, following the disbanding and weakening of state-run public transport enterprises. For instance, in Tirana, Albania, ten-seat minivans called *furgons* emerged as a key form of transport in 1999, even surpassing the service of formal buses on some inner-city routes. Despite being banned from the inner city, such transport continues to play a major role in the metropolitan region of Tirana, accounting for 14 per cent of all trips.[106]

Impacts of informal transport

Paratransit offers distinct service advantages, and in most developing countries – where formal public transport is limited or non-existent – it is often the only dependable service available. With fewer passengers per vehicle, paratransit is more frequent, thereby reducing waiting times and is also more flexible and adaptive by providing door-to-door service. Small vehicles are suited to lower density settings, serving polycentric trip patterns, functioning as complements to large-vehicle, trunk-line services. They also penetrate the narrow streets of low-cost neighbourhoods and better negotiate congested traffic, and are thus faster, often offering a smoother ride and a guaranteed seat. Vehicles used for informal transport can also be more energy efficient, owing to higher load factors. In Abidjan, Côte d'Ivoire, minibuses use an average of 12 per cent less fuel per passenger trip compared to conventional buses.[107]

The greatest appeal of paratransit is that it is financially remunerative. Driven by profit, operators respond quickly to market trends and economize on costs. By organizing into route associations and cooperatives they can lower per-seat costs to the point of being competitive with larger companies.[108] Data from minibus operations in Abidjan (Côte d'Ivoire), Dakar (Senegal) and Douala (Cameroon) reveal sizeable profit margins, fare-box revenues exceeding operating costs by 17–96 per cent.[109] In Johannesburg (South Africa), the operating cost per passenger of formal public transport is estimated to be 13 times higher than informal transport.[110]

Importantly also, the informal sector is a significant gateway employment for many recent immigrants, making up an estimated 15 per cent of total employment in poor countries. In Dhaka, Bangladesh, the figure is close to 30 per cent.[111] In Cotonou, Benin (with just under 1 million inhabitants), motorcycle taxis alone provide 60,000 jobs, mostly for young men.[112] Indirect employment is also significant, as touts, changers (who provide small change) and a cadre of individuals who clean, maintain, repair and rebuild informal carriers.[113] Most motorcycle taxi operators in Bangkok (Thailand), Jakarta (Indonesia) and Yola (Nigeria) are rural migrants with no previous urban employment.[114]

While playing a critical role for the mobility of many urban residents, the informal transport sector faces a number of constraints.[115] A key challenge faced by operators relates to accessing commercial lines of credit. In the Caribbean and Sub-Saharan Africa, banks are reluctant to lend to informal operators. If they do, interest rates are often high (40 per cent or more per month) and payback periods short (three years or less). Unable to obtain credit through formal channels, some operators turn to street lenders, paying most of their daily earnings to creditors and rarely getting out of debt. Operators that lease vehicles pay to vehicle owners, often half or more of their daily in-take, meaning few are able to break out of poverty.[116]

Safety is an additional challenge, with accidents occurring because of poor (or lack of) driver training, inappropriate vehicles and poor maintenance. In Abidjan, Côte d'Ivoire, minibuses (*ghakas*) are involved in around 10 per cent of accidents and shared taxis in 25 per cent. In Yopougon, Côte d'Ivoire, shared taxis account for an estimated 90 per cent of traffic accidents and nearly all associated deaths in these accidents.[117] In South Africa, more than 2000 drivers, attendants and passengers died in paratransit-related violence during the 1990s, according to official statistics.[118] Informal operators rarely insure vehicles (or passengers), thus further aggravating accident impacts.

The informal sector is a significant gateway employment for many recent immigrants, making up an estimated 15 per cent of total employment in poor countries

In environmental terms, paratransit vehicles are significant atmospheric polluters due to two-stroke engines, excessive oil mixtures, low-grade fuels and poorly maintained engines.[119] In Cambodia and Laos, *tuk-tuk* three-wheelers still rely on two-stroke engines. In Thailand, most two-stroke engines have been converted to less noisy and polluting four-stroke engines, some cities experimenting with solar panel propulsion.[120] In much of Sub-Saharan Africa, motorcycle taxis emit from both two-stroke engines and excessive use of oil lubricant in fuels.

Without formal oversight, discrimination and harassment can be experienced by informal transport users. In Malawi and South Africa, women report fear of rape and high levels of verbal abuse.[121] Expectations that women sit side-saddle on motorcycle taxis can pose serious safety risks (Box 2.6). In the Middle East, cultural restrictions on haggling with male drivers means women often pay higher fares. Minibus routes focusing on work connections rather than domestic journeys – along with paying at each mode change – mean that Middle Eastern women pay more than men.[122] Young patrons are also vulnerable. In Dar es Salaam (Tanzania), some *dala dala* minibuses do not allow children to board during rush hours because government concessionary fares are seen as unprofitable.[123]

Corruption is frequently rife within the informal transport sector. Since most service providers are not fully licensed they must often pay bribes. In Dakar, Senegal, bribes to police officers by minibus drivers comprise 5 per cent of total operating costs.[124] In Thailand, Bangkok's *win* motorcycle taxi operators complain of protection payments to police officials and military officers.

Corruption is frequently rife within the informal transport sector

Another consequence of weak regulatory control is abuse of the labour market, seen through a disregard for minimum salaries, age limits, work-hour restrictions and insufficient or absent insurance, etc. Informal workers have few other employment options and are often in debt to vehicle owners who set high rents or provide high-interest loans.

Box 2.6 Gender differences in Nigerian motorcycle taxis

The worldwide economic recession and market liberalization policies from the 1990s have weakened an already struggling public transport sector across Nigerian cities. Buses routinely broke down, roads remained rutted and in very poor condition and formal services never reached the rapidly growing informal settlements on the urban fringes. Informal motorcycle and tricycle auto-rickshaw operators stepped in to fill the gap.

While viewed as just temporary fixes in the minds of public authorities, slowly but surely they have become firmly established as the backbone of Nigeria's urban public transport system. Flexible and market-responsive yet still too expensive for the poor, they predominantly serve more educated, somewhat better-off residents. A recent study of four intermediate-sized Nigerian cities showed that 85 per cent of such motorcycle passengers used the services four or more times a week, with slightly more women than men relying on such transport on a daily basis.

Over 95 per cent of the women surveyed stated that they adjusted their dress accordingly, compared to only 22 per cent of the men. Moreover, 83 per cent of the men were single passengers compared to only 8 per cent of the women, who frequently travelled with their infants and toddlers. Motorcycle fatalities have sharply risen across all cities in West Africa, including Nigeria. Records show that a higher number of females than male passengers were involved in three or more accidents per year. Dress and social norms have played a role in this; as women are expected to sit with two legs placed to the left of the motorcycle, which exposes them directly to traffic and a risk of being thrown off at bends or roundabouts. Children are equally vulnerable where they travel with women under such circumstances.

Sources: Oyesiku and Odufuwa, 2002, p.17; Peters, 2011.

PRIVATE MOTORIZED TRANSPORT

In 2010, there were 825 million passenger cars globally; . . . close to 70 per cent [of these] were in developed . . . countries

The growth of private motorized transport during the twentieth century had major impacts on the growth and development of cities all over the world. Pathways once charted in developed countries are now being followed in the rapidly growing cities of developing countries. This section reviews the global conditions and trends in the use of private motorized vehicles, and in the provision of infrastructure for the same. The externalities associated with private motor vehicles are considered while examining the advantages of private motorization.

In 2010, there were 825 million passenger cars globally. Of these, close to 70 per cent were in developed (including transitional) countries while only 30 per cent were in developing countries, mainly in Asia (Table 2.3). The number of light-duty motor vehicles – cars, SUVs, light trucks and mini-vans – is projected to increase to nearly 1.6 billion by 2035[125] and more than 2.1 billion by 2050 (Figure 2.10). Africa had the lowest ownership rates, accounting for only 3 per cent of all passenger cars globally. Nevertheless, motorization growth rates are higher in developing countries, as discussed below.

Globally, the number of new cars sold annually increased from 39 million in the 1990s to nearly 63 million in 2012.[126] Asia has seen a steady rise in new-car sales figures, from around 7 million in the 1990s to around 25 million in 2012, thereby becoming the leader in new-car sales, accounting for 40

Table 2.3

Global stock of motor vehicles and passenger cars (2010)

	Motor vehicles			Passenger cars			Passenger cars
	Total number	Per 1000 population (millions)	% of total	Total number	Per 1000 population (millions)	% of total	as % of all motor vehicles
TOTAL	**1047**	**159**	**100**	**825**	**125**	**100**	**79**
Developed countries	604	656	58	492	535	60	81
Transitional countries	98	303	9	83	259	10	85
Developing countries	345	64	33	249	47	30	72
Africa	35	40	3	26	29	3	74
Asia and Pacific	213	54	20	150	38	18	70
Latin America and the Caribbean	96	180	9	73	137	9	76

Note: The table is based on data from 164 countries from which data are available for both all motor vehicles (cars, buses and freight vehicles, but not two-wheelers) and passenger cars (motor vehicles, other than two-wheelers, intended for the carriage of passengers and designed to seat no more than nine people, including the driver). These countries account for about 96 per cent of the total global population. Data are the latest available during the period 2005–2010.

Source: Based on data from http://data.worldbank.org/indicator, last accessed 23 January 2013.

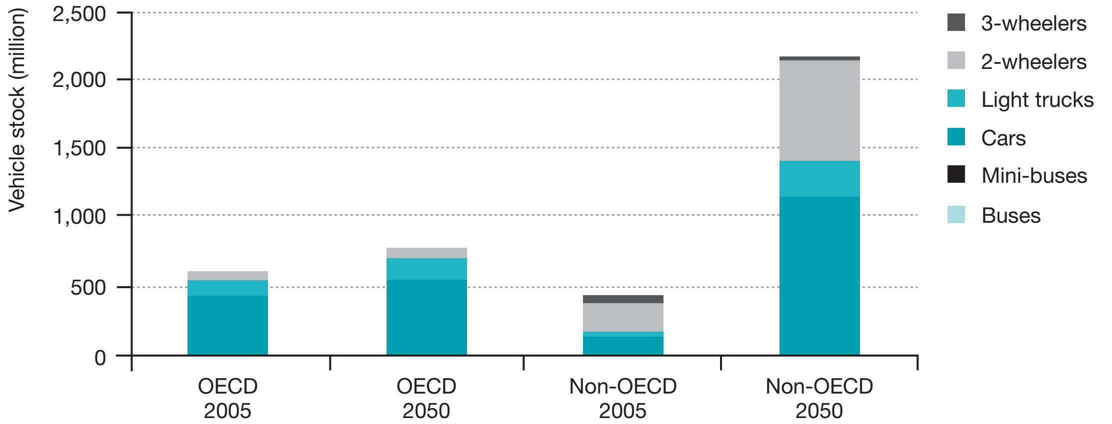


Figure 2.10

Total stock of motor vehicles, OECD and non-OECD countries (2005 and 2050)

Note: OECD = Organisation for Economic Co-operation and Development

Source: IEA, 2009.

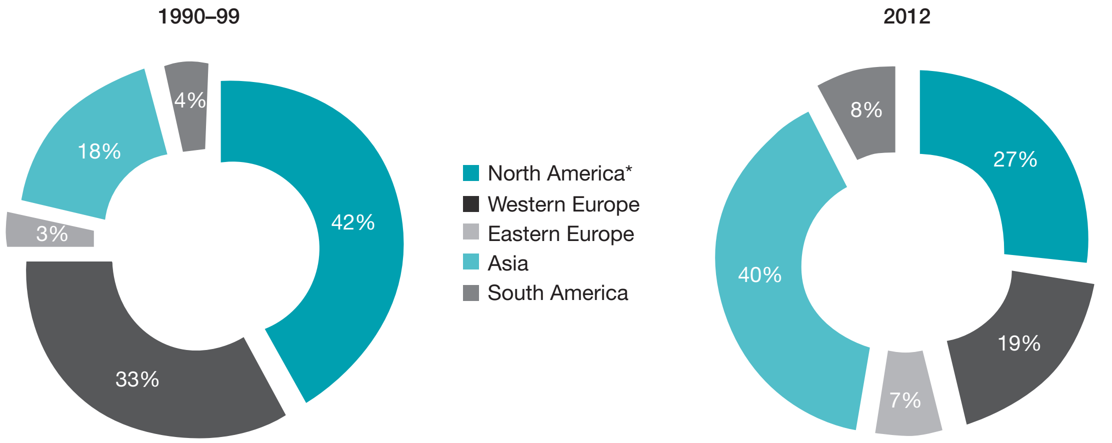


Figure 2.11

Global sales of new cars (1990–1999 and 2012)

*Note: * includes light trucks*

Source: Based on Scotiabank, 2013.

per cent of global sales in 2012 (Figure 2.11). The rapidly growing economies of Asia and South America are expected to continue driving massive future growth in new-car sales. It should here be noted that in many developing countries the bulk of newly registered cars are not new, but rather second-hand imports from developed countries.[127] Statistics on new-car sales are thus an unreliable basis for discussions on motorization levels in these countries.

Developed countries

Car ownership began to emerge as a phenomenon in the early twentieth century in the US, becoming widely available to the middle classes after 1920, and by the 1950s car ownership levels had reached an average of one car per household.[128] This was to have a significant influence on the spatial form of cities, allowing urban sprawl and facilitating the expansion of low-density suburban settlements in much of North America.[129] Within the framework of a government drive to provide affordable housing, land-use dispersal became a prominent feature of urbanization in the US, accompanied by growing car dependence.[130] Increased motorization occurred in other developed countries much later, but given higher population densities in Europe and Japan, public transport continued to play an important role. Indeed, both distances travelled and the number of trips by private car per capita are substantially lower in European countries compared to the US.[131]

Since 1990, vehicle ownership growth rates have been declining in a number of European countries such as Germany, France, Italy and also in Japan.[132] A non-linear relationship has been found between the growth of vehicle ownership and per capita income such that vehicle ownership grows slowly at lower levels of per capita income, then faster at middle and higher income levels reaching saturation at the highest levels of income.[133] In countries with high car ownership there is evidence that travel distances may have peaked, so that further increases in GDP are unlikely to lead to increased travel distances (Figure 2.12).[134] Factors such as higher fuel prices, an ageing population, improved travel options and health and environmental concerns contribute to a growing demand for alternative modes of travel in developed countries.[135]

In countries with economies in transition – following the move away from socialism and related market liberalization – car ownership rates doubled in just a decade (1990–2000). At the same time, these countries have experienced declining use of public transport, particularly due to the removal

In many developing countries the bulk of newly registered cars are not new, but rather second-hand imports from developed countries

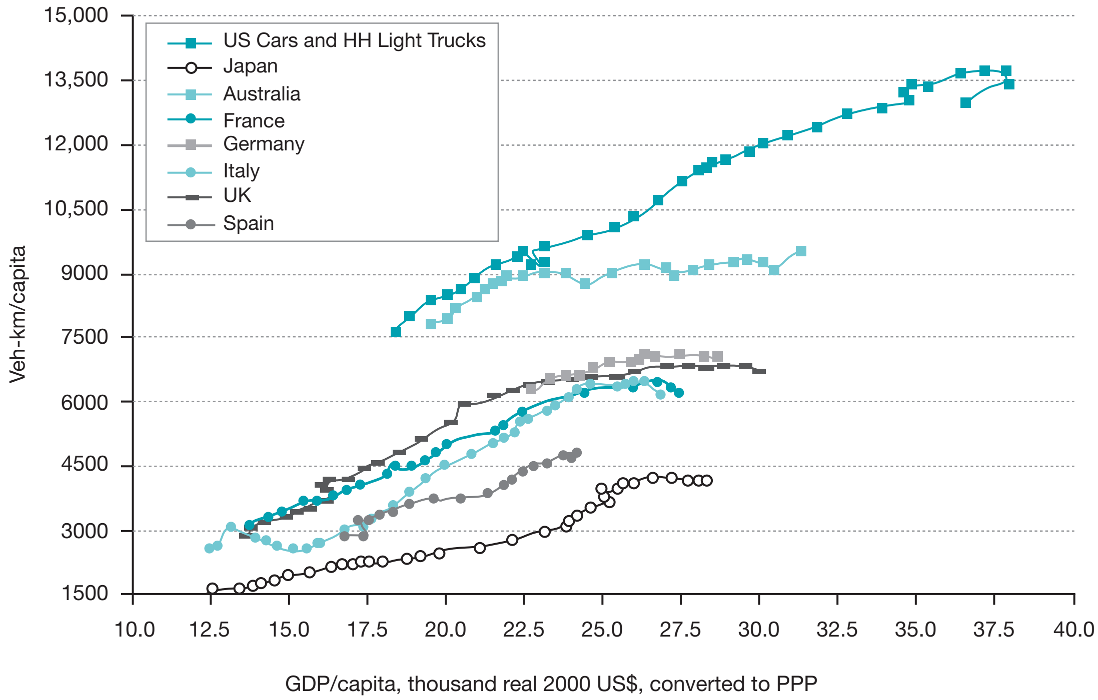
In countries with economies in transition . . . car ownership rates doubled in just a decade (1990–2000)

Figure 2.12

Vehicle kilometres travelled per capita for cars versus GDP per capita (1970–2008)

Notes: Data for some countries include SUVs and light trucks. PPP = purchasing power parity.

Sources: Millard-Ball and Schipper, 2011; Goodwin, 2012.



of state subsidies and disbanding of state-owned operators. Not surprisingly also, suburban sprawl patterns have emerged as prominent features in former socialist countries, representing a departure from the formerly densely built-up urban centres dependent on public transport.[136]

Variations in distances travelled by motorized vehicles in the US illustrate how specific urban forms shape travel behaviour. In 2007, residents of low-density sprawling cities travelled longer distances, as in the cases of Atlanta (48 vehicle kilometres per capita per day), Houston (61 kilometres) and Jacksonville (54 kilometres); while those living in more compact cities travel shorter distances, such as in New York (27 kilometres) and New Orleans (24 kilometres).[137] The relationship between urban form, land use patterns and private motorized travel is elaborated in greater detail in Chapter 5 of this report.

Motorized two-wheelers constitute a sizeable proportion of motor vehicles in developing countries, particularly in Asia

Developing countries

The rate of motor vehicle ownership in developing countries remains significantly lower than in developed countries (Table 2.3). However, ownership levels are not indicative of the high rates of growth in motor vehicle ownership in developing countries. The average annual motor vehicle ownership growth rate in emerging economies is higher than that of most developed countries. The levels of motorization in rapidly emerging cities of developing countries are already higher than expected, given their lower GDPs and their generally dense urban form.[138] With most of the current and future growth in population and urbanization taking place in developing countries, the potential for further motorization is substantial.[139]

Motorized two-wheelers constitute a sizeable proportion of motor vehicles in developing countries, particularly in Asia where 75 per cent of the world's two-wheelers are located, out of which China and India account for 50 per cent and 20 per cent, respectively.[140] It has been estimated that there were some 350 million two- and three-wheelers in use worldwide in 2005 (Figure 2.10). However, in many countries, this is the fastest increasing segment of personal transport. A recent report projects that total sales of motorcycles in 2013 alone may reach 114 million units, up from 39 million in 2003 and 79 million in 2008. The bulk of these, some 80 per cent are sold in Asian countries (55 per cent in China alone), yet the fastest rates of increase in sales are reported from Africa and the Middle East.[141] Thus, by 2050, the global stock of motorized two- and three-wheelers is projected to reach about 850 million (Figure 2.10). Therefore, while the rate of car ownership in many developing countries in Asia may be low (Table 2.3), the rate of motorization may be much higher. In cities such as Ho Chi Minh City (Viet Nam), Jakarta (Indonesia), Chennai and Mumbai (India) and Guangzhou and Shanghai (China) the number of motorcycles per capita exceeds that of cars (Figure 2.13). The inclusion of two- and three-wheelers dramatically alters motorization levels in Asian countries, raising them to levels comparable to developed countries.[142]

The rapid and often unmanageable growth in the number of two- and three-wheelers has resulted in the introduction of a number of government measures to restrict their growth and operation in Asian cities (Table 2.4). Even so – given their affordability,

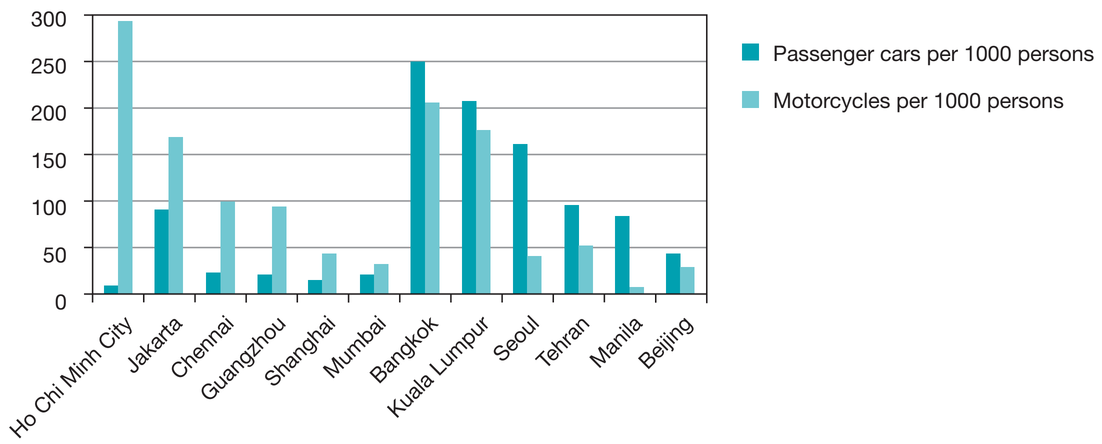


Figure 2.13

Car and motorcycle ownership rates, selected Asian cities

Source: Kenworthy, 2011.

fuel economy and manoeuvrability relative to private cars, and amid restricted access to public transport – two- and three-wheelers are likely to remain a popular option for lower and middle-income residents of Asian cities. In contrast, in Latin America and Africa, the number of motorcycles relative to cars remains low. Although ownership rates for two- and three-wheelers, are currently quite low in African cities, their role is expected to increase in the future.[143]

Infrastructure for private motorized transport

Globally, the provision of road space and parking for vehicles varies considerably, partly reflecting different strategies adopted by cities towards private motorized travel (Table 2.5). In most cities of Africa and Asia, there is less than 1 metre of road per person. Latin American cities, such as Curitiba, Bogotá and São Paulo have slightly more road length per person. Even so, road lengths per person in developing-country cities remain far lower than the average of the US (6.5 metres per person) and Australia (8.1 metres per person). A key objective of urban transport investments in many developing countries has thus been to increase road space for motorized transport. Yet, new road infrastructure tends to generate additional traffic. There is a need to move away from simply predicting growth in motorization in order to provide additional infrastructure, and move towards demand management within the framework of an overall strategy for sustainability.

In most cities of Africa and Asia, there is less than 1 metre of road per person

With respect to parking space, cities such as Bogotá (Colombia), Chennai (India) and Shanghai (China) have less than ten parking spots for every 1000 jobs in their central business district areas. In contrast, other cities such as Kuala Lumpur (Malaysia), Bangkok (Thailand) and Harare (Zimbabwe) have central business district parking spots in relation to jobs comparable to those of richer cities in Canada and Western Europe. The extremes are China at the low end and Riyadh (Saudi Arabia) at the top end with more parking places than jobs (Table 2.5).

The availability of parking is critical for destination accessibility and thus an important determinant of modal choice in urban areas. Control over available spaces, the length of availability and the costs of parking can thus prove effective in restricting private motor vehicle use if incorporated in the overall city-wide transport strategy.[144] Complementary traffic enforcement policies may be needed to ensure informal parking does not take place.[145]

The availability of parking is critical for destination accessibility and thus an important determinant of modal choice in urban areas

In developed countries too the provision of road space is differentiated (Table 2.5). The highest levels of road space per capita can be found in cities

Table 2.4

Two-/three-wheeler use restrictions, selected Asian countries

Location	Vehicle type	Programme details
Dhaka, Bangladesh	Two-stroke engines	Progressive ban from city: pre-1994 models phased out by January 2002, all remaining phased out by January 2003.
Guangzhou, China	All motorcycles and electric bicycles	Ban from entire city and suburban areas since January 2007.
Jakarta, Indonesia	Two-wheelers	Restricted lane use proposed to be extended to peak hour ban.
Kathmandu, Nepal	Diesel three-wheelers	Ban from city since 1999.
Lahore, Pakistan	Two-stroke three-wheelers	Ban from major roads to be progressively extended to entire city by December 2007.
San Fernando, the Philippines	Two-stroke three-wheelers	1970s models ban since 2003; 1980s models ban since 2004.
Taipei, China	Motorcycles above 550cc	Ban from urban districts.

Source: Posada et al, 2011.

Table 2.5

Road transport infrastructure in selected cities

City/region	Country	Length of road (in metres) per person	Length of freeway (in metres) per person	Parking spaces per 1000 CBD jobs
Chennai	India	0.3	0.011	5
Harare	Zimbabwe	1.8	0.000	370
Mumbai	India	0.3	0.000	77
Ho Chi Minh City	Viet Nam	0.3	0.000	105
Dakar	Senegal	0.5	0.003	120
Beijing	China	0.3	0.005	24
Jakarta	Indonesia	0.7	0.007	175
Cairo	Egypt	0.1	0.001	115
Tunis	Tunisia	2.0	0.018	170
Manila	The Philippines	0.5	0.004	29
Shanghai	China	0.3	0.003	2
Tehran	Iran	0.4	0.031	22
Guangzhou	China	0.5	0.000	24
Bogotá	Colombia	1.8	0.000	3
Cracow	Poland	1.5	0.023	31
Cape Town	South Africa	2.3	0.051	298
Johannesburg	South Africa	3.4	0.018	221
São Paulo	Brazil	1.0	0.009	183
Budapest	Hungary	2.2	0.013	147
Riyadh	Saudi Arabia	2.1	0.142	1883
Bangkok	Thailand	0.6	0.013	304
Curitiba	Brazil	3.2	0.000	84
Kuala Lumpur	Malaysia	1.5	0.068	298
Prague	Czech Republic	2.3	0.059	48
Seoul	Republic of Korea	0.9	0.017	25
Athens	Greece	4.5	0.039	225
Eastern Europe		**2.0**	**0.031**	**75**
Middle East		**1.4**	**0.053**	**532**
Latin America		**2.0**	**0.003**	**90**
Africa		**2.0**	**0.018**	**252**
High-income Asia		**2.2**	**0.020**	**105**
Low-income Asia		**0.6**	**0.015**	**127**
China		**0.4**	**0.003**	**17**
US		**6.5**	**0.156**	**555**
Australia and New Zealand		**8.1**	**0.129**	**505**
Canada		**5.3**	**0.122**	**390**
Western Europe		**3.0**	**0.082**	**261**

Note: CBD = central business district

Source: Kenworthy, 2011.

in Australia, New Zealand, the US and Canada, all of which have more than 5 metres of road per person. Western Europe has an average of 3 metres of roads per person, while Eastern European countries have even less. The availability of parking spots is also much lower in Eastern Europe compared to other developed countries. The length of freeways per person in Western Europe is almost triple that of Eastern Europe. On the whole, provision of infrastructure for private motorized transport is lower in Europe when compared to North America and Australia, both in terms of road length, freeway length and availability of parking spaces.

Impacts of private motorized transport

The major element behind the growth of private motorized transport around the world has been the individual freedom it offers, at a cost that is becoming affordable for a growing number of people. The perceived advantages of convenience, privacy and status continue to make the private car an attractive means of transport in cities. Moreover, the private motorized transport industry generates numerous economic benefits, including direct employment in manufacturing, indirect employment in infrastructure and services (fuel stations, maintenance, second-hand markets, policing, emergency services) and major investments in urban areas (road construction).

Overall, the automotive industry supports around 5 per cent of the total global workforce.[146] However, a considerable range of externalities arise from increased motorization in cities. Taken together, these dwarf the benefits of this means of transport. Being heavily dependent on oil, one of the most significant impacts of private motorized transport is on the environment. Increased use of private motorized transport also has impacts on health and safety in cities.[147]

A further externality of private motorized transport is traffic congestion that imposes significant costs on economic efficiency as time lost due to congestion reduces productivity. Congestion costs in Canada are as high as US$4.5 billion[148] nationally of which 80 per cent is accounted for by the country's three largest urban regions: Greater Toronto (43 per cent), Montreal (21 per cent) and Vancouver (17 per cent).[149] In the US, congestion has led urban Americans to travel 5.5 billion hours more and to purchase an extra 11 billion litres of fuel for congestion-related costs of US$121 billion in 2011.[150] In 2005, the cost of congestion in Australia's eight capital cities was US$7.1 billion,[151] comprised of private time costs (37 per cent), business time costs (38 per cent), extra vehicle operating costs (13 per cent) and extra air population (12 per cent).[152] The immense economic impact of traffic congestion is further illustrated by the case of Cairo, which costs Egypt as much as 4 per cent of its GDP.[153] In São Paulo, Brazil, some of the wealthiest residents have resorted to the regular use of helicopters to beat traffic jams.[154]

Access to motorized transport has not been universal in cities, with gender, age, disability and income having an impact. Also, in developing countries, travel by private motorized transport is reserved for a small group of high-income (often male) earners, and so its importance for women is comparatively minor.[155] However, this is changing, particularly in emerging economies such as China, India and Brazil, where middle-class women are increasingly owning and driving cars. The number of female drivers in Russia, where car ownership functions as an important status symbol, has increased by 50 per cent from 2000 to 2006.[156] Similar trends have been observed in Mumbai, India, where (with women earning higher incomes) traditional male-dominated gender roles in car purchase decisions are changing.[157] Gender differences in access to motorized transport in turn translate into differentiated access to opportunities.

INTERMODALITY IN URBAN TRANSPORT

The four modes of urban transport discussed in this chapter are highly complementary in that urban trips are often multi-modal, involving a combination of more than one mode. Modal integration – or the coordination of transport infrastructure, services, facilities and spatial configuration to enable seamless links between at least two different modes, thereby facilitating trip-chaining – is an essential prerequisite for enabling multi-modal trips, and by implication also urban accessibility. Strategies that facilitate this include spatial, network, fare, information and institutional integration to allow smooth transfers between different modes of urban transport.[158] It is particularly important to facilitate easy transfers between other modes and public transport if its modal share is to increase.

The critical importance of intermodality to enable accessibility in cities is recognized, though interventions designed to enhance integration vary across countries. Cities in Western Europe have taken the lead in facilitating modal integration, especially between public and non-motorized transport. Cycling significantly increases the catchment area of public transport stops beyond walking range, while access to public transport makes longer trips possible for bicyclists.[159] In Germany, 70 bike stations located at train stations enable bicyclists and public transport users to smoothly transition from one mode to the other. In the city of Berlin alone 24,000 bike parking spaces are available at public transport stations.[160] All metro and express interurban train stations on the peripheries of the city now have bike parking facilities. Guarded facilities for storing bikes together with complementary services (maintenance and repair) are available at all main train stations in the Netherlands, where 35 per cent of train users use a bike to get to and from train stations.[161] In the UK, train travellers are able to buy a discount bus ticket (PLUSBUS) that enables seamless transfer to buses.[162]

North American cities have, to some degree, also witnessed an increase in facilities designed to integrate cycling and public transport services, with bike parking spaces increasing by 67 per cent in Canada and 26 per cent in the US between 2006 and 2008. Noteworthy examples include the San Francisco Bay Area – where the Bay Area Rapid Transit (BART) system has bike parking in almost all 43 stations – and Vancouver – where integration between public transport and bicycles is facilitated by *TransLink*. *TransLink*, Vancouver's multi-modal transportation authority, has spent more than US$12 million on such integration between 1999 and 2009.[163]

Modal integration has been given minimal deliberate consideration in developing-country cities. Yet, although not by design, informal and non-motorized modes do serve as an important gap filler by feeding other modes of transport. Mexico City's *peseros* vans, shared-ride taxis, and collective minibuses connect the metro with outlying stations

Overall, the automotive industry supports around 5 per cent of the total global workforce

Gender differences in access to motorized transport in turn translate into differentiated access to opportunities

Cities in Western Europe have taken the lead in facilitating modal integration, especially between public and non-motorized transport

Modal integration has been given minimal deliberate consideration in developing-country cities. Yet . . . informal and non-motorized modes do serve as an important gap filler by feeding other modes of transport

substituting, without subsidies, the failing public bus system.

Some notable achievements in modal integration are emerging in Asian and Latin American cities. In China, Guangzhou's BRT system – which serves 800,000 passengers daily – is integrated with the city's bike lanes and bike share system, greatly enhancing physical access to public transport services.[164] The cities of São Paulo, Curitiba (both in Brazil), Bogotá (Colombia) and Santiago (Chile) have all taken action to advance integration between public and non-motorized transport.[165]

Cities remain inaccessible for large numbers of urban residents in spatial/physical or socioeconomic terms

Many of the attempts to facilitate intermodality between non-motorized and public transport in cities to date have focused on integrating cycling. Yet, the contribution of walking as a feeder to public transport systems has also been emphasized.[166] This also applies to developing countries, where most public transport trips involve walking at both ends of the trip. An analysis of access trips for Delhi Metro (India), for instance, found that often between 40 and 60 per cent of the passengers walk to the stations.[167]

CONCLUDING REMARKS AND LESSONS FOR POLICY

'Accessibility' may be the 'holy grail' for the twenty-first century city. Yet, the transport trends and conditions outlined in this chapter indicate that cities remain inaccessible for large numbers of urban residents in spatial/physical or socioeconomic terms. In turn, such limitations restrict access to opportunities for urban dwellers, with implications for their overall wellbeing and progress.

In the absence of accessible public transport services, informal transport remains predominant in developing countries

Public transport offers the greatest potential to enhance accessibility in cities, but is non-existent or declining in most developing countries, and increases in developed countries are not commensurate with the scale required to meet sustainability targets. A new business model for funding public transport needs to be forged. Public transport must always remain affordable but a new commercial paradigm is needed that allows the social dimension of providing a public service to be combined with efficiencies and commercial acumen to improve cost recovery. Moving from captive riders (passengers) to clients and choice riders, making public transport a lifestyle choice, requires a strong customer focus.

Despite the multiple benefits it generates for both users and society as a whole, NMT is often marginalized and receives minimal priority in urban mobility planning and investments, both in developed and developing countries. It constitutes the principal and often only accessible means of transport for the majority of residents in developing-country cities with most who opt for this mode doing so out of a lack of choice. Yet, in most cities, NMT conditions are extremely hostile. Investing in NMT to enhance the safety and security of walking and cycling constitutes a key pillar of planning and design for accessible mobility in cities. Innovative experiences from both developed and developing-country cities that have elevated NMT as a foundation for urban sustainability offer valuable insights to inform planning and investments elsewhere.

Perhaps one of the most alarming trends – which gravely threatens urban accessibility – is the steady increase in the share of private motorized transport. Almost 60 years after the private car became firmly fixed as the icon of the twentieth century, developing countries are experiencing extremely high motorization rates further supported by policies, actions and investments that favour private motorized over non-motorized and public transport modes. While motorization rates have generally reached saturation levels in developed countries, many of their cities continue to bear the consequences of urban and transport planning and land-use policies that facilitated car dependency and urban sprawl. While it does perform a necessary function within the overall arena of urban transport, where it dominates, the externalities of private motorized transport compromise the fundamental sustainability imperatives in cities. Addressing the broader welfare concerns around equal access to mobility thus necessitates action to enable shifts to more sustainable modes through deliberate and targeted policies and investments.

In the absence of accessible public transport services, informal transport remains predominant in developing countries and constitutes the main means of motorized trips for most urban dwellers. Although it provides essential benefits to the urban poor in terms of mobility and livelihoods, informal transport generates a number of environmental and economic externalities. A significant challenge is to balance the efficiency and social equity aspects of informal transport, i.e. to achieve the social benefits of free-market services without exceeding social costs. The sector would benefit immensely from best-practice examples of successful regulation of service quality and safety while at the same time allowing the inherent advantages of private competition and entrepreneurship to flourish.

Given the current state of urban transport globally, improved urban accessibility requires focusing on a number of vital pillars. Increasing the modal share of ***public transport*** is a universally applicable strategy that has significant potential to address mobility challenges of both developed and developing countries. The role of high-capacity public transport systems in this respect is underscored in Chapter 3 of this report and the social, environmental and economic sustainability benefits of public transport are featured in Chapters 6, 7 and 8. Efforts to enhance urban accessibility are best not limited to mode-specific interventions and investments. There is abounding evidence indicating that ***intermodality***, or the integration of infrastructure and services across modes, to facilitate trip-chaining and multi-modal trips, is a vital precondition for accessibility. Urban planning and design principles that offer potential for this are elaborated in greater detail in Chapter 5. Effective ***institutional, regulatory and policy frameworks*** are also indispensable to facilitate urban, land-use and transport planning in an integrated manner that encourages shifts towards more sustainable modes of transport, as is discussed in Chapter 9. Finally, accessible mobility in cities cannot be considered in isolation from the ***movement of goods*** in urban areas that consumes significant space and interacts with passenger transport at times in adverse ways, as accentuated in Chapter 4.

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CHAPTER 3

METRO, LIGHT RAIL AND BRT

This chapter reviews the global conditions, trends and challenges for the main high-capacity transport options: metro, light rail and BRT. Such public transport modes offer solutions for improving urban mobility, quality of life and the environment in both developed and developing countries, providing a competitive alternative to private motor vehicles. An efficient system facilitates seamless movement within and between cities, which in turn is essential for urban functionality and prosperity.[1] Metros, light rail and BRTs are suitable for key corridors in cities and as part of larger, integrated public transport systems.

High-capacity public transport systems are strategic in shaping urban form, promoting higher densities as well as mixed and accessible land use. Such modes reduce the need for trips by private motorized travel, and may thus reduce the total kilometres travelled in cars and motorcycles, mitigating negative externalities such as air pollution, road traffic accidents, lack of physical activity, noise and greenhouse gas emissions. They are also important in providing inclusive access for vulnerable and low-income groups, and in creating jobs.

In the urban planning dialogue, opinions regarding metro, light rail and BRT are diversified, with arguments in favour of and against each mode.[2] In this chapter, these three modes are explored, demonstrating the importance of undertaking comprehensive evaluations that consider all significant benefits and costs of high-capacity public transport systems, prior to implementation. The chapter also presents an overview of current global conditions and trends, including some challenges: service quality, integration, finance and institutions. The chapter concludes with key policy recommendations.

MAIN CHARACTERISTICS OF METRO, LIGHT RAIL AND BRT SYSTEMS

Metro, light rail and BRT are all intended to provide fast, comfortable and cost-effective urban mobility in medium- to high-demand corridors. These modes of public transport, which use specific fixed or exclusive and separated tracks, have superior operating capacity and performance compared to unsegregated road-based transport such as buses, taxis and paratransit.[3] In principle, the introduction of metro, light rail and/or BRT can produce important benefits to a city: it can improve the efficiency of the urban economy by reducing travel cost and time; it can increase the level of city-centre activity, thereby enhancing agglomeration economies that are crucial for the prosperity of urban areas; and it can reduce road congestion, which would then provide various other economic and environmental benefits. In cities where these modes are dominant, they improve the access to opportunities and services, and may be beneficial to the urban poor in a number of ways.[4]

Metro

Metro is an urban electric transport system using rail tracks, exhibiting high capacity and a high frequency of service.[5] Independent from other vehicles, roads or pedestrian traffic, metros are designed for operations using tunnels, viaducts or at surface levels, but with physically separated infrastructure. In some parts of the world, the metro system is also known as underground, tube, subway, rapid rail or metropolitan railway.[6] With metros, carrying capacity of more than 30,000 passengers per hour per direction is possible.[7] Globally, metros have evolved as a major form of public transport, since the first underground railway opened in London in 1863.[8] Although metro systems are the most expensive urban public transport option, their high capacity and best performance (in terms of speed and number of passengers conveyed), make them invaluable parts of highly developed transport systems. Accordingly, metro systems require huge investments and are often implemented as the preferred option of large cities where demand justifies that high capital cost.[9]

High-capacity public transport systems are strategic in shaping urban form, promoting higher densities as well as mixed and accessible land use

Metro, light rail and BRT are all intended to provide fast, comfortable and cost-effective urban mobility in medium- to high-demand corridors

Metro systems require huge investments and are often implemented as the preferred option of large cities where demand justifies that high capital cost

Light rail

Light rail can be described as an electric rail-borne transport, and can be developed in stages to increase capacity and speed.[10] Through the provision of exclusive right-of-way lanes, light rail systems typically operate at the surface level with overhead electrical connectors, and may have high or low platform loading and multi- or single-car trains.[11] Often, segregation is introduced, or priority given to light rail at road junctions, in order to increase speed and service reliability. The general term 'light rail' covers those systems whose role and performance lie between a conventional bus service and a metro.[12] Light rail systems are therefore flexible and expandable. Historically, light rail systems evolved from the 'streetcars', 'trolleycars' or 'tramways' that started in the second half of the nineteenth century as horse-driven carts. With the advent of electricity, tramways became very popular around 1900 and most large cities in developed countries, as well as a few cities in developing countries, had tram systems. After the Second World War, many trams were removed from cities, although many were later modernized and reintroduced in the last part of the twentieth century, as an intermediate, flexible, lower cost public transport mode. Given the relatively high cost of light rail systems, they are often found in wealthy cities and in proximity to high-income developments.[13]

The general term 'light rail' covers those systems whose role and performance lie between a conventional bus service and a metro

Bus rapid transit

BRT is a bus-based mode of public transport operating on exclusive right-of-way lanes at the surface level, although, in some cases, underpasses or tunnels are utilized to provide grade separation at intersections in dense city centres.[14] The term 'BRT' was initially coined in the US[15] and the first wide-scale development of BRT was implemented in Curitiba, Brazil, in 1982.[16] Other names for BRT are 'high-capacity bus system', 'high-quality bus system', 'metro-bus', 'surface metro', 'express bus system' and 'busway system'.[17] While the terms may vary from country to country, the basic premise is followed: a high-quality customer-oriented public transport that is fast, safe, comfortable, reliable and cost-effective. The best BRT systems flexibly combine stations, bus services, busways and information technologies into an integrated system with a strong identity.[18] Depending on the specific system design, BRT capital costs are 4–20 times lower than light rail systems, and 10–100 times lower than metro systems, with similar capacity and service level.[19]

Main physical characteristics, outputs and requirements

The main physical characteristics of metro, light rail and BRT systems are outlined in Table 3.1, while their outputs and requirements are presented in Table 3.2.

Table 3.1

Main physical characteristics of metro, light rail and BRT

Component	Metro	Light rail	BRT
Running ways	Rail tracks	Rail tracks	Roadway
Type of right of way	Underground/elevated/at-grade	Usually at-grade – some applications elevated or underground (tunnel)	Usually at-grade – some applications elevated or underground (tunnel)
Segregation from the rest of the traffic	Total segregation (no interference)	Usually longitudinal segregation (at grade intersections) – some applications with full segregation	Usually longitudinal segregation (at grade intersections) – some applications with full segregation
Type of vehicles	Trains (multi-car)	Trains (two to three cars) or single cars	Buses
Type of propulsion	Electric	Electric (few applications diesel)	Usually internal combustion engine (diesel, CNG) – some applications with hybrid transmission (diesel/CNG-electric) or electric trolleybuses
Stations	Level boarding	Level boarding or stairs	Level boarding
Payment collection	Off-board	Usually off-board	Off-board
Information technology systems	Signalling, control, user information, advanced ticketing (magnetic/electronic cards)	Signalling, control, user information, advanced ticketing (magnetic/electronic cards)	Control, user information, advanced ticketing (electronic cards)
Service plan	Simple; trains stopping at every station between terminals; few applications with express services or short loops	Simple; trains stopping at every station between terminals	From simple to very complex; combined services to multiple lines; express, local – some combined with direct services outside the corridor
User information	Very clear signage, static maps and dynamic systems	Very clear signage, static maps and dynamic systems	Very clear signage, static maps and dynamic systems
Image	Modern and attractive	Modern and attractive	Advanced as compared with standard buses

Notes: Characteristics for high performance metro, light rail and BRT; CNG = compressed natural gas.

Sources: Fouracre et al, 2003; Vuchic, 2007; Federal Transit Administration, 2009.

Table 3.2

Outputs and requirements for metro, light rail and BRT

	Metro	Light rail	BRT
Required roadway space	Low impact on existing roads	Two lanes (narrow 5–8 metres)	Two to four lanes of existing roads (7–15 metres)
Required station space	Large reservation space, especially during construction	Medium reservation space (3–6 metres wide platforms)	Medium reservation space (4–8 metres wide platforms)
Distance between stations	Medium to high (1 kilometre or more)	Short to medium (400 metres or more)	Short to medium (400 metres or more)
Flexibility	Low (trains operate on fixed tracks)	Low (trains operate on fixed tracks)	High (buses can be used inside and outside the busways)
Traffic impacts during operation	Reduce congestion (does not interfere with surface travel)	Variable (takes some space from traffic)	Variable (takes space, reduces traffic interference from buses)
Construction impacts	High (tunnel digging, elevated structures; longer time)	Low to medium (depending on type of construction)	Low to medium (depending on type of construction)
Potential to integrate with existing transport providers	Limited potential	Limited potential	Good potential
Maximum frequency	High (20–30 trains per hour)	High (20–30 trains per hour)	Very high (40–60 buses per hour per platform)
Reliability	High (no interference from other traffic, but could be affected by bunching)	Medium to high (depending on traffic interference)	Medium to high (depending on traffic interference and manual control)
Human safety	Fully segregated from road users, low risk of accidents	Segregated from traffic only, some risk to other road users	Largely segregated from traffic, some risk to other road users
Air pollution	No tailpipe emissions, power generation pollutants dependent on energy source and technologies used	No tailpipe emissions, power generation pollutants dependent on energy source and technologies used	Tailpipe emissions for internal combustion engine, depends on the engine, fuel and emission control technology
Noise	Low (depending on insulation)	Low to medium (depending on tracks)	High (internal combustion engine and rubber-roadway)
Greenhouse gas emissions	68–38 grams per passenger-kilometre	100–38 grams per passenger-kilometre	204–28 grams per passenger-kilometre
Passenger experience	Smooth ride, high comfort (depending on occupancy)	Smooth ride, high comfort (depending on occupancy)	Irregular ride (sudden acceleration and braking), medium comfort (depending on occupancy)

Sources: World Bank, 2002a; Halcrow Fox, 2000; Wright and Fjellstrom, 2003; Fouracre et al, 2003; ADB, 2010b; Demographia, 2005.

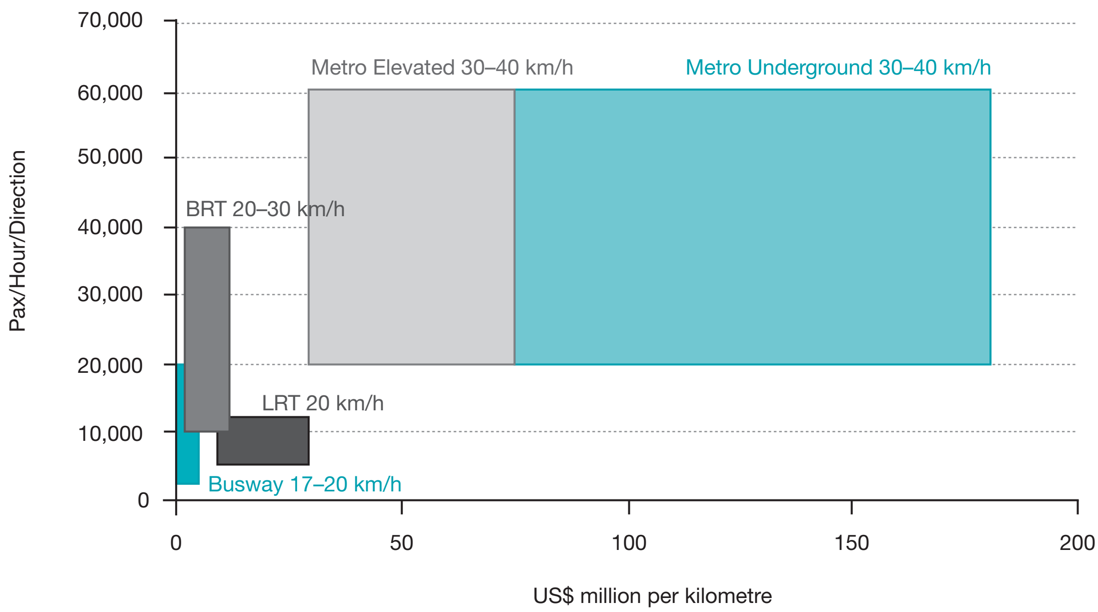

Figure 3.1

Initial cost versus capacity and speed

Note: LRT = light rail.

Source: Hidalgo, 2007.

The key variables for evaluating high-capacity public transport systems include capacity, commercial speed and cost

Metro and light rail systems produce little noise, have low emissions of air pollutants (including greenhouse gases) and have high reliability. In addition, metro systems do not use limited road space on the surface, thus ensuring a consistently reliable and high-quality service. Nevertheless, metro and light rail systems have limited flexibility and require bus or intermediate public transport feeder services for last-kilometre connectivity. Furthermore, the distance between stations is usually higher in metros than in light rail and BRT in order to enable higher travel speeds. While this speeds up long distance commutes, it also requires longer distances for passengers to access stations.

The key variables for evaluating high-capacity public transport systems include capacity, commercial speed and cost. Figure 3.1 indicates that BRT can provide high-capacity services – similar to that of metros and higher than that of light rail systems – at a fraction of their capital costs.[20] While commercial speeds delivered by BRT and light rail systems are usually lower than metros, some BRT systems reach significantly higher speeds than light rail (when using express services or fully separated facilities in expressways). It is also important to note that while elevated and underground metro systems average similar capacities, their initial costs of construction vary greatly (Figure 3.1). A more detailed discussion of construction and operating costs for the various transport modes can be found in Chapter 8.

In the last 15 years, several developing-country cities have started implementing BRT systems, and some have initiated or expanded light rail and metros

EXAMPLES OF NATIONAL POLICIES TOWARD HIGH-CAPACITY PUBLIC TRANSPORT IN DEVELOPING COUNTRIES

Rail-based public transport systems have been a natural part of the development of urban infrastructure in developed countries' cities. However, cities in developing countries have struggled in this respect due to financial and institutional limitations. Nevertheless, in the last 15 years, several developing-country cities have started implementing BRT systems, and some have initiated or expanded light rail and metros. Furthermore, national governments are co-financing public transport infrastructure in order to support the large proportion of the population now living in urban areas, including considerations of energy security, economic efficiency and climate change. This section provides examples from selected developing countries that have introduced national policies to support high-capacity urban public transport systems.

China

In 2011, the Government of China, through the Ministry of Transport, introduced the 'public transport city' project to improve the service level of urban public transport and alleviate traffic congestion in Chinese cities. Supported by the Ministry of Transport, the demonstration projects (in 30 selected cities) will include the construction of public transport hubs, implementation of 'intelligent transport systems', energy conservation and emission reduction practices in public transport. Additional financial support for the demonstration projects will be provided at the national level and co-financed by provincial governments.

As a result of the national support, several Chinese cities have started the construction or expanded their public transport networks in the form of metro, light rail and BRT systems. Beijing, for instance, is implementing a very ambitious rail expansion programme. In 2012, the Beijing metro had 16 lines, with 442 kilometres of track length and 251 stations, becoming the longest metro network in the world.[21] Expansion plans call for 708 kilometres of track in operation by 2015 and 1050 kilometres by 2020.

A number of other Chinese cities are also expanding their metro systems, namely: Hong Kong, Tianjin, Shanghai, Guangzhou, Dalian, Wuhan, Shenzhen, Chongqing, Nanjing, Shenyang, Chengdu, Guangfo, Xi'an, Suzhou, Kunming and Hangzhou. In addition, there are currently 18 cities with metro and light rail systems under construction, and a further 22 cities where construction is either being planned or pending approval. With respect to BRT, a total of 15 Chinese cities had operational systems, while another 11 systems were either under construction or at the planning stage by 2012.

India

In 2005, the Government of India created the US$20 billion Jawaharlal Nehru National Urban Renewal Mission (JnNURM) to fund urban infrastructure improvements and basic services to the urban poor in 65 cities for the 2005–2011 period.[22] It is expected that the programme will be renewed in 2013, as part of the sixth five-year plan.

With financial and technical assistance from the national, state and local governments, the cities of Kolkata, Chennai, Delhi and Bangalore currently have operational metro systems

With financial and technical assistance from the national, state and local governments, the cities of Kolkata, Chennai, Delhi and Bangalore currently have operational metro systems. Encouraged by Delhi's success, six other Indian cities have metro systems under construction, while metro systems in another eleven cities are in various planning stages. In Delhi, where metro operations commenced in 2002, there are currently 193 kilometres of metro tracks (with 145 stations). Expansion plans include another 140 kilometres (approved) and 139 kilometres (proposed) for a total network of 472 kilometres to be completed by 2021.[23]

In addition to the various metro systems under construction, busways exist in Delhi, Pune and Jaipur, while Ahmedabad has a fully operational BRT system (75 kilometres long, with additional 80 kilometres under construction or being planned). Furthermore, BRT systems are currently being introduced in the cities of Rajkot, Surat, Indore, Hyderabad, Pimpri-Chinchwad, Visakapatnam and Bhopal. Another eight cities are planning the introduction of BRT systems.

Brazil

The Government of Brazil is responsible for promoting improvements in public urban transport. As a result, every city with more than 20,000 inhabitants (i.e. some 1600 cities) is required to develop a mobility master plan linked to its urban development plans. The National Policy on Urban Mobility gives priority to non-motorized transport and public transportation, over private motorized transport. It also seeks to limit or restrict motor vehicle use in a given geographic area or during a specific time period. Other measures sought by the policy to reduce traffic congestion and air pollution include establishing congestion and pollution tolls, as well as emission standards for air pollutants.

To support investment in public transport, the federal government created two programmes 'Pro-transporte' and 'Growth Acceleration Programme', in preparation for the 2014 FIFA World Cup and the 2016 Summer Olympic Games. Projects include BRT lanes in 9 of the 12 cities that will host World Cup matches, including Rio de Janeiro and Belo Horizonte. In four cities, including São Paulo and Brasília, light rail systems such as monorails and trams are being built, with another five cities planning the adoption of the same. Currently, there are eight cities with metro: Belo Horizonte, Brasília, Porto Alegre, Fortaleza, Recife, Rio de Janeiro, São Paulo and Teresina.

Inspired by the bus lanes implemented in Curitiba in the 1970s, 31 cities in Brazil currently have BRT systems or bus ways, totalling 696 kilometres. Most of the already existing busway corridors in Brazil need renovation and the BRT systems offer the opportunity of increasing public transport productivity, while overcoming the problems generated by the multiple superimposed radial routes, converging to terminals located at city centres. Several cities – including Belo Horizonte, Porto Alegre, Salvador, Brasília and Belém – are currently upgrading some sections of existing busways to BRT standards.

Mexico

In 2008, the Government of Mexico created the PROTRAM (Federal Support Programme for Public Transport), to improve urban transport efficiency and to reduce urban greenhouse gas emissions. To date, PROTRAM has given financial support to 11 BRT systems and 1 suburban rail system. Other pipeline projects in 34 cities are earmarked for funding from this programme, which provides both grants and credits.

Mexico has a metro system in its capital Mexico City; light rail systems in Guadalajara and Monterrey; and BRT systems in León, Mexico City, Guadalajara, Ecatepec and Monterrey.

Kenya

In 2009, the Government of Kenya launched the Integrated National Transport Policy, which seeks to establish appropriate institutional and regulatory frameworks to coordinate and harmonize the management and provision of passenger transport services. Among the policy recommendations is the establishment of independent institutions to manage urban passenger transport services and operations.[24]

The policy further envisions increasing use of high-capacity public transport through the provision of railway infrastructure for Nairobi and its environs. Consequently, the government opened the Syokimau Railway station in the suburbs of Nairobi in 2012. The railway service from this station to the city centre has reduced travel time by half over the 18-kilometre journey. Furthermore, authorities have also ensured that the railway is integrated with other modes, as *last-mile* link buses have been introduced to boost the city commuter train service.[25]

The transport policy also envisages the provision of infrastructure to support public transport services, i.e. bus lanes, promotion (through fiscal incentives) of high-occupancy public transport vehicles and discouraging private motor vehicle use once the public transport system is efficient.[26] In 2012, the Government of Kenya, supported by the World Bank, launched the National Urban Transport Improvement Project (NUTRIP) to support the development of selected high-capacity public transport corridors.[27]

Inspired by the bus lanes implemented in Curitiba in the 1970s, 31 cities in Brazil currently have BRT systems or bus ways, totalling 696 kilometres

Morocco

The Government of Morocco has embarked on reforming the transport sector along three main pillars: improving the sector's governance; improving the efficiency and developing the supply of urban transport services and infrastructure; and improving the environmental and social sustainability of urban transport.[28] Significant investments have been made towards light rail systems in the cities of Casablanca and Rabat-Salé. Commissioned in 2011, the tramway line between Rabat and Salé consists of 44 trams, with an expected daily ridership of 180,000 passengers. The total length of the dual-line tramway network is 19.5 kilometres and consists of 31 stations that are spaced a half kilometre apart.[29]

In Casablanca, the tramway development company acquired 74 trams for the 31 kilometres Y-shaped network, which commenced operations in 2012. The line has 48 stops and has an expected daily ridership of 255,000 passengers.[30]

Nigeria

Nigeria's 2010 National Transport Policy seeks to develop an efficient, self-sustaining and reliable public transport system, and to improve the infrastructure and institutional framework for public transport service delivery. It also aims to enhance the capacity of the existing infrastructure through proper maintenance of roadways and efficient traffic management. Furthermore, it calls for the substantial expansion of urban infrastructure, with emphasis on public transport infrastructure – railway, dedicated bus routes, etc.[31]

The rapid increase in the number of rail-based systems is an indication of the importance of metros in facilitating mobility, particularly in large urban areas that are beyond city limits

The policy envisions the introduction of a high-capacity bus-based transport system that can be accommodated by the existing infrastructure. Already there are dedicated bus routes in Lagos, where a BRT is being implemented. The policy also aims to promote private sector participation in urban public transport services and in the long-term introduce rapid rail systems into the country's major cities.

To advance the efficiency of urban transport system operations and management, an autonomous body – the Municipal Transportation Agency – will be established in each major city. The task of these agencies will be, *inter alia*, the regulation, planning, designing and maintenance of urban transport infrastructure facilities.

South Africa

Asian cities account for the largest share of metro ridership, totalling more than 51 million riders a day

In South Africa, the Public Transport Strategy aims to improve public transport by establishing an integrated rapid public transport network that comprises of an integrated package of rapid rail and road corridors. Through BRT, the government aims to link different parts of a city into a network and ensure that by 2020, most city residents are no more than 500 metres away from a BRT station.[32] The BRT systems are being implemented through public–private partnerships, whereby cities build and maintain the infrastructure for the operation of the buses, stations, depots, control centres and a fare collection system. Private operators, by contrast, own and manage the buses, hire staff and provide services on a long-term contract.

In Johannesburg, the Rea Vaya BRT is being implemented in phases across in the city since 2009. Notably, the first trunk route running between Ellis Park in Doornfontein and Thokoza Park in Soweto has been completed. The long-term plan is for the Rea Vaya route to cover 330 kilometres, allowing more than 80 per cent of Johannesburg's residents to catch a bus within 500 metres from a BRT station.[33] In addition to Johannesburg's BRT system, Cape Town also has a BRT system known as MyCiTi,[34] while Tshwane is implementing Tshwane BRT that will cover some 80 kilometres of bus lines.[35]

The Gauteng Provincial Government has implemented Gautrain, which is South Africa's first high-speed passenger railway line, connecting OR Tambo International Airport with the cities of Johannesburg and Pretoria. The 80-kilometre high-speed passenger railway network comprises of two routes: the north–south line connecting Pretoria and Hatfield Johannesburg; and an east–west line from Sandton to the airport, which is supported by a network of feeder buses serving most of its ten stations.

METRO SYSTEMS AROUND THE WORLD: TRENDS AND CONDITIONS

Due to government stimulus programmes in the wake of the global financial crisis, the world market for railway infrastructure and equipment has been growing at 3.2 per cent a year, and is set to grow at around 2.7 per cent annually until 2017. Spending on metro rail systems should grow faster still, at perhaps 6–8 per cent.[36] Figure 3.2 shows the growth of metro rail systems around the world in terms of the number of cities with operational systems.[37] By 1970, there were a total of 40 cities worldwide with metro systems, followed by a rapid increase during the next four decades. Currently, there are 187 cities with a metro system as part of their public transport system.[38] Box 3.1 provides an overview of the growth of metros across the world. The rapid increase in the number of rail-based systems is an indication of the importance of metros in facilitating mobility, particularly in large urban areas that are beyond city limits. Notably, metros are less prone to congestion than roadways and are important to those residing in peripheral locations, as they commute long distances to employment centres and other activity nodes.[39]

The global distribution of metro systems in Figure 3.3 shows a concentration of metros in Europe, Eastern Asia and the eastern part of the US. The regional distribution in terms of number of cities and ridership is presented in Table 3.3. Asian cities account for the largest share of metro ridership, totalling more than 51 million riders a day. In terms of total track length of metros, Asian cities account

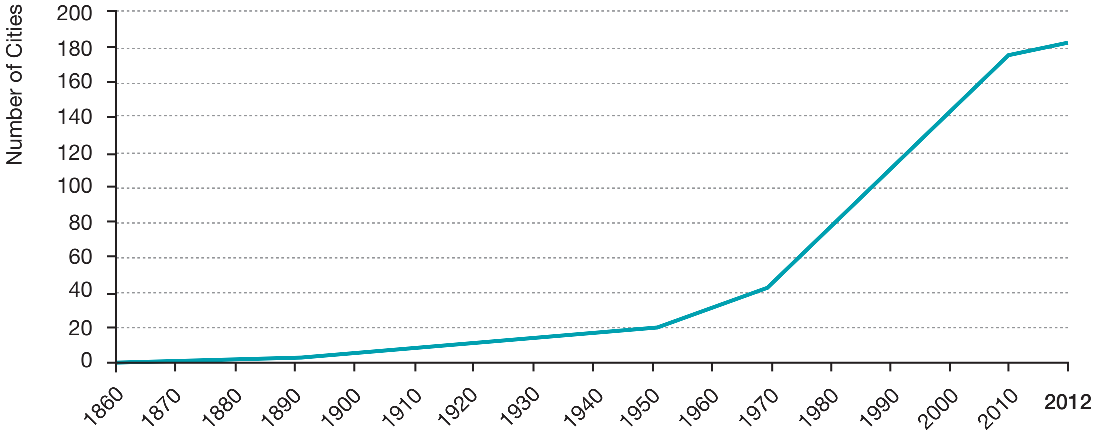

Figure 3.2

Growth of metro systems worldwide

Source: Based on Metrobits, 2012.

Box 3.1 The growth of metros around the world

The building of metro systems accelerated from the 1960s, mainly in reaction to the growth of sprawling mega-metropolises around the world. Currently, 187 cities have metros, with more to come amid a fresh spurt of construction in developing countries. In 2012, the Chinese cities of Suzhou, Kunming and Hangzhou opened their metros, as did the city of Lima in Peru. In 2011, Algiers (Algeria) was the second African capital to launch a metro system.

Whereas China's investment in high-speed intercity railways is tailing off, evidence suggests that it is still pumping money into metros. So is India: Bangalore's metro was launched in 2011, which will soon be followed by Mumbai. Smaller cities, such as Bhopal and Jaipur, have plans on the drawing-board. Brazil is expanding metro systems in its two main cities, Rio de Janeiro and São Paulo, while building new ones in smaller cities such as Salvador and Cuiabá.

Metros are being built in various smaller cities, such as in Dubai, where the world's longest driverless metro (75 kilometres) became operational in 2009; followed by Mecca's in 2010. Abu Dhabi, Doha, Bahrain, Riyadh and Kuwait City have plans in progress. Other cities planning to build metros include Asunción in Paraguay and Kathmandu in Nepal.

Many congested cities in developing countries have spent years planning metro systems. However, very little progress has been made towards implementation. A prime example is Algeria's 1991–2002 civil war that accounts for the long gestation period of its capital's metro. In other cases, sluggish (and sometimes corrupt) bureaucracies are the main obstacle. In 2008, Indonesia's traffic-choked capital, Jakarta, abandoned its attempt to build a monorail and built a successful busway as a stopgap instead. Since then, the city's governor has promised to commence work on an underground metro.

Source: Economist, 2013.

for 41 per cent. European cities also depend heavily on metro systems for urban mobility, accounting for more than 38 million daily riders or 34 per cent of global ridership, and 35 per cent of global track length. This is followed by Latin America and the Caribbean, as well as North American cities that account for 11.5 per cent and 8.6 per cent of the world's metro ridership, respectively. The two African cities that have metros – Algiers and Cairo – have a daily ridership of 2.2 million passengers or 2 per cent of global ridership.

Table 3.4 lists the world's major metro systems – i.e. those with an average daily ridership of more than 2 million passengers per day. Six of these 16 systems are in cities in developing countries, while the rest are in developed countries. The world's largest or most used metro systems are Tokyo (Japan), Seoul (Republic of Korea) and Beijing (China) with

Table 3.3

Metro systems by region

Region	Cities	Length (km)	Average daily ridership (millions)	Share of global daily ridership (%)
Africa	2	75	2.2	2.0
Asia	58	4279	51.0	45.7
Europe	80	3638	38.2	34.3
Latin America and the Caribbean	17	828	11.5	10.3
North America	24	1601	8.6	7.7
Total	**181**	**10,421**	**111.5**	**100.0**

Source: Metrobits, 2012.

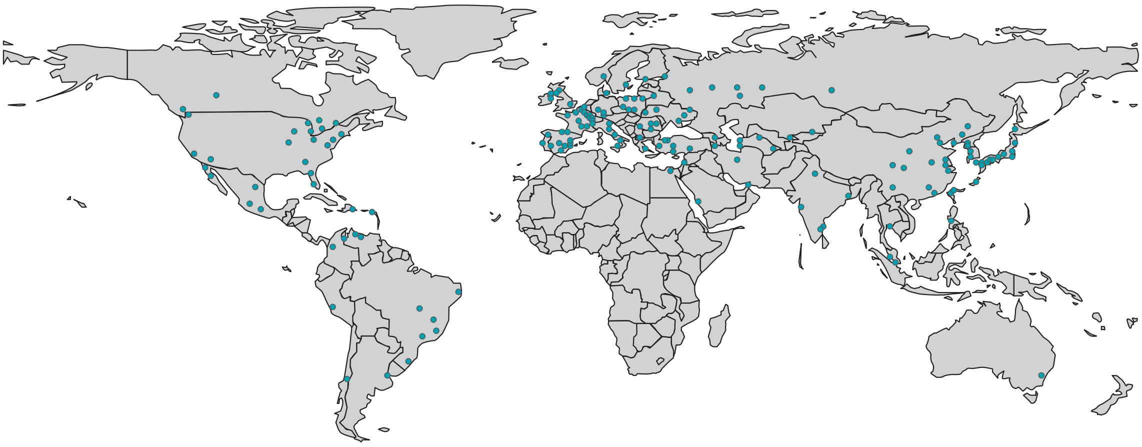

Figure 3.3

Metro systems around the world

Source: Based on data from http://mic-ro.com/metro/table.html, last accessed 5 June 2013.

The world's largest or most used metro systems are Tokyo (Japan), Seoul (Republic of Korea) and Beijing (China) with 8.5 million, 6.9 million and 6.7 million passengers per day, respectively

8.5 million, 6.9 million and 6.7 million passengers per day, respectively. In Tokyo, Japan, the modal share of public transport is nearly 80 per cent of all motorized trips, with the metro accounting for a significant proportion.[40] In Shanghai, China, top priority has been given to the extension of the city's subway with the opening of six additional lines in 2010, and a planned four-fold increase of the current 423 kilometres of track length by 2020.[41] In 2007, the city's metro accounted for 13 per cent of its total public transport; and with further investment this was expected to increase to 45 per cent by 2012, thus reducing the dependence on private cars.

Several developing-country cities, particularly in China, have been able to expand their metro networks in a short time. For instance, Beijing, which has one of the two most developed subway systems in China, has the highest use of public transport in the country.[42] Since 2005, Beijing has allocated 30 per cent of its public construction budget to its public transport system, including its metro. Whereas Beijing's public transport system is strong by Chinese standards, its citizens do not utilize public transportation as much as the residents of other cities, such as Seoul (Republic of Korea) and Tokyo (Japan). As a result, the emission of air pollutants from mobile sources remains one of the government's most urgent challenges.

Since its launch in 1987, the metro system in Cairo, Egypt, has gradually been expanded and the total track length now measures 90 kilometres.[43] Likewise, the metro's modal share of all trips has increased steadily from 6 per cent just after the launch to 17 per cent in 2001. The total number of passengers using the metro has continued to increase, from 2 million per day in 2001 to more than 3 million in 2012, partly due to its relatively affordable fares.[44]

A comparison between metro systems worldwide reveals certain trends. First, a majority of these cities have very large populations. For instance, Tokyo's

Table 3.4

Metro systems with average daily ridership of more than 2 million passengers per day

Rank	City, Country	Initial year	Length (km)	Stations	Average daily ridership (millions)
1	Tokyo, Japan	1927	305	290	8.50
2	Seoul, Republic of Korea	1974	327	303	6.90
3	Beijing, China	1969	442	252	6.74
4	Moscow, Russia	1935	309	187	6.55
5	Shanghai, China	1995	437	279	6.24
6	Guangzhou, China	1999	232	146	5.00
7	New York, US	1904	368	468	4.53
8	Mexico City, Mexico	1969	180	175	4.41
9	Paris, France	1900	218	383	4.18
10	Hong Kong, China	1979	175	95	3.96
11	London, UK	1863	402	270	3.21
12	Cairo, Egypt	1987	90	55	3.00
13	São Paulo, Brazil	1974	74	67	2.40
14	Osaka, Japan	1933	138	133	2.29
15	Singapore	1987	147	100	2.18
16	Saint Petersburg, Russia	1955	110	65	2.15

Sources: Metrobits, 2012; Huzayyin and Salem, 2013 (Cairo).

Box 3.2 Metros, urban structure and land use

The integration of metro systems within the urban fabric makes some important demands on the planning system. Rights-of-way must be established and protected. Space must be released for depots and terminals. In addition, where high-density ancillary developments are intended, the land must be assembled into lots suitable for development and the appropriate densities of development sanctioned.

The most indisputable structuring effect of metros is that they allow central business districts in large dynamic cities to continue growing, where service by road, either by car or bus, would be increasingly frustrated by congestion. Without the high-capacity links, activities would begin to be decentralized. This has implications both for city planning and for project evaluation. A conscious attempt to maintain the growth of the city centre will save on public infrastructure costs in other areas; avoiding these extra costs is an important part of the long-term benefit of metro investments.

Unfortunately, the magnitude of those savings is little researched, particularly in developing countries, and the economic evaluation of metro investments is usually based on the more conventional user cost–benefit appraisal. While that may still be justifiable, in the interest of avoiding the worst kind of 'white elephants', a more wide-ranging multi-criteria analysis may be the most suitable way of ensuring that those unmeasured effects are taken into consideration. An integrated land use, urban transport and air quality strategy, such as the Integrated Urban Transport Plan in São Paulo, is needed to ensure that the metro system is adequately inserted in the urban structure.

Obtaining desirable structuring effects outside the city centre is more difficult. Clustered multi-nuclear development associated with station locations sometimes occurs spontaneously, but normally requires either some planning by government (as in the cases of Singapore and Hong Kong, China) or close links between private ownership of the metro system and contiguous developments (as is common in Japan). In both cases, this requires land to be assembled for development in relatively large lots. This has been achieved by comprehensive public ownership of land in Hong Kong, by compulsory public purchase in Singapore and through market mechanisms in some Japanese private railway developments.

Source: World Bank, 2002a.

metro has the largest ridership in the world, and is located in the world's most populous urban agglomeration (with some 37 million inhabitants[45]). Similarly, major urban agglomerations such as New York and Mexico City, each with an estimated population of more than 20 million have metro systems that carry 4.5 million passengers daily. Being large also implies that metro cities are often the most fiscally sound, while small municipalities lack economies of scale necessary to construct and operate metros. Some of the links between metro systems and urban structure are highlighted in Box 3.2, and further explored in Chapter 5.

Second, urban areas with metro systems have often extended or grown beyond their established boundaries, engulfing surrounding areas, adjacent towns and sometimes into different provinces. For instance, Mexico City has encroached upon municipalities in two states. Tokyo (Japan), which has the world's largest metro system, has 75 per cent of its estimated 37.2 million population living in suburban areas.[46] In China, Shanghai encompasses a mega-urban region occupying an area of over 6340 square kilometres, with the Beijing mega-urban region extending over 16,870 square kilometres.[47] This implies that the governance of metro systems has to go beyond the traditional city limits. The metropolitization of neighbouring districts, municipalities and cities through cross-boundary institutions offers significant benefits in terms of efficiency, construction and operation costs, including creating economic synergies among newly connected areas. This is discussed in more detail in Chapter 9.

Third, many of the cities with metro systems are either capital cities or large cities in their respective countries. Capital cities account for 9 of the 16 cities with the world's largest metro systems (Table 3.4), and 27 per cent of all cities with metros. The rest are major cities. For instance, in China, Japan and Germany, besides the capital cities, 15, 12 and 18 cities in these countries respectively have metros. Being the national capital or major city can determine the extent to which countries invest in metro systems. This is because apart from generating more revenue, capital or large cities dominate the system of settlements and perform major administrative, commercial, diplomatic, financial and industrial functions. In order to perform these functions effectively, capitals and other large cities need an efficient and integrated public transport system that includes metros.

Urban areas with metro systems have often extended or grown beyond their established boundaries, engulfing surrounding areas, adjacent towns and sometimes into different provinces

LIGHT RAIL SYSTEMS AROUND THE WORLD: TRENDS AND CONDITIONS

Light rail is a flexible concept that evolved from the nineteenth century horse-driven rail carts.[48] The re-emergence as an alternative means of transport to cars or buses was due to its potential to mitigate congestion and support mobility in urban centres.

In 2013, there are approximately 400 light rail and tram systems in operation worldwide

The last two decades have seen several European cities either overhauling or implementing new light rail and tram systems as a cornerstone of their redevelopment efforts

As of mid-2013, there were 156 cities worldwide with BRT and bus corridors

Light rail systems have proliferated in both developed and developing countries in the last decades. Among European countries, light rail systems have been particularly evident in the UK, France, Spain, Portugal and Italy. These countries have successfully improved the quality of service and the image of the light rail system at affordable costs. Consequently, the last 20 years have seen many cities in Asia, Africa and Latin America reintroduce light rail systems.

In 2013, there are approximately 400 light rail and tram systems in operation worldwide, while construction of additional systems is ongoing in a further 60 cities. An additional 200 light rail systems are either being constructed or at various planning stages.[49] There is a strong concentration of light rail systems in Western Europe (170 systems) and in the US (more than 30 systems). Eastern Europe and Central Asian countries also have a fair concentration of light rail systems. The growing popularity of light rail systems can be attributed to their ability to provide significant transport capacity, without the expense and density needed for metro systems.[50] Several African countries have developed light rail systems such as Algeria, Egypt and Tunisia. In Algiers (Algeria), the tramway commenced service in 2010. When fully completed and operational, the tramway is expected to carry between 150,000 and 185,000 passengers per day.[51] In addition, the Oran tramway was launched in May 2013. The Oran tramway is 18.7 km long and can carry 90,000 passengers per day.[52] A number of other African countries have light rail projects in the pipeline. Ethiopia, for instance, is implementing a light rail project in Addis Ababa, covering a distance of 34 kilometres.[53] Furthermore, Mauritius is scheduled to commence work on a light rail system in 2014, covering a 28-kilometre corridor between the cities of Curepipe and St Louis.[54]

Globally, light rail systems are challenged by ageing or obsolete assets, as well as the increasing popularity of the private car. As a result, transport authorities in many cities are rejuvenating their existing light rail infrastructure or constructing completely new systems. Increased environmental consciousness and soaring fuel costs are also motivating more and more people to opt for public transport. As indicated in Table 3.5, the leading light rail systems in the world (in terms of ridership) are in Hong Kong and Manila.

Table 3.5

Top ten light rail and tram systems by ridership

City	Country	Passengers per day
Hong Kong	China	617,000
Manila	Philippines	604,822
Bochum-Gelsenkirchen	Germany	392,877
Dortmund	Germany	356,164
Istanbul	Turkey	315,000
Frankfurt/Main	Germany	310,000
Essen	Germany	306,616
Kuala Lumpur	Malaysia	300,301
Calgary	Canada	276,000
Boston	US	219,084

Source: Compiled from several sources.

The last two decades have seen several European cities either overhauling or implementing new light rail and tram systems as a cornerstone of their redevelopment efforts. For example, trams are part of the transformation of 24 French cities, including Nantes, Grenoble, Bordeaux, Clermont-Ferrand and Marseille. Other cities such as Lille and Lyon, Caen, Brest, Nancy and Toulon are advancing planning efforts. The tram networks in France are expected to reach a total track length of 610 kilometres by 2015.[55] Even cities without light rail, such as Astana, Kazakhstan, have reached advanced stages with plans for the implementation of light rail.[56]

An expansion of tram networks is evident in other European cities. A study shows that 40 cities and municipalities in the 15 EU countries had a total length of 488 kilometres under construction in 2009. A further 55 cities and municipalities had planned 1086 kilometres of network developments: 268 kilometres for new systems and 818 kilometres for expansions.[57]

Light rail systems are beneficial for their technology and low emissions, and are also seen as symbols of national pride. Mayors such as Samuel-Weis from the French city of Mulhouse have indicated: 'We wanted a tram that called attention to itself, as a symbol of economic vitality, environmental awareness and civic improvement – transportation as an integrated cultural concept'.[58]

BRT SYSTEMS AROUND THE WORLD: TRENDS AND CONDITIONS

Compared to metro and light rail systems, BRT is a relatively recent phenomenon, starting with the implementation of the first busway in Curitiba (Brazil) in the early 1970s.[59] However, bus priority measures were in place years before the Curitiba BRT system was implemented. Since then, there has been a worldwide increase in the adoption of BRT systems. As of mid-2013, there were 156 cities worldwide with BRT and bus corridors; most of them implemented in the last decade (Figure 3.4).[60]

Since BRT and metro systems are both rapid public transport systems, a comparison of their growth and performance is inevitable. BRT systems are concentrated in Latin America and the Caribbean (64 per cent of global ridership) and Asia (27 per cent) (Table 3.6 and Figure 3.5). The total ridership for BRT – 25.7 million passengers per day – is only 23 per cent of the ridership of metro systems. In terms of system lengths, however, BRT systems cover a total

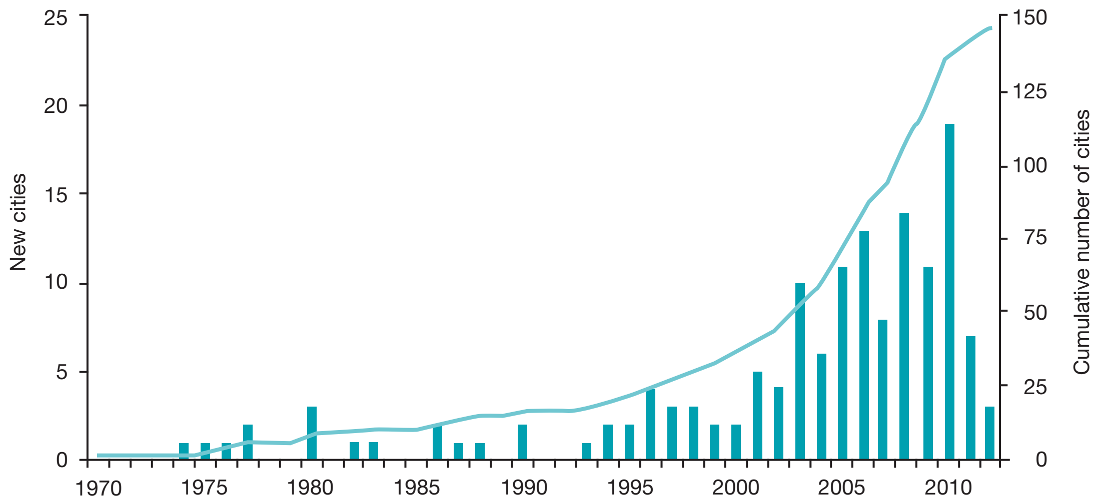

Figure 3.4

Evolution of BRT – Number of new cities each year and cumulative number of cities with operational BRT systems (1970–2012)

Source: Based on Hidalgo, 2012.

of 4072 kilometres,[61] or almost 40 per cent of the total length of all the world's metro systems.

The major BRT systems in the world – i.e. those with a ridership of over 300,000 passengers per day – are listed in Table 3.7. BRT systems are not yet comparable to metro systems in terms of their total track length and daily demand; the longest metro system (Beijing) is 3.3 times longer than the longest BRT system (Jakarta), while the most popular (in terms of daily ridership) (London) carries four times more passengers than the most used BRT (São Paulo).

In Bogotá, Colombia, the TransMilenio BRT provides fast and reliable transport for over 1.8 million passengers per day and in the process reduces traffic congestion.[62] Travel time has been reduced by 34 per cent and traffic fatalities by 88 per cent. In the case of Curitiba (Brazil), 70 per cent of commuters use the BRT to travel to work, thus resulting in a reduction of 27 million auto trips per year.[63] When compared with eight other Brazilian cities of similar size, Curitiba uses 30 per cent less fuel per capita. This helps achieve air quality and other environmental goals. By making high-capacity public transport more accessible, affordable and customer friendly, BRT has the potential to increase overall public transport ridership. In Curitiba, the BRT serves over 1.3 million passengers daily with commuters spending about 10 per cent of their income on transport – much less than the national average.[64]

Recently, African cities have made remarkable strides in developing BRT as part of their public transport systems. In 2008, Lagos (Nigeria) launched a BRT 'lite' corridor (a high-quality system that is affordable in the local context, while retaining as many of the desirable BRT characteristics as possible). This marked the first substantial investment in public transport for the city. The system was launched with a 22-kilometre route, 26 stations and 220 high-capacity buses, and it was designed to carry 60,000 passengers a day. By 2010, it was carrying 220,000 passengers per day, with more than 100 million person-trips being made in the first 21 months of operation. The 'lite' version of BRT halves the costs (about US$2.75 million per kilometre), however, capacity is limited as it uses kerb-aligned busways (not median-aligned busways) and the total route is not on a separated busway. As such, the overall speed (and capacity) of the BRT system is reduced.[65]

The Lagos BRT has brought about many positive changes.[66] Since its implementation, over 200,000 commuters use this bus system daily, with passengers enjoying a 30 per cent decrease in average

In Bogotá, Colombia, the TransMilenio BRT provides fast and reliable transport for over 1.8 million passengers per day and in the process reduces traffic congestion

Table 3.6

Current state of BRT systems around the world (mid-2013)

Region	Number of cities with BRT	Number of corridors	Total length (km)	Average daily ridership (million)	Share of average global daily ridership (%)
Africa	3	3	62	0.2	0.9
Asia	31	77	1097	7.0	27.2
Europe	42	75	704	0.9	3.6
Latin America and the Caribbean	53	163	1368	16.3	63.6
North America	20	39	584	0.8	3.3
Oceania	7	12	328	0.3	1.3
Total	**156**	**369**	**4143**	**25.7**	**100.0**

Source: Based on data from brtdata.org, last accessed 6 June 2013.

Figure 3.5

BRT systems around the world, number of cities and system lengths (mid-2013)

Source: Based on data from brtdata.org, last accessed 5 June 2013; and Hidalgo, 2012.

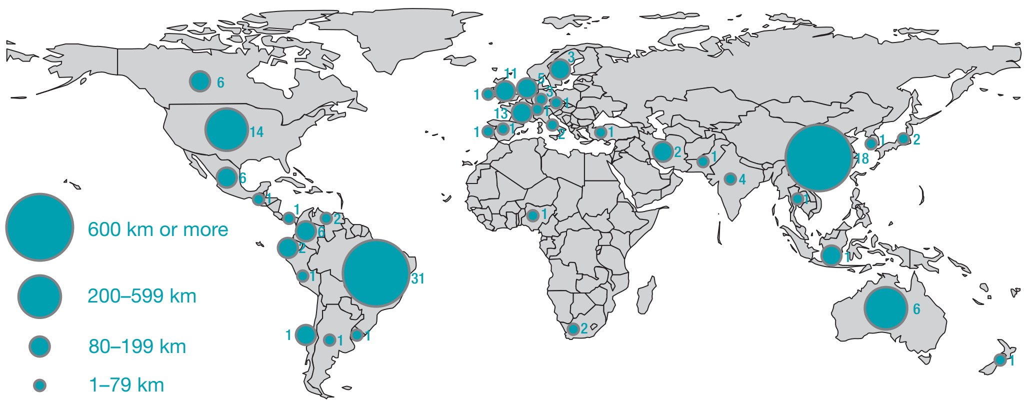

Table 3.7

The world's major BRT systems

City, country	Length (km)	Stations	Average daily ridership (million)	Type
São Paulo, Brazil	122	205	2.1	Open
Bogotá, Colombia	106	135	1.8	Closed
Rio de Janeiro, Brazil	63	70	1.6	Open
Tehran, Iran	91	114	1.4	Closed
Belo Horizonte, Brazil	24	16	1.3	Open
Taipei, China	60	150	1.2	Open
Recife, Brazil	11	25	0.9	Open
Guangzhou, China	22	26	0.8	Open
Mexico DF, Mexico	95	147	0.8	Closed
Istanbul, Turkey	42	32	0.6	Closed
Curitiba, Brazil	81	113	0.5	Closed
Jakarta, Indonesia	134	145	0.3	Closed

Note: In open systems the buses come from outside and continue in the busway, in closed systems the buses stay only in the busway (connection through feeder services). The Jakarta system uses central closed busways in arterials that also carry bus routes in the general traffic; as a result the demand for BRT services is lower than in other systems where the service is exclusive.

Source: Hidalgo, 2012.

fares. Furthermore, commuters have been able to reduce their travel time by 40 per cent and waiting time by 35 per cent, and experience safe, clean and reliable transport. Other significant socioeconomic benefits include the creation of direct employment for 1000 people and indirect employment for over 500,000 people. The Lagos BRT has demonstrated that local operators can run successful public transport systems.[67]

The success of the Lagos BRT can be attributed to the leadership and political commitment at all levels of government; and a capable, strategic public transport authority (LAMATA), a focus on user needs and deliverability within a budget and programme. Also core to the Lagos BRT success was a community engagement programme, which assured citizens that the BRT 'lite' system is a project created, owned and used by them.[68] This type of engagement was crucial, as Lagos residents had little experience with organized public transport. Due to a history of poor delivery of transport improvements – and with prior systems that sought to ensure that profit was directed to the already well-to-do – the community engagement sought to rid the residents of scepticism and suspicion of motives and intentions regarding the project.[69]

With the impetus from the 2010 World Cup, three South African cities (Johannesburg, Cape Town and Port Elizabeth) all initiated BRT lines. The Johannesburg Rea Vaya system was the first full BRT line in Africa (2009), operating on a 22-kilometre route, costing US$5.5 million per kilometre, travelling at 25 kilometres per hour and carrying 16,000 passengers daily. In 2011, the completed Phase 1 included 122 kilometres of busways and carried 434,000 passengers daily.[70]

In Johannesburg, the Rea Vaya BRT links the central business district with Braamfontein and Soweto, providing fast, reliable and affordable transport for 80,000 passengers per day, and in the process, reduces traffic congestion on that route.[71] In terms of employment, the Rea Vaya has created more than 800 permanent jobs and about 6840 temporary construction jobs.[72] Approximately 350 of these employees are recruited among taxi drivers who were affected by the launch and subsequent operation of the BRT system.[73] Transport authorities in Johannesburg paid special attention to ensuring that the Rea Vaya BRT was functional and attractive. This included pre-paid tickets; level boarding for full accessibility; multiple stopping bays; and weather-protected stations. Furthermore, the stations have been designed with the local urban environment in mind and local artists have been commissioned.[74]

Additional BRT schemes are being developed in Lagos, Nigeria, as well as the aforementioned South African cities. Similarly, other African cities are also investing in high-quality, efficient and environmentally clean transport. These include Accra (Ghana), Kampala (Uganda), Dar es Salaam (Tanzania), Nairobi (Kenya) and several other South African cities (Bloemfontein, Durban, East London, Pretoria, Ekurhuleni, Polokwane and Rustenburg). This demonstrates the increasing shift from informal public transport systems to high-technology BRT systems.[75]

MAIN CHALLENGES FACING HIGH-CAPACITY PUBLIC TRANSPORT SYSTEMS

Despite their growth, high-capacity public transport systems still face a number of challenges, especially in developing countries. This section discusses some of the main challenges, which include: integration (within the public transport system, with other modes and with the urban form); quality of service; finance; and institutions.

Integration within the public transport system

Integration occurs at three levels: physical, operational and fare. Physical integration allows for direct connections from one service to another, usually including transfer facilities and terminals. Operational integration consists of coordination of schedules and frequencies so that the service is guaranteed and wait times are not excessive. Fare integration involves free or reduced cost transfers, usually through advanced ticketing systems. Adequate integration requires the development of information systems to coordinate services and provide information to the users.

Most cities in developed countries have advanced integration at all three levels, either through the consolidation of a single public transport authority (e.g. Transport for London, UK, or the Land Transport Authority of Singapore), or the coordination of multiple agencies (Consórcio de Transportes de Madrid, Spain, or STIF in Paris, France). In contrast, most metro, light rail and BRT systems in developing countries are still evolving into integrated systems with the rest of the public transport system. In some cases, such as Bangkok's metro, Manila's light rail and Quito's BRT, different lines are not integrated with one another, requiring passengers to incur additional fares and walk long distances in order to connect between stations. This has proved to be a major disincentive to using the system. Some major cities have successfully integrated high-capacity public transport systems with the rest of the public transport systems in their cities. A descriptive list of these is presented in Table 3.8.

Despite their growth, high-capacity public transport systems still face a number of challenges, especially in developing countries

Integration with other elements of the transport system

Besides the integration between components of the public transport system, it is important to provide adequate connectivity with other components of the urban transport system, such as walking, biking, taxis, informal transport services, cars and motorcycles. These types of connections complement public transport systems, as feeder services, to provide door-to-door connectivity and allow for expanded coverage of the public transport system.

Most metro, light rail and BRT systems in developing countries are still evolving into integrated systems with the rest of the public transport system

Walking is usually the most common access mode to public transport and requires an adequate environment, with protected, well-lit, signalized and surfaced sidewalks. Design should consider the needs of the most vulnerable users: children, the elderly and people with disabilities. It is important to build these spaces according to good practices, but perhaps even more important is to keep such spaces clean and free of encroachments. Whereas the management of sidewalks is often outside the jurisdiction of public transport agencies, adequate coordination with the responsible agencies is important to ensure safe and pleasant travel for public transport passengers who are walking to and from the stations.

It is important to provide adequate connectivity with other components of the urban transport system, such as walking, biking, taxis, informal transport services, cars and motorcycles

In Singapore for instance, adequate facilities are provided for pedestrians. An inventory of pedestrian facilities in Singapore shows that there are: 491 overhead bridges; 54 pedestrian underpasses; 26 footbridges; 24 kilometres of covered linkways; and 98,400 street lightings.[76] All these provide a safe and comfortable walking environment, which is unsurpassed in other Asian cities. Cyclists require two integration elements: infrastructure and safe parking. As discussed in Chapter 2, bike travel should be separated from the walking and the motor vehicle environment as much as possible – to protect pedestrians as well as cyclists. Furthermore, bike lanes should be wide enough to accommodate bike travel, with strong segregation from the car traffic.

To ensure usability by cyclists, public transport vehicles should accommodate bikes inside the trains

Table 3.8

Examples of cities with infrastructure, information systems and payment elements that promote multi-modal connectivity

City	Authority/operator	Multi-modal infrastructure elements	Information systems	Integrated payment solution
London	Transport for London (TfL)	Metro; bus; bike-sharing; taxis; light rail; trams	iBus; Web and Mobile information systems	Oyster smart card
Paris	RATP; JCDecaux (bike-sharing)	Metro; tram; bus; bike-sharing	IMAGE project (real time traffic information)	Navigo pass
Singapore	Land Transport Authority	Metro; light rail; bus; taxis	Web-based and mobile (How2Go) information systems	EZ-Link; NETS FlashPay
Hong Kong	MTR Corporation (metro); private operators (bus services)	Metro; bus	Next Train mobile app; Passenger information display systems	Octopus smart card
Los Angeles	Los Angeles County Metropolitan Transportation Authority (LAMTA)	Metro; light rail; city bus; and BRT	NEXTRIP (NextBus technology)	Transit Access Pass (TAP) card
New York City	New York City MTA	Metro; BRT; local and express bus	MTA Bus Time	MetroCard
Mexico City	Metro: Mexico City Metro; BRT: Metrobus (buses run by private operators); Bike-sharing: Ecobici (operated by Clear Channel)	Metro; BRT; bike-sharing	Web-based passenger information system (mexicometro.org) for all modes	Metrobus Card
Guangzhou	Metro: Guangzhou Metro Corporation; BRT: Guangzhou Bus Rapid Transit Operation and Management Co.; Bike-sharing: Guangzhou Public Bicycle Operation and Management Co.	Metro; BRT; bike-sharing	Web-based and station-based passenger information systems	Yang Cheng Tong
Budapest	Budapesti Közlekedési Központ (Centre for Budapest Transport)	All public transport modes, roads and traffic management and parking	Centrally coordinated ticketing system with special cards and passes	Travel card 24h, Monthly/Annual pass, Students, Pensioners
Chicago	Chicago Transit Authority	Bus; metro; bike-sharing; car-sharing	BusTracker (real time bus information); TrainTracker (real time train information)	Chicago Card, Chicago Card Plus/I-Go card for integration of car-sharing with public transport

Note: Brand names mentioned for illustration purposes only.

or buses and/or provide adequate bike parking at stations. In high-capacity public transport systems, safe parking at the integration point is recommended.

Several cities . . . have been able to implement efficient public transport services and develop urban forms that are highly conducive to public transport ridership

Other mechanisms to provide last-kilometre connectivity are taxis, informal transport services and motor vehicle parking and pick-up or drop-off areas. In Nairobi, the Kenya Railways Corporation introduced *last-mile* link buses to convey passengers to and from the railway station in 2013.[77] The *last-mile* link shuttle services pick passengers from the surrounding areas and feed them into the Syokimau Railway Station, and thereafter drop them off at various points within the city centre. For this purpose, the Corporation has contracted a private firm to provide bus connections for rail transport users within the city centre.

At important integration points, especially in the periphery of cities, adequate space is needed for these mechanisms. This is to ensure that different types of users are able to connect to the public transport system and avoid using cars to go to the city centre.

Integration with the built environment

Accompanied by complementary land-use and zoning policies, high-capacity public transport systems can encourage compact, pedestrian and public-transport friendly environments that are integrated into the surrounding area. Several cities, such as Copenhagen (Denmark), Singapore and Curitiba (Brazil), have been able to implement efficient public transport services and develop urban forms that are highly conducive to public transport ridership.[78] In these cities, public transport and urban form function in harmony: either through mixed-use, compact and accessible development suited for public transport (also known as transit-oriented development), or through flexible public transport options suited to low-density urban development.

Singapore is planned as a public-transport-oriented compact city, with high-density residential and commercial developments around transport nodes. This improves accessibility to public transport. Although public bus and train services are provided on a commercial basis, all forms of public transport are generally affordable to the public – thus contributing to increased use of public transport and a reduction in the use of private vehicles. The adequate integration between public transport and the built environment makes both the public transport system and the city successful. High density (combined with disincentives to private car ownership and use) increases ridership, while public transport provides access to dense, accessible, mixed-use urban environments. Consequently, shorter trips can be completed on foot or bicycle. The result is less vehicle kilometres travelled and thus lower transport emissions and fewer traffic accidents.

Quality of service

Quality of service involves several elements as perceived by the user involving dimensions such as travel time, reliability, safety and security, comfort and user information. Travel time includes the door-to-door connectivity, walking to the station, waiting for the service, travelling on board, transferring between services and walking to the final destination. Reliability involves the confidence on the arrival of the service, and the travel time on board. Safety implies the buses and trains are well maintained and that passengers would not be exposed to preventable accidents. Security implies that passengers travel with the realization that they would not be victims of crime or terrorist attacks. Comfort deals with several amenities, but mainly with the space available, or occupancy. User information comes in many forms to allow the passenger to navigate the system and be aware of real time information and contingencies.

The most advanced public transport systems in the world include all these dimensions of quality to provide a very attractive alternative to car and motorcycle use. Many advanced systems in developing countries have high-quality services, but may not include the first and last leg of the trip (i.e. walking to and from the station). 'Universal design'[79] – which is an important aspect of inclusive public transport systems – is often overlooked.

Cities in developed countries have incorporated reliability as part of the key performance indicator metrics. Nevertheless, in developing cities, reliability is not commonly measured and hence not managed. Typically, light rail and BRT systems in developing cities observe train or bus 'bunching' (i.e. two or three vehicles arriving simultaneously at the stage and gaps between vehicles). This reduces the systems' capacity and causes high occupancy for some vehicles, while others have excess space. Advanced control systems could be used to provide real-time information to the drivers and thereby reduce bunching.

Occupancy levels are the main aspect when considering comfort. Notably, the occupancy standards in developed and developing countries tend to differ: four to five standees per square metre vs. six to seven standees per square metre, respectively. In general, this is a result of financial considerations, rather than user acceptance or cultural considerations. Higher occupancy standards mean fewer vehicles and drivers, and less infrastructure requirements. It also means that the capacity for peak flows is set artificially high.

As a result, public acceptance of several systems can suffer.[80] For instance, surveys in São Paulo's metro (Brazil), Manila's light rail (the Philippines) and Bogotá's BRT (Colombia) indicate that the main user complaint is overcrowding in trains, buses and stations. These surveys indicate that the occupancy standards adopted are not acceptable by users, irrespective of the public transport mode, and should be revised. This is important when considering public transport as an alternative to private motor vehicle use. In the longer run, the high occupancy standards may result in more people choosing motorcycles or cars as they become more affordable due to economic growth.

The most advanced public transport systems in the world include all . . . dimensions of quality [travel time, reliability, safety and security, comfort and user information] to provide a very attractive alternative to car and motorcycle use

User information systems include static and dynamic information, and are particularly useful for new users, visitors and for frequent users making infrequent trips. Modern systems include real-time information on service arrivals, and voice and visual announcements for the visually and the hearing impaired. With the advent of smart wireless technologies this type of information is gradually becoming available on handheld devices.

Finance

The availability of finance is essential for efficient urban mobility systems. Conversely, the absence of finance can constrain the ability of relevant authorities to implement sustainable high-capacity public transport options. These issues, which are addressed in the paragraphs below, are examined in greater detail with respect to urban mobility systems in Chapter 8.

Financial risks in public transport project development

The expansion and maintenance of metros, light rail or BRT systems require large amounts of funding. One common issue in developed and developing countries alike is the tendency to underestimate time and cost (leading to costly overruns for both), and overestimate demand during the decision-making process. The average cost escalation of rail, fixed link and road have been estimated at 45, 34 and 21 per cent, respectively;[81] in the case of overestimating demand, 84 per cent of rail projects, and 50 per cent of road projects have been associated with inaccuracies larger than 120 per cent.[82] This issue requires substantially improved procedures during project preparation, with strong institutions

The expansion and maintenance of metros, light rail or BRT systems require large amounts of funding

and evaluation processes to ensure more reliable data to inform decision-making.

Funding sources

Funding for capital investments in high-capacity public transport requires the participation of local, regional and national governments. Several countries have developed programmes to co-finance capital investments in public transport, often supported by multi-lateral development banks and international technical assistance programmes. It is important to recognize that the major multi-lateral development banks – African Development Bank, Asian Development Bank, Development Bank of Latin America, the European Bank for Reconstruction and Development, the European Investment Bank, the Inter-American Development Bank, the Islamic Development Bank and the World Bank – pledged US$175 billion during the Rio+20 Conference to support sustainable transport between 2012 and 2022.[83] This fund will be used to promote all forms of sustainable transport, including public transport; bicycle and walking infrastructure; energy-efficient vehicles and fuels; railways; inland waterways; and road safety. Additional sources of international funding are the climate change financial mechanisms, but they are usually small, as compared with the funding needs.[84]

Funding for capital investments in high-capacity public transport requires the participation of local, regional and national governments

The national governments' interest in public transport comes from the importance of cities for the productivity of the countries, and national energy security and environmental targets. Other considerations are equity and expanded access, as well as opportunities for low-income and vulnerable populations living in urban areas. It is also important to have adequate evaluation procedures to maximize the benefits of such investments and avoid cost overruns.[85]

In addition to transfers from different levels of government, local authorities require innovative funding mechanisms to support implementation and operation of public transport systems beyond the farebox revenues.[86] Several potential sources for such funding are discussed further in Chapter 8.

Many agencies in developing countries are not able to retain qualified personnel to plan, implement and manage the complexity of public transport projects

Public transport subsidies

Another important aspect of finance is the issue of subsidies. Transport economics literature has shown that public transport subsidies are efficient and socially worthwhile as public transport involves several positive externalities (air quality, climate change, road safety, physical activity). Thus, the provision of subsidies to encourage operators to lower their existing fares and/or expand their existing frequencies is socially desirable.[87] The majority of the social benefits accrue from the 'Mohring effect',[88] which indicates that subsidies increase ridership, and ridership increase engenders higher service frequencies, and the higher frequencies reduce the average waiting times at public transport stops. Hence, subsidies could be justified because of the scale economies conferred on riders. Nevertheless, subsidies need adequate management for them to be targeted towards service improvements and serving the needs of vulnerable populations (low income, elderly, handicapped). Unmanaged subsidies may result in inefficiencies, such as excessive overheads, large number of operators and drivers, and high maintenance costs.[89]

Institutions

Urban transport involves multiple institutions and levels of government that are not always well coordinated. Lack of coordination results in several issues such as the lack of integration among public transport components, other transport modes and the built environment. Very often, the agencies responsible for metros, light rail or BRTs are only responsible for their respective mode, with minimal (if any) coordination with other components of the urban transport system. A second institutional issue is the lack of technical and managerial capacity. Many agencies in developing countries are not able to retain qualified personnel to plan, implement and manage the complexity of public transport projects. There is an urgent need to upgrade the technical capacity through training and professional development programmes. The institutional and governance dimensions of sustainable urban mobility systems are discussed further in Chapter 9.

Significant opportunities exist to enhance technical and managerial capacity, through direct exchanges among peer institutions and benchmarking. Some examples of these efforts include:

- Nova – a programme of international railway benchmarking, made up of a consortium of medium sized metro systems from around the world: Bangkok (Thailand), Barcelona (Spain), Buenos Aires (Argentina), Brussels (Belgium), Delhi (India), Istanbul (Turkey), Lisbon (Portugal), Montréal (Canada), Naples (Italy), Newcastle (UK), Rio de Janeiro (Brazil), Singapore, Toronto (Canada) and Sydney (Australia). The four main objectives of Nova are: to build measures to establish metro best practice; to provide comparative information both for the metro board and the government; to introduce a system of measures for management; and to prioritize areas for improvement.[90]
- CoMET – a programme of international railway benchmarking, made up of a consortium of large metro systems from around the world: Beijing (China), Berlin (Germany), Guangzhou (China), Hong Kong (China), London (UK), Madrid (Spain), Mexico City (Mexico), Moscow (Russia), New York (US), Paris (France), Santiago (Chile), São

Paulo (Brazil), Shanghai (China) and Taipei (China). Just like Nova, the four main objectives of CoMET are: to build measures to establish metro best practice; to provide comparative information both for the metro board and the government; to introduce a system of measures for management; and to prioritize areas for improvement.[91]

- The International Bus Benchmarking Group (IBBG) – a programme of urban bus operations benchmarking, made up of medium and large bus organizations located around the world: Barcelona (Spain), Brussels (Belgium), Dublin (Ireland), Istanbul (Turkey), Lisbon (Portugal), London (UK), Montréal (Canada), New York (US), Paris (France), Seattle (US), Singapore, Sydney (Australia) and Vancouver (Canada). IBBG was established in 2004 to provide a confidential forum to share experiences, compare performance, identify best practices and learn from one another in order for member organizations to improve performance.[92]
- SIBRT – whose mission is to cooperate and create a synergy for the promotion, consolidation and strengthening of BRT and integrated transport systems, so that they become paradigms for the future of mobility in Latin America and the world, and to contribute effectively to improve the quality of urban life.[93]

Additional exchanges are organized through industrial associations such as the International Association of Public Transport (global),[94] the American Public Transportation Association (US),[95] Canadian Urban Transit Association (Canada),[96] and Associação Nacional de Transportes Públicos (Brazil).[97]

CONCLUDING REMARKS AND LESSONS FOR POLICY

This chapter has presented empirical evidence of the trends and conditions as well as challenges with respect to the role of high-capacity public transport systems worldwide. These systems play important social, economic and environmental roles in terms of facilitating more efficient urban mobility systems and sustainable urban development patterns. Such high-capacity public transport systems are primarily appropriate for large and dense urban agglomerations, and serve as important parts of integrated public transport systems. Accordingly, they should be designed to provide a competitive and viable alternative to private cars and motorcycles.

Globally, metro systems have an average of 112 million passengers per day. Asian cities account for 46 per cent of global ridership, followed by European cities with 34 per cent of global ridership. As of 2013, there are only two African cities with metro systems. Ridership on light rail systems is significantly lower, although there are some 400 light rail and tram systems in operation worldwide. Most of these are found in Europe and the US, although the two light rail systems with the highest number of passengers are both located in Asia.

As of mid-2013, there were 156 cities worldwide with BRT system. The total ridership for BRT, which is about 26 million passengers per day, is less than a quarter of that of metro systems. Most BRT systems are located in developing countries, particularly in Latin America and the Caribbean, and Asia.

Integration is important for public transport systems to be efficient and sustainable

Metro, light rail and BRT systems have different characteristics, each with its benefits and drawbacks. This report calls for an advanced evaluation of the costs and benefits of high-capacity public transport systems, prior to their implementation. It is also important to avoid endless discussions about alternatives, as the worst case scenario is 'to-do-nothing'.

The most efficient systems are those that have achieved route integration; integration with other public transport systems; integration with private motorized transport . . .; integration with non-motorized modes . . .; and fare integration

A major issue relating to the successful implementation of high-capacity public transport systems is an accurate understanding of the requirements and perceptions of its potential users. In order to ensure maximum ridership on metro, light rail and BRT systems, these need to be designed and implemented in a manner that meets the aspirations of potential riders.

Integration is important for public transport systems to be efficient and sustainable. The most efficient systems are those that have achieved route integration; integration with other public transport systems; integration with private motorized transport (including through encouraging drivers of private cars to park outside the city centre and use public transport for parts of their daily commute); integration with non-motorized modes (through easy access for pedestrians and/or bicycle parking and allowing bicycles onto public transport vehicles); and fare integration: allowing users to travel throughout the urban public transport system on a single ticket, or at reduced rates when switching between operators and/or lines. Integration also includes the built environment dimension: dense, mixed-use and accessible urban forms enhance ridership and vice versa.

Integration also includes the built environment dimension: dense, mixed-use and accessible urban forms enhance ridership and vice versa

Technical inadequacies in the construction of public transport systems, such as ramps, gaps, steps or waiting areas, represent significant challenges for vulnerable groups. Many high-capacity public transport systems are also characterized by real or perceived security risks. These challenges and risks often lead to reduced ridership and exclusion of many potential users, especially women, children, the elderly, disabled and minorities.

NOTES

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4 World Bank, 2002a.
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61 brtdata.org, last accessed 5 June 2013.
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67 World Bank, 2009a.
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CHAPTER 4

URBAN GOODS TRANSPORT

Urban goods transport, also known as urban freight distribution, concerns a vast range of activities insuring an adequate level of service for a variety of urban supply chains. While cities have always been important producers and consumers of goods historically, much of these activities were taking place in proximity to major transport terminals, with limited quantities of freight entering the city itself. The functional specialization of cities, the global division of production, the emergence of intermodal terminals, the rise of service activities, global consumerism, as well as increasing standards of living are all correlated with an increased demand for urban goods transport in cities. This is characterized by a higher frequency of deliveries, and larger quantities of freight shipments coming from, bound to or transiting through urban areas. The scale, intensity and complexity of urban goods transport necessitate additional forms of organization and management in many large cities, which is the realm of city logistics. City logistics concerns the means to enable goods transport in urban areas by improving the efficiency of urban freight transportation and mitigating the environmental and social impacts.

The need for city logistics is often a derived outcome of the new demands imposed by global supply chains on regional and urban landscapes.[1] Since most of the goods consumed in cities originate from outside locations, urban goods transport is commonly referred to as the 'last mile' along a supply chain. Urban goods transport is thus concerned with establishing an effective interface between the regional or global realms of freight transport and the last mile of urban freight distribution. While maritime shipping, air cargo or rail are the privileged modes for long-distance goods transport, the vehicle, particularly the truck, remains the dominant urban mode as it is perceived to be the most suitable to service specific origins and destinations within the complex urban grid of streets and highways. This last mile requires a shift to different distribution strategies more suitable to an urban context, often resulting in congestion, delays and additional costs proportionally higher than the distance concerned.

The sustainability of cities cannot be reviewed without due consideration to the role of goods transport.[2] Indeed, while a city can be perceived as an economic, social, political and cultural entity, urban freight distribution underlines the physical and managerial activities necessary to support all of the above. However, compared to passenger transport, urban freight distribution has to a large extent been neglected by urban transport policy-makers. Yet, it is extremely important for the social and economic viability of urban areas and has widespread ramifications for the environment, transport infrastructures and overall trends in mobility. The sector is also faced with a number of challenges such as congestion, parking for deliveries and reverse logistics (e.g. recycling and garbage collection).[3]

This chapter thus reviews the trends and conditions of goods transport in urban areas, both within the formal and informal sectors. It outlines the fundamental contribution of goods transport for urban life, and points to the externalities generated by the sector. The elaboration of goods transport processes, in both developed and developing countries, sheds light on the contrasts and similarities across countries. Importantly also, the chapter shows how goods movement interacts with, and is shaped by, the urban context in quite specific ways.

Urban goods transport, also known as urban freight distribution, concerns a vast range of activities insuring an adequate level of service for a variety of urban supply chains

Urban freight distribution has to a large extent been neglected by urban transport policy-makers

URBAN GOODS TRANSPORT: KEY COMPONENTS AND ACTORS

Urban goods transport, as it relates to cities and their populations, is the set of all activities ensuring that their material demands are satisfied. The focus is on the city as a place of production, distribution and consumption of material goods, but also the handling of waste as an outcome of these activities.

Throughout history, cities have had to make provisions for distributing and storing goods to their populations. Commercial areas, including warehouses, tended to be located directly adjacent to facilities such as ports and main arterials. The industrial revolution and later suburbanization offered an extended range of options in the location of activities supporting urban freight distribution. These included rail yards and highway interchanges. The situation became inherently more complex as the intensity and variety of urban goods transport services increased. This in turn made the importance of goods transport more salient, to the point that concerted approaches were developed that led to the emergence of city logistics.

Globalization has enabled the expansion of the distribution sector as a more prevalent element of the urban landscape, with facilities such as terminals and distribution centres

While the functions of production (e.g. manufacturing) and consumption (e.g. retailing) remain prominent forms of urban goods transport, globalization has enabled the expansion of the distribution sector as a more prevalent element of the urban landscape, with facilities such as terminals and distribution centres. City logistics have experienced significant changes, particularly with the concept of lean management, where demand-based supply-chain management has enabled a better management of inventories and less storage requirements. Under such circumstances, most of the inventory is in transit using transport modes and terminals as 'mobile warehouses'; this inventory is consuming valuable urban space either as land use or as vehicles circulating in the urban transport system.

Goods transport accounts for 10 to 15 per cent of vehicle equivalent kilometres travelled in urban areas, 2 to 5 per cent of the employed urban workforce, and 3 to 5 per cent of urban land use

Most of the early city logistics projects were undertaken in Japan and Western Europe[4] (e.g. Germany, France, Belgium, Netherlands, Luxembourg and the UK) as cities in these countries were more constrained by the lack of available land, and had well-established urban planning traditions. The approach was then adopted in other parts of the world, with the growing recognition that the metropolitan area should also be considered as a freight planning unit. Still, and in spite of a growing global awareness, the focus on urban goods transport remains limited, partially due to an enduring bias in urban planning concerning freight issues (Box 4.1).

An important technological change relates to intermodal transportation, which has considerably improved the capacity and efficiency of moving freight between modes such as maritime, rail and road. Of particular relevance is containerization, which has shaped transportation systems in a fundamental way by providing a load unit that can be handled almost everywhere, and by a variety of modes.[5] More recently, the application of new information and communication technologies for improving the overall management of freight distribution has received attention.

Components of urban goods transport

A city is provisioned by hundreds of supply chains servicing a wide array of economic sectors including grocery stores, retail, restaurants, office supplies, raw materials and parts (for manufacturing), construction materials and wastes. Depending on the circumstances, goods transport accounts for 10 to 15 per cent of vehicle equivalent kilometres travelled in urban areas, 2 to 5 per cent of the employed urban workforce, and 3 to 5 per cent of urban land use. A city not only receives goods but also ships them: some 20 to 25 per cent of truck-kilometres in urban areas are outgoing freight, 40 to 50 per cent are incoming freight, and the rest both originates from and is delivered within the city.[6]

There are three main components of city logistics: the modes that carry the freight, the infrastructures supporting freight flows and the operations

Box 4.1 Urban planning and freight distribution

The consideration of freight distribution within urban planning remains limited, leading to substantial biases in the analysis of urban mobility, which overly focuses on passenger issues. The main factors behind this oversight can be attributed to the following:

- Freight distribution is an activity predominantly controlled and operated by private interests, with limited oversight from the public sector. Thus, the public sector tends to have only minimal understanding about the commercial dynamics of freight distribution.
- Accordingly, the public sector tends to have direct control and oversight over public transport systems with planning endeavours focusing on these issues.
- Freight distribution is a profit-seeking activity (making goods available to customers), while public transport is more about maximizing utility (providing accessibility). The planning and operational objectives of stakeholders, including their mentality, are therefore different.
- There is a scale mismatch in the understanding of urban mobility, since passenger flows are predominantly the outcome of local processes (e.g. commuting), while freight flows reflect a dynamic often being driven by processes taking place at the global level (global supply chains).
- Urban transportation and mobility in academic and professional programmes mostly reflect the realm of public engagement, with freight issues remaining a marginal component. Programmes tend to focus on passengers, and planners receive limited exposure to freight issues in their training.

related to their organization and management (Figure 4.1). Each component has subcomponents with their own characteristics and constraints. For instance, transport terminals, roads and distribution centres are infrastructure subcomponents of city logistics. The same applies to scheduling, routing, parking and loading/unloading, which are operational subcomponents.

While trucks remain the dominant mode supporting city logistics, they face constraints mainly related to congestion and environmental externalities. This is in spite of the prominence that road infrastructure takes over urban land use, as well as parking and unloading (or loading) difficulties at the points of final delivery. The balance in the relative importance of the depicted subcomponents appears to be unsustainable in a growing number of urban areas. A major challenge for city logistics is therefore a rebalancing where alternative modes (such as electric vehicles) and infrastructure (such as local freight stations), improved by novel forms of operations, would play a more prominent role. Obviously, the nature and extent of this rebalancing is city specific.

City logistics, as a last-mile distributional strategy, can take many forms depending on the concerned supply chains, as well as the urban setting in which it takes place. It involves two main functional classes: the first concerning consumer-related distribution and second producer-related distribution. Independent retailing, chain retailing, food deliveries and parcel and home deliveries constitute consumer-related distribution while producer-related distribution involves construction sites, waste collection and disposal, industrial and terminal haulage.

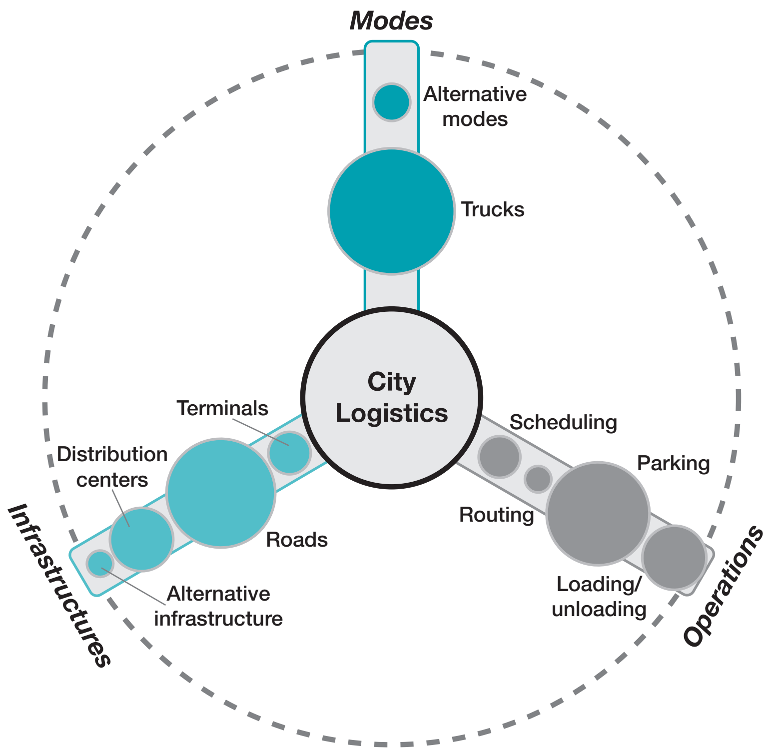


Figure 4.1

Components of city logistics and their relative importance

Actors and stakeholders in urban goods transport

Freight can be handled commercially by two types of actors: private and common carriers. For private carriage, freight is carried out by cargo owners (manufacturers or retailers) with their own employees and fleet, or by subcontracting to an independent carrier with its own vehicles. A common carrier sells its services to any customer on a contractual basis and will often consolidate their cargo and deliveries. There is a significant geographical variation in the role of private and common carriers in urban goods transport. While in developed countries private and common carriers tend to account for an equal share of urban deliveries, in developing countries private carriers tend to be dominant. This is reflective of an urban freight distribution market that is not well developed and assumed in part by an informal sector using motorized and non-motorized means.

The global production network concerns an array of manufacturing activities mostly organized by multi-national corporations in search of comparative advantages. This is associated with a growth in international trade, where cities assume the function of production zones for parts and finished goods bound to global markets. Intermodal terminals are the interfacing means to access the global distribution network. This network supports international trade that circulates over a global network of intermodal terminals linked by modes such as maritime shipping, air freight and for shorter distances by rail and trucking. In this frame, cities act as distribution nodes with their major port, airport and rail terminal facilities. In many instances, a city will play the role of a gateway granting access to a regional freight distribution system, implying that freight distribution will have a spatial imprint well above one justified by the level of urban consumption.

While in developed countries private and common carriers tend to account for an equal share of urban deliveries, in developing countries private carriers tend to be dominant

The global urban network is reflective of the intensity of material consumption, since from a material standpoint the main function of cities is to act as points of final consumption. The multitude of actors and supply chain concerned requires a growing level of organization and management of urban freight distribution. This is particularly problematic since cities are highly constrained areas, with a limited amount of space available for circulation, deliveries and warehousing. However, the differences between cities in developing and developed countries remain salient, particularly over freight flows.

In terms of stakeholders of commercial goods transport in urban areas, it is possible to identify four general groups that are shaping urban freight distribution: cargo owners (e.g. retailers, manufacturers, wholesalers); residents; distributors (mostly carriers, third party logistics companies and freight forwarders); and planners and regulators. The relations between the cargo owners who provide goods and the residents who consume them, with distributors acting on the cargo owners' behalf, are particularly important as cargo owners and distributors strive to fulfil consumers' needs. Planners and regulators try to set rules under which urban freight distribution takes place, with the multi-dimensional aim of satisfying their constituents as well as commercial, transport and distribution interests. Each stakeholder has its own objectives, and while there may be inherent conflicts between stakeholders, under normal circumstances the relations tend to be on the neutral side. However, when a challenge in city logistics requiring an intervention from either a public or private stakeholder emerges, the relationships between stakeholders are likely to change, which can lead to four possible outcomes (Figure 4.2):

The . . . growth in global distribution has reinforced the role of gateway cities, nodes interfacing with global economic processes, mostly through ports and airport terminals

- ***Conflicts***. Due to the scarcity of space, as well as the density and the complexity of the urban landscape, conflicts between stakeholders are common. These conflicts arise when the externalities of existing or proposed projects imposed by urban freight distribution on local communities are judged to be unacceptable by residents, planners and regulators. Sometimes conflicts arise between the residents and planners over specific issues triggering classic NIMBY (not-in-my-backyard) responses. Legal recourse is attempted to stop a development project (e.g. a new distribution centre) or to more strictly regulate a freight activity (e.g. access to a commercial district).
- ***Cooperation***. Usually achieved when additional mitigation strategies are added to a project (change in design) or to modes of operation. It is agreed by some form of consensus that the existing capacity is to be used and shared more rationally. Public–private partnerships are examples where private goals and public interests can be accommodated.[7]

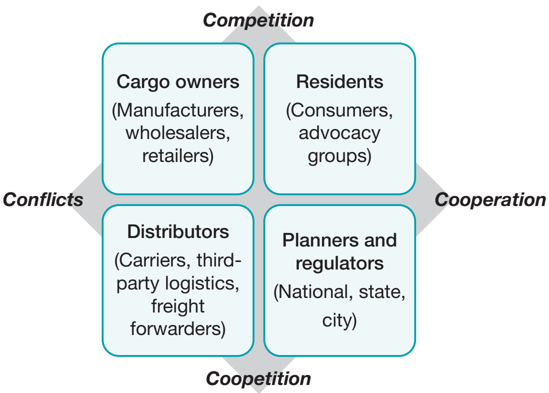


Figure 4.2

Main stakeholders and relationships in urban freight distribution

Source: Adapted from Taylor, 2005.

- ***Competition***. Standard relationships between private shippers and freight forwarders as they bid to access urban real estate and facilities for their operations. Freight forwarders compete to attract and retain customers over their freight distribution services. Commercial and residential developers are also competing within the land-use zoning framework for real estate projects.
- ***Coopetition***. A specific form of collaboration between private stakeholders, particularly when a stakeholder is unable to individually address an issue or is incited to do so by regulation. While they may compete for attracting and retaining customers, freight forwarders could be involved in shared operations. Activities related to the consolidation of urban freight distribution are particularly prone to coopetition with shared facilities (e.g. urban distribution centres) or deliveries (e.g. shippers pooling their demand to negotiate better terms with a freight forwarder).

TRENDS AND CONDITIONS OF URBAN GOODS TRANSPORT

Cities are concomitantly areas of production, distribution and consumption. The growth in global trade reflects growing levels of production and consumption taking place in urban areas. While specific figures are not readily found, it can be assumed that most of global trade either originates in, transits through, or is bound to, an urban area. The associated growth in global distribution has reinforced the role of gateway cities, nodes interfacing with global economic processes, mostly through ports and airport terminals (Box 4.2).

The city is also increasingly transnational. Depending on the economic and geographical context, some cities (such as London, UK; New York, US; Paris, France; and Tokyo, Japan) have a pronounced tertiary function (finance, administration, culture), implying that consumption accounts for the main share of the total goods being handled, with the functions of production and distribution assuming a more marginal role. Other cities (such as Bangkok, Thailand; Busan, Republic of Korea; Guangzhou and Shanghai, China) have emerged as manufacturing centres where production assumes the dominant share of goods flows. With the increasing use of the container and the growth of long-distance trade, several cities act as intermediaries for the goods flows bound to large market areas. For instance, gateway cities often fulfil the material requirements of whole regions by being a point of freight transit and distribution to service inland destinations.

Inasmuch as a majority of urban inhabitants do not interact with freight facilities or have little

Box 4.2 Gateway cities and global distribution

A gateway city is a pivotal point for the entrance and exit of goods in a region, a country or a continent. The global system of freight distribution is articulated by major gateway cities, often composed of a cluster of ports and airports within a metropolitan area. Altogether, the 39 largest gateway cities accounted for 90 per cent of the global containerized and air freight volumes (Figure 4.3). This underlines their fundamental importance in the handling of the world's trade and as intermediary (or final) locations within global distribution systems.

There is a substantial concentration of freight activity along the Tokyo–Singapore corridor in Asia. The world's largest gateway region is Hong Kong–Shenzhen; 14.8 per cent of the world's containerized and air freight traffic is in this region. Expanding this gateway to the Pearl River Delta (with Guangzhou), which can be considered a mega-urban region (Box 5.11), causes this share to reach 16.7 per cent. For Europe, the Rhine/Scheldt delta (from Amsterdam to Brussels) accounts for 7.5 per cent of the global containerized and air freight volume. The most important North American gateway system is the Los Angeles/Long Beach system. Some of the gateways are dominantly hubs transhipping freight from one system of circulation to the other, such as Colombo (Sri Lanka), Dubai (United Arab Emirates) or Singapore.

Source: O'Connor, 2010.

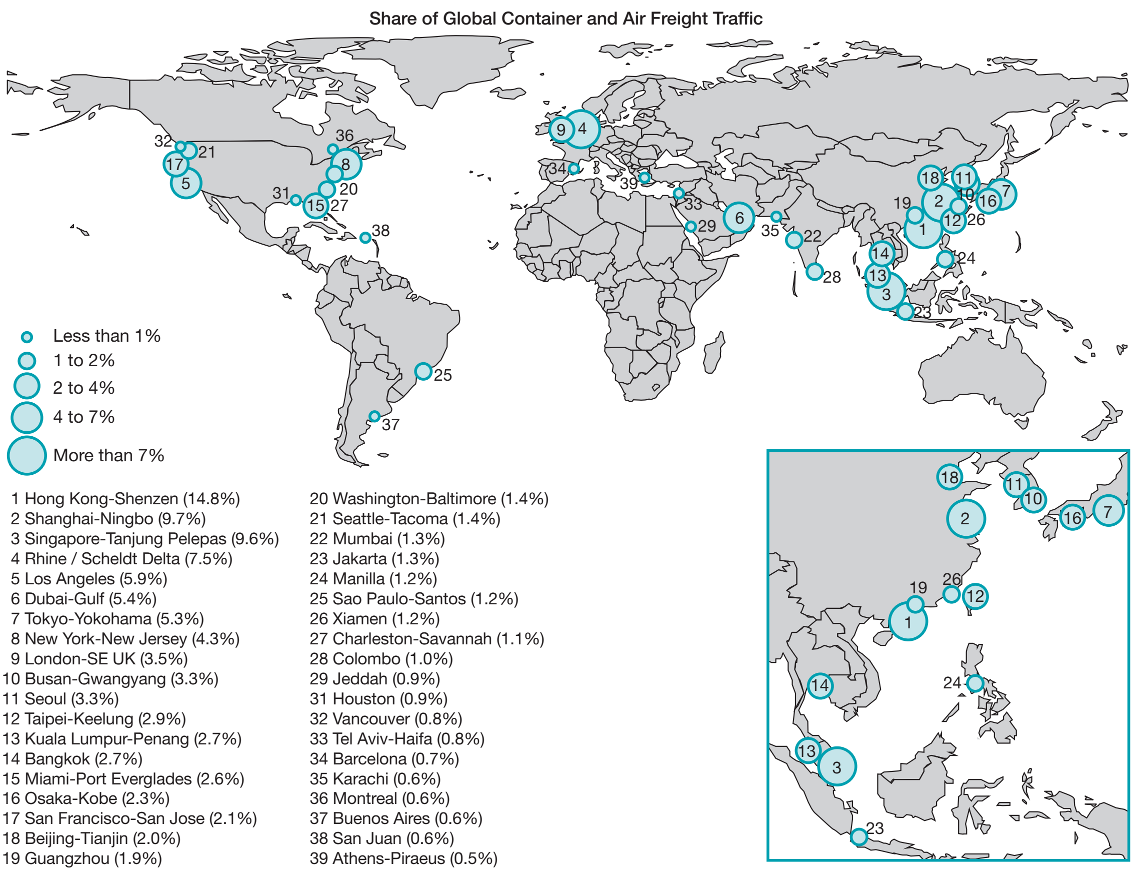


Figure 4.3

World's major gateways (sea and air freight) (2006)

Source: Based on O'Connor, 2010.

awareness of their existence, these play a fundamental role in the urban economy or a city's welfare. Urban freight activities support the supply chains in urban areas and there is a clear link between these activities and the level of economic development of cities as highlighted below. The following subsection also points out areas of convergence between the developed and developing countries with respect to urban goods transport, as well as describing key areas of divergence as dictated by the level of economic development priorities, among other factors.

Developed countries

The material intensiveness of urban freight distribution depends on local economic, geographic and cultural characteristics.[8] It is not surprising that cities in developed countries with high standards of living are coping with a high intensity of urban goods transport. Evidence from Europe suggests that a high-income city generates about one delivery or pickup per job per week, 300 to 400 truck trips per 1000 people per day, and 30 to 50 tonnes of goods per person per year.[9]

The material intensiveness of urban freight distribution depends on local economic, geographic and cultural characteristics

However, conditions vary significantly based upon local characteristics and the role cities play in global freight distribution. For example, Chicago has been preoccupied with maintaining its role as a major rail hub for North America, and is thus primarily concerned with rail freight transport between the numerous rail terminals and large distribution centres located within its metropolitan area, many of which are serviced by trucks.[10] Los Angeles as a gateway city to North America is primarily concerned with air pollution, and thus targets truck transport associated with port terminals and nearby major import-based distribution centres.[11] Paris, France, is concerned with limiting the environmental footprint of freight distribution in order to improve the quality of life of its residents and maintain its role as one of the world's leading cultural and tourism hubs.

In addition to formal goods transport, an informal sector – that may rely on less advanced modes and management techniques – is also very active in supplying the needs of lower-income groups [in developing countries]

Developing countries

The conditions in which urban goods transport takes place in developing countries show an impressive diversity. Several segments of economic activity have a high level of integration to global economic processes and their related freight distribution. Thus, it is not surprising to find state-of-the-art transport facilities such as port terminals, airports and distribution centres in developing countries. This aspect of city logistics is therefore on par with those of developed countries as the same modes, technologies and management techniques are used.

However, in addition to formal goods transport, an informal sector – that may rely on less advanced modes and management techniques – is also very active in supplying the needs of lower-income groups. These may include motorized means such as two-wheelers, and more significantly, non-motorized forms of goods transport (Box 4.3). While several basic consumption goods (apparel, electronic goods, batteries, etc.) enter a country through formal supply chains, a majority enter through informal distribution channels. The informal sector provides crucial city logistics services in developing countries, but tends to be more labour intensive, thus increasing the risk of damage, theft or injuries.

The differences between formal and informal activities are also linked to gender and age. While workers involved in formal forms of transportation, such as delivery truck drivers, are predominantly male, retail workers dealing with the last segment of city logistics are predominantly female. In the least-developed countries, the transportation burden of household needs, such as fuel, water and food, and many other petty trades, is mainly assumed by women.[12] However, urban goods transport can also be a source of income, albeit subject to risks, for the urban poor and other lower-income groups. For children and teenagers, informal freight distribution is a common source of income, before attaining driving age.[13]

As in developed countries, the conditions and priorities in developing countries substantially diverge. For instance, Mexico City is coping with a complex mix of urban growth, rising consumption levels, congestion and environmental externalities where both modern and informal forms of city logistics are present (Box 4.4). With its function as a major transport hub supporting China's export-oriented economic strategies, Shanghai has become the largest cargo port in the world, with advanced logistics capabilities. This highlights the contrast between city logistics of the modern coastal cities of China, in comparison to a countryside that is much less integrated.

Box 4.3 Non-motorized informal goods transport in Asia and Africa

In Delhi, India motorized tricycles haul small loads requiring frequent delivery stops, and handle around 60 per cent of intra-city goods movement, transporting as much as a 5-tonne truck in a day via multiple trips. As well as courier services, deliveries of groceries, furniture, electronics, etc. are increasingly made by auto-rickshaws, vans and tricycles, while larger informal carriers – such as shared taxis, minibuses and light vans are used for longer distances. In most of South Asia, trip-chains involve intermodal connections between micro-vehicles and large-load haulers at railway stations, bus depots, distribution centres, etc. Although efficient and affordable, the limited income earned by indigenous goods haulers undermines capital investment in more efficient vehicles. Access to credit can thus be an important factor for improving city logistics in developing economies.

Non-motorized transport is also frequently used for goods delivery in African cities, due to it being cheap and readily available. In Mumbai, India, about 200,000 *tiffin* lunch boxes are delivered daily by a combination of non-motorized means, thereby generating employment for those involved. Forms of NMT transport for goods in African cities include three-wheel platform rickshaws (*gudrum matatu* in Dar es Salaam, Tanzania), waste cart pushers (*kayabola*) in Accra, Ghana, and animal-drawn carts in South African low-income townships for waste picking, scrap metal haulage and coal delivery.

Sources: Jain, 2011; McMillan, 2011; Howe and Bryceson, 2000; Metropolis, 2005; UN-Habitat, 2009; Langenhoven and Dyssel, 2007.

Box 4.4 Relationships between formal and informal city logistics, Mexico City

Mexico City, with a population of 20 million, typifies very large and fast-growing metropolises of emerging economies. The city is a logistics gateway of Latin America where many regional headquarters of multi-national companies and associated advanced services are located. It also accounts for a third of the country's manufacturing output. The informal sector is also a significant feature of Mexico City's economy, with a high number of very small businesses in operation. As an enormous urban centre whose activities and population generate a high and diversified demand for freight, its logistics features relate to both formal and informal processes.

The part of goods transport that is formal (and documented) represents about 400 million tonnes annually, and is mostly based on road transportation. The main and growing mode of freight supply is trucking, whose flows and characteristics are well surveyed. Despite recent private investments, congestion, the lack of space for loading and unloading, regulatory complexity (e.g. weight and access restrictions), public corruption, the risk of theft and the lack of safety, there are widespread concerns for freight distribution in the city. Congestion is an acute issue, as it can take up to four hours for trucks to cross the city. As a consequence, many companies are moving their logistics facilities to suburban areas, where several extensive logistics clusters have grown to accommodate distribution centres and private logistics facilities. Furthermore, inadequate infrastructure in Mexico City leads to poor regional accessibility, which hinders market extension and international integration, and keeps logistic costs high.

At the same time, informal means of transportation (foot, wheelbarrows, bikes, motorbikes) represent a significant share of freight transport, but are difficult to record. All these features make Mexico City a good example of the challenges facing urban freight management in very large cities in emerging economies.

Sources: Antún et al, 2010; Dablanc and Lozano, 2011; Jirón, 2011.

GOODS TRANSPORT IN AN URBAN CONTEXT

Goods transport systems are often specific to distinct urban built environments, implying that no city is alike with respect to the nature and challenges of its city logistics. In addition to broader factors shaping the conditions of urban goods transport such as geographical settings, history, levels of economic development and government policies, the urban context shapes goods transport trends in specific ways.

Urban density is closely associated with patterns of goods transport. While cities in developing countries tend to have higher densities than cities in developed countries, higher income levels in developed countries increase the generation of freight per density level.[14] High-density areas are associated with high absolute consumption levels, but adequately supplying such needs is not without challenges. This tends to be paradoxical, as high densities are commonly advocated as sustainable urban development goals. However, high urban densities can also result in congestion if mass forms of transportation (i.e. public transport) are not adequately provided. Still, high density provides additional opportunities to consolidate deliveries and use alternative modes.

The distribution of the density in relation to the street layout, or urban spatial structure, also influences goods transport. Many urban areas that were established before motorization have a street layout that is not suitable for goods transport, with narrow and sinuous streets. Up to some density levels, a motorized and grid-like street layout provides an efficient setting for urban deliveries but comes with externalities such as high energy consumption, noise and emission of pollutants.

The urban land-use structure relates to the organization of economic activities, which can be centralized, decentralized, clustered or dispersed, and impacts upon goods transport. Therefore, a decentralized and dispersed land-use structure is thus associated with a disorganized urban goods transport system, as it becomes problematic to reconcile origins and destinations in urban interactions. For instance, delivering the same quantity of goods in a decentralized and dispersed land-use setting generally involves longer trips and more frequent stops than in a centralized and clustered setting.

A decentralized and dispersed land-use structure is . . . associated with a disorganized urban goods transport system, as it becomes problematic to reconcile origins and destinations in urban interactions

The city scale in terms of population size may also influence urban goods transport trends. While there is no formal methodology to make such an assessment, empirical evidence in the US underlines that congestion starts to be a recurring issue once a threshold of about 1 million inhabitants is reached.[15] This obviously concerns cities having a high level of motorization, thus applying this threshold to a range of cities around the world is problematic, since each city has unique local conditions that influence the nature and intensity of congestion, such as the share of public-transport use and land-use density. For instance, Antwerp (Belgium) with a population of nearly a million appears to be well below the congestion threshold, but this overlooks the fact that it is one of Europe's main port cities. The amount of truck-based freight circulating within the metropolitan area, particularly on the ring roads, is well above any city of a similar size.

Freight distribution, as an activity fundamental to urban life, consumes a substantial amount of

Freight distribution . . . consumes a substantial amount of space in urban areas and competes with other activities for the use of land and infrastructure

space in urban areas and competes with other activities for the use of land and infrastructure. Land requirements for urban goods transport are significant as both transport modes and terminals consume space for the setting of their respective infrastructures.[16] Industrial land uses are also complementary to city logistics, as they are important generators and attractors of freight flows. Additionally, there are rights of way, mainly roads, that are often shared between goods and passenger transport.

The land used for freight infrastructure can be particularly extensive in metropolitan areas that are points of convergence for global material flows, and involve several stakeholders (Table 4.1). However, the amount of land devoted to freight is not necessarily related to the size or the level of consumption in a city. Some cities (such as Dalian and Ningbo, China) focus on production such as export-oriented economic development zones, while other cities (such as Singapore; Dubai, United Arab Emirates; Los Angeles, US; and Panama City, Panama) are major gateways or hubs managing regional systems of freight circulation.

Freight facilities such as intermodal terminals and distribution centres tend to be highly capital intensive and mechanized. The sections below highlight how the growing consumption of land by these facilities has led to new forms of dislocation within urban areas, in terms of terminal and distribution facilities. The discussion also describes the tendency for spatial de-concentration of these facilities in areas where there is severe land pressure.

The world's . . . largest container port terminal facilities . . . jointly account for 0.035 per cent of the total urban area. Although this figure represents a very small share of urban land use, . . . facilities occupy prime waterfront real estate, which is a scarce resource in coastal areas

Terminal facilities

Intermodal transportation places tremendous pressure on the land in metropolitan areas, particularly those with container terminals and their ancillary facilities (e.g. access ramps, container and chassis storage). The global urban footprint is estimated to account for 658,760 square kilometres, about 0.51 per cent of the total global land area.[17] A sample of the world's 453 largest container port terminal facilities reveals that they jointly account for 230.7 square kilometres of land take (0.035 per cent of the total urban area).[18] Although this figure represents a very small share of urban land use, container port terminal facilities occupy prime waterfront real estate, which is a scarce resource in coastal areas. The construction of new port facilities now requires extensive land reclamation projects as suitable sites are no longer readily available. For instance, the construction of the Maasvlatke II port terminal in Rotterdam (Netherlands) or the Yangshan container port near Shanghai (China) are examples of the massive land reclamation demands that new port terminal facilities require. The true transportation land take for freight distribution is difficult to assess as many infrastruc-

Table 4.1

Major actors in urban freight distribution and their land-use handhold

Transport sector	Function	Land-use handhold
Maritime shipping companies	Key actors in global trade, owning fleet assets that are capital intensive. Establish shipping networks composed of a sequence of ports of call.	Limited. Often through parent companies (e.g. terminal operators, third-party logistics providers).
Port terminal operators	Operate major port terminal facilities, mostly through concession agreements. Interface between maritime and inland transport systems.	Mostly lease terminal facilities with long-term bails.
Port authorities	Manage the port's land and its development, such as leasing terminal facilities. Interact with maritime and inland stakeholders.	Landlords controlling significant parcels of centrally located waterfront real estate.
Real estate promoters	Development freight-related activities on their real estate, such as logistics. Lease for distribution facilities.	Various private commercial real estate holdings depending on local regulations. Lease the facilities to private companies such as freight forwarders.
Rail and rail terminal operators	Responsible for moving freight inland, from raw materials to containerized shipments. Own and/or operate terminal facilities.	Significant handhold in central areas, including terminals and rights of way.
Trucking industry	Carry freight over short to medium distances. Provide and organize road transport services between terminals, distribution centres and final customers ('last mile').	Limited holdings (warehouses) but heavy users of road and terminal facilities.
Third-party logistics providers	Organize transport on behalf of their customers. Contract transport and distribution activities, sometimes with their own assets (e.g. trucking companies, air cargo, distribution centres).	Various, but mostly limited (some can own distribution centres).
Air freight transport companies	Provide air transport services for high-value and time-sensitive cargo.	Significant holdings (e.g. distribution centres) near airport facilities.
Freight forwarders	Provide services to cargo such as packaging as well as load consolidation (different small loads into one large load). Organize regional and international freight deliveries, either by contracting to transport operators (truck, maritime, rail) or third-party logistics providers.	Significant holdings in logistics zones. Many rent the facilities they use.

tures, such as roads and airports, are mainly used for passenger transport and can be considered as shared facilities.

Wherever there is an intermodal facility, there is a tendency to have an agglomeration of distribution facilities. This is particularly the case for large airports located near clusters of distribution centres and third-party logistics services providers; air freight being a time sensitive endeavour requiring supply chain managers to be in proximity. As a result, a new urban form, the 'aerotropolis' is taking shape around major airports.[19] It contains an inner zone of distribution centres, logistics complexes and just-in-time manufacturers. In addition, it includes a ring of office parks, hotels, restaurants and convention centres, and then a largely residential periphery, which serves as the home to those who work in the aerotropolis. High-capacity highways and rail lines provide access to the rest of the metropolitan area, within which an aerotropolis is set. These activities are competing at a global level, which commonly implies that the economy of the aerotropolis tends to be linked more to global processes than to regional ones. Dubai, United Arab Emirates, may be the best example of a planned aerotropolis, but several Asian airports (such as such as Bangkok, Thailand; Singapore; and Kuala Lumpur, Malaysia) have initiated this type of development. A few examples can also be found in the US and Europe, including Dallas-Fort Worth (US) and Schiphol (Netherlands).

Distribution facilities

Distribution land requirements include various facilities to hold freight in bulk storage facilities (e.g. oil reservoirs or grain silos) and warehousing facilities for break-bulk (e.g. consumer goods in containers). Distribution centres consume a lot of space, as a wide array of added-value activities are performed on a one floor design, including consolidation and deconsolidation, cross-docking and storage. The last of these can also require specialized facilities, such as cold storage for supporting urban food distribution. It was estimated that for England and Wales alone, warehousing was accounting for 0.8 per cent of non-agricultural and forestry land.[20]

The spatial distribution of industrial, commercial and logistics facilities has a direct impact on the number of vehicle-kilometres, and the average trip length that will be necessary to reach stores, industries and households. In cities such as Chicago, US, which emerged after the late nineteenth and early twentieth centuries, most of the freight-related activities such as industries, warehouses and terminals were located in close proximity to the central business district. A majority (more than two-thirds, in the case of European cities) of all shipments to and from urban areas are organized from terminals and distribution centres. As a result, a contemporary pattern where logistics are specialized and separated from other urban activities has emerged.

Global supply chains rely on novel forms of urban land use such as the logistics zone, which is a planned area entirely devoted to freight distribution. While in the past, the agglomeration of freight distribution activities would organically take place where land was available, and where (road) accessibility was suitable, logistics zones are often set by large transnational real estate promoters and some, labelled as 'freight villages', can include ancillary activities such as hotels, convention centres and restaurants. In some developing countries (Brazil, Malaysia), the export-oriented free trade zone has become a city within the city, with a value proposition based on foreign investments and access to global markets through port and airport facilities. China, with its special economic zones, epitomizes this type of development, which sheds light on Chinese urbanization processes along its coastal areas. In the last 30 years, employment opportunities in special economic zones such as Shenzhen (China), were a strong driver behind the migration of 100 to 140 million people from inland provinces.[21]

Wherever there is an intermodal facility, there is a tendency to have an agglomeration of distribution facilities

Distribution centres consume a lot of space, as a wide array of added-value activities are performed on a one floor design, including consolidation and deconsolidation, cross-docking and storage

Logistics sprawl

Another key trend is logistics sprawl, or the spatial de-concentration of logistics facilities in metropolitan areas. Confronted with the severe land pressure in large cities, as well as with the large urban renewal projects that took place during the 1960s and 1970s, logistics and transport companies began to follow centrifugal locational patterns (Box 4.5). The physical moves were achieved through small-scale changes in their spatial organization, with the closing of urban distribution centres and the opening of new ones in the periphery. Greater land requirements and better accessibility to highways were two of the main driving forces.

While it results in the creation of new spaces, better fitting the functional and operational characteristics of freight distribution, logistics sprawl also creates challenges. With globalization, large terminal and warehousing facilities have generated demands for land to support urban goods distribution, but also conflicts and dislocations. Another impact of logistics sprawl concerns the patterns and the modes of commuting. Due to their low density and suburban settings, logistics zones are generally not well serviced by public transport and contribute to automobile dependency.

The spatial structure of metropolitan areas has led to forms of city logistics that seek to provide the most suitable distribution strategy, based upon the level of density. While higher density levels are associated with congestion and difficulties for urban deliveries, they also offer additional opportunities for alternative forms of urban distribution (Box 4.6).

With globalization, large terminal and warehousing facilities have generated demands for land to support urban goods distribution, but also conflicts and dislocations

Box 4.5 Logistics sprawl, Paris, France

Paris can be considered one of the most active European cities in the field of urban freight management. The city-region has a population of 11 million, and is among the largest and most economically developed metropolitan areas in the world. Ile-de-France is an important logistics hub, concentrating 17 million square metres of warehouses, which represents a fourth of the French warehousing market. Paris has a very high commercial density; it hosts many independent retailers and food stores, and a high proportion of hotels, cafés and restaurants, due to Paris' role as one of the world's most popular tourist destinations.

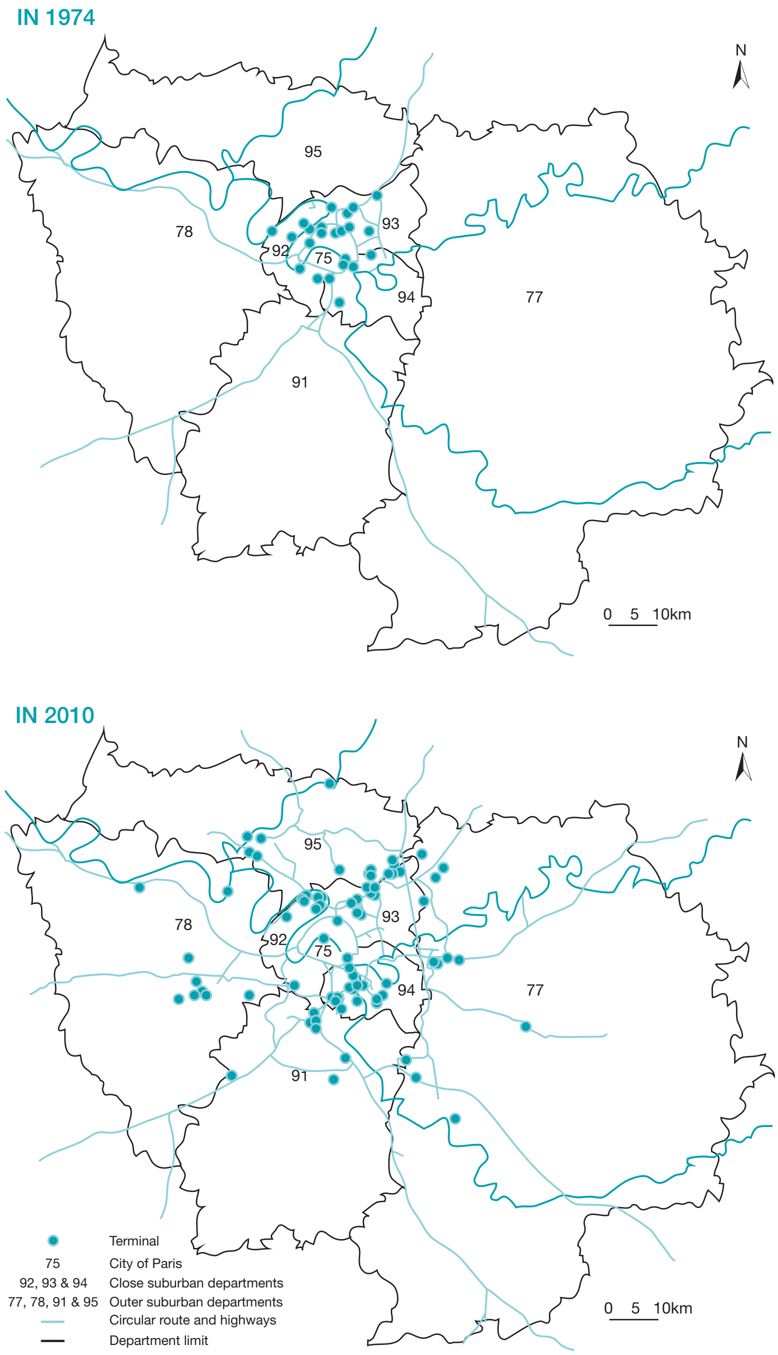
An important feature of urban and regional freight transportation is referred to as 'logistics sprawl'; the relocation of freight facilities and distribution centres in remote suburban areas. During the 1970s and 1980s, terminals that were used for freight transport and logistics activities in Paris relocated to outlying municipalities (Figure 4.4). However, the economic activities have not dispersed as much as logistics facilities. This has increased distances for delivery trucks to reach destinations, adding a lot of vehicle-kilometres to the regional traffic.

Sources: Dablanc and Rakotonarivo, 2010; Dablanc, 2011; Browne et al, 2007.

Figure 4.4

Logistics sprawl: Location of terminals of large parcel and express transport companies in the Paris region (1974 and 2010)

Source: Dablanc, 2011.



Box 4.6 Land use and forms of city logistics

A metropolitan area can be serviced through several freight distribution strategies that vary in scope depending on the level of urban density.[a] An urban freight distribution strategy that is frequently used in high and low urban densities alike is illustrated in Figure 4.5 and constitutes the following three elements:

- Urban logistics zones try to rationalize the multiplication of freight distribution transport, as well as their longer distances, by providing space in relative proximity to central areas. They are commonly developed over brownfield sites that can provide additional benefit if adjacent (co-located) to existing port, airport or rail terminal facilities. Users have the opportunity to consolidate their urban deliveries.
- Urban freight distribution centres are shared facilities interfacing with a set of distribution centres, each being connected to their respective supply chains.[b] Thus, a wide array of supply chains can achieve a better efficiency within the central city. In this case, the last mile' is assumed by shared vehicles operating on the behalf of the urban freight distribution centre's customers. On some occasions, urban freight distribution centres can combine several activities within the same facility, such as office and retail functions, to maximize revenue generation.
- Urban freight stations are small facilities where cargo can be dropped and picked up. A common problem in parcel delivery or pickup is that it requires both the customer and the carrier to be available at the same time and location. Urban freight stations near highly frequented locations offer the highest proximity level to customers, and can therefore mitigate the matching issue between the delivery vehicle and the customer.

Sources: [a] Boudouin, 2006; [b] Browne et al, 2005; BESTUFS, 2005.

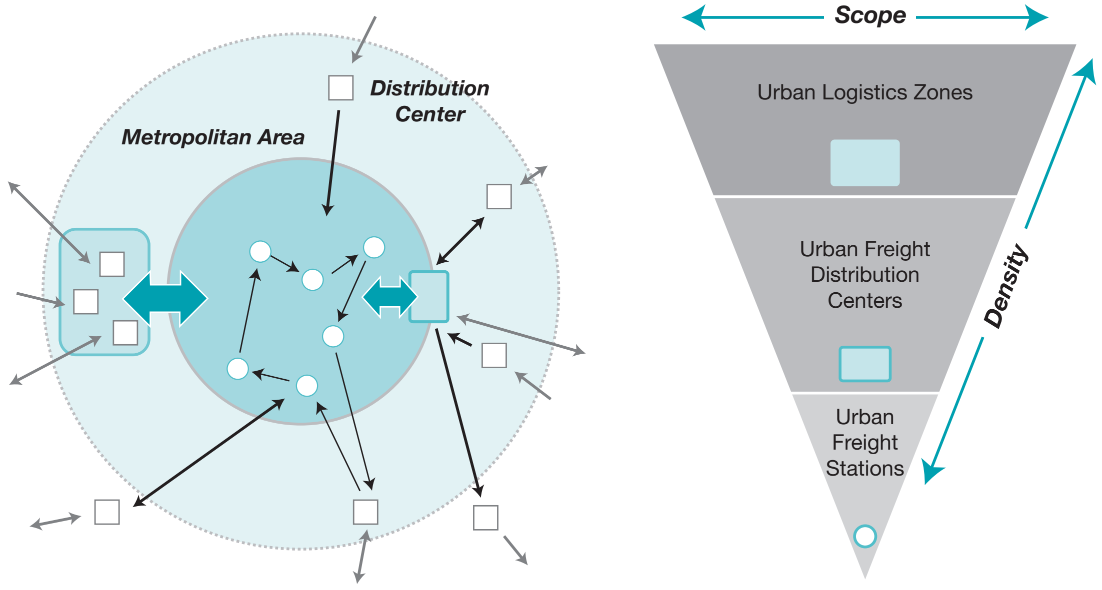


Figure 4.5

City logistics and land use

As the density of urban land use increases, specialization becomes more effective and enables a narrower scope of city logistics. However, a distribution centre servicing a low-density area often needs to carry a large variety of goods in its inventory for a longer period of time.

CHALLENGES OF URBAN GOODS TRANSPORT

The diffusion of modern freight distribution systems on the urban landscape generates environmental and social externalities, ranging from vehicle emissions, accidents and congestion to logistics sprawl. Addressing these externalities represents a set of environmental, economic, social and institutional challenges (Table 4.2).

Environmental challenges

Road transportation is the most polluting land transport mode per vehicle kilometre travelled, but urban freight distribution offers limited alternatives to roadways.[22] Air pollution has decreased with the gradual phasing out of leaded petrol and better engine design.[23] However, diesel trucks, the dominant mode of urban deliveries, remain a major source of particulate matter and nitrogen oxide emissions.[24] The share of urban freight depending on the informal sector is hard to evaluate, as are economic, environmental and social indicators for these unreported activities.[25] For the same number

Road transportation is the most polluting land transport mode per vehicle kilometre travelled, but urban freight distribution offers limited alternatives to roadways

Challenges	Dimensions
Environmental challenges	Mitigate environmental externalities (emissions, noise). Reverse logistic flows (waste and recycling).
Economic challenges	Capacity of urban freight transport systems (congestion). Lower driving speeds and frequent disruptions (reliability). Distribution sprawl (space consumption). E-commerce (home deliveries).
Social and institutional challenges	Health and safety (accidents, hazardous materials). Passenger/freight interferences (conflicts). Access (allowable vehicles, streets and delivery hours). Zoning (land use, logistics zones, urban freight distribution centres).

Table 4.2

Key challenges in urban goods transport

of tonne-kilometres, urban freight distribution tends to be more polluting, often twice as much as long-distance freight transport. The main reasons are as follows:

- ***Vehicle age***. Urban delivery vehicles are older than the average freight transport truck. It is common that trucks end their lifecycle in drayage operations[26] between port or rail terminals and urban distribution centres. The renewal of freight fleets is generally slower than that for non-urban road freight traffic, because urban freight involves numerous competing small operators that cut costs as much as possible. This problem is compounded in developing countries where vehicles are even older, and thus more prone to higher emissions and accidents.
- ***Vehicle size***. Urban delivery vehicles tend to be smaller than standard freight trucks, implying that some economies of scale advantages are lost. While smaller vehicles may be prone to fewer emissions per kilometre travelled, at an aggregate level, this may result in more emissions because of a greater number of vehicles required to carry the same amount of freight.
- ***Operating speeds and idling***. Urban operating speeds are slower due to congestion and traffic restrictions, implying that the engines of delivery vehicles are running at speeds consistently lower than the optimal speed. This results in higher fuel consumption and higher emission levels. Constant acceleration and deceleration due to traffic lights and traffic congestion result in an increase in fuel consumption, as well as the wear on vehicles. Vehicle idling is frequent either for deliveries or at stops, which contributes to emissions.

Trucks account for 22 per cent of the global greenhouse gas emissions generated by transportation, but due to circulation conditions in urban areas this share is higher

Greenhouse gas emissions and noise pollution are other environmental effects of urban freight transport. Trucks account for 22 per cent of the global greenhouse gas emissions generated by transportation,[27] but due to circulation conditions in urban areas this share is higher. For instance, in large European cities, freight transport is responsible for a third of transport-related nitrogen oxides and half of transport-related particulate matter emissions, mostly due to a higher reliance on diesel fuels for trucks. In London, freight distribution accounts for less than 10 per cent of urban traffic but contributes to 30 per cent of nitrogen oxide emissions and 63 per cent of particulate emissions.[28] In the metropolitan area of Mexico City, about 60 per cent of particulate matters generated by mobile sources were from freight vehicles.[29] While little is known about the potential vulnerability of urban goods transport to climate change, it is assumed that events such as floods, storms and heat waves will be as disruptive to urban goods transport as they are to urban activities in general.[30]

Since urban areas are large consumers of final goods, the issue of reverse logistics deserves consideration, as it involves the collection of wastes and recycling of materials.[31] City logistics and environmentally sustainable logistics (green logistics) are thus decisively linked. Most developed countries have formal recycling programmes, while in developing countries cities essentially leave a significant share of the recycling of goods to the informal sector. The recycling of used goods, packages and cardboard takes specific forms; scavengers and recyclers are an important feature of city life, with active informal supply chains. The urban landscape of developing countries also includes active street vending, providing a wide range of retail and food goods. Informal settlements are also an important component of the city landscape in many developing countries, and have specific characteristics and supply needs that are not well documented.

Economic challenges

The growth in the amount of freight circulating within urban areas has further exacerbated traffic congestion. Urban goods transport is usually subject to smaller volumes but with frequent deliveries, as inventory levels in urban stores tend to be low. Due to the limited availability of storage space in central areas, urban goods are delivered regularly from distribution centres at the periphery. However, despite peak-hour traffic congestion, a regular flow of deliveries must be maintained. This incites freight distribution activities to take place during the night if possible. Furthermore, many stores in high-density areas have limited capacity to accommodate deliveries, implying that delivery trucks must park along the street in the vicinity of the store, preferably in front. This induces the usage of smaller trucks better able to circulate within urban areas and find parking space for deliveries. It is not uncommon for trucks to double-park for short deliveries, thus seriously impeding local circulation.

Since real estate is at a premium in urban areas, stores tend to have limited warehousing space and are smaller in size. Urban freight distribution

Box 4.7 Cities and logistical performance

No international comparative analysis of the logistical performance of cities has yet been undertaken, but country-wide surveys have been compiled in recent years by the World Bank. The logistics performance index (LPI) is a composite index based on proxy measures for transport and information infrastructure, supply chain management and trade facilitation capabilities. These indicator scores are calculated using a world survey of international freight forwarders and express carriers. LPI values range from 1 (worst) to 5 (best) and show that building the capacity to connect firms, suppliers and consumers, is key, in a context where predictability and reliability are becoming as important as costs in supply chain management. An LPI value of less than 3 reflects an array of problems within a country's freight distribution system, causing undue delays and additional costs. For instance, a difference of one point lower in the LPI is related to two to four additional days of port hinterland access, and a 25 per cent higher physical inspection rate at customs. The performance metrics of the LPI do not capture the environmental and social externalities of logistics.

While the LPI reflects global trade and supply chains, it can also be reflective of the logistical capabilities of cities. For instance, a low LPI is reflective of inefficient customs procedures, including governance that does not appropriately regulate and mitigate urban freight distribution. Of the world's cities with more than 1 million inhabitants, 334 million inhabitants lived in cities within countries with a low LPI (less than 3), and 593 million lived in cities with below average LPI conditions (between 3 and 3.5). Only 330 million people were living in cities of more than 1 million inhabitants, with good LPI conditions (more than 3.5). It can thus be inferred that more than half of the world's urban population are living in cities where the logistical capabilities are deficient. This assessment should be interpreted with caution, as significant national differences exist, for example, between coastal China, which has efficient export-oriented freight distribution systems, and its interior provinces where the quality of transport infrastructures is more inadequate. Port and airport cities tend to have more capabilities for city logistics, because of the availability of international trade infrastructures and a concentration of third party logistics service providers.

Source: Arvis et al, 2010.

is subject to smaller volumes, with time-sensitive freight necessary to replenish a constant demand. This requires a high frequency of deliveries, particularly considering high sales volumes, which imposes a contradiction in the cargo load. Stores in central areas would benefit from the economies of scale of larger deliveries, but the setting does not permit this advantage. This is one of the reasons why retailing has emerged in suburban areas. Large stores with ample parking space can have their own cargo docking bays that can accommodate the largest delivery trucks available; the benefits of economies of scale are multiplied with economies of distribution.

The tendency of large urban areas to have high congestion levels poses a challenge towards the reliability of freight distribution. This is particularly the case for the disruptions and lower driving speeds that urban congestion imposes, making urban freight distribution prone to inefficiencies, compared to circulation taking place in a suburban or non-urban setting. Although there have been some attempts to assess countries' performance on trade logistics (see for example Box 4.7), the logistical performance of cities remains problematic and difficult to assess. However, evidence shows that port and airport cities tend to have more capabilities for city logistics because of the availability of international trade infrastructures and a concentration of third-party logistics service providers. A share of these capabilities is used for urban freight distribution.

The diffusion of e-commerce has also created new forms of demands and new forms of urban distribution with a growth in home deliveries.[32] The parcels industry has been booming, largely because of e-commerce, and in some cases has been proactive at establishing novel forms of last-mile deliveries.

The tendency of large urban areas to have high congestion levels poses a challenge towards the reliability of freight distribution

Social and institutional challenges

From a social standpoint, the interactions between people and freight in cities create many disturbances related to health, safety (accidents) and the quality of life (Table 4.3). Urban goods transport can have substantial impacts on the communities they originate from, are bound to or are transiting through. This is particularly the case when large freight facilities such as a port, airport, rail yard or distribution centres are operating. Passenger and freight transport do not mingle well, particularly during commuting around peak hours where both systems seriously impair their respective capacity and performance. In developing countries, traffic congestion is a significant operational problem for city logistics, with slow non-motorized vehicles sharing urban roads with motorized traffic.

Freight-intensive activities such as terminals, container storage areas, warehouses and truck depots can be an aesthetic blight on the urban landscape, and are associated with lower property values

Freight-intensive activities such as terminals, container storage areas, warehouses and truck depots can be an aesthetic blight on the urban landscape, and are associated with lower property values. As many freight facilities operate on a 24-hour basis, lights can be an annoyance and a source of potential sleep disruption. Furthermore, living or working in proximity to roads or terminals with substantial freight activities exposes residents, particularly

Table 4.3

Social externalities of freight distribution

Dimension	Hazard	Externality
Air pollution (regional and local)	Particulate matter; Carbon monoxide; Nitrogen dioxide; Living in proximity to roads or terminals.	Healthcare costs; Productivity losses; Quality of life impairments.
Noise	Emissions from trucks and terminal activities.	Stress; Quality of life; Lower property values.
Health and safety	Accidents; Contingent employment; Working conditions (vehicles and facilities); Dangerous goods.	Occupational risks; Limited work benefits.
Community	Industrial blight; 24-hour lighting; Congestion; Rights of way; Eminent domain.	Disruptions; Longer commuting time; Lower property values.

women and children, to harmful pollutants such as particulate matters emitted by diesel engines. Other disadvantages include associated healthcare costs, productivity losses for workers and general impairments in the quality of life. Noise emissions by urban freight distribution, including terminal operations, are also a salient issue, as trucks are noisier than other vehicles.

Actors involved in urban goods transport are . . . prone to more regulatory pressures than freight forwarders operating outside major urban areas

Safety is an important consideration for both citizens and freight operators. Freight vehicles are not necessarily more unsafe than other vehicles, but because of blind spots, slower vehicle reaction times, larger loads or loads of hazardous materials, freight should always be considered in the planning process. It may be particularly important to understand how freight vehicles interact with motorized and non-motorized passenger transportation. Therefore, the risk of accidents by heavy freight vehicles and the reconciliation of truck traffic with non-motorized transport is an emerging policy concern. This is mainly due to the safety issues that arise when heavy freight vehicles encounter pedestrians on local streets. Given that freight contributes to traffic congestion, it has a negative impact on the social cohesion of communities, resulting in lower levels of social interaction.[33]

Workers in the freight distribution sector, from drivers to warehouse workers, have a higher occupational risk than most professions.[34] A majority of freight-related jobs offer low wages and limited benefits to their employees, in a work environment that is fast paced and prone to accidents and injuries. Safety issues can also arise during the frequent shipment and transportation of hazardous materials taking place along urban corridors. Also, the prevalence of sexual risk behaviour among truck drivers along urban corridors and in some cities has had negative social impacts and exacerbated the spread of HIV/AIDS and other sexually transmitted diseases in many developing-country cities. In Brazil, for instance, high levels of sexual risk behaviour were recorded among truck drivers in two port cities, Santos and Itajai.[35]

From a regulatory standpoint, urban areas are highly constrained with a variety of rules related to zoning, emissions and even access conditions to roads and terminals. High population densities imply a low tolerance for infringements and disturbances brought by freight distribution.[36] Actors involved in urban goods transport are thus prone to more regulatory pressures than freight forwarders operating outside major urban areas. This represents an additional risk of having urban freight activities deemed a nuisance, which could result in costly mitigation strategies. For example, several major airports within metropolitan areas have had their night operations curtailed due to noise emissions over nearby residential districts.

Furthermore, compensation and resettlement mechanisms are often not adequate, particularly in developing countries where the state and local governments use the power of eminent domain to create spaces for transportation infrastructures, thus increasing the vulnerability of the poor in cases of involuntary resettlement. Another issue gaining prominence in urban goods transport is the need to address environmental justice, since concentrations of the poor and minority populations suffer disproportionately from negative social impacts from transportation-related developments.[37] This is far from being a recent phenomenon, as the siting of communities with lower economic status was historically associated with proximity or adjacency to terminals and industrial areas. Often, communities are caught in a vicious circle of deriving limited benefits from activities integrated in global and national supply chains that generate strong externalities. In this context of growing conflicts between freight and the city, port authorities tend to be more proactive in mitigating the social impacts on adjacent

Table 4.4

Main city logistics policies

Strategy	Advantages	Drawbacks
Rationalization of deliveries		
Night deliveries	Less traffic congestion and faster deliveries. No conflicts with commuting.	Organization of labour and work shifts. Potential disruptions to communities and family household dynamics (due to noise and night work).
Extended delivery windows	More delivery options and fewer impacts during peak hours.	Organization of labour and work shifts.
Freight facilities		
Urban freight distribution centres	Better usage of delivery assets. Less traffic congestion.	Additional costs and potential delays due to consolidation. May not well service consignee delivery requirements (e.g. time).
Local freight stations	Less delivery parking. A single consolidation/deconsolidation location.	Deliveries from freight station to consignee. Management costs for the freight station.
Designated delivery parking areas	Better access to consignees. Less disruptive deliveries.	Fewer parking spaces for passenger vehicles.
Modal adaptation		
Adapted vehicles	Less impact on local traffic congestion. Easier to find a parking spot. Environmentally friendly vehicles.	More journeys for shipments larger than the load unit. Additional costs.

communities, as they generally are public entities. For instance, in 2010 the Port of Los Angeles (US), after pressures from adjacent communities, established the Port Community Mitigation Trust Fund, where capital derived from port operations was set aside to be invested in social and environmental mitigation efforts.[38]

EXISTING POLICY RESPONSES

Urbanization and its associated growth in material consumption have reached a point where a more concerted approach to freight distribution is advocated.[39] This requires an understanding of the key challenges in urban freight distribution and the dissemination of practices and methods, notably data collection, to enhance urban mobility and sustainability.[40] As stated earlier, urban areas are constrained and subject to a complex regulatory framework. Thus, the urban space is prone to conflicts between different stakeholders, but there are also opportunities for collaboration as space for urban logistics must be recognized as a fundamental element of urban planning.[41] It can be complex for a distributor to adapt homogeneous freight distribution practices to a specific urban environment with its particular regulations.

Furthermore, priorities diverge. In Europe and Japan, an enduring concern relates to the circulation of heavy vehicles in urban areas, as density and the physical characteristics of streets challenge urban freight distribution. In North America, due to lower densities, the focus has been on load consolidation as urban deliveries are commonly less than a truckload. In many developing countries, the lack of resources often hinders adequate policy responses. Still, an array of policies have been considered to mitigate urban freight distribution problems, most of which are related to traffic congestion (Table 4.4).[42]

Rationalization of deliveries

Night deliveries are emerging as a preferable strategy for city logistics since they take place at a time when there is less traffic congestion and fewer conflicts as a result of commuting. However, night deliveries impose important changes in the organization of labour, for both the freight forwarder and the consignee. Distribution centres must be open at night, even intermodal terminals, while the consignee must have labour available to receive deliveries. For smaller stores, night delivery could impose prohibitive additional labour costs. In such a setting, carriers tend to prefer night deliveries, since their vehicles can operate in a less-congested setting, with the possibility of using larger vehicles, while retailers would prefer daytime deliveries that correspond to the availability of their workforce. In high-density areas, night deliveries can also result in local disturbances such as noise at a time when families are at home.

Night deliveries are emerging as a preferable strategy for city logistics since they take place at a time when there is less traffic congestion and fewer conflicts as a result of commuting

Extended delivery windows provide additional options, particularly outside peak hours. Like night deliveries, they impose challenges in the organization of labour with longer and irregular hours. Developing countries are better placed to see the implementation of this form of rationalization as labour conditions are more ‘flexible’,[43] but operational margins for activities such as retail are tight.

Carriers tend to prefer night deliveries, . . . while retailers . . . prefer daytime deliveries that correspond to the availability of their workforce

Freight facilities

Freight facilities can be designed and adapted to suit the requirements of city logistics. An important aspect is to achieve a level of consolidation of loads, many of which are less than a truckload, so that more

Appropriate design of bus stations – i.e. with a section allocated to freight (e.g. delivery areas and warehouses) – is a strategy that could help mitigate city logistics problems in several developing countries

Using bicycles as cargo vehicles is particularly encouraged when combined with policies that restrict motor vehicle access to specific areas of a city

The existing public transport system could also be used to move freight, but this implies numerous challenges: in terms of the adaptation of modes, the usage of existing passenger terminals and scheduling issues

cargo can be placed per delivery vehicle. One such facility is labelled the urban freight transhipment centre, where deliveries bound to specific commercial districts are grouped even if for different customers. It is similar to cross-docking facilities used by retailers to organize their regional distribution. These facilities encourage a better usage of delivery assets, resulting in less traffic congestion in central areas. This is linked with higher costs, as an additional consolidation stage takes place at the urban freight distribution centre. This again involves additional delays and undermines the potential profitability of such a strategy. It is also likely that the common delivery service does not necessarily meet the requirements of the consignee in terms of delivery time and frequency.

Local freight stations are an additional alternative in high-density areas, by offering a local point of consolidation or deconsolidation for pickups and deliveries. Cargo is delivered by trucks to local freight stations, with the final deliveries from the freight station to the consignee commonly done on rolling carts. The implementation of local freight stations has received limited attention, particularly due to its higher costs and lack of flexibility to accommodate the needs of specific supply chains. Automated locker banks are a type of local freight station that is gaining momentum, since it fits well the needs of e-commerce. In Germany, the Deutsche Post (DHL) has installed thousands of 'PackStations' at strategic locations, so that consignments can be delivered at any time of the day. In the US, the giant online retailer Amazon initiated a similar initiative with the setting of delivery lockers in the central areas of large cities, mostly in collaboration with pharmacies and convenience stores that have long opening hours.

An important element of urban freight distribution in developing countries is the bus station, which doubles as a nexus for regional passengers' transportation and a common point of entry for freight.[44] These stations are particularly relevant since vehicle ownership tends to be low, with the population relying on intercity bus services. Small freight forwarding companies and distribution centres, often informal, are filling an important role in city logistics. Appropriate design of bus stations – i.e. with a section allocated to freight (e.g. delivery areas and warehouses) – is a strategy that could help mitigate city logistics problems in several developing countries, particularly since bus stations tend to be centrally located.

Another strategy concerns the implementation of designated delivery areas, ensuring that delivery vehicles have better access to consignees, and that deliveries take place in a less disruptive fashion (e.g. avoiding double-parking). However, reserving parking space for deliveries implies that less parking space is available for passenger vehicles, which can lead to conflicts with residents (even if freight parking spaces are available during the night). Despite the availability of delivery areas, the intensity of freight distribution may create a parking demand beyond the capacity of available delivery areas.

Modal adaptation

Urban delivery vehicles can be adapted to better suit the density of urban distribution, which often involves smaller vehicles such as vans, including bicycles. The latter have the potential to become a preferred 'last-mile' vehicle, particularly in high-density and congested areas. In locations where bicycle use is high, such as the Netherlands, delivery bicycles are also used to carry personal cargo (e.g. groceries).[45] Due to their low acquisition and maintenance costs, cargo bicycles convey much potential in developed and developing countries alike, such as the *becak* (a three-wheeled bicycle) in Indonesia.[46] Services using electrically assisted delivery tricycles have been successfully implemented in France[47] and are gradually being adopted across Europe for services as varied as parcel and catering deliveries. Using bicycles as cargo vehicles is particularly encouraged when combined with policies that restrict motor vehicle access to specific areas of a city, such as downtown or commercial districts, or with the extension of dedicated bike lanes.

Efforts can also be made to have less polluting and more energy-efficient vehicles, including CNG and electric vehicles, which can reduce energy consumption and lower environmental impacts. However, these vehicles tend to be more expensive, which can be prohibitive in developing countries. Furthermore, greener vehicles and alternative fuels cannot mitigate the increasing traffic levels worldwide. Information technologies that are actively used by parcel carriers, such as vehicle tracking, load management and navigation, have the potential to improve the usage of distribution assets such as warehousing space and vehicles. The introduction of such technologies can lead to new forms of urban distribution, such as collaborative distribution (competing activities, such as stores, hotels and restaurants, using the same distribution services) with better trip sequence matching (better order of pickups and deliveries to minimize travelling distance). Since information technologies are increasingly low cost and ubiquitous (e.g. cellular data networks), such applications are suitable in both developed and developing countries.

The existing public transport system could also be used to move freight, but this implies numerous challenges: in terms of the adaptation of modes, the usage of existing passenger terminals and scheduling issues. One particular point of concern is that the mandate of public transport authorities does not involve freight. As a result, many agencies either have little incentive or do not have the legal authority to develop freight initiatives. Fares can also be an issue, since public transport fare systems are per passenger with no equivalent for freight. From a logistics perspective, the rationale behind using public transport is limited, as it involves load-break and potential breaches in integrity. Many attempts at developing 'cargo-trams' (tramways adapted to carry cargo) have failed, such as the ambitious cargo-tram project in Amsterdam (the Netherlands) that went bankrupt in 2009.[48] The expansion of passenger rail services in suburban areas often raises conflicts, due to the dominance that freight assumes in interurban services. For instance, passenger rail services and freight trains that share the same track segments are likely to result in delays and schedule integrity issues. Outside building new rail infrastructures, the options are limited to stringent infrastructure sharing agreements between passengers and freight rail services.

CONCLUDING REMARKS AND LESSONS FOR POLICY

The city of the twenty-first century is a city of intense flows of people, material and information. As such, goods transport is a fundamental component of the urban environment, an issue that until recently was neglected in the planning process. The challenge is to balance the need to ensure efficiency of goods transport, while minimizing externalities such as congestion, the emission of pollutants, noise and accidents.

As new strategies and practices are implemented, and also because of a trend towards higher energy prices, more efficient urban freight distribution systems will emerge as part of a transition towards greener forms of city logistics. Such strategies are centred mostly around the rationalization of deliveries; the development of freight facilities better adapted to the urban environment; and a modal adaptation (vehicles, including non-motorized modes, better adapted to urban circulation). While these strategies are likely to reflect the unique modal and infrastructural lattice of each city, it remains uncertain if advances in city logistics will be sufficient to cope with growing levels of congestion and the related socioeconomic externalities, particularly in developing countries. Accordingly, unique forms of city logistics are emerging in developing countries, due to significant differences in levels of income and density. However, these cases are far less documented.

Goods transport remains a fundamental element of urban sustainability. Thus, it is essential that the role and impact of goods transport in the urban context is taken into consideration, if planning accessible mobility for passengers is to be effective. This is especially so when considering the close interactions between urban land use, form and goods transport within an increasingly contested landscape.

Passenger rail services and freight trains that share the same track segments are likely to result in delays and schedule integrity issues

It is essential that the role and impact of goods transport in the urban context is taken into consideration, if planning accessible mobility for passengers is to be effective

NOTES

1 Taniguchi and Thompson, 2008.
2 Boschmann and Kwan, 2008; Goldman and Gorham, 2006.
3 OECD, 2003.
4 Benjelloun et al, 2010.
5 Hesse and Rodrigue, 2004.
6 Dablanc, 2009.
7 See Chapter 8.
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CHAPTER 5

MOBILITY AND URBAN FORM

Heightened concerns over climate change, rising gasoline prices, traffic congestion and social exclusion have sparked renewed interest to explore the link between mobility and urban form.[1] Worldwide, city officials share relatively similar concerns about travel time, air quality, road accidents, social integration, better accessibility and improved use of different modal transport solutions.

Despite this, most cities, particularly in developing countries and emerging economies, continue to prioritize motorized transport and related urban infrastructure. A large number of cities both in the developing and developed countries are experiencing fast and uncontrolled growth in their peripheries. Consequently, there is a wide variety of urban forms, defined by land-use and transportation systems that are not conducive to the provision of 'efficient' forms of urban mobility. There can be little doubt that designing neighbourhoods, cities and regions in a way that can reduce private car dependency, promote healthier, more sustainable urban forms and a variety of travel solutions, can make the city more accessible to all. The pressure to develop sustainable transportation and mobility systems is particularly acute in urban areas.

In recent years, city planners, developers and policy-makers have increasingly looked towards designing more compact cities with a mixture of land uses in order to achieve a more sustainable urban form. The 'compact city' policy, although difficult to implement, can help shorten travel distances, thus lower emissions and fuel consumption, reduce travel costs and improve quality of life in many cities. However, there is need for better solutions on how to move from current unsustainable trends in urban form and transportation towards a more sustainable future.

There is increasing evidence that the form and functionality of the city is crucial for the promotion of sustainable mobility. Indeed, transforming cities wherein a mix of activities is closer together, in a more compact configuration, and interlaced by high-quality pedestrian and bicycle infrastructure, is tantamount to the creation of a more *accessible* city. As stressed in Chapter 1, accessibility lies at the core of achieving an urban form that is environmentally sustainable, socially equitable and inclusive, with higher potential to generate economic interactions that lead to productivity and income gains. Sustainable mobility is an outcome of how cities and neighbourhoods are designed and take form, but it also shapes the urban form itself. This reflects the powerful, bi-directional relationship between mobility and urban form that underscores the importance of carefully coordinating and integrating the two. A re-invigorated notion of urban planning, solid institutions and governing structures is therefore required, which can lead a process for this transformative change.

The form and functionality of the city is crucial for the promotion of sustainable mobility

A number of pressing mobility and environmental issues, which policy-makers at all levels of government are wrestling with today, hinge on changes in the design and form of cities for a more efficient and sustainable solution. With the transport sector accounting for nearly a quarter of greenhouse gas emissions in metropolitan areas worldwide, campaigns to stabilize the global climate include the creation of less car-dependent urban forms.[2] Stopping sprawl,[3] promoting public-transport-oriented growth and creating compact, walkable neighbourhoods that reduce vehicle-kilometres travelled (VKT) per person are the cornerstones of such campaigns. The EU's Climate Change Programme calls for the promotion of 'low-emission land-use activities' as a way to moderate VKT growth, making an interesting connection between urban form and transport.[4] It is important to track VKT per capita, as it is the strongest single correlate of environmental degradation and resource consumption in the urban transport sector. It has been projected that, in the absence of substantial reductions in VKT per capita worldwide, all increases in fuel-efficient and low-carbon fuels will only slow, not reverse, the rise in per capita CO_2 emissions.[5]

Accessibility lies at the core of achieving an urban form that is environmentally sustainable, socially equitable and inclusive

'Sprawl' [burdens] municipal budgets, imposing high costs for extending infrastructure and public services to suburbs and exurbs

Environmental objectives are but one reason for moderating urban travel. There are important economic and social considerations to be made as well. Spread-out, car-oriented development patterns, commonly referred to as 'sprawl', burden municipal budgets, imposing high costs for extending infrastructure and public services to suburbs and exurbs. The 'hard cost' of providing local roads and utilities for low-density growth is upwards of US$30,000 more per household in the US compared to more compact, mixed-use growth.[6] If one-third of the future urban growth of the US were directed toward central cities and inner-suburbs, an estimated US$10,000 per household (in year 2000 US$) could be saved.[7] A recent study estimated that converting peripheral housing projects to infill planned residential developments in the consolidated parts of Malaysian cities could reduce the financial costs for municipal services by 19 per cent.[8]

Physical separation from jobs, schools, and health clinics imposes economic burdens on the poor

Growing concerns over social equity have also prompted interest in the design of cities. Physical separation from jobs, schools and health clinics imposes economic burdens on the poor, many of whom reside on the urban periphery. Overcoming this physical separation often means devoting disproportionate shares of income to public transport fares and enduring long journeys. Besides shortening journeys and making social amenities more accessible, the connection between adequate transport solutions and the provision of public goods can promote more social interactions and when done properly, gives rise to urban form that is conducive to community building and 'place making'.

This chapter describes current global trends and conditions that have influenced urban form and as a result, mobility (or the lack thereof). Forces propelling the spread-out growth of cities and the impacts of these trends on urban mobility are discussed. The capacity of higher urban densities to encourage alternative means of travel, particularly public transport usage, is reviewed. Other elements of built environments, such as the diversity of land uses and urban designs, like integrated bikeway networks, and their implications for travel, are also examined. Creating compact, mixed-use and highly walkable neighbourhoods and cities can create more accessible urban landscapes, and in so doing moderate levels of motorized travel and the ill-effects associated with it. More accessible cities are also more socially equitable and inclusive. The other direction of the relationship – how urban transport infrastructure, such as motorways and metro-rail systems, shapes urban form – also receives attention. The chapter closes with discussions on the potential of various policy strategies, such as transit-oriented development (TOD) and regional jobs–housing balance, to strengthen mobility–urban form linkages and promote sustainable transport modes.

Box 5.1 Suburbanization in Eastern Europe

The transitional economies of Eastern Europe have witnessed rapid suburbanization. During the era of centralized planning, most cities in Eastern Europe were products of integrated transportation and land development, characterized by extensive urban rail networks with residential towers, shopping districts and industrial zones physically oriented to stations. The change to free-market economies and privatization of land development quickly unravelled this. In some Eastern European countries, the rate of suburbanization has surpassed that of cities in Western Europe. The latest studies of land-cover changes have ranked cities in Estonia, Latvia, Croatia, Slovakia, Poland, Hungary and Bulgaria, as among the most sprawling urban areas in Europe. By one account:

> '"communist" urban forms were by many measures more environmentally friendly and, thus, more sustainable than capitalist urban forms. They were more compact and had smaller ecological footprints; they were high-density and had a clear urban edge rather than sprawling and mono-functional suburban-type peripheries; they had better integrated land uses and were less socially polarized; they had abundant parks and greenbelts; and, they had reliable public transit systems. Ironically, all these aspects of the communist city are hallmarks of urban sustainability. Most of them were lost during the post communist transition.'[a]

Privatization of land development, such as the construction of mega-malls and housing estates on the periphery, coincided with the abandonment and often discontinuation of former state-owned urban rail services, which along with the rapid growth in private car ownership resulted in motorways being built in their place. Some observers have criticized international aid agencies – such as the European Bank for Reconstruction and Development and the European Investment Bank – for fanning the flames of sprawl in Eastern Europe by favouring investments in suburban motorways over revamping and upgrading aging inner-city rail lines. Hyper-suburbanization has spawned dramatic shifts in travel, such as in Prague, Czech Republic, where former trips by foot or public transport to central-city shops are rapidly being replaced by long-distance car trips to freeway-served malls and large-scale retail outlets, dramatically increasing VKT.

Sources: Suchorzewski, 2011; Hirt and Stanilov, 2009; Hook, 2001; Newmark et al, 2004; [a] Hirt and Stanilov, 2009, p63.

Box 5.2 Dispersed growth in India

In recent years, Indian cities have witnessed an accelerated transformation of agricultural lands on their peripheries to new townships, residential subdivisions and commercial centres. This has lead to marked increases in traffic congestion, air pollution, demand for roads and parking, accidents and energy consumption. Around Mumbai, seven new towns have emerged within 50 kilometres of the old city. Around Delhi as well, new urban centres have cropped up within 20 to 50 kilometres radius of the city centre.

Most public policies in India encourage sprawl. In an explicit attempt to decongest city centres, government regulations limit floor to land area ratios for buildings in the centre, and thus restrict building heights and development densities. By contrast, government regulations allow higher floor space indexes in suburban areas, effectively pushing new growth from the core to the periphery.

Sources: Bertaud, 2011; Glaeser, 2011.

DECENTRALIZATION, CAR DEPENDENCE AND TRAVEL

This section reviews the influences of decentralized urban growth on mobility and travel worldwide, the role played by transport in the decentralization process, as well as the impact of urban densities and urban land coverage on travel.

The dispersal metropolis

The dispersal of growth from the urban centre is a worldwide phenomenon. Dispersal, as a form of decentralization, at least when it is poorly planned, lies at the heart of unfolding patterns of urban development that are environmentally, socially and economically unsustainable. With dispersal come: lower densities, separation of land uses and urban activities, urban fragmentation, segregation by income and social class, consumption of precious resources such as farmland and open space and more car-dependent systems. While megatrends like rising affluence and modernization have fuelled the dispersal of cities worldwide, social-cultural factors have played a role as well. In Latin America, land held by government agencies, military authorities and religious foundations often triggers leapfrog (i.e. skipped-over) development.[9] Social exclusion, class segregation and poverty itself can also stretch the boundaries of cities; *tugurios* and *favelas* (i.e. slums) mark the peripheries of most Latin American cities. In Chinese cities, peri-urban development is partly driven by financial motives, e.g. municipalities buy land at low agricultural prices and lease the land to developers at higher prices as a way to raise revenues. Like in China, the transition to free-market economies has accelerated suburban growth throughout Eastern Europe (Box 5.1). In India, zoning policies that suppress permissible densities as a means of decongesting central cities have been blamed for inducing sprawl in recent decades (Box 5.2). Easy-to-obtain credit for low-income housing has triggered an explosive growth in low-cost but isolated residential enclaves on the outskirts of many Mexican cities, which over time has led to abandonments; between 2006 and 2009, some 26 per cent of such housing that was built was unoccupied.[10] Nearly a third of individuals who abandoned their homes did so because of poor access to jobs, schools and family.

Dispersal of growth from the urban centre is a worldwide phenomenon

Urban dispersal has an unmistakable and profound influence on travel. Spread-out growth not only lengthens journeys by separating trip origins and destinations, but also increases the use of private motorized vehicles. In developed countries, suburban living, associated with the lowering of population and employment densities, has contributed to rising motorization rates and the environmental problems related to car dependency. When urban dispersal is driven almost exclusively by market forces and is largely unplanned, car dependency, energy consumption, environmental degradation and social problems in urban areas are further exacerbated (Box 5.3). Over-regulation of urban development (e.g. zoning codes that require significant supplies of off-street parking) can also induce car-dependent sprawl by suppressing market preferences. Increasingly, trends both in developed and various developing countries suggest that many young adults want to live in compact, walkable neighbourhoods.[11]

Urban sprawl is increasingly prevalent in developing countries. From 1970 to 2000, the physical expansion of all urban areas in Mexico was nearly four times more than their urban population growth.[12] In Cairo (Egypt), Sana'a (Yemen), Panama

Box 5.3 Urban sprawl

The term 'urban sprawl' describes low-density, dispersed, single-use, car-dependent built environments and settlement patterns that, critics charge, waste energy, land and other resources and divide people by race, ethnicity and income/wealth. A cardinal feature of sprawl is the physical separation of co-dependent land uses – e.g. housing is isolated from jobs, schools, hospitals, retail activities, etc. – leading to increasingly lengthy (and thus resource-consuming) journeys. Sprawl is synonymous with poorly planned, piecemeal and haphazard patterns of urban growth, requiring larger shares of trips to be made by motorized modes over increasingly longer distances.

Sources: Ewing, 1997; Burchell, 2005; Burchell and Mukherji, 2003; Tsai, 2005.

Class and income disparities are deeply embedded in the spatial arrangements and mobility challenges of many developing-country cities

City (Panama) and Caracas (Venezuela), sprawl is blamed for consuming scarce agricultural lands and dramatically increasing municipal costs for infrastructure and service delivery.[13] In urban Sub-Saharan Africa, Latin America and South Asia, sprawl has been associated with class segregation. Often, higher-income households occupy the most accessible and expensive districts near the urban core, forcing many low-skilled, low-income immigrants from rural areas and displaced low-income inner-city residents to outlying, marginal areas, where land is cheaper. Class and income disparities are deeply embedded in the spatial arrangements and mobility challenges of many developing-country cities.[14]

Urban densities can be expected to decline another 26 per cent by 2040

Global urban density patterns and trends

Figure 5.1 shows that Asian and African cities are, on average, around 35 per cent denser than cities in Latin America, 2.5 times denser than European cities, and nearly 10 times denser than cities in North America and Oceania (mostly from the US, Australia and New Zealand). Overall, 39 of the world's 100 densest urban areas were situated in Asia in 2010.[15] Cities of developing countries have been sprawling more rapidly than those in developed countries. From 1990 to 2000, average urban densities fell from 3545 to 2835 people per square kilometre in developed countries compared to a drop from 9860 to 8050 people per square kilometre in developing ones.[16]

The advent of low-cost urban transport modes . . . has accelerated the outward physical expansion of cities

A two-century perspective reveals dramatic longitudinal declines in urban densities, especially in developing countries. Figure 5.2 traces the downward trend in built-up area densities for 25 cities from as early as the late 1700s to 2000. Densities declined fourfold from their peak, from an average of 43,000 persons per square kilometre to an average of 10,000 persons per square kilometre around the year 2000, at an average annual rate of 1.5 per cent.[17] At this rate, urban densities can be expected to decline another 26 per cent by 2040. According to one projection, a continuation of the trends in sprawl translates into a tripling of land area for each new resident by 2030, converting on average some 160 square metres of non-urban to urban land.[18] If past trends hold, this invariably translates into more car-dependent, and thus inherently less sustainable, cities of the future.

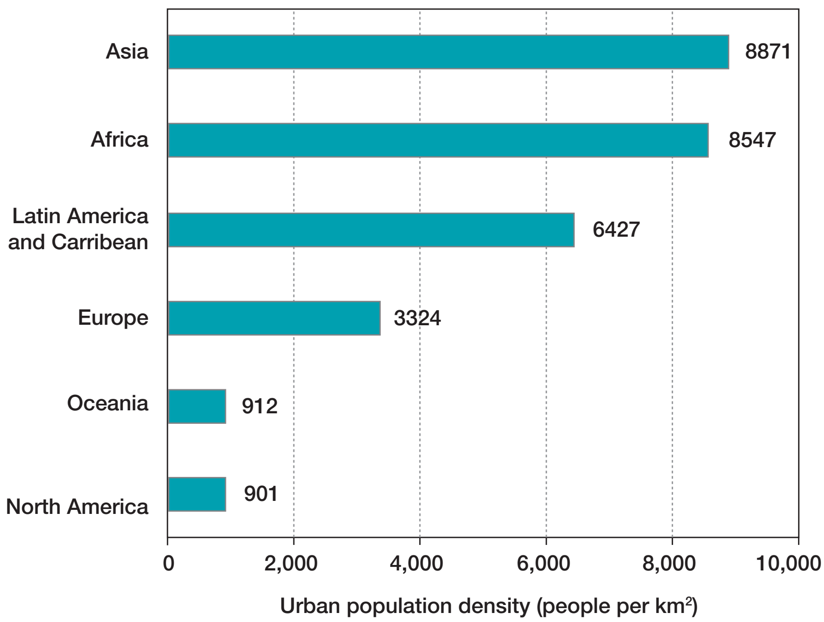
Urban transport as a factor increasing urban sprawl

As many cities worldwide continue to experience sprawl, built-up densities become lower. Transport has played an important role in the sprawl of cities.[19] Indeed, the advent of low-cost urban transport modes – omnibuses, horse cars, trolleys, commuter trains and later buses and cars – has accelerated the outward physical expansion of cities, making density declines possible.[20] In the pre-automobile era, movements within cities tended to be restricted to walking, and urban forms compact, in order to reduce the need for physical travel. The location of homes, shops, restaurants and even factories kept urban distances short and walkable. However, extreme overcrowding, lack of privacy and the overpowering stench of manure from horse-drawn carriages forced many who had the means to escape. Streetcar cities, which emerged and expanded with the development of electrical power in most western cities, were heralded as a triumph over the walking and horse-car city. This is because they allowed the middle class to move to lower density suburbs and escape the suffocating urban densities of the early 1900s. Soon afterwards, rail-served suburbs blossomed. Streetcars defined the

Figure 5.1

Urban population densities of 1366 cities, mean densities by region (2000–2010)

Source: UN-Habitat database.



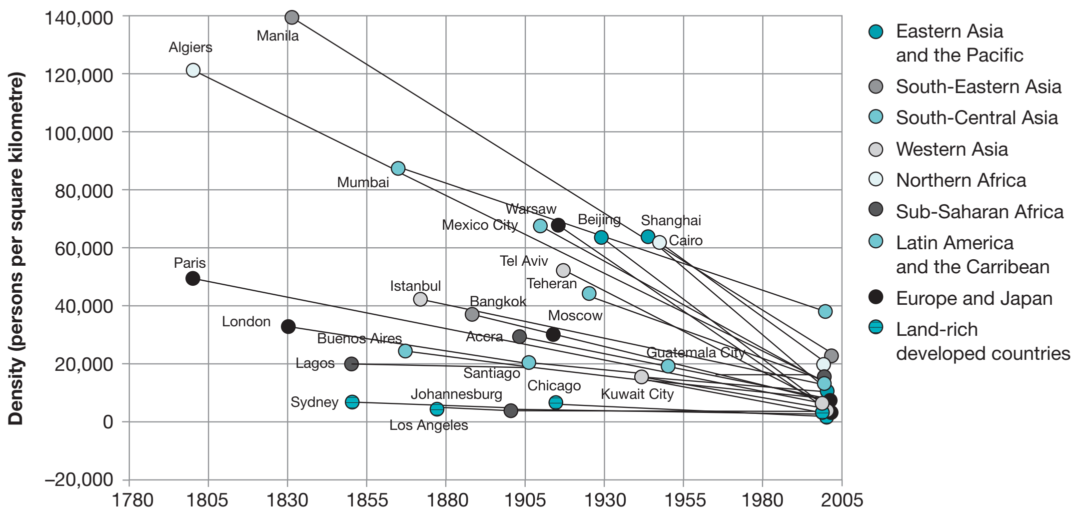


Figure 5.2

Long-term decline in built-up area densities in 25 selected cities (1800–2000)

Source: Angel, 2011.

radial spines of most regions, extending urban boundaries five-fold or more beyond those of the walking city.[21] The internal combustion engine car technology developed rapidly during the twentieth century, and with it came the advent of the automobile city. The automobile city allowed development to fill in the wedges between radial corridors of the streetcar city and metropolitan boundaries to extend outward four to five times.[22] The automobile city, and notably the provision of grade-separated, limited-access freeways, further accelerated the dispersal of economic activities, unleashing low-density, discontinuous patterns of urban growth associated with sprawl.[23] Alongside the freeways (among other factors), a more polycentric urban form was developed, marked by shopping malls, office parks, airports and other major activity centres, congregated near major access points.[24]

Seventy years ago, a noted urban sociologist observed that urban form is largely a product of the dominant transportation system that was in place during a city's prevailing period of growth.[25] European cities such as London (UK), Madrid (Spain) and Prague (Czech Republic) that grew, in relative terms, most rapidly in the 1800s, retain many features of walking and streetcar cities in their urban core. US cities such as Atlanta, Los Angeles, and Houston, whose explosive periods of growth coincided with the construction of freeways, by contrast, are sprawling and car dependent. This increasingly characterizes the outskirts of Jakarta (Indonesia), Lagos (Nigeria), São Paulo (Brazil) and many other cities in developing countries that are presently experiencing rapid motorization and population growth. Further, the urgency of advancing sustainable mobility and urban-form practices in rapidly expanding towns and cities of developing countries, such as India and China, is underscored.

Urban density and travel

Urban densities strongly influence travel. The impact of densities on travel – and therefore, energy consumption and natural environments – gained particular attention in the 1990s, in the wake of a global energy crisis and economic recession. A 1989 cross-sectional comparison of 32 cities showed transport-related energy consumption declines precipitously with urban densities (Figure 5.3).[26] US cities averaged the lowest densities and nearly twice the petrol consumption per capita as Australian cities, around four times as much as more compact European cities, and ten times that of three compact Asian cities – Hong Kong, Singapore and Tokyo. These results were attributed to far higher usage and kilometres travelled by private cars in sprawling cities than in compact, public-transport-oriented ones. Follow-up studies of 37 cities in 1999 found similar results: low-density cities averaged considerably higher VKT per capita than high-density ones.[27] Even within countries, this relationship remains strong. Panel studies of density and travel in the US and the UK have associated the doubling of urban densities with 15 per cent and 25 per cent declines in VKT per capita.[28] However, what accompanies density – e.g. lower car ownership rates, less road space per capita, fewer and more expensive parking and better quality public transport services – can also be important factors associated with density.[29] In most instances, density is a necessary, though not a sufficient, condition for moderating private car use and fuel consumption.

City-level studies such as shown in Figure 5.3 have also been criticized for being too aggregate, thus masking variations within cities, and differences among subpopulations. However, even within the same metropolitan area, substantial differences in VKT per capita have been recorded. A study of three US metropolitan areas – Chicago, Los Angeles

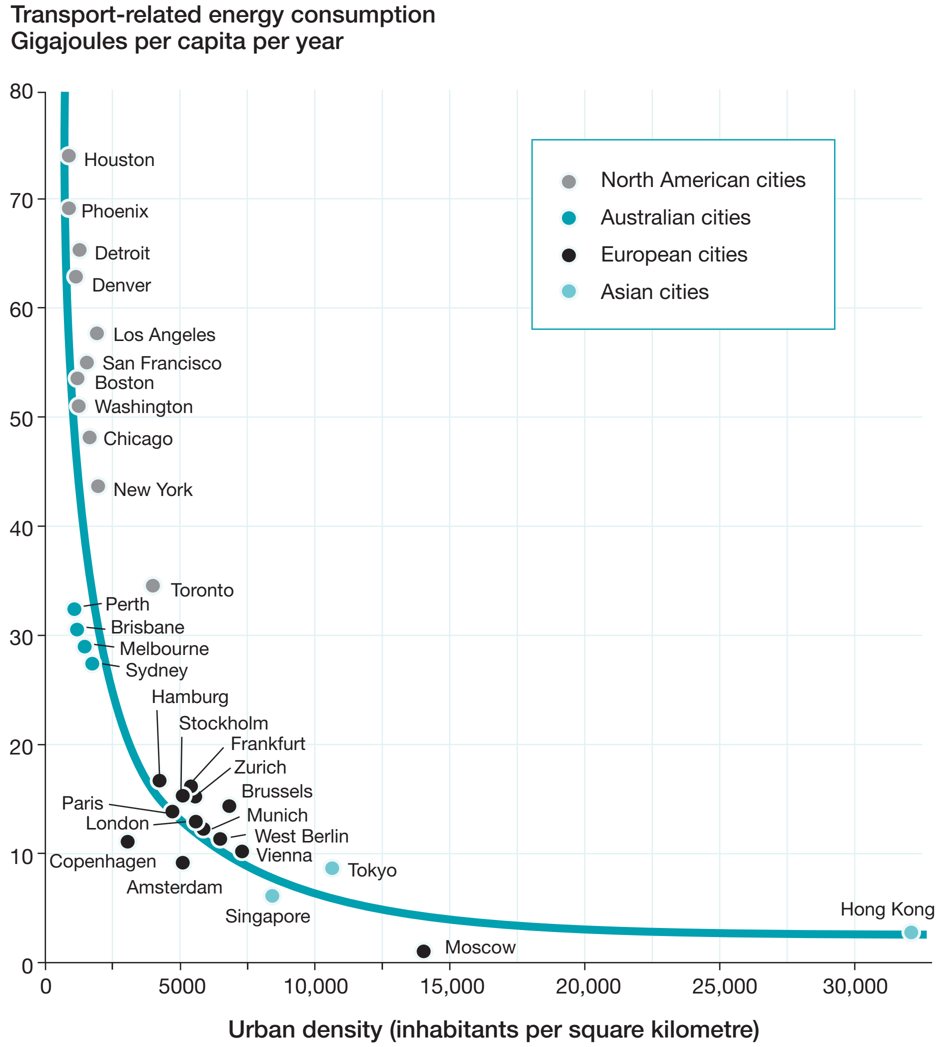
The automobile city . . . accelerated the dispersal of economic activities, unleashing low-density, discontinuous patterns of urban growth

Urban form is largely a product of the dominant transportation system that was in place during a city's prevailing period of growth

Figure 5.3

Influences of urban densities on transport-related energy consumption, 32 cities (1989)

Source: Newman and Kenworthy, 1989; cited in Lefèvre, 2009.



Going from very low-density sprawl . . . to modest densities of town homes and duplexes, produces the biggest declines in transport-sector energy consumption and VKT

and San Francisco – found, after controlling household size, income effects and using odometer readings, that car ownership and use declined in a systematic and predictable pattern as a function of increasing residential density.[30] Similarly, evidence suggests a negative association between urban densities and vehicular travel in other big cities that are rapidly motorizing including Santiago (Chile), Beijing (China), Lisbon (Portugal) and Moscow (Russia).[31] Once average density levels are reached, the rate of drop-off tapers, offering a useful policy guide to the association between mobility and urban form. For example, Hong Kong style high-rise densities are not needed for major declines in energy consumption and motorized movements to be achieved. Rather, going from very low-density sprawl (e.g. the suburbs of car-oriented Houston) to modest densities of town homes and duplexes, produces the biggest declines in transport-sector energy consumption and VKT.

The risk of potential self-selection bias is also worth noting. Might less car travel be due to density or the fact that those who walk or bike more in compact, mixed-use neighbourhoods choose such places because of lifestyle and personal preferences? One way to control for such possible effects is to study changes in travel among individuals who moved from one neighbourhood type to another. A study from Seattle, US, found that those moving to neighbourhoods with higher accessibility (e.g. dense, mixed-use settings closer to other destinations) logged far fewer kilometres in vehicles.[32] Furthermore, a recent review of 38 studies that statistically controlled for self-selection effects revealed that virtually all studies found that built environments, including density metrics, still had statistically significant influences on travel.[33]

Other attributes of urban form influencing travel

Density is but one element of urban form that influences travel. The spatial distribution of population and employment densities are also important.[34] Where people live, work, shop and socialize, sets the stage for travel by defining the location of trip origins and destination, and thus the length of trips and the energy they consume.

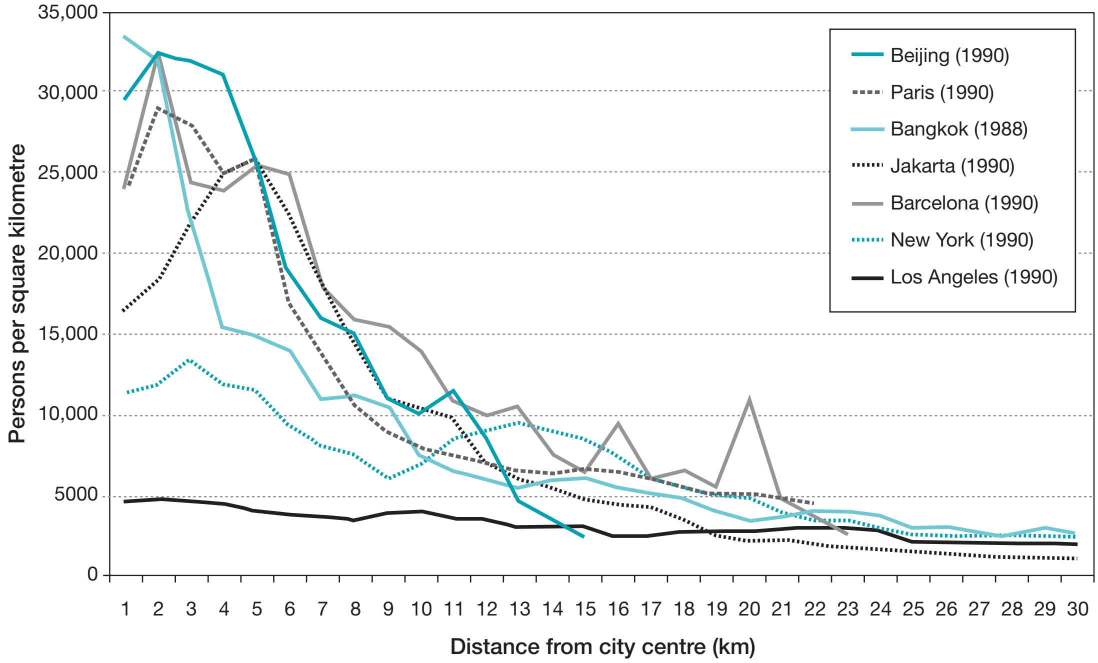


Figure 5.4

Population density gradients of seven cities

Source: Based on Bertaud and Malpezzi, 2003.

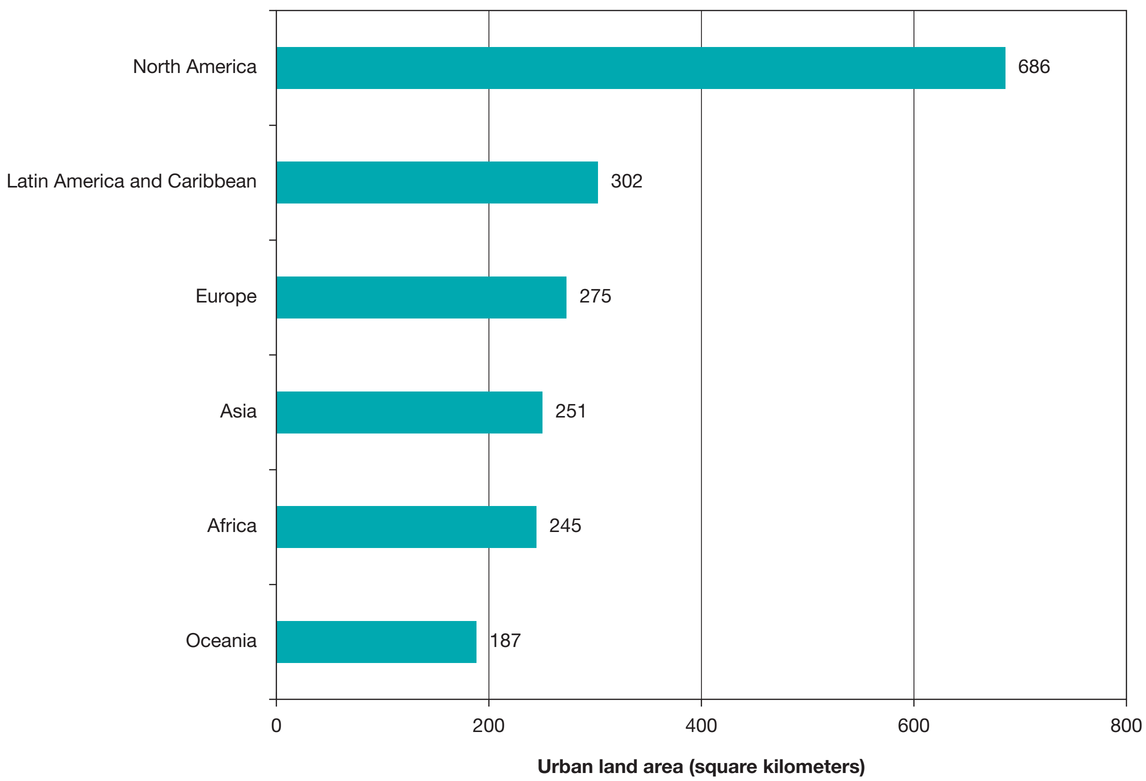


Figure 5.5

Average land coverage by region, among 1366 cities (2000–2010)

Source: UN-Habitat database.

Density gradients – i.e. the rate at which densities taper with distance from the core – are another way to represent urban form. Figure 5.4 shows that densities fell sharply from the centres of Asian and European cities. This is characteristic of a monocentric or strong-centred metropolis. In contrast, the density gradients of US cities are more flat, revealing a more sprawling, car-oriented urban form (even for greater New York City). Higher densities in the core than the outskirts reflect higher market demand, and higher real estate prices for more central and accessible locations. The regulation of permissible densities through zoning restrictions along with factors such as rising affluence and the construction of high-capacity freeways, have flattened the density gradients of US cities and increasing numbers of European cities. It has also resulted in the lengthening of journeys and induced private car travel in the process.[35]

Zoning restrictions along with factors such as rising affluence and the construction of high-capacity freeways, have flattened the density gradients of US cities

Urban land cover (i.e. the total built-up area of a city) and compactness (i.e. the degree to which a city's footprint approximates a circle rather than a tentacle-like shape) are additional ways to characterize urban form.[36] Figure 5.5 shows that, on average, North American cities take up more than twice as much land as Latin American cities, which consume slightly more land than European, Asian and African cities.

North American cities take up more than twice as much land as Latin American cities

Tracing city footprints of Bandung (Indonesia) and Accra (Ghana) reveals the types of land consumed by new development in two fast-growing developing-country cities. Between 1991 and 2011, Bandung's urban footprint roughly doubled, from 108 to 217 square kilometres.[37] Of the newly built-up area, 60 per cent consisted of urban expansion into farmland and open space, 17 per cent was leapfrog or non-contiguous development, and the rest was urban infill (i.e. redevelopment of existing built-up areas). Leapfrog development can be costly to serve since basic infrastructure, such as sewerage and piped-water, must be extended to far-flung, outlying settings. Overall, Bandung's urban densities declined 1.4 per cent annually over this ten-year period. From 1985 to 2000, Accra's land area grew 153 per cent, which is twice as fast as its population growth. Accra's urban growth consisted largely of the extension of city boundaries into former agricultural areas.

A monocentric urban form . . . mostly produces radial trips

Urban form and travel

Just as density influences the distances and modes of travel, other attributes of urban form – including the spatial distribution of population and employment and land coverage – shape the spatial patterns of trips. A monocentric urban form, wherein the vast majority of jobs and commercial activities are concentrated in the city centre and most households reside on the periphery, mostly produces radial trips (Figure 5.6). Whereas the convergence of vehicles near the centre often gives rise to extreme road congestion, it also allows for heavily patronized radial public transport networks to thrive. A multi-centred, or polycentric, form results in more dispersed, lateral and cross-town travel patterns, which generally favour flexible forms of mobility, such as private cars.[38] Polycentric regions can mount successful public transport services by using sub-centres to interlink high-quality and synchronized rail services, such as those in Singapore and Paris. Suburban centres and nodes effectively become the interchange points for connecting large-scale public transport networks. The degree to which station nodes average higher densities depends on the larger shares of trips by non-motorized modes such as walking and cycling.

Polycentric regions can mount successful public transport services by using sub-centres to interlink high-quality and synchronized rail services

Like densities, urban land coverage influences travel. From 1980 to 2005, average kilometres driven per person in the US increased by 50 per cent, a change partly explained by the nearly 20 per cent increase in land consumed per person over the same period.[39] In India, trip lengths are more influenced by land area (Figure 5.7) than by urban densities (Figure 5.8). Among India's 21 largest cities, the relationship between population density and average trip length is slightly positive. The slope of the plot of urbanized land area and trip length, however, is noticeably steeper. This reflects the sprawl-inducing effect of floor space index (FSI) restrictions in the urban cores of most Indian cities, used to decongest the centre. Redirecting growth to the periphery might lessen central-city traffic congestion at the expense of longer distance trips, which are more dependent on motorized transport (including two- and three-wheelers).

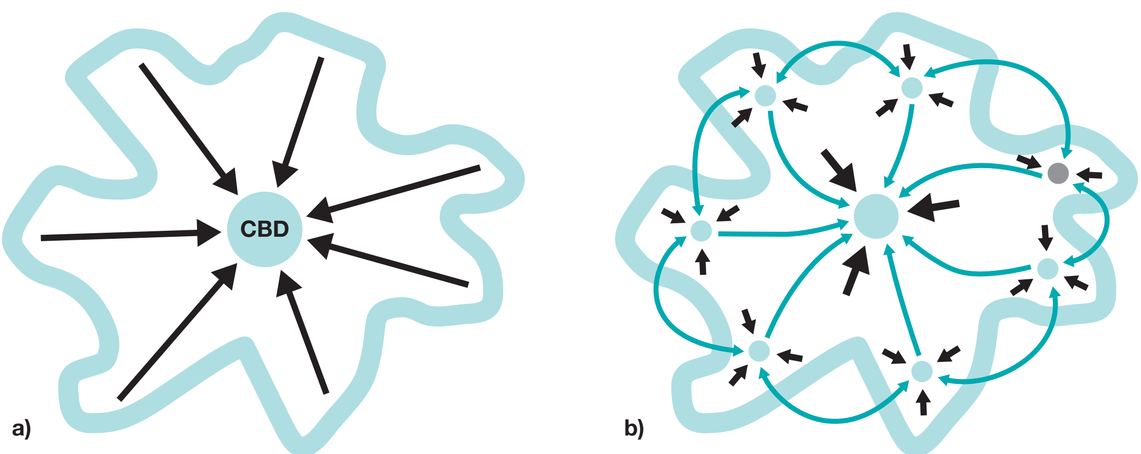
The larger the city, the greater its complexity and the potential to influence future traffic conditions, particularly if not well managed. Larger cities have significantly higher average urban densities than smaller cities and thus higher traffic densities (e.g. vehicles travelling roads per square kilometre). Between 1990 and 2000, a doubling of population among 120 cities worldwide was associated with a 16 per cent increase in density.[40] As city size and spatial coverage increase, so do the average lengths of trips, the severity of traffic congestion and environmental pollution. Traffic congestion is part of the territory of megacities, regardless of the quality of metro services.[41] The rate of congestion growth is also increasing rapidly in medium-sized cities that

Figure 5.6

Urban form and the spatial pattern of travel flows

Note: Monocentric cities (a), with a dominant central business district, generate radial trips. Polycentric cities (b), with multiple urban centres, produce a mix of radial and lateral trips. Black arrows represent strong links; blue arrows denote weaker links.

Source: Based on Bertaud, 2001, cited in Lefèvre, 2009.



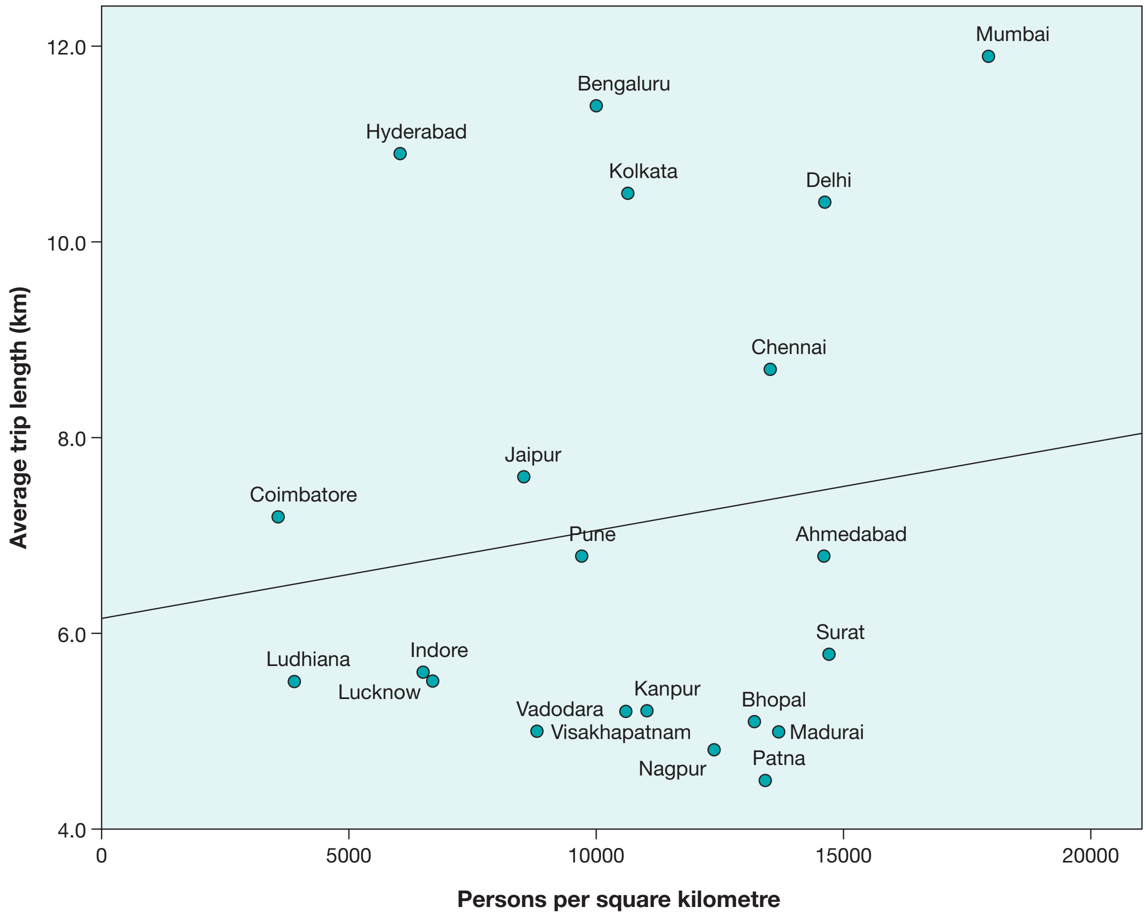


Figure 5.7

Average trip lengths in Indian cities as a function of population densities

Source: Centre of Excellence in Urban Transport, 2012.

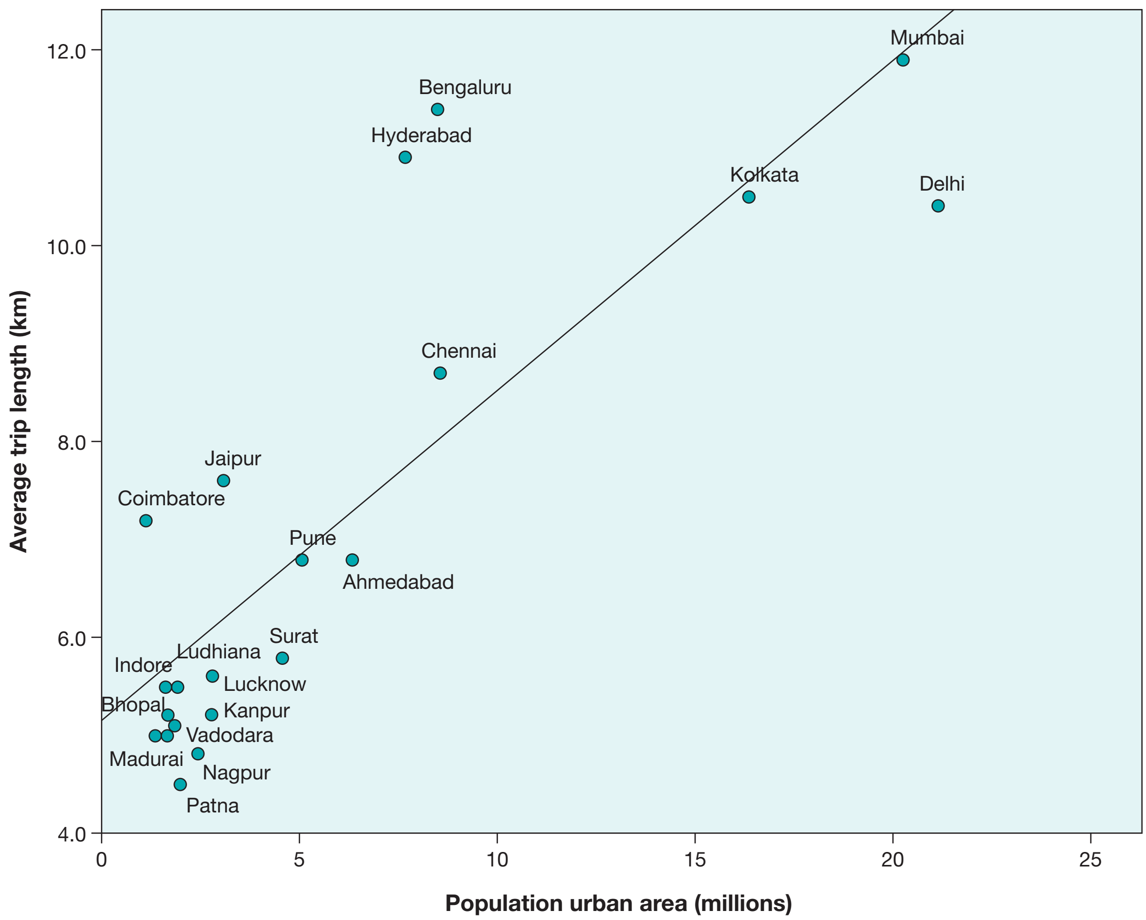


Figure 5.8

Average trip lengths in Indian cities as a function of total urban population

Source: Centre of Excellence in Urban Transport, 2012.

Box 5.4 Mobility and over-concentrated development in Beijing, China

Beijing's 2005 master plan called for the creation of 11 new towns in peripheral regions of the city. The primary aim of shifting growth to the outskirts has been to mitigate over-crowding in the city's central built-up area. The city has built a total of seven ring roads in an attempt to connect the new towns and divert traffic from the city's core. While new town development embraced the idea of China's capital city becoming a polycentric one, Beijing's urban form is characterized as high-density monocentric, rather than multi-centred. The city has witnessed a seemingly continuous outward expansion from the central built-up area, with densities tapering only slightly from the core. That is, the region has become a high- to moderate-density development, from the traditional core to the outskirts, with few dominant centres.

The high and continuous concentration of urban activities over a large geographic territory has led to extreme traffic congestion and air pollution. The fact that the city has failed to create relatively self-functioning suburban clusters has undermined its ability to develop cost-effective high-capacity public transport services, leading to high levels of car usage and VKT per capita. Beijing's failure to implement a multi-centred urban form stems from the tendency for ring roads to spread development evenly in all directions, from the traditional core. Expanded rail investments and a policy commitment to TOD – i.e. concentrating more growth around metro stations – could give rise to a more clustered pattern of suburban development in the future, with increased mobility and environmental benefits.

Sources: Yang et al, 2012; Zhao, 2011.

Agglomeration diseconomies . . . is expressed in the form of lost labour productivity from extreme traffic congestion, increasing air pollution, and an overall decline in the quality of urban living

High densities are essential for sustaining cost-effective public transport services

suffer from deficient street layouts, poor connectivity and inadequate public transport. These conditions are further exacerbated when traffic demand approaches or exceeds the available capacity of the transport system during peak hours. The expansion of cities and high densities inevitably creates challenges in the urban environment, particularly in developing countries. For example, the large concentration of employment and economic activities, coupled with inadequate public transport in megacities such as Manila (the Philippines), Lagos (Nigeria), Jakarta (Indonesia) and Mexico City, have resulted in exceedingly high traffic densities, and comparatively long trips by motorized transport.[42]

While urban agglomeration allows for job specialization, efficient market transactions and knowledge spillovers, if concentrated growth is not well planned – such as the integration of urban growth with metro investments – the resulting economic benefits tend to erode. Agglomeration diseconomies – i.e. the inefficiency and loss resulting from poorly planned concentrations – is expressed in the form of lost labour productivity from extreme traffic congestion, increasing air pollution and an overall decline in the quality of urban living. The over-concentration of activities in the city's urban core has been blamed for Beijing's increasing traffic congestion and environmental problems (Box 5.4). Evidence from recent studies conducted in UK cities revealed that decongesting the core by dispersing growth to sub-centres can raise economic productivity without increasing transportation energy use, greenhouse gas emissions and air pollution levels.[43]

URBAN DENSITIES AND PUBLIC TRANSPORT THRESHOLDS

No aspect of urban form and travel has been more closely studied than the influences of urban densities on public transport ridership. It is widely accepted that high densities are essential for sustaining cost-effective public transport services. Mass transit, it is said, needs 'mass', or density. As observed almost a half-century ago, 'nothing is so conducive to the relative economy of rail transit as high volumes and population density. High population density increases the costs of all urban transportation systems, but substantially less for rail than for other modes'.[44] Rail, with its high up-front capital costs and economies of scale, needs to attain a threshold density of trips, in order to cost less than accommodating the same trips by car or bus. Since rail-based public transport needs high passenger volumes to be cost-effective, it also needs high concentrations of people and jobs around stations.

Figure 5.9 indicates a relationship between public transport ridership and urban form. Very low-density cities with a predominantly polycentric form are unabashedly autocentric. In spread-out cities such as Atlanta (US), public transport has a difficult time competing with the private car. Public transport that is cost-effective can only be achieved through high urban densities and a large share of jobs and retail activities concentrated in the urban core (such as in Shanghai, China), or in polycentric cities with multi-directional travel patterns (such as Stockholm, Sweden). Many large cities, such as Jakarta (Indonesia) and Paris (France), lie somewhere between the aforementioned extremes: both private mobility and public transport can compete for trips when densities

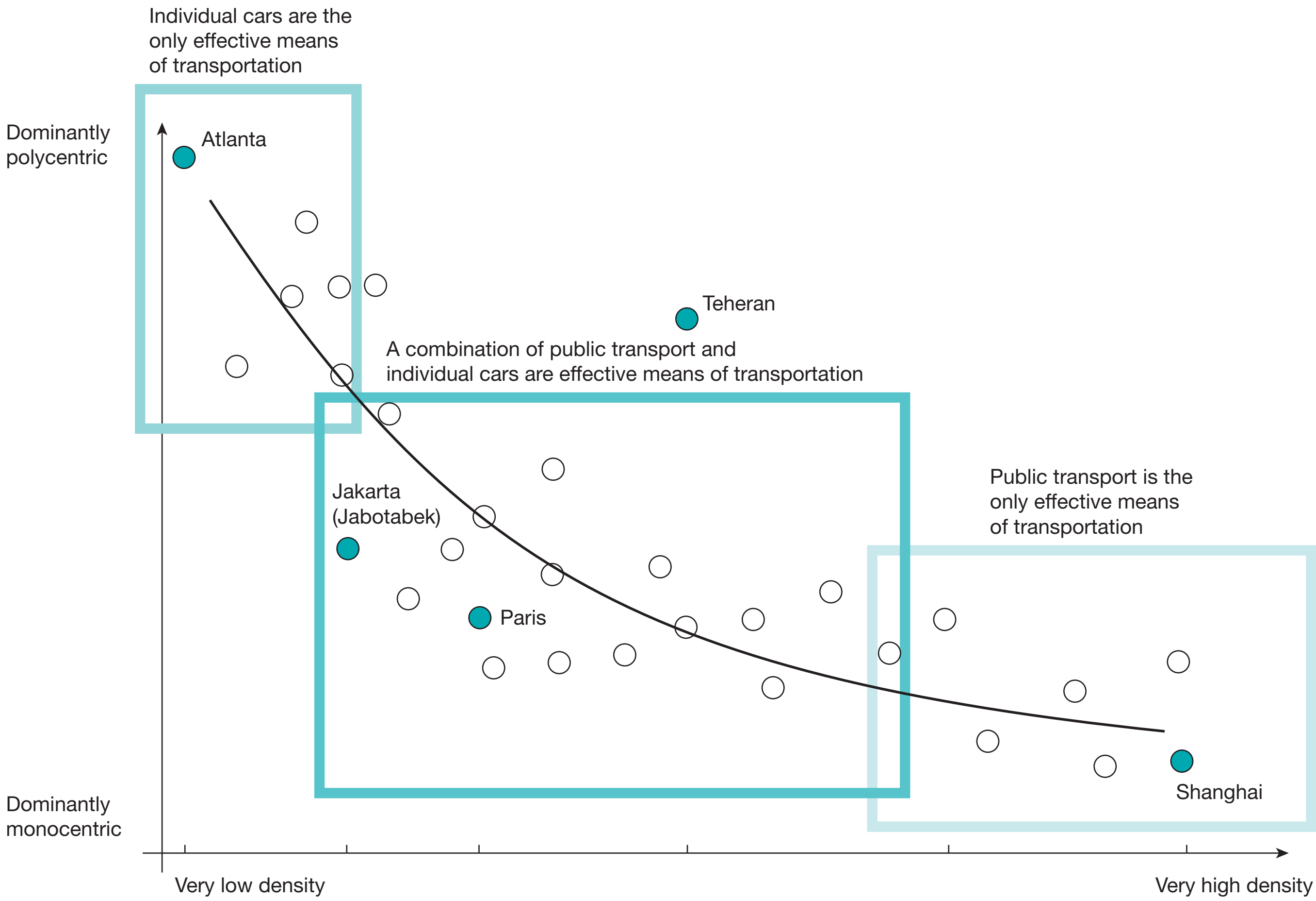


Figure 5.9

Relationship between urban form and cost-effective public transport

Source: Bertaud and Malpezzi, 2003, cited in Lefèvre, 2009.

are moderately high and activities span the monocentric–polycentric spectrum.

Figure 5.10 shows that there is a positive correlation between urban population density and public transport ridership per capita. Hong Kong, with extremely high densities, is a statistical outlier – averaging comparatively low transit trips per capita relative to its high densities. This maybe attributed to the fact that many trip destinations are close to each other, thereby resulting in an extraordinarily high share of trips made by foot. Removing the Hong Kong case from the database produces an even stronger statistical fit.

The reliance of public transport on urban densities has prompted efforts to define the minimum density thresholds required to support successful public transport services. On one hand, cities need to average 3000 inhabitants per square kilometre to support reasonably cost-effective public transport services.[45] On the other hand, for wealthier, more car-oriented countries such as the US, UK, Canada, Australia and New Zealand, a minimum threshold of 3500 people and jobs per square kilometre is necessary if public transport is to generate sufficient ridership to cover costs.[46] Evidence suggests that new suburbs in these countries rarely achieve more than half of this minimum threshold.[47] A similar study in Athens (Greece) found that public transport trips per capita sharply increased to 20,000 persons per square kilometre and then tapered, suggesting this figure as a planning norm for successful public transport services.[48] While density thresholds have long been set to guide public transport investments and TOD planning in the US, these benchmarks are based on limited data points and experiences (Box 5.5).

A recent US study examined the job and population densities that are associated with cost-effective public transport investments, based on the country's experiences with recent light-rail and BRT investments.[49] Figure 5.11, which is based on this study, shows that a BRT system that costs US$30 million per kilometre would need around 4000 jobs and residents per square kilometre within 800 metres of its station to be in the top 75 per cent of cost-effective investments. A light-rail investment at the same per-kilometre cost requires 11,000 jobs and residents per square kilometre; and a heavy-rail investment requires nearly 14,000 per square kilometre to fall in the top quartile.

Cities need to average 3,000 inhabitants per square kilometre to support reasonably cost-effective public transport services

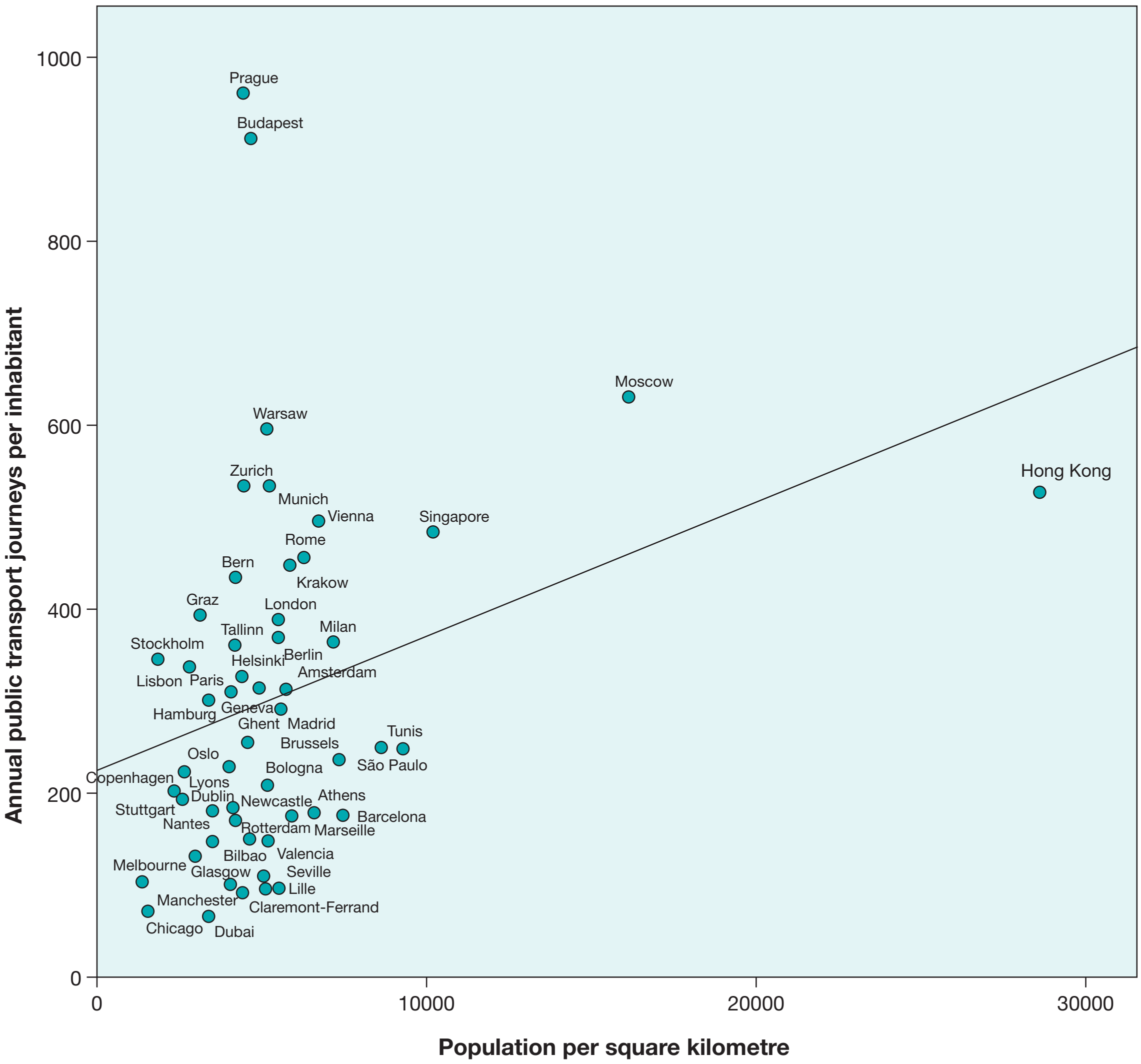
However, as there are many city features that influence public transport ridership, some observers have cautioned against a fixation on density.[50] The walkability and land-use mixes of neighbourhoods that surround stations are also important to viable public transport services. If people cannot safely and conveniently walk the half kilometre to or from a

Figure 5.10

Urban population density and public transport travel

Note: Data drawn from a sample of 50 cities in 2001, primarily in developed countries.

Source: UITP, 2006.



Box 5.5 Density thresholds for cost-effective public transport in the US

The development of minimum density thresholds for successful public transport investments in the US has been the focus of numerous studies undertaken and policy initiatives introduced to the world's most car-dependent country. Between the 1960s and 1970s, it was estimated, that the high costs of heavy-rail investment required a minimum net residential density of at least 3000 households per square kilometre. A minimal light-rail investment, by comparison, would require at least 2400 households per square kilometre.

A more recent study of 59 capital investments in public transport in the US since 1970, found light rail to be more cost-effective than heavy rail, resulting in approximately 7000 people and jobs per gross square kilometre. Across these 59 US projects, a 10 per cent increase in total population and jobs per square kilometre corresponded with a 3.2 per cent decrease in annualized capital costs per rider.

While capital investment costs also rise with density, US experiences show the increased ridership more than offsets these costs per passenger kilometre. As a result, the justification for fixed-guideway public transport investments has led to the adoption of density thresholds in US cities. The city of San Diego, for instance, has adopted TOD guidelines that call for a minimum of 6300 dwelling units per square kilometre for light rail services serving urban transit-oriented districts. In its TOD guidelines, metro Portland has set slightly higher thresholds – 7500 dwelling units per square kilometre for development within one city block of light rail stations.

Sources: Pushkarev and Zupan, 1977; Guerra and Cervero, 2011.

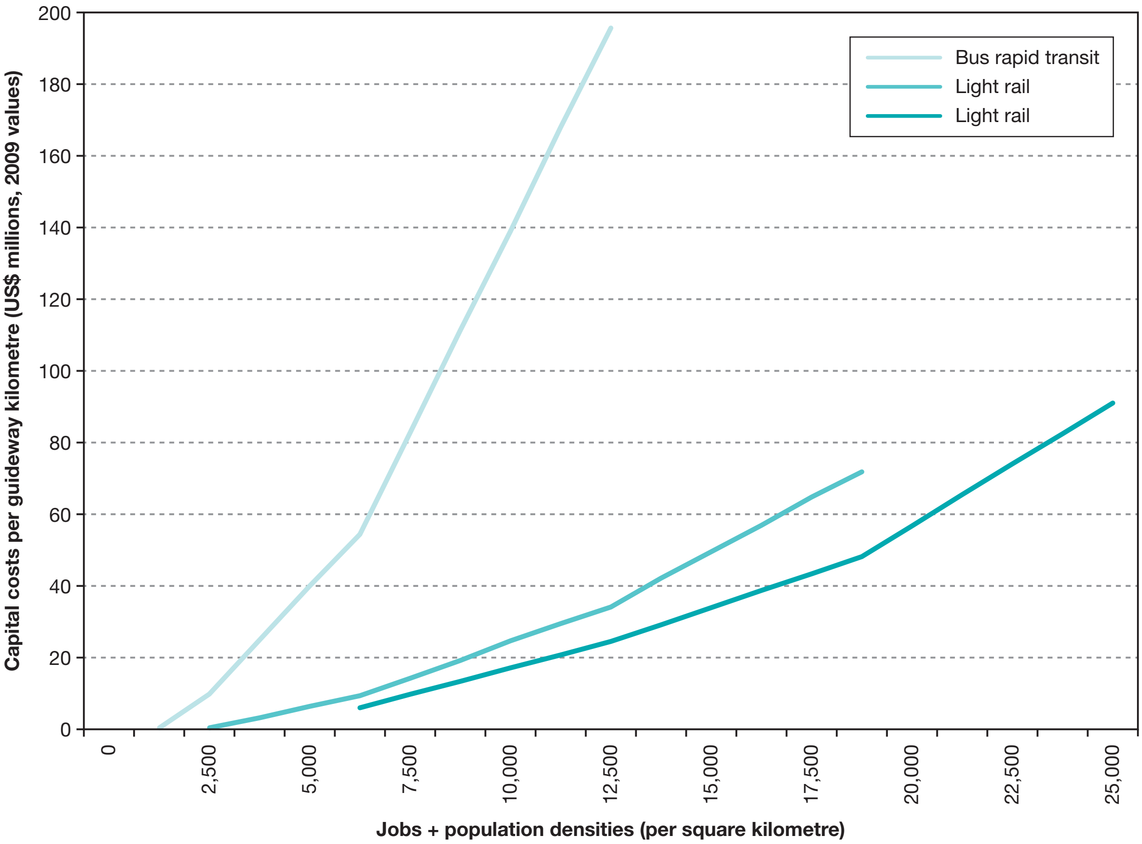


Figure 5.11

Minimum urban densities needed for top-performance investments, fixed-guideway capital costs in the US

Sources: Based on Guerra and Cervero, 2011.

Box 5.6 Dysfunctional densities of Los Angeles, US

The city of Los Angeles averages the highest overall population density in the US matched by a thicket of criss-crossing freeways and major arteries, which form a dense road network. The city also averages the highest level of vehicular travel per capita, and the worst traffic congestion in the US. This dysfunctional combination of high population and road densities has been called the 'worst of all worlds' – because traffic congestion increases exponentially with car density and city size; so do the externalities associated with car travel. The suburbs of Los Angeles are dotted with three to four story walk-up garden-style apartments, horizontally stretched within superblocks, creating long walking distances. Whereas densities are high by US standards, they are not public transport-oriented by European standards. In Los Angeles, densities are generally too high for a car-dependent city and are not organized along linear corridors in public transport-friendly manner. Such population densities are too high for cars and too poorly organized for successful public transport – they are, in effect, dysfunctional densities.

Sources: Eiden, 2005; Schrank and Lomax, 2007; Cervero, 1998.

station, chances are they will not use public transport. Conversely, if they can easily run errands and coordinate trips on the way to or from a station, they are more likely to take public transport. Further, the presence of a convenience retail store along the walk-access corridor to a public transport stop increases the odds of public transport riding.[51] The manner in which densities are designed also matter. Lineal and well-articulated densities aligned along busways, such as the case of Curitiba (Brazil), are far more conducive to public transport travel than the uniformly spread-out, poorly planned densities in Los Angeles, US (Box 5.6). Where there is a mismatch between the ***geometry*** of transportation systems (e.g. point-to-point rail systems) and the ***geography*** of travel (e.g. many origins to many destinations), public transport will struggle to grab reasonable market shares of trips regardless how good services might be.[52]

Lineal and well-articulated densities aligned along busways, such as the case of Curitiba (Brazil), are . . . conducive to public transport travel

PLANNING THE ACCESSIBLE CITY

Coordinating and integrating urban transport and land development is imperative to creating sustainable urban futures. Successfully linking the two is a

Box 5.7 'Compact cities' or 'smart growth'

'Compact cities' or 'smart growth' are terms that have gained currency in the field of urban planning for describing urban development that is compact, resource-efficient and less dependent on the use of private cars. The term of 'smart growth' is most commonly used in North America, while in Europe and Australia the term 'compact city' is often used to connote similar concepts. As an antidote to sprawl, these terms aim to reduce the municipal fiscal burden of accommodating new growth, while at the same time promoting walking and cycling, historical preservation, mixed-income housing that helps reduce social and class segregation and diversity of housing and mobility choices that appeal to a range of lifestyle preferences. Ten accepted principles that define such developments have:

1. mixed-land uses;
2. compact building design;
3. a range of housing opportunities and choices;
4. walkable neighbourhoods;
5. distinctive, attractive communities with a strong sense of place;
6. preservation of open space, farmland, natural beauty and critical environmental areas;
7. development directed towards existing communities;
8. a variety of transportation choices;
9. development decisions that are predictable, fair and cost effective;
10. community and stakeholder collaboration in development decisions.

Sources: Bullard, 2007; Duany et al, 2000; http://www.smartgrowth.org/network.php, last accessed 6 May 2013.

Design and layout of a city strongly influence travel demand

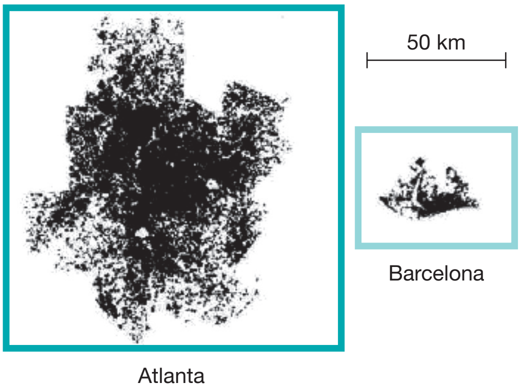
signature feature of 'compact cities' or 'smart growth' (Box 5.7).[53] Successful integration means making the connections between transport and urban development work in both directions. As noted, the design and layout of a city strongly influence travel demand. At the same time, transportation infrastructure is an essential feature that shapes the city. The coordination and integration of transport planning and development, as well as spatial planning and development are key.

The coordinated planning of urban mobility and land development starts with a collective vision of the future city, shared by city government and major stakeholders of civil society. Thereafter, a strategic plan that orchestrates urban development is developed to realize the shared vision, and must include, among other things, building the institutional, regulatory and fiscal capacities to implement the plan. A strategy plan aims to translate urban development goals into long-range implementation in terms of where and in what form development and redevelopment occurs, and the tools (e.g. laws and regulations, fiscal instruments, organizational reforms) necessary to achieve desired outcomes.[54] Visioning the future city as a precursor to transportation decision-making reflects the derived nature of travel. People travel to reach places, and it is these places that serve the purposes of trips and the aspirations of people who make them. Well-planned cities, such as Singapore, Stockholm (Sweden) and Curitiba (Brazil), crafted cogent visions of the future to shape transportation investments and achieve the best outcomes, whether measured in economic prosperity, energy resourcefulness, cleanliness of the natural environment or quality of life.[55]

Well-planned cities, such as Singapore, Stockholm, and Curitiba, crafted cogent visions of the future to shape transportation investments and achieve the best outcomes

The city of Copenhagen (Denmark) and its celebrated 'Finger Plan' is a text-book example of a long-term planning vision, which shaped rail investments and urban growth. A five-finger hand became the metaphor for defining where growth would and would not occur. Each finger was oriented to a traditional Danish market town within the orbit of metropolitan Copenhagen. The construction of rail-based public transport was purposed to steer growth along the desired growth axes, in advance of travel demand. Also, greenbelt wedges set aside as agricultural preserves, open space and natural habitats were designated and major infrastructure was directed away from the districts.

Ottawa, Canada, with a population under 900,000, offers a good example of concordance between urban vision and transportation investments. The 1974 plan called for a multi-centred urban structure, with five directional corridors of future growth emanating from the city centre. Ottawa's leaders began with a concept plan that defined desired growth axes, thereafter invested in a high-quality, high-capacity busway to drive growth along these corridors. A combination of land-use regulations and incentives (e.g. targeted infrastructure investments) channelled commercial and employment growth to the busway corridors. The plan mandated, for example, that all shopping centres over 354,000 square metres gross leasable space had to be sited near the busway or future extensions. Transportation demand management measures such as mandatory parking charges were also introduced. In 2007, Ottawa adopted guidelines that called for building designs and set-backs that create attractive human-scale development; public art to enliven station areas; and short street blocks to make it easier and more enjoyable for pedestrians to access busway stations.[56] Since 1990, the public transport's mode share in Ottawa has remained steady at 15 per cent of daily trips, while declining in nearly all other Canadian cities.[57]



Atlanta	Barcelona
Population 5.25 million	Population 5.33 million
Urban area: 4280 km²	Urban area: 162 km²
CO_2 emissions 7.5 tonnes per hectare per year (public + private transport)	CO_2 emissions 0.7 tonnes per hectare per year (public + private transport)

Figure 5.12

Comparison of urban forms and transport-sector CO_2 emissions in Atlanta (US) and Barcelona (Spain)

Source: Lefèvre, 2009, citing Newman and Kenworthy, 1999.

The two examples above of where the urban-form 'horse' leads the transportation 'cart', with transport investments that have been used as tools to create hoped-for outcomes. Similarly, local authorities can utilise a range of tools to influence urban growth such as land-use regulations; infrastructure investments; tax policies (e.g. enterprise districts); and land purchases (e.g. greenbelts). However, experience shows that transportation investments are one of the most important.[58] This is particularly the case in fast-growing cities with vibrant economies, worsening traffic congestion and a high pent-up demand for mobility. Arguably, 'transport-land use links are the most important ones in infrastructure plans and thus should take precedence'.[59]

Rather than being site or corridor specific about where growth should take place, and in what form, some cities opt to advance principles and ideals, expressed in fairly general terms, about desired growth. This is often in the form of ***strategic spatial plans*** that contain long-range directives and conceptual ideas, as opposed to detailed spatial designs.[60] An example is Barcelona's recent strategic plan, which calls for maintaining a compact urban form, preserving the city's legacy of high-quality urban design and keeping the city walkable.[61] The plan provides a framework for this vision to be refined and set into motion, through a series of local multi-sectoral projects, such as housing development and brownfield redevelopment, as well as proactive investments in sustainable transportation infrastructure.[62] With a population similar to Atlanta's, Barcelona's longstanding commitment to planning and designing a compact, mixed-use walkable city has produced a spatial coverage and carbon footprint that is only a fraction of Atlanta's (Figure 5.12). The short distances created by a compact city have meant that 20 per cent of trips made by Barcelonans are by foot.[63]

In developing countries, long-term strategic plans governing the growth of cities tend to be less clearly defined. In its 'Accessible Ahmedabad' plan, the city of Ahmedabad (India) embraced the principle of creating a city designed for accessibility rather than mobility, without specific details on the siting of new growth.[64] The plan calls for guiding development and investing in transportation so as to: (1) reduce the need for travel; (2) reduce the length of travel; and (3) promote the use of public transport and non-motorized vehicles to reduce car dependence. The city's BRT system forms the backbone of Ahmedabad's evolving transportation network. A better articulation to urban development was needed to make 'accessibility' a key element of mobility and city growth.

Transport investments . . . have been used as tools to create hoped-for outcomes

Planning the accessible city also involves increasing the percentage of urban land allocated to streets, to enhance connectivity. Studies show that the overall connectivity of the city can be measured by proxy, by comparing the ratio of urban land allocated to streets with the total land area of the city.[65] Current trends indicate that the bulk of urban population growth is occurring in developing countries, most of which have a limited street and other infrastructure required for increased accessibility. While it is important for these cities to invest in streets, it should be noted, however, that having a high percentage of urban land allocated to streets is only the first step in making a city more accessible. There is, in addition, a need to take into account the efficiency of the street system and its adaptability to essential urban mobility modes such as high-capacity public transport systems (such as metros or BRTs), walking and cycling. An efficiently laid out street system integrates three main variables, namely; the proportion of land area allocated to streets, the number of street intersections and the distance between these intersections. Furthermore, the hierarchy – arterial, primary and secondary, as well as bikepaths and footpaths – of the street system constitutes another essential element of the connectivity matrix for the city, which is a fundamental aspect of accessible urban mobility systems.[66] Each city thus needs to invest in adequate and well-laid out street networks, according to its economic, institutional, social and environmental capacities.

The short distances created by a compact city have meant that 20 per cent of trips made by Barcelonans are by foot

Having a high percentage of urban land allocated to streets is only the first step in making a city more accessible

Integrated mobility planning and urban growth need to occur at multiple spatial scales – e.g. the region as a whole, districts and corridors, as well as neighbourhoods. Such multi-level planning is a centrepiece of Portland, Oregon's widely celebrated

Integrated mobility planning and urban growth need to occur at multiple spatial scales

The regional scale best captures the ecological contexts in which cities exist

The district or corridor scale captures the spatial context in which many day-to-day economic transactions take place

5 Ds strongly influence travel demand – notably, the number of trips made, the modes chosen, and the distances travelled

approach to smart-growth development. There, a long-term regional vision of multiple, hierarchical growth centres, interlaced with high-quality public transport and secondary bikeway/pedway systems, has been adopted. The formation of an urban growth boundary has been pivotal to Portland's efforts to curb urban sprawl, reduce car-dependence and create a healthier, more liveable city. This boundary works at the regional scale, ensuring that future growth is inward and upward, not outward. The regional scale best captures the ecological contexts in which cities exist, and spatially corresponds to fragile resources such as airsheds and water tributary areas. The district or corridor scale captures the spatial context in which many day-to-day economic transactions take place, such as going to work and shopping for everyday items. For a public transport corridor, say, a necklace of pearls urban form (Figure 5.15) might take shape wherein nodes of mixed-use, public transport-served centres encourage residents to use public transport for their daily activities. In the case of the neighbourhood scale, activities such as convenience shopping, socializing with neighbours and walking to school usually take place where urban design approaches such as gridded street patterns and TOD are targeted. Spatial harmonization between these three levels – regions, districts/corridors and neighbourhoods – can be crucial for the successful integration of transportation and urban development, as experienced in Portland (US) and Curitiba (Brazil).

The next three sections of this chapter refer to each of these three scales, namely: neighbourhoods, corridors and regions. In addition, the directions of the transportation–urban form relationship are discussed at these scales. In particular, these sections look at how urban development and land-use patterns influence travel, and how transportation investments and policies influence the growth and shape of the city. Examples are cited that highlight the successes and challenges of integrating transportation and urban development at each scale.

BUILT ENVIRONMENTS AND TRAVEL AT THE NEIGHBOURHOOD SCALE

The mobility influences of finer-grain features of the city – such as the size of city blocks, the layout of street networks, parking arrangements and the intermixing of land uses – are best measured at the neighbourhood scale. Contemporary forms of smart growth, such as TOD and new urbanism, both discussed in the next section, aim to place many daily activities within a five to ten minute walk of each other. This corresponds to the spatial coverage of a typical neighbourhood.

Many studies have been conducted on the potential to reduce motorized travel through changes in the built environment.[67] Analysts often express features of built environments along five core dimensions or the '5 Ds': density, diversity, design, destination accessibility and distance to transit (Box 5.8). These 5 Ds strongly influence travel demand – notably, the number of trips made, the modes chosen and the distances travelled – and are evident in many contexts and settings.[68] Both singularly and collectively, the 5 Ds affect VKT per capita.

Box 5.8 5 Ds of built environments that influence travel

- ***Density*** gauges how many people, workers or built structures occupy a specified land area, such as gross hectares or residentially zoned land.
- ***Diversity*** reflects the mix of land uses and the degree to which they are spatially balanced (e.g. jobs–housing balance), as well as the variety of housing types and mobility options (e.g. bikeways and motorways).
- ***Design*** captures elements such as street layout and network characteristics that influence the likelihood of walking or biking – e.g. pedestrian and bike-friendliness. Street networks vary from dense urban grids of highly interconnected, straight streets, to sparse suburban networks of curving streets forming loops and lollipops.
- ***Destination accessibility*** measures ease of access to trip destinations, such as the number of jobs or other attractions that can be reached within 30 minutes travel time.
- ***Distance to transit*** is usually measured as the shortest street routes from the residences or workplaces in an area to the nearest rail station or bus stop.

These are not separate dimensions and indeed are often co-dependent. Having high-rise housing and office towers will yield few mobility benefits if the two activities are far from each other. A diversity of uses and improved accessibility to destinations from home or work are needed if denser development is to translate into more pedestrian and transit trips. City downtown areas are considered the densest part of most cities. They also tend to be the most diverse in terms of land use and the most walkable – e.g. small city blocks, complete sidewalk networks and fine-grain grid street patterns.

Sources: Cervero and Kockelman, 1997; Ewing and Cervero, 2010.

Most evidence on this comes from developed countries. A recent meta-analysis of more than 100 studies in North America, Table 5.1 shows the average influence of each D factor on VKT, expressed as elasticities (denoting the per cent change in VKT for a 1 per cent change in each D factor). The study's conclusion is that 'destination accessibility' is by far the most important land use factor that strongly influences travel – on average, a doubling of access to destinations (e.g. the number of jobs that can be reached within 30 minutes by public transport) is associated with a 20 per cent decline in VKT. Almost any development in a central, accessible location will generate less motorized travel than the best-designed, compact, mixed-use development in a remote location.

Other attributes that influence travel include: urban design (e.g. street connectivity and safe, complete sidewalk provisions) and well-sited pedestrian routes. Box 5.9 describes the importance of land-use diversity such as level of mixing, which tends to exert strong influences on travel modes and distances to the workplace, rather than the residential end of trips. The rather weak statistical relationship between density and travel in the US reflects the fact that density is intertwined with other D variables – e.g. dense settings commonly have mixed uses, small city blocks, and central locations, all of which shorten trips and encourage walking. While individual elasticities might appear low in Table 5.1, their influences are additive.

European studies on the 5 Ds and travel, largely corroborate US experiences. As in the case of the US, location within a region matters. Isolated neighbourhoods with poor accessibility result in a high level of car use. A study in Copenhagen, Denmark, revealed that VKT increased by 30 per cent with a doubling of distance to the city's downtown area.[69] The importance of road designs and land-use mixes is revealed by a study of two European cities with similar land areas and household incomes – the master-planned British new town, Milton Keynes, and the more traditional Dutch community, Almere.[70] Almere was designed for walking and cycling, while Milton Keynes is a car-oriented city laid out on a super-grid of four-lane thoroughfares, separating homes, offices and shops into different quadrants. The study found that two-thirds of the out-of-home trips made by urban residents in Milton Keynes were by car, compared to 42 per cent in Almere. In addition, the average trip distances in Almere were 25 per cent shorter. A more recent comparison of Milton Keynes with another Dutch master-planned new town, Houten, that was more consciously designed for bicycle travel revealed greater differentials. In 2010, 55 per cent of all trips made by Houten residents were by bike, as compared to 20 per cent of the trips made by urban residents in Milton Keynes.[71]

While very little is known about the 5 Ds and travel in developing countries, evidence is beginning to trickle in. In Santiago (Chile) evidence revealed that between 1991 and 2001, the effect of urban densities on car ownership doubled, with increasing population densities reducing the likelihood of households owning a car.[72] Being close to a subway station also reduced car ownership rates. However, land-use diversity had a minimal influence on travel.

Table 5.1

5 D influences on VKT, expressed as average elasticities

	Elasticity	Per cent change in VKT from a doubling of value of the 'D' variable
Density (intensity of use)	–0.05	–5%
Diversity (mix of use)	–0.07	–7%
Design (walkability)	–0.08	–8%
Destination (accessibility)	–0.20	–20%
Distance (to transit)	–0.05	–5%

Note: Data are drawn principally from empirical studies in the US.

Sources: Ewing and Cervero, 2001; Ewing and Cervero, 2010.

'Destination accessibility' is by far the most important land use factor that strongly influences travel

Isolated neighbourhoods with poor accessibility result in high level of car use

Box 5.9 Land-use diversity

Mixing up land uses can shorten trips and encourage non-motorized travel. A recent study of six mixed-use activity centres across the US found that 30 per cent of generated trips were internal to the project – i.e. short journeys, mainly by foot. Trips meant for private cars to external destinations away from the development were instead on-site and often by foot. Such trips put no strain on the surrounding road networks and generate relatively few vehicle kilometres of travel. Unless such benefits are accounted for in traffic impact studies, the traffic-inducing impacts of mixed-use developments become overstated.

Other benefits of mixed land uses include opportunities for shared parking and an even distribution of trips (and thus a flatter peak period) throughout the day and week. Situating employment and entertainment activities close to each other, for example, means the parking used by white-collar employees during working hours can also be used in the evenings and weekends by theatre-goers and restaurant patrons. In such settings, co-locating land uses whose parking demands vary by the time and the day of week can shrink the footprints of impervious parking surfaces by as much as 35 per cent. Parking regulations and liability laws might need to be adjusted to allow shared parking among various activities in mixed-use settings.

Sources: Cervero, 1988; Ewing et al, 2011; Zegras, 2010.

In Colombia, a study of Bogotá residents found that while density and land-use diversity had very little influence on the amount of time spent walking and cycling, neighbourhood design attributes such as street connectivity and sidewalk provisions had significant impacts.[73] Moving from a neighbourhood in Bogotá with low levels of road connectivity (measured by the ratio of links to intersections) to higher levels, resulted in an increased likelihood (by 220 per cent) that residents walked 30 minutes or more per day.[74] Many of Bogotá's older neighbourhoods that evolved organically during the pre-car era had strict zoning laws, thereby resulting in urban neighbourhoods that exhibit similar densities, mixes of land use and access to public transit. The quality of the walking environment varied, however, and did not strongly influence non-motorized travel. Similarly, in Taipei and Hong Kong (China) street designs tend to strongly influence walking, as compared to high densities and mixed land uses (which are commonplace in both cities).[75]

The quality of the walking environment has important age and gender dimensions

The quality of the walking environment has important age and gender dimensions. In Teheran, a recent study found highly walkable neighbourhoods to be most conducive to the elderly, resulting in their walking more often.[76] Environments designed with more street lighting and a mixture of land uses that generate foot traffic are likely to decrease the risk of violence to women.[77] Further, people of all ages and genders tend to socialize more and are physically active in compact, mixed-use neighbourhoods.[78] Well-designed streetscapes with destinations close by tend to draw city residents to sidewalks and public spaces, creating what urban designers call 'natural surveillance' and more 'eyes on the street'.[79] Bogotá's proactive investment in walkways, plazas and sidewalks close by, and the city's connection to the Transmilenio BRT system has further enhanced public safety and encouraged households to upgrade their homes and neighbourhoods.[80]

Expanded, improved and better connected pathways are important features of slum upgrading programmes. In La Vega Barrio, one of Caracas, Venezuela's largest and oldest informal settlements, 30 pathways that criss-cross steep hillsides have been built or rehabilitated to enhance access to jobs, schools and medical clinics, as part of a major neighbourhood upgrading initiative.[81] Design features such as smaller city blocks can also encourage foot travel in developing cities. Smaller blocks mean that trips made by foot are likely to be less circuitous. In Ahmedabad, India, only 13 per cent of trips made by those living in neighbourhoods with an average block size of 4 hectares, were by foot, compared to the recorded 36 per cent in a similar neighbourhood, with average block sizes of 1.2 hectares.[82]

Experiences from China reveal how changes in built environments fundamentally change travel in rapidly growing settings. Paralleling China's shift to a market economy have been dramatic transformations of urban environments – from a traditional high-density, pedestrian- and cyclist-oriented urban form to an increasingly spread-out, auto-oriented one.[83] The liberalization of land markets in the 1990s resulted in the displacement of many Chinese working-class households to the periphery – often to isolated superblock development enveloped by wide streets.[84] The change from organically evolved, mixed-use enclaves – where many people lived, worked and shopped in the same area – to car-oriented large-block suburbs, dramatically enlarged households' travel footprints. A study on the travel impacts of 900 households that moved from Shanghai's urban core to isolated, superblock and gated housing units on the periphery revealed dramatic shifts from non-motorized to motorized travel and journeys of far longer duration. This resulted in a 50 per cent increase in VKT from the households surveyed.[85] Another study found that residents living in higher-density areas in Shanghai, with smaller blocks and denser street networks averaged around one-half of the car ownership levels, compared to the urban residents living in more car-oriented, superblock districts.[86] Moreover, residents of pedestrian/cycle-friendly neighbourhoods travelled shorter distances than those of other neighbourhoods, even in cases whereby the travel mode was the same.

Globally, various neighbourhood designs and retrofits are being introduced to reduce the need for travel by private cars and invite more sustainable forms of mobility

Globally, various neighbourhood designs and retrofits are being introduced to reduce the need for travel by private cars and invite more sustainable forms of mobility. Among these are: traditional neighbourhoods, also known as new urbanism; TOD; and car-restricted districts.

Traditional neighbourhoods and the new urbanism

[In the pre-automobile era], traditional neighbourhoods were compact and highly walkable

Before the advent of the private car, traditional neighbourhoods were compact and highly walkable. Daily activities (e.g. shops, restaurants and schools) that were no more than five minutes away were characteristic of the pre-automobile era.[87] In the early 1980s, an urban design movement, called 'new urbanism', was developed in the US. This movement sought to return neighbourhoods to their pre-automobile designs and ambiances – places that promoted walking, allowed daily face-to-face interaction of people from all walks of life and provided a range of housing types, workplaces, commercial-retail offerings and public places.[88] Diversity and place-making became catchwords of the movement.[89] In contrast to the sameness and sterility of suburban sprawl, new urbanism emphasized the fine details of what makes communities enjoyable, distinctive and functional – such as gridiron street patterns well suited to walking, prominent civic spaces that draw people together (and thus help build social capital),

'New urbanism' . . . sought to return neighbourhoods to their pre-automobile designs and ambiances

tree-lined skinny streets with curbside parking and back-lot alleys that slow car traffic, and a mix of housing types and prices.[90]

More than 600 new urbanism neighbourhoods have been built, planned or are under construction in the US.[91] Most notable is Seaside, Florida, that was launched in the early 1980s. In Europe, a number of former brownfield sites have been redeveloped since the 1980s, based on traditional versus modernist design principles. One example is Poundbury, England, on the outskirts of Dorchester.[92] Other notable European new urbanism communities already built or taking form include Heulebrug (Belgium), Pitiuosa (Greece), Agelada de Cima (Portugal), Hardelot Plage (France) and Kemer in Istanbul (Turkey). In developing countries, recent examples of neighbourhood designs and redevelopment projects that follow new urbanism principles to varying degrees are Orchid Bay (Belize), Rosetown outside of Kingston (Jamaica), Timphu (Bhutan) and Melrose Arch in Johannesburg (South Africa).[93] However, these projects mainly cater for the middle- or high-income households that can afford the neighbourhood amenities (e.g. civic squares, streetscape enhancements, etc.) that accompany new urbanist communities. Accordingly, they have contributed little to relieving deeply entrenched social problems such as slums and concentrated poverty.

Among the objectives for designing communities, like those proposed by new urbanism, is that there will be a reduction in car dependence by making the communities pleasant places to walk and cycle. Experience largely bears this out.[94] In the Research Triangle area of North Carolina a study found that VKT reductions were due to the substitution of out-of-neighbourhood car trips for within-neighbourhood walk trips.[95] At similar income levels, those living in compact, mixed-use 'traditional' neighbourhoods made as many daily trips as those in low-density, single-family suburban neighbourhoods. However the switch from driving to walking and the shortening of trip distances resulted in around 20 per cent fewer VKT per household each weekday.

Transit-oriented development (TOD)

TOD is traditional or new urbanism development that is physically oriented to a public transport station

TOD is traditional or new urbanism development that is physically oriented to a public transport station.[96] By concentrating a mix of pedestrian-oriented development around public transport nodes, residents and workers are more likely to catch a train or a bus for out-of-neighbourhood trips, and walk or bike for shorter within-neighbourhood trips.[97] TODs aim to function as community hubs, and places where people not only 'pass through' but also choose 'to be' – e.g. for public celebrations and demonstrations, outdoor concerts, farmers' markets and other activities that help build community (Box 5.10).[98] If there is a logical place to concentrate urban growth and redevelopment, it is around public transport stops – an idea that planners, politicians and lay-citizens alike understand. Of course, high-quality, well-connected public transport service must exist to draw passengers to the station area in the first place, thus TOD relies on and implicitly assumes public transport is safe, reliable and time-competitive with the private car.[99]

TODs aim to function as community hubs

Increasingly, TOD is globally recognized as a viable model for shaping urban growth. TOD is most fully developed in Europe, and particularly in Scandinavia. Step one in making TOD a reality is the formulation of a vision and conceptual image of the future metropolis, such as Copenhagen's celebrated 'finger plan' and Stockholm's 'necklaces of pearls' (Figure 5.16). In both these cities, corridors for channelling overspill growth from the urban centres

TOD is globally recognized as a viable model for shaping urban growth

Box 5.10 Transit-oriented development

The term TOD refers to compact, mixed-use, pedestrian-friendly development that is 'oriented', and not just adjacent to, urban rail and busway stations. Besides being the 'jumping off' point for catching a train or bus, TOD also serves other community purposes. In the Scandinavian model, TOD is characterized by a large civic square that functions as a community's hub – a gathering place for public events, such as open-air concerts, farmers' markets, public demonstrations and civic celebrations. Thus, TOD can serve both functional and symbolical purposes, as the centrepiece of communities. Experience shows that the Scandinavian approach to TOD designs can have significant benefits to communities such as: increasing public transport ridership; providing mobility choices; increasing public safety; reducing air pollution and energy consumption rates; building social capital; and increasing commerce and economic activities.

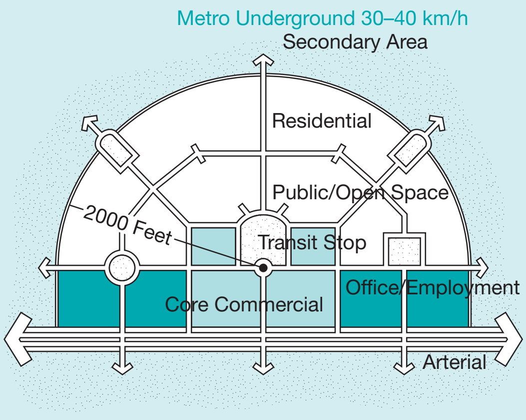


Figure 5.13

Neighbourhood-scale TOD site design, with mixed-use development within a walkshed (650 metres) of a public transport stop, with densities tapering with distance from the station

Source: Curtis et al, 2009, citing Calthorpe, 1993.

were defined early in the planning process, and rail infrastructure was built, often in advance of demand, to steer growth along desired growth axes.

Traditionally, few cities in developing countries were public-transport oriented, featuring fine-grain mixes of land uses, plentiful pathways for pedestrians and cyclists, and ample transit services on major roads. In Latin America, TOD is being planned or has taken form to varying degrees around BRT stations in Curitiba (Brazil), Santiago (Chile) and Guatemala City. Other noteworthy experiences with bus-based TOD can be found in Asian cities such as Kaoshiung, Qingdao and Jiaxing (China) and Kuala Lumpur (Malaysia).

TODs can reduce car use per capita by half, thus saving households around 20 per cent of their income

Many cities in China are looking to TOD in order to manage growth and capitalize upon massive rail and BRT investments. Recently, Beijing and Guangzhou adopted TOD as a guiding design principle in their long-range master plans.[100] However, failure to articulate densities (e.g. tapering building heights with distances from stations), the siting of stations in isolated superblocks and poor pedestrian access have undermined TOD efforts in many Chinese cities.[101] Over the past two decades, Beijing's investment in a massive 372-kilometre subway metro network has seen housing projects gravitate to rail corridors outside of the urban core, with a few jobs and consumer services following suit.[102] Many rail-served neighbourhoods have become veritable dormitory communities, skewing commuting patterns. A study of three residential neighbourhoods in Beijing's rail-served northern suburbs found as many as nine times the number of rail passengers heading inbound in the morning peak as those rail passengers heading outbound.[103] In addition, poor integration of station designs with the surrounding development has produced chaotic pedestrian circulation patterns and long passenger queues at suburban stations.[104]

With traffic calming, the street becomes an extension of a neighbourhood's liveable space – a place to walk, chat, and play

Evidence on how TOD has influenced travel and environmental quality comes mainly from the US. There, studies show that TODs can reduce car use per capita by half, thus saving households around 20 per cent of their income since they have, on average, one less car or often none.[105] Typically, TOD residents in the US commute by transit four to five times more than the average commuter in a region.[106] Similar ridership bonuses have been recorded for TOD projects in Toronto, Vancouver, Singapore and Tokyo.[107] In China, a recent study found smaller differentials of around 25 per cent in rail commuting between those living near versus away from suburban rail stations.[108]

While TOD planning tends to focus on residences, experience from the US shows that concentrating jobs around rail stops in well-designed, pedestrian-friendly settings can exert even stronger influences on the choice of travel mode.[109] The location of TOD in a region and the quality of connecting public transport services can strongly influence the choice of travel mode. A TOD as an island in a sea of auto-oriented development will have little influence on travel.

Traffic-calmed and car-restricted neighbourhoods

Many European cities have brought liveability and pedestrian safety to the forefront of transportation planning. Initiatives have sought to tame and reduce dependence on the private car.[110] Traffic calming is one such example, pioneered by Dutch planners who have added speed humps, realigned roads, necked down intersections and planted trees and flowerpots in the middle of streets to slow down traffic. With traffic calming, the street becomes an extension of a neighbourhood's liveable space – a place to walk, chat and play. Car passage becomes secondary. After traffic calming its streets in the early 1990s, the city of Heidelberg, Germany, witnessed a 31 per cent reduction in accidents and 44 per cent fewer casualties.[111]

An even bolder policy in the same direction has been the outright banning of cars from the core of traditional neighbourhoods and districts, complemented by an upgrading and beautification of pedestrian spaces. This practice has become commonplace in many older European cities, whose narrow and winding inner-city streets were not designed for motorized traffic. Today, car-free historical districts thrive in Athens (Greece), Seville (Spain), Lübeck and Bremen (Germany), Bologna and Siena (Italy) and Bruges (Belgium), as well as substantial portions of university towns such as Groningen and Delft (the Netherlands), Oxford and Cambridge (UK) and Freiburg and Münster (Germany). Extended pedestrian-only shopping streets and promenades have also gained popularity, such as Copenhagen's Strøget (Denmark), Lisbon's Baixa (Portugal) and Gamla Stan in old town Stockholm (Sweden). Similarly, multi-block car-free streets and enhanced pedestrian zones are also found in developing-country cities, including Curitiba, Brazil (20 city blocks), Buenos Aires, Argentina (12 blocks of Florida Street and several car-free waterfront redevelopment projects), Guadalajara, Mexico (15 downtown streets) and Beirut, Lebanon (much of the historical core). Entire residential communities, either newly built or redeveloped, that are car-restricted can be found such as Vauban (Box 7.12) and Rieselfeld outside of Freiburg (Germany), Amsterdam's GWL Terrein brownfield redevelopment (the Netherlands), Vienna's Mustersiedling Floridsdorf housing project (Austria), Munich's Kolumbusplatz neighbourhood (Germany), the Stellwerk 60 project in Cologne (Germany) and Masdar City outside of Abu Dhabi (United Arab Emirates).[112]

	Retail sales transactions and turnovers			Total %
	Increase %	Decline %	No change %	
Pedestrianized area				
Retailing	83	3	14	100
Hotels	28	8	64	100
Restaurants	63	1	36	
Outside pedestrianized area				
Retailing	20	17	63	100
Hotels	20	2	78	100
Restaurants	25	5	70	100

Source: Hass-Klau, 1993.

Table 5.2

Changes in retail sales transactions in pedestrianized areas of West German cities (1965–1975)

Some European communities have opted for traffic calming measures using cellular neighbourhood designs that require motorists to follow round-about routes, while providing direct connections to cyclists and pedestrians when going from one cell to another. One example is Houten, a master-planned, largely bedroom community of 41,000 inhabitants south of Utrecht (the Netherlands), which was designed and built to prioritize travel by bicycle and walking. Despite some initial uneasiness by business merchants, residents and politicians, global experiences with creating car-free districts, auto-restricted neighbourhoods and pedestrian-only streets have generally been positive. However, consideration needs to be made to ensure that high-quality and frequent public transport services are in place to absorb displaced car traffic. A study of pedestrianization in German cities recorded increases in pedestrian flows, public transport ridership, land values and retail sales transactions (Table 5.2), as well as property conversions to more intensive land uses, matched by fewer traffic accidents and fatalities.[113] A study of over 100 cases of road-capacity reductions (e.g. car-free zones, pedestrian-street conversions as well as street and bridge closures) in developed countries found an average overall reduction in motorized traffic of 25 per cent, even after controlling for possible increased travel on parallel routes. This 'evaporated' traffic represented a combination of people forsaking low-value, discretionary trips and opting for alternative modes, including public transport, walking and cycling.[114]

CORRIDOR CONTEXTS

A transportation 'corridor' consists of 'one or more primary transportation facilities that constitute a single pathway for the flow of people and goods within and between activity centers, as well as the abutting land uses and supporting street network'.[115] Corridors represent the spatial context in which significant challenges are often faced in coordinating transportation and land development across multiple jurisdictions. They are also where 'access management' – trading off the mobility versus site-access functions of roads – can pose significant policy challenges, particularly in fast-growing cities and regions.[116] If well planned and designed, corridors also present a spatial context for designing a network of TODs.

Consideration needs to be made to ensure that high-quality and frequent public transport services are in place to absorb displaced car traffic

Mobility and development trade-offs

Transportation corridors function to move people and goods but often face intense development pressures that over time can erode their mobility function.[117] Experiences show that building motorways without carefully managing urban growth is a surefire recipe for future traffic tie-ups.[118] This is particularly the case of developing country cities. New roadways open up access to new territories, spawning building construction and land development and thus more traffic.[119] In Sub-Saharan Africa, road improvements have stimulated the local production of cash crops, spurring urbanization in secondary towns where farmers sell their products and buy services and imported goods.[120] Access to port cities is especially crucial since most African trade is transoceanic. A study of 287 cities in 15 African countries found that cities relatively closer (465 kilometres) to a major port via paved roads grew 6 per cent faster, between 2002 and 2008, than otherwise similar cities.[121] Another study of proposed road upgrades between northeast Congo and the Central African Republic estimated that, in addition to stimulating urban growth, goods traded via this route would increase from a current value of US$16 million to US$142 million, nearly 800 per cent increase.[122] The study concluded that trade expansion promoted by the upgrading would exceed costs by about US$220 billion over a period of 15 years.

Transportation corridors function to move people and goods but often face intense development pressures that over time can erode their mobility function

With time, induced economic growth and new urbanization generates new trips, congesting roadways. Unless such growth is properly managed, economic and urbanization benefits will diminish.[123] Effectively, the roadway's role and function transforms from one of providing ***mobility*** to providing ***site access*** (Figure 5.14). The two are in fundamental

Figure 5.14

Mobility and accessibility trade-off along freeway corridor

Note: Top: multiple interchanges enhance site access, inducing new growth that over time slows mainline traffic flows. Bottom: limited interchanges constrain land development and thus help preserve speeds.

Source: Ferrell et al, 2012.

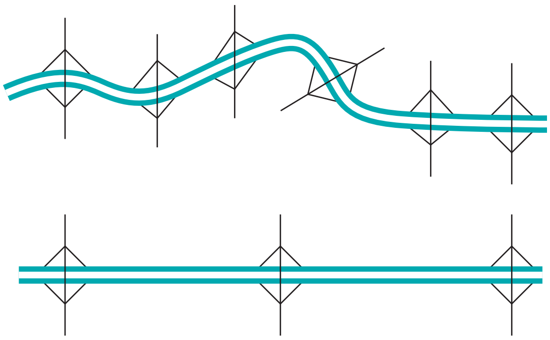
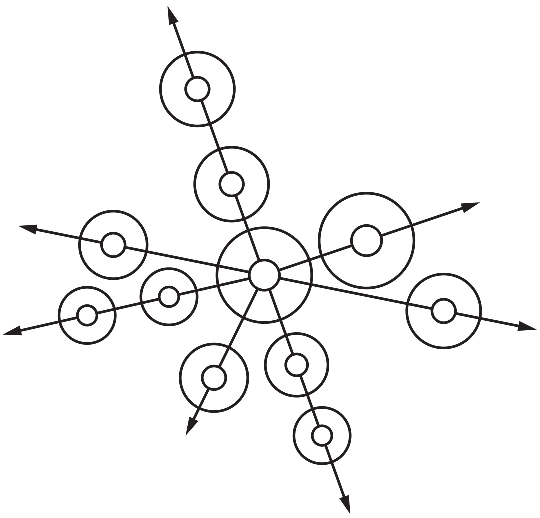


Figure 5.15

Public transport corridors as 'necklaces of pearls'

Note: 'Necklace of pearls' = strings of TOD aligned along public transport corridors.

Source: Cervero and Murakami, 2008a, p23.



Freeways and rail systems can complement rather than compete with each other through multi-modal corridor planning and design

'Necklace of pearls' built form not only induces public transport riding but can also produce balanced, bi-directional flows . . . through land-use intermixing

conflict. High corridor access, marked by frequent driveways, curb cuts and slow-moving cars accessing/exiting sites interferes with through-traffic movements. Further, travel speeds decline and accident levels increase. The problem is often accentuated when different institutions control infrastructure and land development along the corridor. If a national government or state builds a new road to improve cross-city traffic flows, the intention of local governments is to take advantage of the added capacity by allowing new development – a means to grow the local economy and generate property tax income.[124] Such scenarios whereby localities exploit newly provided roadway infrastructure, in order to leverage new growth and increase tax revenues at the expense of intercity mobility, are particularly problematic in parts of Sub-Saharan Africa and South-Eastern Asia.[125]

One approach to mitigating unintended consequences is improved corridor access management.[126] This can be done through growth management, road designs, price signals or other policy instruments (e.g. license-plate restrictions on travel). An example of a road-design response is the construction of frontage roads that separate through-moving traffic from local, slower-moving traffic. This is a common practice in North America and Europe. Front roads and auxiliary lanes are common in wealthier countries where sufficient rights of way have been preserved to accommodate them. However, these can be difficult to build in Sub-Saharan Africa and Asia because of land constraints. Limited-access toll-ways can also be built to allow those willing to pay for travel-time savings to avoid local congestion.[127]

In lieu of supply-side corridor-management responses (e.g. construction of frontage roads and curb-cut restrictions), corridor-level growth management plans that link land use to new or expanded improvements can also be developed. Both land development and transport infrastructure need years for implementation. Therefore, coordinated and strategic long-range planning is essential. Once a transport investment is committed and land-use policies are adopted, the two can co-evolve over time.

Freeways and rail systems can complement rather than compete with each other through multimodal corridor planning and design.[128] In the suburbs of Munich (Germany), suburban trains and motorways are physically integrated to allow motorists to efficiently switch to trains. Large digital screens inform motorists of downstream traffic speeds and expected travel times for reaching the city centre via train.[129]

Public transport-oriented corridors

Some cities have directed land uses that are scattered throughout suburbia – e.g. housing, offices, shops, restaurants, strip malls – to corridors served by public transport.[130] Scandinavian cities such as Stockholm (Sweden), Helsinki (Finland) and Copenhagen (Denmark) have created networks of linked TODs – that is, public transport-oriented corridors. This 'necklace of pearls' built form (Figure 5.15) not only induces public transport riding but can also produce balanced, bi-directional flows (and thus more efficient use of infrastructure) through land-use intermixing. While some stations have a balance of land uses, others are more specialized, functioning as either employment centres or residential communities. However, within the 10–15 kilometre linear corridors served by rail, one finds a balance of jobs, housing, retail and population services. Consequently, there are multi-directional flows of traffic during peak hours. Public transport is efficiently used in both directions, rather than the asymmetrical flows found in imbalanced settings.

Greater Stockholm has evolved along public transport-oriented corridors. During the last half-century, strategic regional planning has given rise to regional settlement and commutation patterns that have substantially lowered car-dependency in Stockholm's middle-income suburbs.[131] The city's investment in radial rail lines has produced a necklace-of-pearls urban form and a balanced use of land for work and housing. A number of mixed-use

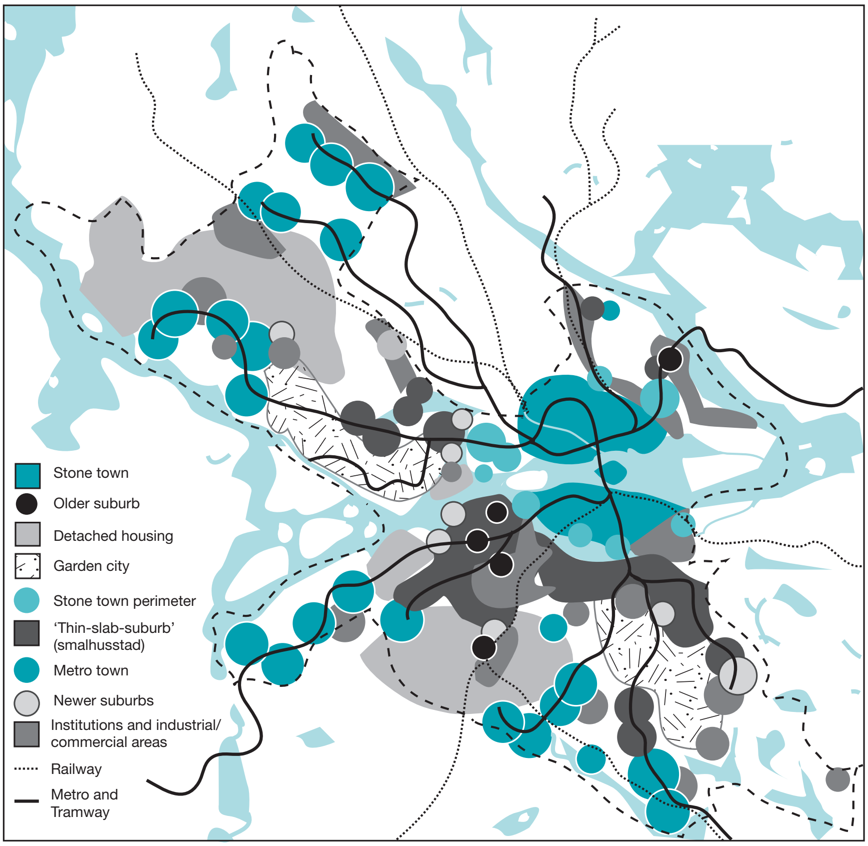


Figure 5.16

Stockholm's necklace-of-pearls built form

Source: Stockholm Municipality, 2000.

neighbourhoods dot the region's extensive radial rail network, interspersed by lower-density development and open space (Figure 5.16). Stockholm planners consciously created jobs–housing–retail balance along rail-served axial corridors, leading to a high share of trips self-contained within sub-regional corridors, and a directional balance of travel flows during peak hours. Less cross-hauling from one quadrant of the region to another has reduced traffic burdens on the region's transportation networks and rationalized travel flows to produce short-to-moderate distance trips that are well served by railway and fast-bus services. This has resulted in high modal splits for public transport (higher than in larger rail-served cities such as Berlin, Germany; and London, UK) and comparatively low CO_2 emissions per capita in the transport sector (lower than Tokyo, Japan; New York, US; and Rome, Italy).[132] Most residents in Stockholm use public transport to commute to work, and selectively use private cars for grocery shopping or when travelling on long weekend excursions.

Curitiba, Brazil, one of the world's most sustainable, well-planned cities, is another text-book example of successful public transport-oriented corridors, albeit using a lower-cost public transport technology than in Stockholm, namely: BRT. By emphasizing planning for people rather than cars, Curitiba has evolved along well-defined radial axes lineal corridors that are intensively served by dedicated busways. Along some corridors, streams of double-articulated buses haul 16,000 passengers per hour, comparable to what much pricier metro-rail systems carry. The city's current system of 390 routes served by 2000 vehicles carries 2.1 million passengers per day, double the count of 15 years ago. To ensure a public transport-oriented built form, Curitiba's government mandates that all medium- and large-scale urban development be sited along a BRT corridor.

A design element used to enhance accessibility and ensure balanced corridor growth in Curitiba is the 'trinary' – three parallel – roadways with compatible land uses and building heights that taper with distance from the BRT corridor (Figure 5.17). Zoning ordinances and urban design standards promote ridership productivity and environmental quality. The first two floors of buildings along the busway – which do not count against permissible plot ratios (building height/land area) – are devoted to retail uses. Above the second floor, buildings must set back at least 5 metres from property line to allow sun to cast on the busway. The inclusion of upper-level housing entitles property owners to density bonuses, leading to vertical mixing of uses within buildings. Further, the higher densities produced by the trinary design have resulted in increased ridership. Concentrated commercial development has also channelled trips from residences beyond BRT terminuses to the trinary corridors. In 2009, for example, 78.4 per cent of trips boarding at the ter-

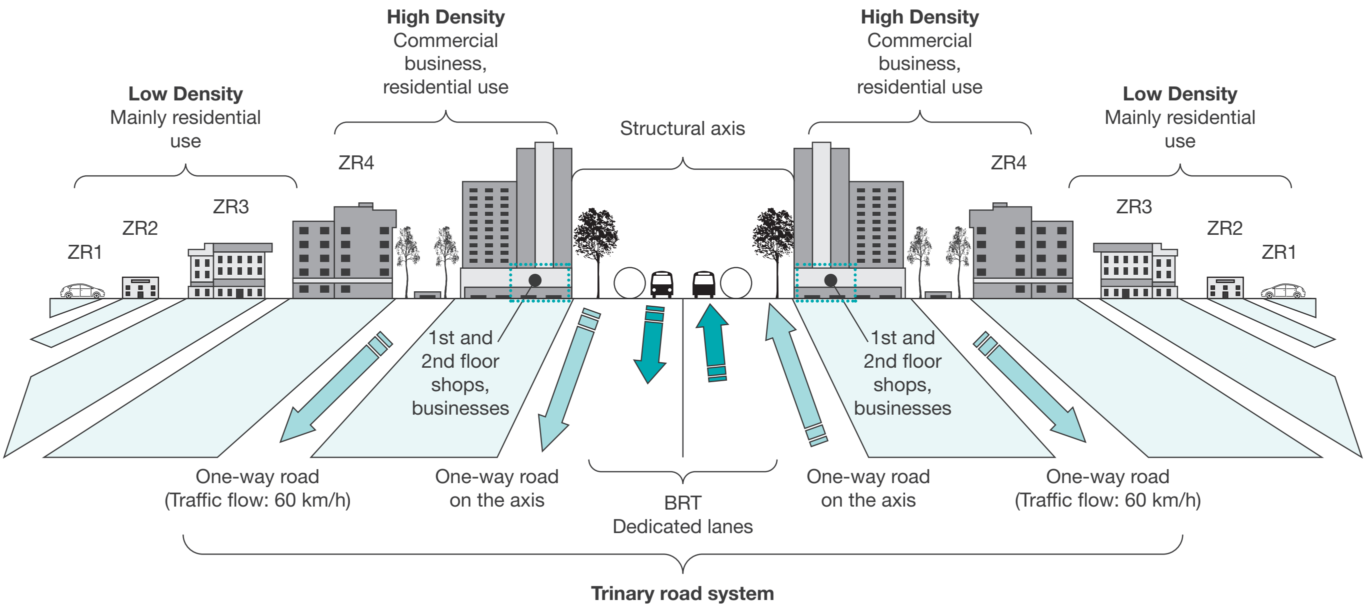


Figure 5.17

Curitiba's trinary road system, Brazil

Source: Suzuki et al, 2010.

minus of Curitiba's north to south trinary corridor were destined to a bus stop on the same corridor.[133] Figure 5.18 shows daily ridership at stops along Curitiba's north to south BRT line superimposed on the corridor's skyline. Typically, experience shows that when densities increase, so does public transport ridership. In addition, the mixing of land uses along the trinary corridors has produced bi-directional flows, ensuring efficient use of bus capacity.

The mobility and environmental benefits from Curitiba's three-plus decades of integrated development along public transport corridors are well celebrated. Curitiba has Brazil's highest public transport mode splits (45 per cent), the lowest congestion-related economic losses and lowest rate of urban air pollution (despite being an industrial city).[134] On a per capita basis, Curitiba is one of Brazil's wealthiest cities, yet it averages considerably more public-transport trips per capita than much-bigger Rio de Janeiro and São Paulo.[135] In 2005, Curitiba's VKT per capita (7900) was only half as much as in Brazil's national capital Brasília, a city with a similar population size and income level but a sprawling, autocentric built form.[136] Based on 2002 data, Curitiba's estimated annual congestion cost per capita of US$0.67 is only a fraction of São Paulo's (US$7.34).[137] The strong, workable nexus that exists between Curitiba's bus-based public transport system and its mixed-use linear settlement pattern deserves most of the credit.

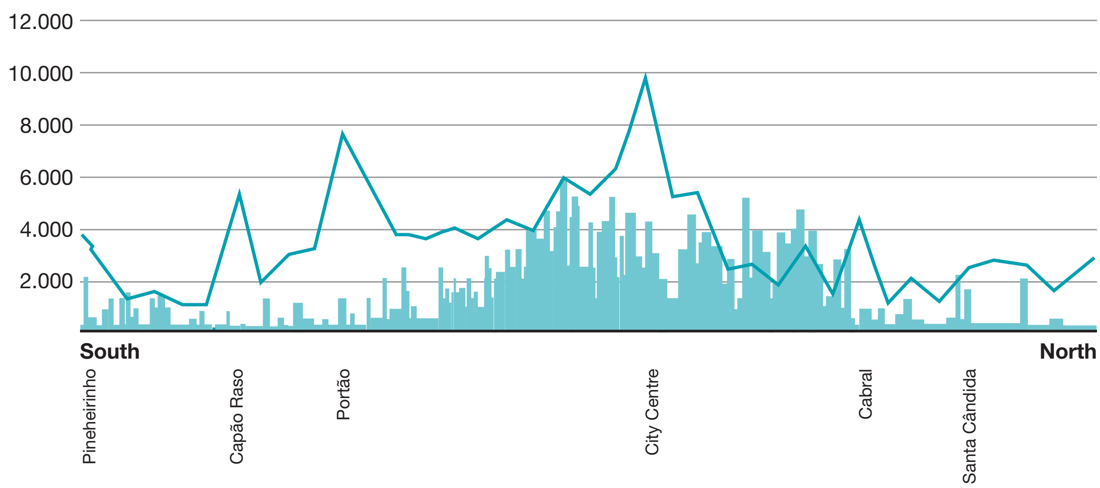
Curitiba has Brazil's highest public transport mode splits (45 per cent), the lowest congestion-related economic losses and lowest rate of urban air pollution

Sustained political commitment has been an important part of Curitiba's success. The harmonization of transport and land use took place over 40 years of political continuity, with forward-looking, like-minded mayors who built on the work of their predecessors.[138] A cogent long-term vision and the presence of a semi-autonomous municipal planning organization[139] to implement the vision have been

Figure 5.18

Correspondence between daily public transport boardings (vertical axis) and skyline profile along Curitiba's north to south trinary axis

Source: Duarte and Ultramari, 2012.



crucial in allowing the city to chart a sustainable urban pathway.

In recent years, Curitiba has begun to experience the limits of rubber-tire technologies. With buses operating on 30-second intervals on main routes during the peak hour, bunching problems have disrupted and slowed services. Veritable elephant-trains of buses have increased operating costs and precluded the kinds of economies of scale enjoyed by single-driver operated trains. Extreme overcrowding has prompted many middle-class choice travellers to switch to driving.[140] A long-discussed light-rail line, to replace overcrowded buses, has yet to gain momentum due to cost concerns.[141]

Curitiba has also been criticized for giving short shrift to intermodal connections to BRT corridors. Only six of the city's 22 BRT stations, for example, are connected by dedicated bicycle paths, which is a smaller share than Bogotá's Transmilenio BRT.[142]

REGIONAL CONTEXT

Cities have grown and spilled beyond their walls and jurisdictional boundaries for centuries. However, the development of city clusters and large urban agglomerations is more recent. The modern approach to new town development began with Ebenezer Howard's concept of the 'Garden City' in 1898, leading to the evolution of Letchworth and Welwyn Garden City.[143] This development was followed by the UK new towns movement in the late 1940s, which has since been emulated in many countries, particularly in the building of new national capitals such as Canberra (Australia), Dodoma (Tanzania) and New Delhi (India), which are designed as cluster or regional cities. Many countries, especially China, have adopted new towns as the preferred planning approaches previously adopted in European and US cities.[144] For example, Shanghai has developed extensive plans for its metropolitan region. Other Asian cities, such as Delhi (India), Kuala Lumpur (Malaysia) and Jakarta (Indonesia), are perusing new town approaches to the planning and development of their region based on clusters. Navi Mumbai, adjacent to the Indian city of Mumbai, is being planned as the largest new town in the world.[145] Latin American cities such as Buenos Aires (Argentina), Rio de Janeiro (Brazil), Santiago (Chile) and Mexico City have also adopted new town approaches to regional development based on clusters. The concept of city cluster development was applied to the planning of Abuja (Nigeria) and Brasília (Brazil), Shanghai (China), Mumbai (India) and Hanoi (Viet Nam), promoting cross-river expansion into new urban growth areas. Growth triangles, such as in Singapore, Jahor Baru (Malaysia) and Bintan (Indonesia), and Shenzhen, Hong Kong and Macau (China), are examples of network planning approaches based on a regional agglomeration concept.

Connectivity and large urban configurations

Cities of different sizes have increasingly started to merge and form new spatial configurations that typically take three principal forms, namely: mega-regions, urban corridors and city regions. These forms act as nodes where global and regional flows of people, capital, goods and information combine and commingle, resulting in faster growth, both demographic and economic, than the growth of the countries where they are located.[146] Connectivity and regional transport are crucial for the development of these large agglomerations.

In some cases, large cities such as Cairo (Egypt), Mexico City or Bangalore (India) are creating large urban configurations in which they dominate the surrounding regional space, amalgamating other cities and towns within their economic orbit. In other cases, two or more large cities, such as Mumbai and Delhi in India; São Paulo and Rio de Janeiro in Brazil; or Ibadan, Lagos (Nigeria) and Accra (Ghana) form transport corridors for the purposes of industrial development, business services and trade. Still, in other cases, the government creates planned 'supra-agglomerations' as part of a regional and national development strategy. This is the case in China, where the Guangdong Provincial Government recently announced the development of the Pearl River Delta mega-region, which would include nine large cities, with an aggregate surface area of 40,000 square kilometres, and an impressive transport infrastructure (Box 5.11). Similarly, the large economically prosperous cities of Shanghai and Guangzhou have invested in infrastructure to connect peripheral towns and enhance the large urban configuration.[147]

Such large urban configurations, grouped in networks of cities, amplify the benefits of economies of agglomeration, increasing efficiencies and enhancing connectivity. They also generate economies of scale that are beneficial in terms of labour markets, as well as transport and communication infrastructure, which in turn increases local consumer demand.

City cluster variances and transport responses

There are significant differences in the patterns of city clusters between regions and sub-regions. These are explained by factors related to geography, climate, population size, natural resources, culture, land management, political history, infrastructure, markets and levels of development. In addition, they are also defined by economic activities and the roles played by transport and connectivity.

In Europe, urban and regional planning has had much more influence than in any other region of the world. Large urban configurations have been located along major transport routes that use multi-modal

A cogent long-term vision and the presence of a semi-autonomous municipal planning organization to implement the vision have been crucial in allowing [Curitiba] . . . to chart a sustainable urban pathway

Connectivity and regional transport are crucial for the development of . . . large agglomerations

Large urban configurations, grouped in networks of cities, amplify the benefits of economies of agglomeration, increasing efficiencies and enhancing connectivity

In Europe, urban and regional planning has had much more influence than in any other region of the world

Box 5.11 Pearl River Delta mega-region

Megacities have become so large that some countries have moved to planning supra-cities. These are network cities with populations of over 40 million. In 2010, the Guangdong Provincial Government in China announced it was planning to create the world's biggest 'mega-city' by merging nine cities into a mega-region metropolis. The new megacity would incorporate a large part of China's manufacturing heartland, and stretch in an arc from Zhuhai to Shenzhen and include the cities of Foshan, Dongguan, Zhongshan, Zhuhai, Jiangmen, Huizhou and Zhaoqing. The nine large cities that would make up the new mega-region account for nearly a tenth of China's economy.

Transport infrastructure will improve connectivity and spatially integrate the network of cities that make up this large urban/regional configuration.

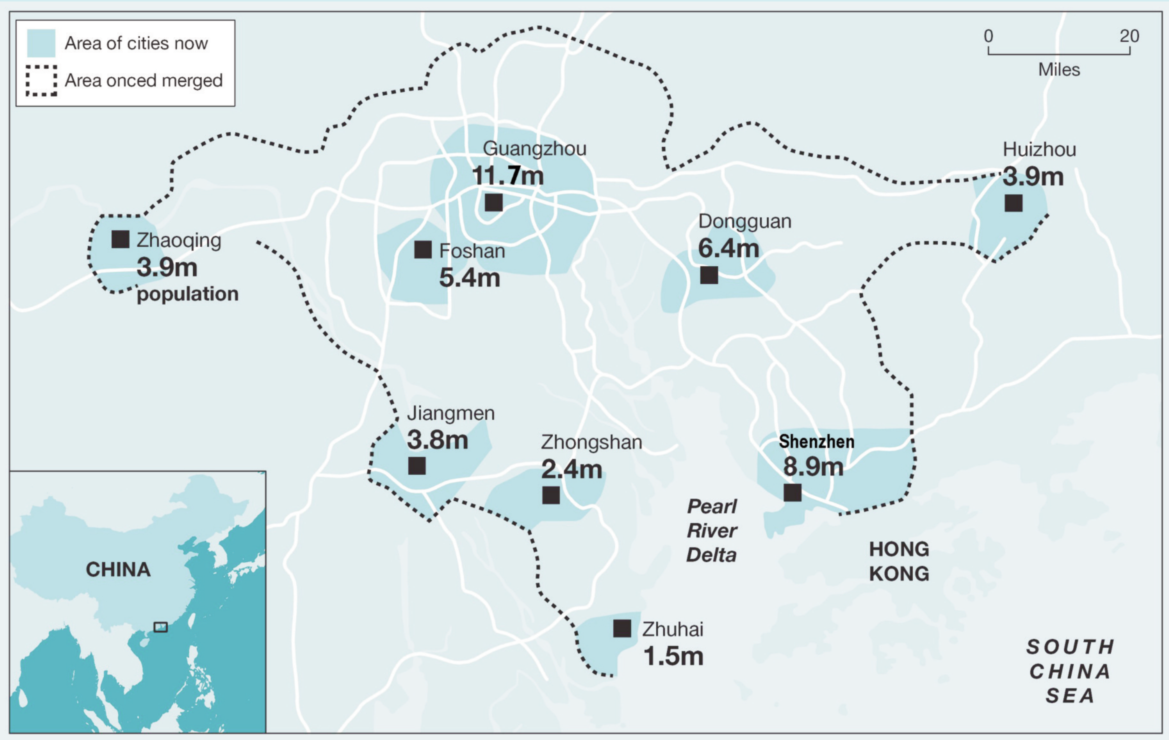


Figure 5.19

Pearl River Delta mega-region

Source: Moore amd Foster, 2011.

networks that integrate land, sea and air transport systems. The Trans-European Transport Network (TEN-T) has constituted a key element in boosting competitiveness and employment through a better connectivity that allows goods and people to circulate quickly and easily for higher economic, social and territorial cohesion.[148] TEN-T is working to improve citizens' quality of life and strengthening the econ - omy by promoting sustainable urban mobility and increased use of clean energy-efficient vehicles.[149] The regional infrastructure looks at specific inter-modal platforms at city level for better mobility and connectivity at different scales.

Large urban configurations in Europe have emerged as specialized industrial and business centres along key transport routes. However, these urban configurations have populations that are less dense than their counterparts in developing regions. Many European capital cities have become so called supra-clusters[150] of cities, with massive integrated national transport systems and the national capital as a hub. Eastern and Southern European city clusters are becoming much more dispersed, taking the form of regional city dominated clusters. Cities such as Warsaw (Poland) and Moscow (Russia) have expanded in a concentric pattern from the historic city centre. Moscow has many features similar to Beijing (China) and Dallas (US), with an expanding ring road system and decentralized employment and residential development.

City clustering in North American cities . . . is the result of massive investment in freeway systems and planned urban/regional development

City clustering in North American cities, particularly in the US, is the result of massive investment in freeway systems and planned urban/regional development, with dispersed urban settlement patterns and specialized functions. Most cities in these large urban configurations have populations of over 1 million, and the typical morphology is polycentric in terms of both urban form and economic structure. Most North American cities have well-established central business districts. However, an increasing proportion of economic and employment activities is occurring outside these areas. The Washington DC region, for example, has expanded as a large polycentric city into adjacent Maryland and Virginia.

It is made up of cluster or sub-regional global employment centres located near the intersection of the beltway and freeway systems. This is repeated in cities such as Dallas, Boston, San Francisco, Los Angeles and Chicago, to name just a few.

A network of strategic highways made up of 260,000 kilometres, known as the National Highway System, connects major airports, ports, rail or truck terminals, railway stations, pipeline terminals and other strategic transport facilities in the US. Although the system includes 4 per cent of the nation's roads, it carries more than 40 per cent of the highway traffic, 75 per cent of heavy truck traffic and 90 per cent of tourist traffic. All urban areas with a population of over 50,000 and about 90 per cent of America's population live within 8 kilometres of the network, which is the longest in the world.[151] Inter-city or high-speed rail systems in the US are undersized, with only one high-speed rail line in operation. The Acela Express runs between Washington and Boston via New York City (633 kilometres). As a result of the dispersed population and great distance between major cities, high-speed rail in the US is of less value than air or car travel. In comparison, China with its high population densities has a high-speed railway network that spans over more than 8300 kilometres already in service, and about 17,000 kilometres under construction.[152]

Large urban agglomerations in Asia are more dispersed and less well planned. Densities of large urban agglomerations in newly industrialized countries are typically much higher – over 15,000 persons per square kilometre – but in city regions, they can be twice as high, particularly in inner-city areas. Large urban configurations are becoming more specialized, including industrial cluster development (high technology and traditional manufacturing) and services (health, technology and transport). There is significant variance in the city cluster development in Asian sub-regions. The lack of basic services, overcrowding and high levels of congestion and pollution in South, Central and South-Eastern Asia have led to a dispersed pattern of urban city cluster development, with industrial/commercial development moving out from the congested inner-city areas. Cities in these sub-regions are becoming much bigger, more decentralized and specialized. Some cities, such as Manila (the Philippines), Delhi (India) and Kuala Lumpur (Malaysia), have well developed sub-metropolitan centres of employment, including commercial centres and large export enterprise zones. However, the links and integration of transportation systems and services between the city centres are poor. Uncontrolled leapfrogging of urban development and satellite city develop ment has occurred unabatedly in most cities in these sub-regions. As a result, urban densities across these city clusters are rapidly declining, with some cities recording annual decreases in density rates of more than 3 per cent.[153]

Based on the regional planning principle to use large cities to drive the development of small cities, China has pursued its strategy of spatial concentration of urban population and industries. Clusters of cities are grouped along the horizontal axes of Longhai Railway (Lianyungang–Lanzhou) and the coastal area of China, along Beijing–Guangzhou and Beijing–Harbin Railways and Baotou–Kunming transportation corridors, respectively. Africa has very few large urban configurations. Those in existence tend to be linear along transport corridors or coastal trading routes (e.g. the Abidjan (Côte d'Ivoire)–Accra (Ghana)–Lagos (Nigeria) corridor) and major arterial roads between adjacent provincial cities (Johannesburg–Pretoria, South Africa, and Lagos–Ibadan, Nigeria). The Abidjan–Lagos coastal corridor (998 kilometres) links some of the largest and economically most dynamic capitals in Africa, such as Abidjan, Accra, Lomé, Cotonou and Lagos. The corridor serves a population of over 35 million people with up to 10,000 people and several thousand vehicles crossing borders daily, accounting for the highest traffic in West and Central Africa.[154] These corridors are not properly planned. As a result, transport services are poor and so are infrastructure and transport logistics. Employment in these areas is driven primarily by trading, natural resources and low-level services. The typical pattern combines high population density in inner cities and low densities in outer areas. Eastern, Middle and Southern African large urban agglomerations tend to form into low-density urban cluster development, dispersed over large peri-urban areas. This results in poor connectivity and nascent transport infrastructure.

Large urban agglomerations in Asia are more dispersed and less well-planned

Africa has very few large urban configurations. Those in existence tend to be linear along transport corridors or coastal trading routes . . . and major arterial roads between adjacent provincial cities

Despite having the highest proportion of urban population in the world, Latin American and the Caribbean region has very few large urban configurations. Initially, the historic pattern of urbanization was monocentric. However, with the development of secondary cities and better connectivity, a city cluster pattern has emerged resulting in a polycentric urban growth. Recently, a small number of mega-regions have emerged, such as the one that stretches from São Paulo to Rio de Janeiro (Brazil) that is home to 43 million people. This mega-region is mainly served by road and commercial flights, though there is a project to develop a high-speed train in the near future. City regions such as Rio de Janeiro, Santiago (Chile) and Caracas (Venezuela) are constrained by physical geography, leading to spillover corridor development along valleys and inter-provincial highways. Various other large cities are growing in a diffuse, low-density pattern with peripheral industrial development and housing.

IMPACTS OF TRANSPORTATION INVESTMENTS ON URBAN FORM

Transportation investments shape urban form

Just as urban form and land-use patterns shape transportation, transportation investments shape urban form. The opening of a new road or public transport line influences the locations, intensities and types of development as well as the value of land. It is the changes in accessibility, not the physical infrastructure itself, that drive urban-form and land-use changes, following transportation infrastructure investments. Matching the infrastructure ***hardware*** with supportive policy ***software*** is essential, if hoped-for land-use outcomes are to follow. Supportive policies might include permissive zoning that allows densification near metro-rail stations, or complementary expansion of sewerage/water-supply trunk line capacities that accommodate new growth.

Transportation is a necessary but hardly a sufficient precondition for land-use changes

The section below reviews the impacts of public transport investments on urban form. This is followed by discussions of motorways and their urban development impacts. Collectively, experiences show that transportation is a ***necessary*** but hardly a ***sufficient*** precondition for land-use changes.

Impacts of public transport investments

Urban rail systems, like metros and light-rail, are potential city-shapers

History shows that urban rail systems, like metros and light rail, are potential city-shapers.[155] They often define the growth spines and axes of cities, leading to higher density concentrations of industries, offices and businesses along rail-served corridors. Rail-based public transport investments – matched by frequent, high-quality services – strengthen the economic primacy of central-city locations. They also spur sub-centring and decentralization, and are contingent on levels of proactiveness in leveraging new development and minimizing the growth-restricting impacts of onerous regulations (Figure 5.20).[156] In cities such as Toronto (Canada), Portland (US) and Munich (Germany), regional governing systems help orchestrate TOD through a combination of regulation and incentive-based policies (e.g. assistance with land assembly and underwriting development costs in redevelopment districts). The new rail systems in these cities have attracted significant shares of new developments to station areas.[157]

Public transport investments in rail-based services exert their strongest spatial influence in large, congested cities.[158] While most empirical knowledge is drawn from developed countries, theory suggests that the city-shaping impacts of new rail investments in developing countries might be stronger. This is due to rapid rates of population growth and motorization, high levels of congestion (and thus a pent-up demand for siting new development in accessibility-enhanced locations) and rising disposable incomes. In developing-country cities, however, weak institutions for regional-scale planning and an orientation toward near-term project investments versus long-term strategic planning are working against successful public transport and land-use integration.[159]

Often, rail-based public transport investments end up being a stronger force toward decentralization than concentration

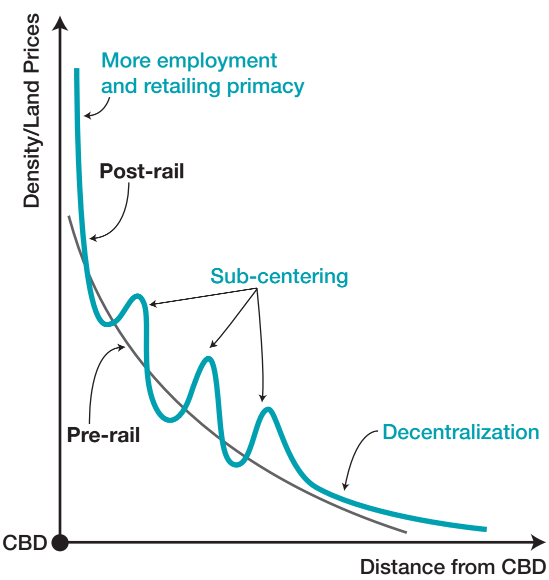
Often, rail-based public transport investments end up being a stronger force toward decentralization than concentration, by adding new layers of accessibility to outlying settings (Figure 5.20). While growth might be funnelled in a particular direction as a result of a new public transport line, more often than not, this direction will be outward.[160] Metro-rail investments in Santiago, Mexico City and other Latin American cities have also contributed to the segregation of households by income and class, displacing the urban poor to the metropolitan periphery, while modernizing and opening the inner city to wealthier segments of the population.[161] Critics argue that such mal-distributive impacts are rooted in transportation investments that favour the mobility interests of wealthier individuals. This situation is further exacerbated by lack of compensatory programmes, such as affordable housing requirements, to moderate such displacements.[162] A more balanced portfolio of transportation improvements that ensures benefits accrue to all socioeconomic groups can help mitigate such unintended consequences. The desire to better serve the mobility needs of the poor partly explains Bogotá's proactive investments in world-class BRT and bikeway networks over the past decade.[163]

Global experiences show that a number of preconditions are necessary for urban public transport investments to spawn sustainable urban-form outcomes. Some of these are outlined in Box 5.12, and are based on insights from a number of empirical studies on the impacts of high-capacity public transport systems on urban form in both developed and developing countries.

Figure 5.20

Urban public transport investments and urban-form outcomes

Source: Cervero, 1998.



Box 5.12 Prerequisites to urban-form changes

Proactive planning is necessary if decentralized growth is to take the form of sub-centres. Whether decentralized growth takes a multi-centred form rests largely with the degree of public commitment to strategic station-area planning, carried out on a regional scale. Experiences in cities such as Toronto (Canada), Stockholm (Sweden), Munich (Germany), Hong Kong (China) and Singapore show that an aggressive stand to leverage the benefits of rail services can lead to more concentrated forms of decentralized growth. Given public-resource commitments, railways and busways do not only strengthen the core but also produce multiple sub-centres.

Railways and busways can spur central-city redevelopment under the right conditions. When government agencies are willing to absorb some of the risks inherent in redeveloping economically stagnant neighbourhoods, public transport can help attract private capital and breathe new life into struggling areas, as revealed in large cities such as Tokyo (Japan), Hong Kong (China), London (UK), San Francisco Bay Area and metropolitan Washington (US).

Other pro-development measures must accompany public transport investments. In addition to financial incentives, experiences show that supportive policies and public actions must be in place to leverage land development. Foremost among these are:

- permissive and incentive zoning (e.g. density bonuses);
- the availability of nearby vacant or easy-to-assemble and developable parcels;
- support for land-use changes among local residents (i.e. organized opposition and NIMBY forces);
- a hospitable physical setting (in terms of aesthetics, ease of pedestrian circulation and a healthy neighbourhood image);
- complementary public improvements (e.g. upgrading of sidewalks, expansion of water and sanitation trunk-line capacities and burying utilities);
- an absence of physical constraints (e.g. pre-emption of land development by park-and-ride lots or the siting of a station in a busy freeway median).

Public transport service incentives and private car 'equalizers' (disincentives)[a] help induce station-area land-use changes. The provision of frequent and reliable rail and feeder bus connections is needed if private capital is to be enticed to station areas. Only then will railways become time-competitive with the private car. Such pro-public transport measures often need to be accompanied by 'equalizer' policies[a] that remove many of the built-in incentives to drive, such as the availability of plentiful, low-cost parking. Congestion pricing in Singapore, Stockholm (Sweden) and London (UK) partly explains why railway services in these cities are heavily patronized and not unrelated, and why new land development is occurring around these cities' rail stations. The combination of TOD and transportation demand management can be especially powerful, yielding synergistic benefits, as suggested by experiences in Singapore, Copenhagen (Denmark), Stockholm and Ottawa (Canada).

Network effects matter. For fixed-guideway public transport systems (e.g. railways and BRT systems with exclusive rights of way) to induce large-scale land-use changes, it is essential that they mimic the geographic coverage and regional accessibility of their chief competitors, limited-access freeways and highways. Good intermodal connections between high-capacity public transport systems and secondary systems, like bus and paratransit feeders, serve to extend the spatial reach of backbone systems. The strong city-shaping influences of metros in Paris (France), London (UK) and Tokyo (Japan) are, to a large extent, a result of such network effects, wherein railways serve shares of origin-destination combinations that are comparable to freeway and motorway networks. The addition of a new railway or BRT line creates spillovers and synergies, benefiting not only the newly served corridors but existing ones as well. For existing metro lines, newly opened lines increase the number of regional origin-destination combinations that can be served.

Note: [a] The term 'equalizer' is preferred to 'disincentive' as such policies are not punitive, and aim to 'level the playing field' so as to remove any unfair advantages to private car travel.

Sources: Knight and Trygg, 1977; Pucher and Lefèvre, 1996; Cervero, 1998; Cervero et al, 2005; Mees, 2009; Suzuki et al, 2013.

Public transport and land price appreciation

Accessibility benefits conferred by rail systems get capitalized into land prices. Higher values of rail-served parcels in turn exert market pressures to intensify land development. Land-value premiums of commercial parcels within walking distance of metro-rail stations are sometimes as high as 100 per cent in the downtowns of some large cities.[164] A survey of 150 rail projects in the US, UK and Europe found that public transport services generated positive effects on residential as well as commercial properties, though the magnitude of impacts varied considerably.[165] When rail investments are carefully co-ordinated with land development through public–private partnerships, as in Portland, Oregon, the results can be dramatic and catalytic. Portland's east and west light rail lines attracted over US$2.4 billion in investment within walking distance of their stations.[166] The city's new streetcar line through the mixed residential-commercial Pearl District triggered US$2.3 billion in private investments. According to estimates, every dollar in public investment in public transport leveraged US$31 in private investments in Portland.[167]

Accessibility benefits conferred by rail systems get capitalized into land prices

Public transport value captures not only add revenues to the public coffers, but also . . . [reduces] land speculation

Land-value appreciation presents an opportunity to recapture the value created by public investments in public transport, as practiced in Hong Kong, China (Box 8.7) and Tokyo, Japan (through private railway consortia). Public transport value captures not only add revenues to the public coffers, but also by sharing the value-added from public investments, land speculation is reduced. In Hong Kong, the 'Rail+Property' approach also creates market demand that ensures high-ridership services.[168] Hong Kong's version of public–private partnership is not about off-loading the cost of building railways to the private sector. Rather, it is about 'co-development' – each sector bringing a natural advantage to the table (e.g. land acquisition powers in the case of the public sector; access to equity capital in the case of the private sector). The resulting 'win–win' situation leads to financially viable investments and an intimate connection between rail systems and nearby real-estate development that attracts tenants, new investors and public transport riders. Public-transport joint developments (e.g. the leasing of air rights above metro-rail stations to private developers) are another way to financially capitalize on the accessibility benefits conferred by public rail investments.[169]

Bus-based public transport and urban-form adjustments

Motorways generally exert stronger influences on urban form than public transport lines

Conventional wisdom holds that traditional bus services have imperceptible influences on urban form and land-use patterns because, in contrast to many rail systems, they fail to deliver appreciable accessibility benefits. This is especially the case in developed countries where high levels of private car ownership mean conventional buses are considerably slower than cars for the vast majority of trips. The ability to alter bus service levels, change bus routing, as well as the stigma attached to the low-income status of bus patrons, most likely suppress the land-development impacts of conventional bus services. An exception, however, is BRT wherein buses are provided with an exclusive, dedicated lane, which significantly improves the quality of service. BRT investments in Ottawa (Canada), Pittsburgh (US), Brisbane (Australia) and Curitiba (Brazil) generated land-use benefits that were as large as those that would have been created by railway investments.[170] Thus, it is not public transport 'hardware' – i.e. steel-wheel trains or rubber-tire buses – that unleash land-use changes, but rather the quality of service and more specifically, the comparative travel-time savings of taking public transport vis-à-vis the private car.

In poorer countries, road investments generate new economic growth, opening access to new markets and expanding trade-sheds

As with rail, where BRT investments have triggered land intensification, property markets have responded. Significant land price increases have also been recorded near BRT stops in Bogotá (Colombia), Seoul (Republic of Korea), Brisbane (Australia) and Los Angeles (US).[171] One study revealed that multi-family housing units within five-minutes walking distance of Bogotá's TransMilenio BRT, were rented for appreciably more per square metre than those units located farther away.[172] Pedestrian-friendly environments near TransMilenio stops, further increased land-value benefits.[173] Bogotá's TransMilenio has also enjoyed network effects: the addition of new TransMilenio lines increased housing rents for currently served residences more than opening new lines to previously unserved ones.[174] Such land-value appreciations create opportunities for value capture, just as with urban rail systems. Bogotá practices value capture to finance urban infrastructure under a programme called Plusvalia, however implementation problems – including high revenue collection costs and charges of assessment biases and institutional corruption – have undermined the programme.[175] More successful has been Ahmedabad's programme of exacting surcharges from landholders, for the right to increase their building densities by up to 30 per cent, along the 89-kilometre Janmarg BRT system in India. Some of the funds received are channelled towards building affordable housing, particularly for low-income households displaced by BRT expansion. In addition, the construction of parallel cycle tracks to the Janmarg BRT is helping to create multi-modal corridors and an ethos of 'complete streets' in the minds of system designers and local citizens.[176]

Impacts of motorways

Motorways generally exert stronger influences on urban form than public transport lines.[177] Since access is nearly ubiquitous with a car-based system, activities tend to be dispersed and segregated. US metropolises such as Los Angeles and Phoenix are testaments to the sprawling effects of motorways. Like a rail system, whatever clustering and agglomeration occurs tends to be around freeway interchanges – e.g. shopping malls and large stand-alone retail outlets. Also, impacts are often context specific, shaped by the permissiveness of land-use regulations and local real estate market demands. Other impacts include the institutional capacity to supplement roadways with other supportive infrastructure to accommodate new growth, and the ability to moderate potential neighbourhood opposition to nearby infrastructure investments.

Worldwide, the impacts of new roads may vary considerably. In poorer countries, road investments generate new economic growth, opening access to new markets and expanding trade-sheds. Developed countries, by contrast, experience impacts that are largely redistributive, hence shifting growth that might otherwise occur in some settings to newly served highway settings.[178] This is mainly due to the fact that accessibility levels are usually already so high in developed settings that the economic impacts of any new highway tend to be marginal.

CONCLUDING REMARKS AND LESSONS FOR POLICY

A paradigm shift is occurring in the relationship between transportation systems, mobility and cities. Public-policy turnarounds, like the removal of elevated freeways, the building of high-rise downtown towers interlaced by great pedestrian infrastructure and transit-oriented corridors, all recognize that travel is a 'derived demand' – secondary to the primary objective of connecting people and places. As long as transportation is rightfully cast as a means to an end, and not an end in and of itself, policies can be put into place that enhance mobility while avoiding (or at least reducing) negative externalities and promoting community stability and cohesion.

Urban form is principally a product of the dominant transportation system in place during the period of a region's prevailing growth. Cities that grew rapidly when high-capacity public transport systems were being built, such as Toronto (Canada) and Curitiba (Brazil) have high-density and lineal built forms. Those that sprouted at the time when freeways were being built – such as in Phoenix and Houston (US) – have low-density, autocentric layouts. As cities develop and prosper in developing countries, unprecedented opportunities will arise for linking land development and transport infrastructure. While levels of motorization are stabilizing in developed countries, they are increasing rapidly elsewhere. Given the fact that a vast majority of future urban growth is projected for cities with a current population of less than 500,000 inhabitants, a bus-based form of smaller scale TOD interlaced by high-quality infrastructure for pedestrians and cyclists may be appropriate in many urban settings. Cities introducing railway and BRT solutions are bound to trigger meaningful land-use changes, including rapid growth and rising real incomes. This, of course, assumes there is supportive planning and zoning, public-sector leveraging and risk sharing, a commitment to travel-demand management to remove many built-in incentives to car use, and the capacity to manage the land-use shifts that are put into motion by transportation infrastructure investments.

There are signs that cities in different parts of the world are moving towards the development of more compact forms. Numerous cities have unveiled development plans that emphasize urban designs that shorten trips, create complete streets, encourage mixed-use developments and make cities more liveable.[179] Globally, there is a growing appreciation in various developing-country cities that integrated transport and land-use planning is critical toward future economic success, more equitable development and environmentally sustainable solutions.

Global experiences reveal that a cogent regional vision helps considerably in ensuring transportation investments produce desired urban-form outcomes. Visions need visionaries, such as Curitiba's Jaime Lerner, Bogotá's Enrique Peñalosa and Seoul's Myong-Bak Lee. However, visions are malleable, and are therefore subject to change as realities unfold. Often, cities are path dependent in their spatial evolutions, thus breaking away from established practices can be difficult and slow. Traditionally, highways were built to serve urban sprawl, which in turn requires the construction of more highways. This vicious cycle of road construction and urban growth feeding off each other is often difficult to break. Accordingly, sustained leadership in working toward a common urban-form visionary becomes all the more crucial.

While the importance of linking land use and city form to transportation and mobility is increasingly recognized, moving from rhetoric to reality is not always easy. The list of true success stories is quite short. Whereas the experiences of Curitiba (Brazil), Portland (US), Singapore, Copenhagen (Denmark) and Stockholm (Sweden) are well-chronicled, there is a need for best-case practices that are directly applicable and relevant to the unique problems of cities in developing countries. Another notable gap is the limited knowledge about the influences of 'goods movements' on urban development patterns and vice versa. The siting of large warehouse distribution complexes on urban peripheries no doubt contributes to sprawl. As noted in Chapter 4, the spatial needs for goods handling and freight terminals, warehousing, commercial markets and the array of formal and informal delivery carriers are rarely given due priority in urban planning. Opportunities exist for improving urban logistics, such as the creation of freight consolidation centres on the periphery that allow a single truck to deliver goods to multiple destinations. Compact, mixed-use development, moreover, can promote efficient urban logistics by allowing few-stop deliveries.

The integration of transportation, city form and function and mobility strategies are not, in and of themselves, a panacea to the multitude of problems facing today's major cities. Transportation and land-use integration, with the development of more sustainable densities in strategic locations, is but one of a number of strategies that must be pursued if substantial headway is to be made in shrinking the transport sector's ecological footprint. In addition to the environmental dividends of improved transportation and land-use integration, there are other reasons – such as social inclusion, economic growth and municipal cost savings – for creating more accessible, more liveable and less car-dependent cities of the future. Such issues are discussed in the next three chapters of this report.

As cities develop and prosper in developing countries, unprecedented opportunities will arise for linking land development and transport infrastructure

A bus-based form of smaller scale TOD interlaced by high-quality infrastructure for pedestrians and cyclists may be appropriate in many urban settings

A cogent regional vision helps considerably in ensuring transportation investments produce desired urban-form outcomes

The importance of linking land-use and city form to transportation and mobility is increasingly recognized

NOTES

1 In this report, the term 'urban form' is used broadly to express the physical layout, design, space and morphology of cities, including buildings, roads and streets. It represents the spatial configuration of a city and, as discussed throughout the chapter, is both shaped by and gives form to transportation infrastructure and services. The term 'built environment' is often used to reflect the many physical dimensions of a city and its neighbourhoods that influence travel. In this report, terms such as urban form, land use and built environment are used interchangeably.
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49 Guerra and Cervero, 2011.
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CHAPTER

6

EQUITABLE ACCESS TO URBAN MOBILITY

Mobility is a social and economic need. The availability of transport options, and the way they are delivered, can present major challenges to the mobility of many residents in today's cities. Investments in urban transport infrastructure do little to alleviate the mobility difficulties of the urban poor or other vulnerable and disadvantaged groups if the services provided are unaffordable or physically inaccessible. Such barriers contribute to socio-spatial inequities in urban areas, including discrimination against vulnerable and disadvantaged groups. These barriers are not only fiscal or technical in nature, but arise from political, social and institutional factors that prevent progress towards socially sustainable urban mobility systems. Thus, this chapter focuses on the aspects of urban mobility that relate to providing affordable access to opportunities, minimizing social exclusion and improving the quality of life for all.

In recent years, transport policy has begun to focus more intently on new assessment and evaluation regimes, to better articulate the impacts of transport investments. Whereas transport projects undergo environmental and economic impact assessments, the application of social impact assessments is relatively less advanced.[1] Integrating social dimensions throughout the lifecycle of transport projects enhances their potential to bring life-changing benefits to the end users, while reducing the risk of negative social outcomes.[2] The additional effort invested in social analysis can bring disproportionate returns: projects that are more appropriate, sustainable, safe and high quality, and that enhance community engagement and participation.

As city mobility systems become increasingly motorized, travellers are vulnerable to traffic-related conflicts and accidents, congestion, as well as the costs of motorized transport, while penalizing those who cannot afford a car. Without a good public transportation system, travellers face a complex trade-off between shelter security, travel distance and travel mode.[3] At the same time, non-motorized road users (primarily pedestrians and cyclists) and public transport users – particularly in developing countries – are often overlooked in the design and modernization of transportation infrastructure.[4]

As noted in Chapter 1, the main purpose of urban mobility systems is to provide access to basic goods, services and activities – such as work, education, medical care, shopping, socializing – and to enable people to participate in civic life. The Habitat Agenda explicitly calls for full accessibility to work, goods and services – to affordable public transport – including for those belonging to vulnerable and disadvantaged groups, stressing that priority should be given to the needs of women and children 'who often bear the greatest burden of poverty'.[5] Yet, in reality, people and communities do not have equal access to urban opportunities. The unequal access per se is not necessarily problematic, however, the distribution of impacts (benefits, disadvantages and costs) can be considered 'unfair', in which case this becomes an issue of social equity. Considerations of equity in urban mobility systems frequently analyse disparities in access to urban opportunities, as well as disparities in income and travel-related costs. In light of these challenges, the satisfaction of the mobility needs of all groups of society is a necessary condition for supporting equal chances in life.[6] Ultimately, restrictions in access to urban opportunities may imply an abuse of human rights, most notably economic, social and cultural rights (such as the rights to free choice of employment; the right to public health, medical care, social security and social services; the right to education and training; and the right to equal participation in cultural activities) and the right of access to any place or service intended for use by the general public.

This daunting information raises the question: what do we mean by socially sustainable urban mobility? As there are competing perceptions and applications of 'social sustainability',[7] some cities opt for a single, encompassing definition that denies much of the concept's complexity. Additionally, translating the complex subjective, qualitative and

The availability of transport options, and the way they are delivered, can present major challenges to the mobility of many residents in today's cities

In reality, people and communities do not have equal access to urban opportunities

political dimensions of social sustainability into easy-to-measure quantitative indicators is complicated (at best).[8] In order to produce meaningful results, metrics must be tailored to reflect unique socio-cultural characteristics of contexts and locations, hindering the adoption of any one common measurement. Nonetheless, it is important to consider the elements of social sustainability in any evaluation of mobility modes, since these social implications affect behavioural choices, which are ultimately responsible for the success or failure of any urban mobility system.

Improved transport connections can help in tackling social exclusion through addressing barriers posed by the accessibility, availability, acceptability, and affordability of the urban mobility system

Meeting the mobility needs of burgeoning urban populations in a socially inclusive (and equitable) manner will not be an easy task. The most critical challenge is the heterogeneity of urban populations and the spatial dispersion of social and economic activities. The best way to meet the mobility needs of the poor and vulnerable and disadvantaged groups is to provide adequate public transport and appropriate infrastructure for non-motorized modes of travel. Furthermore, improved urban planning, new technologies and infrastructure measures are needed. Notably, emphasis should be placed on moving people and goods, freely and safely, and facilitating equitable access to services.

This chapter documents global trends, conditions and challenges with respect to equitable access to urban mobility. It highlights actual and potential policy responses and practices that may address social equity and enhance social sustainability in urban mobility systems. The first section discusses affordability as an important aspect of equitable access. It notes that transport expenditures affect low-income households disproportionately. The second section discusses the access of disadvantaged groups to urban mobility systems. This provides the necessary background to understand and accommodate the differential mobility needs of various population segments. The third section explores issues relating to safety and security in urban mobility systems. It distinguishes between the problems of transport safety (accidents and damages) and the problems of transport security (privacy and freedom from fear). The final section provides concluding comments and lessons for policy.

AFFORDABLE URBAN MOBILITY

In order for urban mobility systems to be socially sustainable, urban public transport must be affordable to the majority of the urban population, and in particular for those that have no other way of travelling to access basic goods, services and activities. This is a critical equity objective that can reduce burdens and expand opportunities, particularly to persons who are vulnerable and/or disadvantaged. Based on the discussion in earlier chapters, this section analyses challenges and impacts related to equitable access and public transport affordability. It also examines policy responses designed to promote affordable transportation. It finishes by presenting good practices and policies from around the world, pointing the way towards successful transformation of urban mobility culture.

Challenges and impacts of urban poverty

An understanding of the travel patterns of urban public transport users is required to determine the extent of their mobility challenges. The notion of ***motility*** implies the balance between accessibility (i.e. transportation opportunities: public transport and other modes) and individual skills (i.e. how to use the transportation on offer), with the user's appropriation of the mobility system (i.e. their experiences, habits, perceptions and values linked to travel mode and space).[9] As such, access is the most important facet of motility, because it sets the scene for possible mobility. Improved transport connections can help in tackling social exclusion through addressing barriers posed by the ***accessibility***, ***availability***, ***acceptability***, and ***affordability*** of the urban mobility system (Box 6.1). In such cases, information from and the participation of all stakeholders, throughout the planning process, is needed in the development of mobility systems.

Box 6.1 Understanding the parameters of urban transport

Affordability refers to the extent to which the financial cost of journeys puts an individual or household in the position of having to make sacrifices to travel, or to the extent to which they can afford to travel when they want to.
Availability of transport is used to refer to route possibilities, timings and frequency.
Accessibility describes the ease with which all categories of passenger can use public transport. For example, buses with high steps are difficult to board, particularly if they are one-person operated and there is no assistance. Accessibility also includes ease of finding out about travel possibilities, i.e. the information function.
Acceptability is another important quality of public transport, either because of the transport or the standards of the traveller. For example, travellers may be deterred from using public transport due to lack of personal security on buses and trains.

Source: Carruthers et al, 2005.

International research into the relationships between transport and poverty indicates that the poor are increasingly concentrated on the periphery of urban areas.[10] As a result, they travel longer distances than many better-off groups and their need for affordable transport is increased. This implies that where (transportation) inequities persist, these exacerbate social exclusion and poverty, both at the individual and at the society level. In this case, poverty is viewed as the lack of financial resources to meet basic individual or household needs, while social exclusion refers to existing barriers that make it difficult for people to participate fully in society.[11]

The choice of mobility mode is related to income levels.[12] For those with low incomes there are very few affordable choices. As a result, in many developing countries, only a small proportion of trips are undertaken using motorized vehicles.[13] The prevalence of long walking trips indicates poor access and lack of affordable mobility options. Therefore, it is essential that pedestrians must be accounted for in any public transport policy. In Tianjin, China, 80 per cent of all commuter trips are by non-motorized modes, mainly bicycles.[14] Cycling offers an inexpensive means of improving accessibility for all. In some European countries, the use of bicycles as a mode of transport is steadily increasing, both as a main mode and as a subsidiary or feeder mode.[15] However, in Africa and Latin America, it is often neglected in terms of design and safety, due to negative social representations, associating bicycle use with poverty.[16]

In developing countries, car ownership remains the privilege of a small (although rapidly growing) minority. In some countries of Africa and parts of Asia, vehicle ownership rates are as low as three motor vehicles per 1000 population.[17] Hence, financially deprived households depend exclusively on public transport (formal or informal) for motorized trips, and are exposed to the risks of increasing transport costs. In many developed countries, the dependency on private motorized transport tends to increase per capita transportation costs and reduce transportation affordability.[18] As most road infrastructure is subsidized, there is no incentive for car owners to shift to cleaner travel options, as it costs so much less to drive. Yet, urban sprawl and car-dependent urban growth continue worldwide, and can compromise the levels of accessibility among vulnerable and disadvantaged groups, such as the elderly and children.[19]

Socioeconomic differences in travel patterns in many developed countries (such as the UK and the US) indicate that the poor and ethnic and other minorities are less likely to have cars and are more likely to travel by public transport. From Delhi to Shanghai and Brussels to New York, the provision of economical and convenient 'last-mile connectivity' – i.e. from the trip ends to the point of accessing public transport systems – remains a major issue of concern.[20] Poor walking and cycling environments further accentuate the problem for public transport users, particularly the disabled and elderly. In larger cities, the trend is towards fixed-route bus services, which often implies that journeys become more complex, often involving interchanges and lengthy waiting and walking times. Evidence suggests that public transport deficiencies in urban areas have a greater impact on the poor than on other groups.[21]

The provision of economical and convenient 'last-mile connectivity' – i.e. from the trip ends to the point of accessing public transport systems – remains a major issue of concern

However, the fares charged by private informal operators are often higher than publicly operated ones, particularly if one takes into account the lack of fare integration between routes. While a passenger of a public transport service may often pay a flat rate for a trip that involves several individual legs, such fare integration is rare among informal transport providers. Consequently, the poor are forced to carefully prioritize their mobility needs and expenditure.

For many urban dwellers, the cost of mobility is very high in relation to their household incomes. In cities of developing countries, between 8 and 16 per cent of household income is spent on transport. Among the poorest households in large cities, this rises to more than 25 per cent.[22] Thus, the level and quality of transport services are often lower for those in low-income areas, where commuters are heavily dependent on public transport for their mobility needs. People have little option but to endure a deteriorating service. The disproportionate financial burden felt by the poor in reaching job opportunities is not limited to developing countries. Data from the US suggest that low-income earners spend nearly twice as much of their income reaching their place of employment compared to the non-poor (6.1 per cent versus 3.8 per cent).[23]

Public transport deficiencies in urban areas have a greater impact on the poor than on other groups

Constrained mobility is an important element of the social exclusion that defines urban poverty.[24] As outlined above: without effective transport systems, poor households are unable to access basic goods, services and activities. It is important also to consider the flow of social capital in the form of information, news or job opportunities facilitated through transport networks.[25] Table 6.1 illustrates how improved mobility has a significant impact on the four major dimensions of poverty.

In cities of developing countries, between 8 and 16 per cent of household income is spent on transport

As indicated in Table 6.1 there are several important links between transport infrastructure and services and different dimensions of poverty. Poor people's lack of assets and technologies means that production – for the market as well as for the household – is time and energy intensive. The greatest proportion of the lowest productivity, most time-consuming work is done by women.[26] By focusing more investment in the infrastructure and services used by (and appropriate to) women, their 'time poverty' can be drastically reduced.

Table 6.1

Dimensions of poverty and the impact of improved transport

Dimensions of poverty	Expression of poverty	Impact of improved transport
Opportunity	Inadequate access to markets, employment opportunities and resources. Constraints on mobility. Time burdens, especially for women.	Improved access to markets and resources. Efficient transport networks save time that can be used for productive activity.
Capability	Lack of access to public services.	Provides access to public services.
Security	Vulnerability to economic risks and civil and domestic violence.	Reduces insecurity due to isolation but can be a source of vulnerability.
Empowerment	Being without voice and power at the household, community and national levels to influence decisions.	Enables participation in social and political gatherings.

Source: TRL Limited, 2004, citing World Bank, 2000.

The access and mobility of the urban poor is constrained by: city planning, socioeconomic characteristics, transport facilities and the availability of services

Other direct impacts on poverty that the transport sector can help achieve include employment generation – in transport infrastructure projects, as well as in the transport service industry. Delivery of infrastructure can be done in ways that optimize the use of local labour and resources. Similarly, local transport services have a potential for providing employment to operators and providers of other support services. However, improved infrastructure planning and service provisions are resources that, in combination, either enhance or disadvantage the livelihood of urban dwellers.[27]

A key example is eviction and resettlement resulting directly from urban transport infrastructure projects. As illustrated in Box 6.2, these projects often disrupt lives and livelihoods, and may form physical barriers that cause community severance. Streets that were once a place where people stopped for conversation and children played are transformed into the exclusive domain of cars. Furthermore, the quality of the local environment is vastly reduced with noise and air pollution.[28] Moreover, without secure tenure the poorest groups risk being displaced through gentrification. The narrow focus on solving congestion tends to mostly benefit high-income private vehicle users. More thoughtful and holistic solutions are thus needed to bring benefits to a wider population.

Detailed and systematic consideration of social issues in urban mobility appraisals maximizes the opportunities for positive outcomes and reduces or mitigates the risks and negative impacts of transport infrastructure projects. Unfortunately, the urban poor are often marginalized in transport planning and project evaluations. However, the establishment of good relationships with stakeholders and a focus on their concerns have the potential to generate significant positive opportunities for the project and the organizations involved.

In summary, ***the access and mobility of the urban poor is constrained by: city planning, socioeconomic characteristics, transport facilities and the availability of services***. The next section outlines some general ways in which policy can be refocused to give particular assistance to the poorest groups, through concentration on the needs of specific social groups, or indirectly through assistance to those modes of transport on which the urban poor are known to be particularly dependent.

Box 6.2 Nairobi–Thika highway improvement project, Kenya

The Nairobi–Thika highway is one of the three major corridors linking downtown Nairobi to the suburbs and satellite towns. Jointly financed by the African Development Bank, and the Chinese government, the project aims to contribute to and improve the accessibility, affordability and reliability of the transport infrastructure, as well as reduce traffic congestion. The expanded Thika Road, which was completed in July 2012, has drawn mixed reactions from residents living along the highway, who are particularly concerned about the socioeconomic impact the new road will have on their lives.

The construction of the highway disrupted neighbourhoods by relocating urban residents to the periphery and increasing their travel distances and expenditures. Severance of communities by traffic and the highway is a particular problem for people without access to a car, some older people, people with disabilities and school children, because they often rely on walking. The project's focus on fast and free-flowing traffic has resulted in the need to construct pedestrian overpasses and barriers, which often leads to community severance and inconvenience for the local population.

The skyrocketing property values along the new road have been reported to threaten food security in an area whose residents rely on subsistence farming for sustenance, as farmland is bought up for new development. Furthermore, due to the increased cost of living, many tenants in the area have been forced to move out, as they could no longer afford the rents. Moreover, inadequate or unaffordable transport has led to excessive building and population densities, causing deterioration of the living environment.

Source: KARA and CUSD, 2012.

Policy responses and innovative practices

This section highlights some ambitious policy responses that have been introduced in recent years to address the challenges outlined above. Achieving transport affordability objectives requires actions that support non-motorized transport; reduce the financial costs of transport services; and increase transportation affordability through improved land-use accessibility.

■ *Supporting non-motorized transport*

Transport policy measures can reduce levels of car use by supporting walking and cycling.[29] These modes are relatively low cost, and they are important for short trips, which make up the largest share of trips in urban areas.[30] Non-motorized transport can be stimulated by a policy package consisting of investments in facilities, improved transportation networks, awareness campaigns, as well as disincentives for the use of private motorized vehicles. Many cities in developed countries recognize the need to plan walkable environments and street network designs that promote neighbourly interactions, and through this, the development of social capital.[31]

Some significant transport interventions offer interesting lessons. Amsterdam (the Netherlands) and Copenhagen (Denmark) have high levels of bicycle use and very low death rates from road traffic accidents.[32] The high modal shares were made possible through decades of investment in non-motorized transport infrastructure. This includes wide-scale improvements to pedestrian and bicycle facilities; development of facilities for intermodal connectivity; and adoption of complete pedestrian and bicycle design standards, wherever feasible. Many other cities have moved away from car-centric urban models and embraced full pedestrianization of downtown commercial areas such as observed in Shanghai (China) and Curitiba (Brazil).[33] This has provided economic savings and benefits, reflected in increased land values. [34]

Combining public transport and cycling can provide a high level of affordable mobility. A case in point is *vélib*, a free public bicycle rental scheme in Paris, France.[35] Hangzhou (China)[36] and Mexico City have also established bicycle hire schemes to encourage cycling at a minimum cost to taxpayers and users of the scheme. Such policies are increasingly linked with investments in BRT systems, for instance in Delhi (India), Guangzhou (China), Jakarta (Indonesia) and Dar es Salaam (Tanzania), placing non-motorized transport infrastructure as important feeder networks for BRT ridership.[37] Box 6.3 highlights recent developments in Africa that encourage increasing investments in non-motorized transport infrastructure.

Non-motorized transport can be stimulated by a policy package consisting of investments in facilities, improved transportation networks, awareness campaigns, as well as disincentives for the use of private motorized vehicles

The need to consider bicycle designs that will accommodate both environmental requirements and commuters' needs is essential.[38] Recently, the Institute for Transportation and Development Policy (ITDP) succeeded in the commercial adoption of an improved Indian cycle rickshaw. Reduced weight and greater comfort have allowed rickshaw operators to increase their wages by 20–50 per cent.[39] However, whereas they are important for the survival of numerous owner-drivers, rickshaws had been banned from major roads in Dhaka as a way to reduce road congestion. Such policies can have adverse impacts on vulnerable and disadvantaged persons, such as loss of employment and reduced mobility levels.[40] Uganda, meanwhile, was home to about 200,000 *boda bodas* (bicycle-taxis) in 2000, [41] which provide employment for large numbers of previously unemployed youth. Subsequently, there has been a widespread increase in the use of motorcycle taxis within both Uganda and Kenya.[42]

Training is an important strategic instrument not only for disseminating new knowledge but also for capacity building and increasing the awareness of the needs of non-motorized transport users. The private sector could be a key partner in supply-side interventions to increase bicycle ownership and use through the promotion of micro-credit programmes and providing cycling education. In the 1990s, women in Pudukkottai, India, were provided with loans to purchase bicycles and given cycling lessons, so that they could access a literacy programme. Additionally, the programme provided employment opportunities for the women, who were trained as bicycle mechanics. Five years later, it is now socially acceptable for women to ride a bicycle, and bicycles

Box 6.3 Supporting non-motorized transport investments in Africa

In 2008–2009, African government ministers participated in workshops that developed framework agreements that recognized the importance of transport infrastructure and urban planning. The need to raise investments in non-motorized transport infrastructure is identified as a key component to an integrated approach in transport for Africa.

The agreed article in the 'Eastern Africa Regional Framework Agreement on Air Pollution', endorsed the idea of a 10 per cent investment policy as follows: 'Encourage the use of non-motorized transport systems that have many advantages and are used by an overwhelming majority, but are constantly overlooked. At a minimum 10% of infrastructure costs should be dedicated to this majority and the focus should be on safety. Particular emphasis should be given to high-demand, mixed-use roads in urban and peri-urban areas'.

Source: Worldwatch Institute, 2008, p4.

Box 6.4 Integrating non-motorized transport into transportation systems in Bogotá, Colombia

During the administration of Mayor Enrique Peñalosa, Bogotá's visionary goal was centred on liveability, social equity and reclamation of public space. To achieve this, the administration established policies in seven areas: institutional strengthening, restraining private car use, public space, public transport, non-motorized transport, road maintenance and traffic management.

Large investment in infrastructure for non-motorized and public transport was justified by its impact on equality. Inclusive investments for all, such as bicycle lanes, pedestrian highways and the BRT system, demonstrated a commitment to public good over private ownership. Likewise, actions such as the removal of cars from sidewalks, car-free Sundays and establishing a highway solely for Transmileno, exhibited consideration to those on low incomes who do not benefit from investment in motorized transport infrastructure. The theme of equality was a key driver in the development of a 357-kilometre long bicycle network (known as *cicloruttas*). The bicycle network was deliberately designed to run through low-income and wealthy areas in order to promote integration and a sense that all citizens had an equal stake in city-wide development. These developments acted as 'social equalizers', providing the poor with better transport links and free leisure facilities. People supported the measures once they saw results, and Peñalosa left office with a record approval rating. Decisive leadership, political will and strong institutions were the critical factors contributing to success.

Source: Ardila and Menckhoff, 2002.

Travel-demand management . . . [affects] the demand for travel through the pricing and regulation of different modes of transport

are being used for going to school, fetching water and going to hospital during an emergency. The example of Bogotá, Colombia, shows that strong non-motorized transport policies, awareness campaigns and political commitment can bring about a shift in public attitudes towards non-motorized transport, as well as enhanced social inclusion (Box 6.4).[43] However, there is still a lot to be done, and the Transmileno system still needs to be further developed to fulfil its promises. One of the major critiques is the lack of coverage, as many groups of people are excluded from the current 84-kilometre system simply because it is not yet operating in their neighborhoods. Thus, many of Bogotá's residents are still relying on the traditional bus system, which is, in effect, operating in competition with Transmileno.[44]

Public transport fares . . . in developing countries, . . . are often set above competitive equilibrium levels

Most cities in developing countries are high density and therefore suitable for policies promoting non-motorized transport. Travel-demand management has a key role to play in this context. Such urban policies affect the demand for travel through the pricing and regulation of different modes of transport. An important benefit of travel-demand management strategies, besides improving the quality of low-cost transportation modes, has been increasing public transport affordability for low-income groups.[45] In the UK, there has been a change from road building towards the introduction of demand-management initiatives. Progressively, London has experienced a modal shift, in part due to its congestion charging scheme, making it possible to convert traffic lanes to bicycle lanes.[46] The adoption of automated bus lane enforcement has dramatically improved the speed and reliability of bus services. Generally, consumers are able to save money if they use alternative modes, routes or travel times to avoid driving on congested roads.[47]

Conventional planning tends to consider a relatively limited range of transport affordability impacts and objectives

■ *Improving affordability and quality of service of public transport*

Public transport fares should be set at rates that allow commuters to use it. In developing countries, fares are often set above competitive equilibrium levels.[48] This promotes excessive entry of buses, and is further exacerbated by the capture of the regulator. Since buses are not perfect substitutes, price competition is not an effective mechanism for regulating the optimal quantity of buses in the market. To minimize waiting time, most riders prefer to use the first bus that arrives, even though a cheaper bus may come along in a few minutes. Time, not fares, seems to be the most important variable for the rider. This simplifies the bus operator's market power to raise fares.[49]

Notably, consideration should be made to ensure that the fare (plus subsidies) covers the cost of operation, and at the same time remains affordable to the public. This is particularly important, as setting fares artificially low – without compensating service providers – can undermine the viability of a transport system. For instance, the bus fare needed to cover the operating costs in Lomé (Togo) was 295 CFA Francs. Yet, the fares charged were 250 CFA Francs, which was later reduced to 200 CFA Francs (by the government), thereby resulting in an operating deficit of 22 million.[50] Thus, a delicate balance must be struck between the consumer's convenience and willingness to pay, and the operator's need to balance its budgets (or to make a profit, in the case of private-sector operators).[51]

The promotion of affordable transportation requires a robust framework that defines and measures transportation affordability appropriately. Conventional planning tends to consider a relatively limited range of transport affordability impacts and objectives. To address this limitation, the World Bank has developed an affordability index to address the need for easily available and comprehensive,

Table 6.2

Public transport affordability index values for selected cities

City, Country	Per capita income (US$ PPP[b])	Income of bottom quintile population as percentage of average income	Fare for 10km travel (PPP US$ cents)	Affordability index[a]	
				Average income	Bottom quintile income group
São Paulo, Brazil	8,372	10.0	130.1	11	113
Rio de Janeiro, Brazil	14,325	10.0	125.4	6	63
Brasília, Brazil	12,985	10.0	106.8	6	59
Cape Town, South Africa	14,452	10.0	75.8	4	38
Buenos Aires, Argentina	15,493	15.5	87.6	4	26
Mumbai, India	8,585	41.0	112.2	9	23
Kuala Lumpur, Malaysia	18,351	22.0	121.6	5	22
Mexico City, Mexico	9,820	15.5	39.3	3	19
Chennai, India	3,717	41.0	39.3	8	19
Manila, the Philippines	9,757	27.0	63.0	5	17
Krakow, Poland	15,579	36.5	130.6	6	17
Amsterdam, the Netherlands	28,170	36.5	226.6	6	16
Moscow, Russia	16,154	24.5	84.6	4	15
Guangzhou, China	9,165	30.0	55.1	4	14
Warsaw, Polan	26,024	36.5	142.5	4	11
New York, US	51,739	27.0	200.0	3	10
Los Angeles, US	42,483	27.0	160.0	3	10
Chicago, US	48,300	27.0	180.0	3	10
Singapore	38,797	25.0	130.3	2	10
Beijing, China	14,379	30.0	55.1	3	9
Seoul, Rep. of Korea	16,784	40.0	85.5	4	9
Shanghai, China	20,814	30.0	55.1	2	6
Cairo, Egypt	7,117	43.0	26.1	3	6
Budapest, Hungary	22,106	50.0	89.2	3	6
London, UK	53,057	30.5	116.4	2	5
Prague, Czech Republic	32,757	52.0	88.0	2	4
Bangkok, Thailand	20,386	31.0	32.2	1	4

Notes: [a] Percentage of income required to undertake 60 trips, each of 10 kilometres, per month; [b] PPP = Purchasing power parity.

Source: Based on Carruthers et al, 2005.

comparative information on affordability of public transport fares across the globe (Table 6.2). The index values may be defined as the fare expenditure (for a total of 60 10-kilometre trips per month) as a percentage of income. It can be computed for various income groups and the results may be used to determine whether the proportion of income spent on fares is reasonable, high or onerous.

The data in Table 6.2 show huge variances between cities, due to their different contexts. The low-income residents of São Paulo, Rio de Janeiro and Brasília (Brazil) are all faced with unbearable situations, as transport expenses would account for more than half of their incomes. Cities such as Bangkok and Cairo, by contrast, have low fares, due to the low public transport fares (Bangkok) and the absence of extreme poverty in the lower quintile (Cairo).[52] Despite this improvement, the index is limited by the simplified nature of the indicators employed, as well as the questionable quality of available statistics. As such, there is need for a more precise analysis.

Transport subsidy is an important policy option for ensuring equitable transport access for the poor and other road users

Transport subsidy is an important policy option for ensuring equitable transport access for the poor and other road users. However, such subsidies are blunt instruments and require careful design to be both socially and economically justified. Poorly targeted subsidies may result in the rich deriving a disproportionate benefit compared to the poor. A more efficient approach is a strategy involving appropriately targeted subsidies by route or through employer-based schemes.[53] In Brazilian cities, since 1987 employers must, by law, subsidize the transport costs of their employees (if these costs exceed 6 per cent of their salaries) under the *Vale-Transporte* ('transportation vouchers') system. This system implies that the employer buys public transport vouchers or tops up the electronic transport passes of their employees directly (i.e. without involving the government). Employers can, as an alternative,

The affordability of urban mobility can be increased by improving land-use accessibility, and addressing the physical separation of activities and the means by which distance can be reduced

The integration of land use and travel-demand management measures can substantially enhance accessibility and lead to improved public transport affordability

provide staff transport.[54] However, the system applies only to the employees of the formal sector, meaning that more than 50 per cent of the urban workforce (including the major part of the poor and low-income population) is excluded from the scheme.[55]

The reform of the urban public transport sector in Kazakhstan is an illustration of a project resulting in poverty alleviation for the poor. Prior to reform, the public transport system was characterized by inadequate services, as well as crowded and lengthy waiting times. A transport intervention was initiated to deregulate and liberalize the provision of transport services, as well as improve the quality of the service.[56] Consequently, transportation affordability for transport users improved due to the reduction in fares.

Many cities (and regions) are modernizing their fare payment technologies, and integrating fare systems between different public transport routes, modes and even operators, for users' convenience. Experience with the 'Oyster' smartcard ticketing scheme in London, UK, has resulted in increased bus patronage, due to the simplified fare system and ease of interchange. This has also empowered commuters with information on the range of fully integrated fare products and improved service coordination.[57] Another positive development can be observed in Seoul, Republic of Korea, where the implementation of 'smart cards' allows commuters to transfer from one mode to another at a discounted rate.[58] A receptive institutional environment helps to create integrated and unified tariff systems, resulting in cost-effectiveness in ticketing. An exemplary model is Germany's transport federations (*verkehrsverbund*).[59]

■ *Improving affordability through urban form and land use*

The affordability of urban mobility can be increased by improving land-use accessibility, and addressing the physical separation of activities and the means by which distance can be reduced. The intention is to build sustainable mobility into the patterns of urban form and layouts, and make public transport, pedestrian and bicycle use practical and affordable. Accessibility planning[60] offers a new way to ensure that urban residents can reach the services and facilities they need by walking, cycling and public transport. Box 6.5 presents institutional arrangements created in Atlanta, US, that allow for the coordination of land-use and transport infrastructure investments, which could improve affordability and accessibility, particularly for ethnic minorities.

The integration of land use and travel-demand management measures can substantially enhance accessibility and lead to improved public transport affordability. Curitiba, Brazil, is a case in point, with 40 years of carefully integrating urbanization and transportation improvements.[61] By replacing cars with people, Curitiba has evolved along five well-defined linear corridors that protect the city centre. Zoning laws encourage high-density commercial development along these transport corridors, thus reducing the amount of travel needed to access basic goods, services and activities. Minibuses are used to quickly and efficiently transport individuals from residential neighbourhoods to express bus lines. Compared with other Brazilian cities of its size, Curitiba uses 30 percent less petrol per capita, and affordable fares make it possible for the average low-income family to spend around 10 per cent of its

Box 6.5 Metropolitan regional transport plans and priorities, Atlanta, US

The State of Georgia and the Atlanta metropolitan region have experienced constant growth since the 1990s. Suburban areas continue to expand, resulting in large-scale needs for transport infrastructure projects. However, this urban sprawl encourages disinvestment in housing and infrastructure decline, placing a strain on the provision of public transport services, particularly in older inner-city areas where African Americans and other minorities are concentrated.

Recognizing the spatial distribution (and economic and environmental impact) of highway spending, there is a growing need for Atlanta's metropolitan region to connect its evolving plans for infrastructure investment with the realities of land-use patterns. The regional transport plan for 2000–2025 helps guide the prioritization and funding of transportation investments. It has been hailed as 'an excellent example to illustrate how the metropolitan growth can be managed by proper land use-transportation planning and policy-making without compromising sustainability'.[a] However, Atlanta's regional transportation policies have actually exacerbated sprawl-related problems, with unintended consequences that are not evenly distributed. The transport strategies were designed to serve commuters from distant (more affluent) suburbs, with no provision for reverse commute that might help lower-income (primarily African American) communities reach suburban employment opportunities (for example as domestic workers, gardeners, etc., in the more affluent suburban households).

This resulted in a lawsuit and subsequent reconsideration of objectives. US$300 million state funds allocated to the proposed sprawl-inducing road programme was redirected to public transport, footpaths, bicycle paths and road safety and maintenance projects. It also led the federal government to scrutinize the distribution of transportation benefits and burdens among ethnic groups in the Atlanta metropolitan region.

Sources: Replogle and Kodransky, 2010, pp4–5; [a] Ong et al, 2010, p96.

income on transportation, which is relatively low in Brazil.[62]

Public support for suitable low-cost housing near large employment centres, or for public transport is a fundamental aspect of land-use planning. Singapore has successfully created self-sufficient new towns (in terms of jobs) and is systematically addressing the housing needs of the poor.[63] The regional centres are planned as commercial centres surrounded by high-density housing, integrated with an efficient public transport system. Improving the variety of services within the neighbourhood can be an effective way of reducing the transport expenditure of low-income households. However, the Singapore experience may not be readily applicable to cities suffering urban sprawl, with low-density suburbs.

Linking urban mobility systems and housing policy makes good financial sense. Together, transportation and housing often make up a good half or more of household consumption expenditures. To the degree less is spent on transport, more income is freed up for housing consumption. This is partly the philosophy of Europe's successful car-sharing schemes. Location-efficient mortgage policies in the US encourage residents to live in high-density, high-accessibility areas that reduce their need for cars.[64] They allow a household to commit what it saves from not owning a car to buy a more expensive home in an area marked by location efficiency.[65]

VULNERABLE AND DISADVANTAGED GROUPS AND URBAN MOBILITY

Vulnerable and disadvantaged groups – women, ethnic minorities, elderly, disabled people, youth, children, etc. – stand to gain important social benefits from improved urban mobility networks, technologies and facilities, as improved access and mobility reduce isolation, vulnerability and dependency. However, mobility networks will need to cater to the specific needs of such groups if they are to access the benefits.[66] Even in well-functioning public transport systems, some passengers may be unable to afford the services offered. Furthermore, it may also be difficult for some to travel alone due to poor security, or the public transport service may be physically inaccessible for many elderly and disabled persons. Vulnerable and disadvantaged groups are often overrepresented as pedestrians, and their special needs as pedestrians should be considered. For example, elderly and disabled persons often face challenges in crossing roads or navigating congested pavements.

This section outlines the determinants of the travel behaviour of vulnerable and disadvantaged groups. It identifies global conditions, trends, challenges and impacts faced by these segments of the urban population. It also considers the extent to which urban mobility policies address or conflict with the different activity needs of such passenger groups.

Global conditions, trends and challenges

Worldwide, societies are ***gendered***, in that men and women often play different roles. In developed countries, women's commuting patterns are often different from men's, particularly if they are married with children. They are also most likely to 'trip-chain', implying that when travelling, they have multiple purposes and destinations within one trip.[67] This is partly due to time constraints, and the fact that they normally have less access to both private and public transport. The situation is further compounded by age. On average, women are more likely to be working in part-time and lower-wage jobs than men, contributing further to women's increased expenditure in terms of time spent travelling. In the EU for example, 31.9 per cent of employed women were working part-time in 2010, compared to only 8.7 per cent of men.[68] Furthermore, available evidence suggests that across the globe, the percentage of women working in transport-related employment is low; with those employed in the transport sector earning 20 per cent less than men.[69]

Public support for suitable low-cost housing near large employment centres, or for public transport is a fundamental aspect of land-use planning

While presenting similar gender differences, women's travel patterns in developing countries are affected by their multiple roles as income earners, childcare providers, household managers and maintainers of community networks.[70] Whether in urban or peri-urban areas, women tend to make more trips, although over shorter distances, than men. Table 6.3 provides an overview of women's urban travel patterns and constraints in developing countries.

While presenting similar gender differences, women's travel patterns in developing countries are affected by their multiple roles as income earners, childcare providers, household managers and maintainers of community networks

High costs of public transport can make such services particularly prohibitive for women when it comes to reaching places of work, education or basic services. A study in Kampala, Uganda, revealed that women spend approximately 29 per cent of their income on public transport.[71] As a result, women appear to work closer to home than men.[72] Also, women tend to walk, and they rely on public transport primarily for longer distances.

High costs of public transport can make such services particularly prohibitive for women

Significant levels of sexual harassment of women on urban public transport systems are frequently reported from numerous cities. For example, a Tokyo Metropolitan government survey of women who travel during rush hour in Tokyo, revealed that two-thirds of the women in the 20–30 age group said they had been groped on crowded trains.[73] In many cities with Islamic populations, the situation is further exacerbated by the social institution of *pardah*, which prohibits the mixing of men and women in public.[74] In Dhaka, Bangladesh, women's exclusion from public transport results from overcrowded buses, public sexual harassment (referred to as 'Eve teasing') and

Table 6.3

Female travel patterns and constraints in developing countries

Urban areas	Peri-urban areas	All areas
• Women are more likely to walk than men. • Women have more diverse destinations and modal splits than men. • Women have a greater reliance on public transport than men.	• Women have fewer transport options than men. • Women incur higher transport costs and more waiting time than men. • The number of trips and distance travelled by women is often linked to transport accessibility rather than need.	• Personal safety and security. • Harassment. • Comfort. • Cultural constraints and norms.

Source: Based on World Bank, 2010a.

The major cause of drop-outs in primary schools in developing countries is the distance that children have to walk to reach their schools

inadequate sidewalks that hinder their access to the workplace.[75] Markedly, women will change their transport behaviour and have their transport options constrained if they perceive urban transport to be unsafe.[76]

Furthermore, evidence suggests that the planning, provision and operation of public transport in particular – and urban mobility in general – is primarily undertaken by men. Given that 'women's travel patterns are different from men's, and these differences are characterized by deep and persistent inequalities . . . [whereby they] have inferior access to both private and public means of transport'[77] there is a strong case for mainstreaming gender concerns in the working ethos of urban transport organizations.[78]

The mobility needs of ***children*** and ***youth*** (Box 6.6) are primarily related to their need to access educational facilities and childcare and related services. Due to their age, the majority of youth under the age of 18 in developed and developing countries alike are unable to drive.[79] Thus, someone has to provide them with transportation, when distance and other factors become barriers. In most countries, the greatest burden of this passenger-serving trip-making falls on women.[80]

Across the globe, evidence suggests that children's travel needs have a significant impact on household travel patterns, due to the largely car-dependent nature of those needs. This partly reflects the parents' perceptions of traffic danger, which are supported by statistics on accident rates involving children, particularly when they are walking or cycling. In South Africa, more than 26 child deaths per 100,000 population occur as a result of road traffic crashes, compared to 1.7 per 100,000 in the EU. In Bangladesh one in every four road deaths and one in six serious injuries experienced by the poor involves a child.[81]

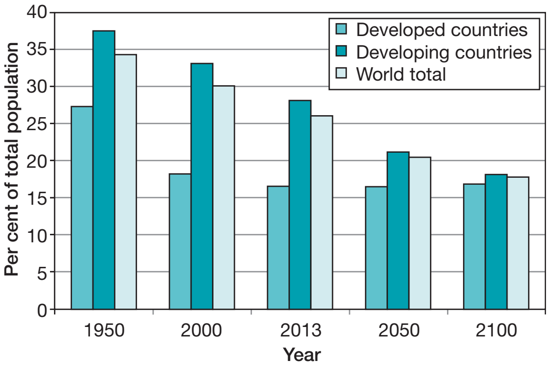
With respect to education, the major cause of drop-outs in primary schools in developing countries is the distance that children have to walk to reach their schools. Studies in Nepal show that for every kilometre a child walks to school, the likelihood of school attendance drops by 2.5 per cent.[82] This figure rises for girls and children with disabilities. Fatigue, exhaustion and risk of dangers, such as sexual assault, are some of the contributory factors to non-attendance or irregular attendance.[83]

Public and informal motorized transport provides greater mobility and a means of independent travel for youth. Whereas a majority of developed countries have dedicated school bus services in prominent schools, the poorest are often dependent on public and informal transport. In the context of developing countries, typical problems of informal transport parallel those of public transport related to

Figure 6.1

Proportion of world population under the age of 15 (1950–2100)

Source: Based on data from UN, 2011a.



Box 6.6 Children and youth: Population trends

As indicated in Figure 6.1, children and youth contribute a steadily diminishing proportion of populations world-wide. While 34.3 per cent of the global population were under the age of 15 in 1950, this figure has decreased to 26.2 per cent in 2013, and is projected to decline further to 20.5 per cent by 2050. It should be noted, however, that at the same time, the total population of children and youth under the age of 15 has more than doubled, from 869 million in 1950 to 1866 million in 2013. Projections indicate that the population below the age of 15 will stabilize at about 1.9 billion by the year 2050.

A similar trend can be seen for the 15–19 age group, where the global population has nearly tripled from 239 million in 1950 (9.4 per cent of world total) to 601 million in 2013 (8.4 per cent of world total), and is expected to grow slowly to 628 million by 2050 (6.7 per cent of world total).

Source: UN, 2011a.

Table 6.4

Estimated prevalence of moderate and severe disability, by region, sex and age (2004)

Region	All people and ages %	Males			Females		
		0–14 years %	15–59 years %	60 years and older %	0–14 years %	15–59 years %	60 years and older %
				Severe disability:			
World	**2.9**	**0.7**	**2.6**	**9.8**	**0.7**	**2.8**	**10.5**
High-income countries	3.2	0.4	2.2	7.9	0.4	2.5	9.0
Low- and middle-income countries (by WHO region):							
Africa	3.1	1.2	3.3	15.7	1.2	3.3	17.9
America	2.6	0.7	2.6	9.2	0.6	2.6	9.2
South East Asia	2.9	0.7	2.7	11.9	0.7	3.1	13.2
Europe	3.0	0.9	2.8	7.3	0.8	2.7	7.2
Eastern Mediterranean	2.8	0.9	2.9	11.8	0.8	3.0	13.0
Western Pacific	2.7	0.5	2.4	9.8	0.5	2.4	10.3
				Moderate and severe disability:			
World	**15.3**	**5.2**	**14.2**	**45.9**	**5.0**	**15.7**	**46.3**
High-income countries	15.4	2.9	12.3	36.1	2.8	12.6	37.4
Low- and middle-income countries (by WHO region):							
Africa	15.3	6.4	16.4	52.1	6.5	21.6	54.3
America	14.1	4.6	14.3	45.1	4.3	14.9	43.6
South East Asia	16.0	5.3	14.8	57.5	5.2	18.0	60.1
Europe	16.4	4.4	14.9	41.9	4.0	13.7	41.1
Eastern Mediterranean	14.0	5.3	13.7	53.1	5.2	17.3	54.4
Western Pacific	15.0	5.4	14.0	46.4	5.2	13.3	47.0

Source: WHO and World Bank, 2011, Table 2.2.

unregulated fares. In Dar es Salaam (Tanzania), Colombo (Sri Lanka) and Faisalabad (Pakistan), transport operators will not ferry school children and pensioners on concessionary fares, and/or they break their journey arbitrarily to ensure a double payment.[84]

It has been estimated that there are more than 1 billion people in the world with some form of ***disability*** (i.e. 15.3 per cent of the global population). Among these, 'nearly 200 million experience considerable difficulties in functioning'[85] (i.e. 2.9 per cent of the population). As can be seen from Table 6.4, the prevalence of disability is generally higher in developing countries than in developed countries and highest among older persons. More than half of the population aged 60 years or older in many developing countries are suffering from moderate or severe disabilities, compared to about a third in developed countries.

People with disabilities often find transport to be limited, unaffordable or inaccessible, and frequently cite lack of adequate transport as a barrier to accessing healthcare.[86] In the years ahead, disability will become an even greater concern. This is due to ageing populations and the higher risk of disability in older people, as well as the global increase in chronic health conditions such as diabetes, cardiovascular disease, cancer and mental health disorders. Since 1950, the proportion of ***older persons*** (i.e. those aged 60 or more) has been rising steadily, from 8.1 per cent in 1950 to 11.7 per cent in 2013, and is expected to reach 21.8 per cent in 2050 (Figure 6.2). By 2050, it is estimated that 3.2 million people will be over 100 years old; of which 1.3 million will live in developing countries.[87] Whereas mobility is important for daily living, many people who have got used to driving their own cars will have to stop driving due to age-related disabilities.

The challenges faced by these people vary considerably, due to the different types of disabilities and their impact on mobility. For example, hearing-impaired and vision-impaired persons in wheelchairs face different obstacles and thus need a variety of assistance methods.[88] Their movement is impaired by steps, stairways, etc., which require redesign of floor space requirements and facilities.[89] Furthermore, where there is no pedestrian infrastructure – such as signage or zebra crossings – they may need to travel with an escort, or use special guidance equipment. Older persons and persons with disabilities

People with disabilities often find transport to be limited, unaffordable or inaccessible

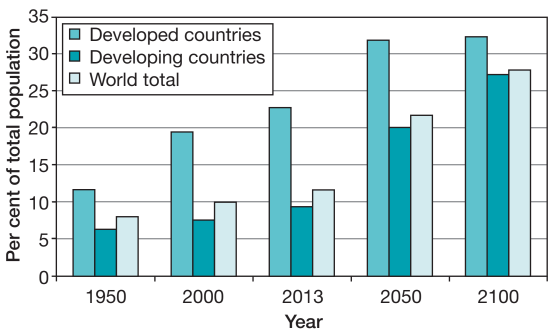


Figure 6.2

Proportion of world population 60 years and older (1950–2100)

Source: Based on data from UN, 2011a.

would thus benefit from design modifications such as better information systems and low-floor vehicles.[90] Privately run services such as shared taxis and minibuses are preferred by older and disabled persons due to their demand for door-to-door services. Nevertheless, most of these vehicles are not able to accommodate the users of wheelchairs and can be prohibitively costly. The alternative of hiring private transport is often out of the price range of disabled people, and parking spaces exclusively for their use in the central city are limited.

The participation of women transport users is critical for the establishment of equitable practice and the development of gender-sensitive understanding of transport needs and systems

While many countries have legislative frameworks requiring these challenges be addressed, effective responses are limited. African countries in particular suffer from insufficient monitoring, implementation and realization of such legislation.[91] The adoption of the United Nations' Standard Rules on the Equalization of Opportunities for Persons with Disabilities in 1994[92] and the Convention on the Rights of Persons with Disabilities in 2006[93] signalled broad international consensus on how disability issues should be addressed. National regulations are also in place on a country-by-country basis.

It should also be noted that many persons suffer from several different types of vulnerability and/or disadvantage. Women with disabilities for example often suffer compounded discrimination on the grounds of gender and available income in addition to the impairment.

Policy responses and innovative practices

There is a wide range of policy options and initiatives in place in some cities that have worked to improve mobility for the urban poor and enhance urban access for vulnerable and disadvantaged groups. Some of the policies and programmes described here do not require expenditure. Others could result in savings or payback from spin-off effects through more cost-effective management. Cities at various levels of development can draw on the experiences of other cities for further development or for improving existing conditions. The actual design of the policy or practice will have to be modified for the specific circumstances of each individual city.

In recent years, there have been significant developments in the methodologies associated with gender planning in respect of accessibility, mobility and transport organization. Evidence shows that many countries have integrated gender into their transport programmes and projects.[94] Opportunities need to be provided for women to gain meaningful and beneficial employment in the transport sector. Hiring female bus operators was a key component of the Trans Jakarta BRT initiative in Indonesia, which provided Indonesian women with a first opportunity of formal, regularized employment in the sector.[95] Experience shows that increased female recruitment helps advance gender equality in society in general, and also increases women's level of comfort and security in negotiating transport situations.[96]

Such a focus on gender issues is justified by the fact that it enhances the effectiveness of actions in the transport sector, and therefore impacts on poverty reduction. Data on user needs and access constraints should be gender disaggregated and collected through routine transport project monitoring and evaluation processes.[97] A recent World Bank pilot study in Lesotho that promotes the use of cognitive mapping exercises and geographic information system (GIS) for gender-sensitive transport planning is a good example of one such programme to map targeted stakeholder use patterns for integration with planning.[98] The participation of women transport users is critical for the establishment of equitable practice and the development of gender-sensitive understanding of transport needs and systems (Box 6.7).

Establishing a sustainable urban transport system requires a comprehensive and integrated approach to policy-making, with the aim of delivering people-oriented, affordable and environmentally friendly

Box 6.7 Women's participation in the transport sector in China

As part of an urban transport project in Liaoning Province, China, women were integrated into the various phases of the project, with the specific aim of increasing their participation. The project specification was established through community participation with separate focus groups for both men and women. This made it possible to identify the number of journeys made on a daily basis, which prompted priority to be given to the issue of pavements, road drainage, hard shoulders and their separation from the carriageway used by motor vehicles, lighting and signing.

By providing a specific forum for women, planners learned about specific concerns, opportunities and needs voiced by a key stakeholder in the project that may not have been raised in mix-gendered discussions. Women expressed concerns about the lack of security encountered in using buses: dark alleys, lengthy waiting times and vulnerability to traffic accident and injury. The outcome led to changes being made to the initial project in order to hasten improvements to secondary roads and traffic management. Precedence was given to the creation of pathways and pedestrian crossings, the installation of public lighting and improved frequency of bus services.

Source: Duchène, 2011.

mobility systems. The following sections give practical examples of policy responses that seek to deliver transportation that is gender sensitive, efficient, safe and responsive to the mobility needs of vulnerable and disadvantaged groups.

■ *Gender-sensitive design, infrastructure and services*

Public transportation planning must be based on a recognition of the distinct needs of women's distinct roles, needs and experiences. As such, gender mainstreaming is essential. In Bangladesh, an Asian Development Bank project aims to improve infrastructure facilities and the design of transport vehicles.[99] The project takes account of women's specific needs (public toilets, separate market stalls, lower steps in buses, etc.). It also reserves 15 per cent of the small businesses located along the roads under construction for women.[100] The small modifications made to the existing infrastructure balance women's needs for privacy with their need for social inclusion. Furthermore, it begins the process of further integrating women into social and economic domains that are traditionally segregated by sex, and often dominated by men.

Other policy initiatives focus on safeguarding women's safety and comfort in urban transport. Passenger rail cars reserved for 'women only' have been implemented in Japan, Brazil, Egypt, Mexico, India, Belarus and the Philippines. Similarly, women-only taxis are found in countries with large Islamic populations, such as Lebanon, Syria and the United Arab Emirates.[101] Most of these cabs are clearly marked in pink and feature women drivers. Whereas such sex-segregated initiatives are often debated, they have undoubtedly improved conditions for female passengers.[102]

In France, rolling stock manufacturers pledge to follow a charter proposed by an association called *Femmes en mouvement, les transports au féminin*, which requires the association to be present during the design of new vehicles.[103] Consultations are carried out in relation to safety, accessibility, internal configuration and respect for the environment. This helps to improve the gender sensitive design of public transport vehicles to accommodate women with children and/or shopping bags such as women-only carriages, child seating, storage spaces for prams and shopping.

In many developing countries, means of transport such as carts, bicycles and animals are considered a cost-effective manner to assist in meeting women's mobility needs.[104] Bicycles have often been recommended as a means of increasing the overall mobility of women, to enhance their socioeconomic and political participation. A study in India shows women's preference for the door-to-door demand service provided by auto-rickshaws.[105] The construction of segregated lanes for auto-rickshaws can reduce time burdens and benefit disadvantaged groups.

Public transportation planning must be based on a recognition of the distinct needs of women's distinct roles, needs and experiences

New mobility services – such as carpooling schemes reserved for women – are beginning to thrive throughout North America and Europe.[106] Such programmes provide the convenience of inexpensive access.[107] Families, commuters and employers are able to share cars at different times of the day, with subsidized or preferential parking. In Germany, well-lit parking sections have been set aside for women near stairs and elevators in multi-storey parking lots to ensure their safety.[108] Similarly, laws supporting disability parking privileges ensure that persons with disabilities have access to parking that does not present an undue hardship. For instance, the UK's blue badge disabled parking scheme helps disabled people with severe mobility problems to access goods and services, by allowing them to park close to their destination.[109]

Private transport options for many elderly and disabled travellers are also increasing (Box 6.8). There are a number of stable non-motorized vehicles, such as three-wheeled bicycles, hand-operated bicycles and a variety of carts in use. In Bangladesh,

Box 6.8 Private transport for special groups

Many cities, particularly in developed countries, promote the use of private transport for disabled people by licensing the use of scooters, motorized three-wheelers or electric wheelchairs. Furthermore, street or pavement designs are modified to accept them. In Belgium, loans and grants are provided for car-adaptation and training costs, both of which allow disabled people to enter the labour force. In many parts of the world, protected right or left turns are used as a safety measure particularly for the elderly, as well as designated turning lanes which aid in channelling the disabled away from through-traffic.

Many elderly people prefer to use private motor vehicles; however, the standards therein need to be tailored to meet the needs of the elderly and frail. Car designs need to take the functional mobility limitations of elderly, frail and disabled groups into account. Extensive research in road standards is important for finding the most suitable conditions for disabled and elderly road users.

Although the issue of aging populations has been less of a political issue in developing countries, it should be noted that the conditions for many aging and disabled road users in such countries are often deplorable, thus obstructing their right of access.

Source: OECD, 2001, citing OECD, 1986.

Integrated fare structures make it relatively easy and less expensive for vulnerable and disadvantaged groups to travel, particularly when undertaking trip-chains

hand-propelled tricycles provide valuable local mobility and are environmentally friendly.[110] Other motorized vehicles on the market include electric wheelchairs, three-wheeled motorized vehicles and cars and vans with hand controls.

Fare structures allow governments to determine who pays and who benefits.[111] In countries such as the UK, Denmark, Spain (Madrid) and Mexico (Mexico City), just to mention a few, special categories of passengers – such as students, children, the elderly and the unemployed – travel free or at least at a reduced fare.[112] There is a strong case for cross-subsidies to increase affordability, as has been done in Bogotá, Colombia, where the fare for low-income groups is subsidized by that of higher-income groups.[113] Integrated fare structures make it relatively easy and less expensive for vulnerable and disadvantaged groups to travel, particularly when undertaking trip-chains. For example, in Denmark, financial grants from the government have allowed integration of train and regional bus services, enabling passengers crossing regional borders to use a single ticket – even if the journey requires a transfer involving different public transport companies. Similar grants have allowed free public transport for children under the age of 12 who are accompanied by an adult.[114]

■ *Increasing pedestrian accessibility and safety*

Building exclusive sidewalks as components of road and transport projects responds well to . . . vulnerable users' travel needs by increasing pedestrian accessibility and safety

Building exclusive sidewalks as components of road and transport projects responds well to women's and other vulnerable users' travel needs by increasing pedestrian accessibility and safety. A majority of cities in developed countries have launched a curb-cut programme whereby all new sidewalks will be built with curb cuts that allow wheeled pedestrian traffic to negotiate the height change comfortably while at the same time helping sight-impaired people identify the street margin when using walking aids such as a cane.[115] Cities such as Mexico City, Rio de Janeiro (Brazil) and Pretoria (South Africa) have installed thousands of curb cuts to existing footways.[116] Agencies such as the World Bank are also increasing their focus on improving infrastructure for non-motorized transport.[117]

In Tokyo, Japan, a textured surface identifies the change in level, including the direction, of the pedestrian crossing.[118] The textured area is bright yellow and clearly visible, with curb cuts installed in existing sidewalks. At key intersections, the timings of the pedestrian crossing lights have been increased by 20 per cent to accommodate the slower crossing speed of elderly or disabled pedestrians.[119] Locations for the installation of light and sound signals for pedestrian crossings are also identified. Different sounds inform pedestrians whether or not it is safe to cross and whether they are crossing in an east to west direction or a north to south direction.[120] In Ottawa, Canada, for example, 'peep-peep' sounds are used for east to west crossings and 'cuckoo' sounds for north to south.[121] Pedestrians may press a button to activate the pedestrian crossing light. In some cases, where there is sufficient wheelchair traffic, wheelchair sensors may be installed.

The make-up of streets and the built environment can play a role in physical activity promotion and active travel behaviours, especially among children to and from school.[122] For instance, the availability of paved roads had a significant influence in school attendance levels in a community in Morocco. Attendance rates rose from 21 per cent to 48 per cent for girls and from 58 per cent to 76 per cent for boys.[123] School travel is an opportunity to shift a portion of car trips to walking and cycling, if accessibility, safety and the social benefits of the experience are recognized and addressed.

■ *'Universal design' or 'access for all'*

Across the globe, many countries are introducing legislation that requires transport services to be made more accessible, to conform to international law (Box 6.9). South Africa, for example, has adopted an integrated national disability strategy committed to developing accessible and affordable public transport. In 2010, the UK government passed an act that covers accessibility issues related to age, ethnicity, gender and disability as part of a single integrated approach to ensure equal access for all.[124]

In Europe, and more recently in North America, access to urban public transport has been transformed by the introduction of low-floor vehicles.[125] Passengers in wheelchairs can board the bus via a simple ramp or directly from the sidewalk if the curb is raised at stops. Inside the bus, there is space to park wheelchairs and strollers, where they can be secured

Box 6.9 Convention on the Rights of Persons with Disabilities (Article 9, paragraph 1)

'To enable persons with disabilities to live independently and participate fully in all aspects of life, States Parties shall take appropriate measures to ensure to persons with disabilities access, on an equal basis with others, to the physical environment, to transportation, . . . and to other facilities and services open or provided to the public. . . . These measures, which shall include the identification and elimination of obstacles and barriers to accessibility, shall apply to, inter alia: (a) Buildings, roads, transportation and other indoor and outdoor facilities, including schools, housing, medical facilities and workplaces'.

Source: http://www.un.org/disabilities/documents/convention/convoptprot-e.pdf, last accessed 25 March 2013.

with a clamp belt. This caters for people with small children or baggage, persons with disabilities and frail elderly persons.

In Delhi, India, a local NGO has worked with transport authorities to make metro stations barrier free; to include safety features and tactile guide ways[126] on platforms; and to ensure carriages have adequate space for wheelchair users.[127] Similarly, a forum bringing together an advocacy group for the disabled in Mexico City has led to thousands of kerb ramps on major streets and the introduction of accessible buses and trolley buses.[128]

Accessible taxis, both purpose-built and modified vans, are also becoming more prevalent. In Canada, the Province of Ontario offers a grant to adapt taxis to accommodate all users.[129] Private-sector companies may adapt one or more of their fleet and provide regular service and they send accessible taxis to disabled passengers who call for them. A variation on taxi service is the 'Dial-a-ride' service that works in many cities in the US and the UK.[130] In Berlin, a 'telebus' operates on the same principle.[131] Often, disabled passengers are given a 'travel card' and then allowed a certain number of rides.

Some attempts have also been made to ensure that information is availed to passengers in an easily understood manner. For instance, a number of taxis in Hong Kong have audio devices that provide the taxi fare in English, Putonghua and Cantonese.[132] It is also important that authorities promote disability awareness and training of public transport drivers and conductors to improve the assistance they offer passengers with special needs. Part of Mexico City's public information campaign aims to raise awareness among the general public about the integrated system of accessible pedestrian and transport services in the city. Sensitivity training for taxi drivers has also been considered.[133]

SAFETY AND SECURITY IN URBAN MOBILITY SYSTEMS

Safety and security are key components in creating sustainable urban mobility systems, particularly in making roads safer and more secure for vulnerable and disadvantaged road users, including the poor. Likewise, improving the safety and security of transport modes can be an extremely important step in encouraging transport users to change to alternative (and more sustainable) modes. Numerous terror attacks against urban infrastructure during the last two decades have compelled stakeholders to understand transport security as more than a single element of the global networks that move people and goods.[134] Once a routine component of modern transportation, security now represents an urgent national priority.

Global conditions, trends and challenges

This section examines the trends and impacts of traffic accidents in urban areas.[135] It considers reducing the global burden of such accidents through improved policies, road design and safety and traffic management. It also looks at transportation security more generally, in terms of people's (real or perceived) assessments of personal security. Due to the paucity of data on urban areas, this section refers to road traffic accident data at the national level.

Safety and security are key components in creating sustainable urban mobility systems

■ *Road traffic accidents*

Road traffic accidents are the ninth leading cause of death worldwide, accounting for 2.2 per cent of all deaths or 1.2 million deaths per year. The WHO estimates that a further 20–50 million are injured in road traffic crashes each year. The highest road traffic fatality rates occur in Africa and the Middle East (about 32 per year per 100,000 population). The average road traffic fatality rate of developing countries (about 20 per year per 100,000 population) is nearly twice that of developed countries. In fact, more than 90 per cent of fatalities occur in developing countries,[136] despite the fact that these countries have only 33 per cent of all registered vehicles.[137]

Road traffic accidents are the ninth leading cause of death worldwide

About half of the fatalities are in the most productive age group (15–44 years). In the 15–29 years age group, road traffic accidents are the leading cause of death. Males are overrepresented among fatalities in all age groups.[138] The most vulnerable road users – pedestrians, cyclists and motorized two-wheelers – account for nearly half of all road traffic fatalities. And, as can be seen from Figure 6.3, the proportion of fatalities among such vulnerable users is significantly higher in developing countries than in developed countries.

In the 15–29 years age group, road traffic accidents are the leading cause of death

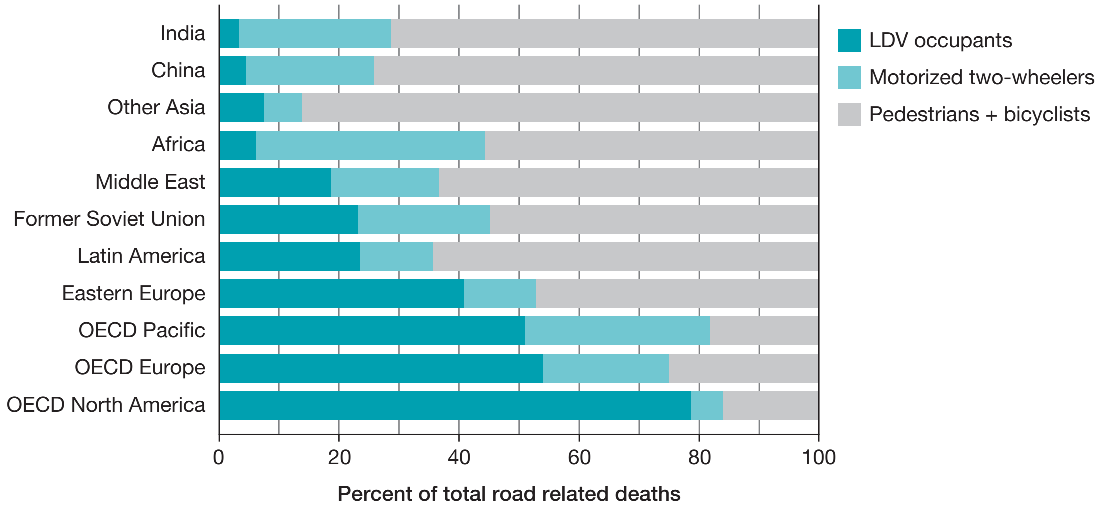
The predominance of vulnerable road-user casualties in Asian and African countries can be attributed to the unique traffic mix on the roads, characterized by the abundance of vehicles and non-motorized transport, as well as a lack of segregated facilities in the road network.[139] Poor enforcement of traffic safety regulations due to inadequate resources, administrative problems and corruption, exacerbate the situation further.[140] Arguably, the number of accidents and fatalities is likely to increase before they can be reduced, placing a strain on the poor public health infrastructure in developing countries. In India, road traffic injury patients account for 10–30 per cent of all admissions to surgical wards.[141] Delays in emergency response time can compromise the patient's recovery, resulting in adverse health outcomes and long-term disability. Furthermore, lack of trained expertise in trauma care, in many developing countries in particular, often results in treatable injuries becoming permanent or life threatening.[142] The annual cost of road traffic accidents in developing countries has been estimated

Figure 6.3

Road traffic fatalities by modes of transport

Note: 'LDV occupants' = 'Light-duty vehicle occupants', i.e. occupants of cars, small passenger vans, SUVs and personal-use light trucks.

Source: WBCSD, 2004, p43.



There is . . . an urgent need for an effective system of accident recording and analysis

Crimes . . . such as being robbed or killed while waiting at a bus stop – discourage many people from using public transport

Inadequate street lighting and poor design of public transport stops tends to 'facilitate' sexual harassment and gender violence

as at least US$100 billion a year.[143] Add to this the already considerable cost of congestion in cities, and the combined cost of a lack of road safety and accessibility is daunting.

Older pedestrians are also associated with very high rates of road injury and death. In 2002, some 194,000 older persons (aged 60 years and above) died as a result of road traffic accidents; this figure is equivalent to 16 per cent of all such fatalities globally.[144] Despite elderly drivers having the lowest crash rates of all age groups, there is a widespread misconception that they are a threat to traffic safety.[145] In Japan, for instance, incentives such as discounts in restaurants are offered to elderly drivers aged 65 years and above to encourage them to give up their licenses.[146]

Transport safety is not limited to private motorized vehicles only. Some 88 per cent of all motorized travel in Mumbai, India, is by bus or rail.[147] Accidents at railway level crossings clearly dominate the railway accident picture in Asia, where they are more frequent and can also be more severe in their consequences, involving injuries and fatalities to railway passengers, road vehicle occupants and other users of railway level crossings. In several developing countries, passengers in buses and informal transport systems also constitute a significant group at high risk of road traffic casualties.[148] Along with the profit motive of overloading, additional factors such as reckless driving, poor driver training and driver fatigue have led to the increased fatalities.

Most countries have some form of national system for aggregating data on road crashes, using police or hospital records, or both. However, the quality and reliability of data on traffic accidents is particularly weak in developing countries.[149] There is thus an urgent need for an effective system of accident recording and analysis that would be useful for a range of agencies (police, judiciary, emergency personnel, etc.).

Transportation security: Risks and fears related to the use of public transport

Across the globe, security risks and fear of crime while engaged in transportation activities have skyrocketed. The terrorist attacks in Madrid, Spain (March 2004)[150] and London, UK (July 2005)[151] show that public transport systems are vulnerable and potential targets for terrorists. Transport hubs and facilities have come under terrorist attacks as they concentrate large numbers of people. When attacks occur, there are disruptions in the public transport service, which leave many commuters stranded. Evidence suggests that passengers' confidence in the London metro and buses declined, and instead preference was given to two-wheelers and bicycles.[152]

While the most dramatic attacks have occurred mostly on major systems in major cities, this does not mean that local bus services or smaller cities are safe from attack. Crimes ostensibly unrelated to the use of public transport – such as being robbed or killed while waiting at a bus stop – discourage many people from using public transport. Table 6.5 summarizes the four main types of threats to security of person and property. In each case, while the origin of the problem may not lie primarily in transport conditions, questions arise about the planning and management of transportation facilities and services. Sexual harassment is widespread in many countries on and around public transport facilities, and inadequate street lighting and poor design of public transport stops tends to 'facilitate' sexual harassment and gender violence.[153]

A growing phenomenon in many cities is the expansion of criminal gangs that extort money from transport operators and passengers. Nairobi, Kenya, for instance, has seen the emergence of criminal youth gangs such as Mungiki. In April 2003, over 50 armed Mungiki members attacked a *matatu* (minibus) crew, killing five people.[154] These are indications of widespread social malaise. While it affects the transport behaviour of everybody, in most cases, low-income groups cannot afford alternatives.[155] As a result, indispensable trips for work, health or education are reduced.

It is also well established that older persons have higher safety and security concerns than other age groups.[156] Many are aware of their frailty and vulnerability, which make them susceptible to certain forms of crime (such as bag snatching). This in itself generates a range of safety concerns (i.e. road safety, skateboard users in shopping malls, living alone, etc.) that have implications for policy and operations.[157]

Table 6.5

Threats to security of person and property

Type of threat	Manifestations
Sexual harassment	Occurs in overcrowded or isolated places.
	Includes physical or verbal harassment.
Theft by stealth	Function of crowded buses.
	Includes unattended parking of motorized and non-motorized vehicles.
Theft by force	Occurs in less-crowded locations.
	Includes vandalism and violent physical attack.
Political and social violence	For example burning of buses or attacking of commuters.

Source: World Bank, 2002a.

Policy responses and innovative practices

This section explores policy responses and examples of good practice initiatives to reduce traffic accidents and improve road safety and transportation security. It should be stressed that the type of traffic, the mix of different categories of road users, and the type of road traffic accidents in developing countries differ significantly from those in developed countries. Furthermore, the traffic patterns of developing countries today have never been experienced by developed countries in the past. Hence, technologies and policies cannot be automatically transferred from developed to developing countries without adaptation.

■ *Reducing road traffic accidents*

Most developed countries have been experimenting with radical measures to reduce the number and severity of road traffic accidents. Based on a combination of engineering, enforcement and education measures, improvements have been made in infrastructure design; vehicle characteristics (e.g. seatbelt use, enacted by 57 per cent of countries surveyed by the WHO[158]); and driving behaviour (including speed limits and campaigns to dissuade drunk-driving). An estimated 96 per cent of countries have a national or sub-national policy on drinking and driving. Furthermore, some 49 per cent of countries have restrictions on the blood alcohol concentration of drivers.[159] Sweden's 'vision zero' initiative is exemplary, with a clear vision of reducing traffic accidents to zero in the near future. Some three-quarters of the significant reduction of deaths and injuries on Swedish roads have been attributed to the effects of the implemented traffic-calming measures.[160] A key lesson from these experiences, however, is the importance of maintaining the goodwill of all road users.[161]

Most developed countries have been experimenting with radical measures to reduce the number and severity of road traffic accidents

In developing countries, the policy focus has been on the protection of poor people who are disproportionately affected by road traffic accidents owing to the mixture of vehicles and unprotected road users on the same roads (Box 6.10). Simple, low-cost interventions have been found to have a significant impact on their safety. For example, in Accra and Kumasi (Ghana) the introduction of speed bumps in the form of rumble strips and speed humps resulted in a 35 per cent drop in road crashes between 2000 and 2001.[162] Road designers in Malaysia are working towards new regulatory guidelines requiring pedestrian risk assessments in order to separate road users.[163]

With respect to new transportation projects, mandatory safety audit procedures have existed in a number of countries (including Australia, Denmark, New Zealand and the UK) for several years.[164]

Box 6.10 Rwanda's road-safety programme

After the genocide that plunged Rwanda into mourning in 1994, the nation embarked on the improvement of its road infrastructure that was damaged by the effects of war, leading to many road traffic deaths. New regulations were enforced in 2001, which included the mandatory wearing of seatbelts, speed limits, vehicle inspections to ensure standards of roadworthiness and limits on blood-alcohol concentrations. These legislative changes were followed up in 2003 by a public awareness campaign and a law introducing further penalties for lack of seatbelt use or failure to wear helmets on motorcycles. This led to a 30 per cent reduction in traffic accidents.

The Rwandese government also introduced national speed limits of 60 kilometres per hour, which is 20 kilometres per hour lower than neighbouring countries. Plans to extend this successful programme of road-safety measures include further reinforcements for the traffic police to better enforce the law, as well as more public education about how to prevent accidents and observe good conduct.

Sources: WHO Regional Office for Africa, 2006; Brown, 2007.

Box 6.11 Toolkits for road safety

The International Road Assessment Programme (iRAP) has developed a toolkit that rates roads according to criteria for safety design, maps fatalities and serious injuries across the road network, and makes cost/benefit calculations for fatality reductions based on implementation of proposed countermeasures. It then applies tailored solutions. The iRAP methodology provides:

- 'Star rating' tables and maps showing the safety of roads or car occupants, motorcyclist, cyclists and pedestrians.
- A road inventory database with 30 inspected attributes describing the network.
- An estimate of the numbers being killed and seriously injured on each inspected road.
- A recommended network-wide countermeasure programme for consideration by local stakeholders and funding bodies.

In Malaysia, it has been estimated that an investment of US$180 million in road design improvements could deliver US$3 billion in benefits and prevent over 30,000 deaths and serious injuries over 20 years. iRAP has pilot projects in Chile, Costa Rica, Malaysia and South Africa showing positive cost–benefit ratios. Positive economic outcomes combined with the alleviation of human suffering make investment in safer roads a development priority.

Sources: iRAP, 2009a and 2011.

The enforcement of traffic regulations . . . is essential for the safety of cyclists, other non-motorized vehicle users and motorcyclists

Such procedures are also at various phases of implementation in developing countries such as India, South Africa and Thailand.[165]

The enforcement of traffic regulations, governing all road users and vehicles, is essential for the safety of cyclists, other non-motorized vehicle users and motorcyclists. In Iran, a law was passed in 2004, making the use of helmets compulsory countrywide for motorcycle users. By 2007, fatalities per 100,000 inhabitants decreased from 38.2 to 31.8. Some 40 per cent of countries surveyed by the WHO have a comprehensive motorcycle helmet law, in which some countries have clearly defined standards for both motorcycle drivers and their passengers.[166] Exclusive motorcycle lanes can be created and separated from the main carriageway by a physical median, as observed in Kuala Lumpur (Malaysia). Box 6.11 presents a toolkit for addressing road safety.

Traffic calming and the redesign of roads can reduce the vulnerability of pedestrians and cyclists to road traffic accidents

Most countries provide some pedestrian facilities, but in most cases the road environment is not designed with pedestrians in mind. In many developed countries 'pedestrian refuges' – elevated islands designed usually in the middle of streets – are a common feature to offer pedestrian safety when crossing the road. Such crossings are rare in developing countries. Instead, zebra crossings (where pedestrians are supposed to be granted immediate priority over approaching vehicles) are provided in some developing countries. Other low-cost pedestrian facilities – which are affordable at a wide scale and can be easily implemented – include pedestrian footways, controlled signals for at-grade pedestrian crossings, grade-separated crossings, and segregated bicycle lanes. As evidenced by pilot projects, traffic calming and the redesign of roads can reduce the vulnerability of pedestrians and cyclists to road traffic accidents.[167]

Other effective interventions for road safety include better land-use management for optimized traffic flow and the promotion of alternative modes of transportation such as public transport (Box 6.12). For instance, Singapore has been successful in reducing car journeys and alleviating traffic congestion through a combination of integrated land-use and transport planning, and demand-management measures. This can help to reduce traffic accidents by minimizing the number and length of motorized trips.[168] Similarly, in Brazil, Curitiba's high-capacity traffic-management system has not only improved urban transport and mobility but has also reduced the number of accidents along its routes, through the construction of safer infrastructure.[169] Higher occu-

Box 6.12 Reducing road traffic fatalities in Bogotá, Colombia

Since 1993, Colombian legislation requires all vehicle owners to be insured. As a result, a 3 per cent levy was instituted on all vehicle insurance policies, earmarking that money for a 'road accident prevention fund'. This resulted in Colombia's time-record high for the reduction of traffic fatalities – 7874 in 1995.

In Bogotá, several programmes have been introduced to prevent and mitigate road traffic deaths and injury. Typically, bars are closed at 1am instead of 3am, and citizens are cautioned against driving under the influence of alcohol. The stiff penalties deter people, who instead opt for alternative means of transportation (such as carpooling), resulting in the reduction of road traffic fatalities in Bogotá from 1387 in 1995 to 697 in 2002.

Source: WHO, 2004.

pancy vehicles are given priority in the road network, thus reducing the exposure risk of pedestrians and other road users. Surrounding areas have also been improved with better lighting and other equipment to make the transport system safer, more efficient and more user friendly.

The responsibility for regulating traffic and enforcing rules falls with the police. However, many police agencies in developing countries are plagued with poor enforcement of regulations – due to a lack of resources, unsatisfactory systems or general inefficiency on the part of the staff. Evidence suggests that a sustained systemic approach to road policing, with international support, can improve the performance (and image) of the police. A study of enhanced traffic enforcement in Uganda showed a 17 per cent drop in road deaths. The implemented scheme was worth US$72,000 and an average cost-effectiveness of US$27 per life year saved.[170]

Partnerships between community groups, civil society and NGOs and the police can help in preventing and mitigating traffic accidents, and enforcing transport safety measures.[171] For example, in Bangalore, India, the World Bank's Global Road Safety Partnership has created partnerships to launch a campaign against drunk-driving, and to improve roadways in high-traffic areas to enhance safety.[172] In addition, the Centres for Disease Control and Prevention have been working with the ministries of health and other groups in Mexico, Colombia and El Salvador to reduce injuries to pedestrians, cyclists and motor-vehicle occupants.[173]

■ *Improving the safety and security of vulnerable groups*

'Safe route to school' programmes exist worldwide.[174] Spearheaded by Denmark in the 1970s, the programme focuses on engineering enforcement, education and encouragement of safe walking and cycling for schoolchildren.[175] Under the Road Traffic Act, police and local authorities are responsible for the safety of children on school journeys. This involves many improvements on local roads, including slow-speed areas, 'road narrowings', traffic islands and separate foot and bicycle paths. The programme has been highly successful, and in some localities the accident frequency has been reduced by 85 per cent.[176] Denmark's experience with these programmes has provided an example for many other countries worldwide.

Many European cities are working towards limiting through-traffic on their streets to protect children, deaf people and those in wheelchairs from accidents.[177] The Netherlands has developed an amicable street-design solution for sharing of space between pedestrian and motor traffic in residential areas.[178] Selected areas are designated *woonerfs* ('living streets') and they are clearly marked with a traffic sign based on the image of a house. The street design is modified giving priority to pedestrians, with the pavement clearly demarcating areas where parking is acceptable. Through-traffic slows down due to the judicious use of speed bumps and winding thoroughfares. The harshness of asphalt and concrete is softened with amenities such as trees and flower boxes, small areas where children may play and benches where adults may meet with each other. By 2011 it was estimated that some 20 per cent of the population of the Netherlands were living in *woonerfs*.[179] Similar initiatives have been introduced in a number of other countries as well, including Norway (where they are called *gatetun*)[180] and the UK ('home streets').

Many European cities are working towards limiting through-traffic on their streets to protect children, deaf people and those in wheelchairs from accidents

Since the 1980s, transport planners in some countries have taken into consideration the personal security of passengers using public transportation systems, especially women. In Toronto, Canada, a 'request stop' service was launched in 1980 for the hours after dark, allowing a female passenger to ask the bus driver to stop along the route, where it is more convenient for the woman to get off, not necessarily at the bus stop. This was done to shorten the woman's walk between bus and destination. The service was later adopted in Montreal in 1996,[181] and later in a few UK cities.[182] Other measures taken to improve the personal safety of passengers in Toronto include increasing the presence of security personnel in stations, adding more services at night and raising awareness among station employees, drivers and passengers.[183]

Environmental design plays an important role in reducing crime in public transport. In the US, the Washington Metropolitan Area Transit Authority[184] and the New York Port Authority Bus Terminal are classic examples of success stories of applied security design against crime in rail transport environments.[185] In each case, environmental design shares the credit for increased security with strategic policing, strict maintenance procedures and 'zero tolerance' policies in enforcing rules and regulations. Another example of crime prevention through environmental design is evident in the UK, where closed circuit television cameras are used widely to monitor public spaces such as shopping malls, car parks and a few residential areas.[186]

The emergence of low-cost open-source mapping tools; widespread cellular network coverage in developing countries; declining costs of mobile phone hardware; and increasing internet use by public agencies have resulted in unprecedented opportunities to support transport planning and management in developing countries.[187] Some three-quarters of the world's inhabitants now have access to a mobile phone. The number of mobile subscriptions grew from fewer than 1 billion in 2000 to over 6 billion in 2012; nearly 5 billion of these are in developing countries. In 2011 alone, more than 30 billion mobile applications, or 'apps' (the software that

The importance of the social sustainability of urban transport cannot be underestimated; it is a key prerequisite for social development

extends the capabilities of phones, for instance to become mobile wallets, navigational aids or price-comparison tools) were downloaded.[188]

Advances in technology now make it possible to respond to specific needs, including those of particularly vulnerable groups such as women, persons with limited mobility and persons with disabilities. This could mean benefiting from new opportunities through safer and easier transport access. In Egypt, an innovative website 'HarassMap' was launched in December 2010 to help report and map cases of harassment.[189] Due to the affordable and adaptable technology, victims of harassment are able to anonymously report incidents by simply sending an SMS message to this website.

To minimize poor accessibility, appropriate urban planning and land use is essential

Another innovation is the 'Access Advisr', a pilot web application in the UK that uses crowd-sourcing to identify local people's needs in order to improve accessibility to the existing public transport network for disabled and older persons.[190] The application identifies problem areas for accessible transport, and allows the review of information about the physical infrastructure, and to rate it – through a live feedback community of users who can contribute their views, photos and videos based on their own experiences.

CONCLUDING REMARKS AND LESSONS FOR POLICY

Accessibility planning is viewed as a mechanism for ensuring equity and reducing mobility

Mobility is required to ensure access to basic goods, services and activities, and in that sense it is essential to social equity. Restrictions on such access may imply an abuse of human rights. In order to ensure equitable access, cities need to understand the transport needs of ***all*** urban dwellers, distinguishing between the priorities of men and women, the young and old, the able and the disabled. There is thus a need to understand the purposes and uses that would be derived from improved access, and the constraints preventing those needs from being fulfilled. While social objectives are often acknowledged in transport strategies, experiences show that very little practice goes beyond pilot schemes and case studies. Yet, the importance of the social sustainability of urban transport cannot be underestimated; it is a key prerequisite for social development.

Greater equity in urban mobility is an essential prerequisite for achieving sustainable urban mobility systems

In theory, there are already both awareness and some knowledge of the role that mobility plays in terms of improving – or worsening – a person's quality of life. However, the complex dynamics are often not well understood. This leads to a situation whereby those responsible for taking action fall back on traditional solutions; namely: infrastructure development, improvement of conditions for private transport, and lump-sum payments or untargeted subsidies. Transport subsidy is an important policy option for ensuring equitable transport access. However, it is essential that such subsidies are designed carefully to target the poor and other vulnerable and disadvantaged groups.

Good mobility policies should contribute to poverty reduction by recognizing both the necessity of improved macroeconomic efficiency, and the need for direct targeting of transport interventions. There has been a tendency to treat these two dimensions of transport policy separately, with the result that an effective and unified approach to urban mobility has been lacking. One way of dealing with this is by ensuring that poverty reduction becomes an explicit objective of transport policies, with clear strategies to bring the benefits of economic efficiency to poor people, through redistribution and direct targeting programmes, including preferential treatment of specific vulnerable and disadvantaged groups.

In order to minimize poor accessibility, appropriate urban planning and land use is essential. As a derived demand, transport infrastructure that enables access to low-cost transport can make a crucial contribution to poverty reduction. However, large-scale transport infrastructure projects tend to benefit high-income groups the most. The poor and other low-income groups are often displaced to make way for the projects, and may derive little or no benefit.

Accessibility planning is viewed as a mechanism for ensuring equity and reducing mobility. Developing services and facilities on a localized basis that places transport within easy and affordable reach of the poor, forms a central principle within a sustainable urban mobility paradigm. Greater attention should be given to investments in bus-priority and non-motorized transport facilities, in order to reduce the negative impacts of congestion. In some developed countries, it may even be possible to learn from the experience of some developing countries, where the urban poor are supported by the existence of cheap (mostly informal) transport solutions. Many low-cost actions can be implemented, which focus on both walking and cycling facilities, especially in poorly equipped areas. Such interventions could contribute to the welfare of the urban poor, as well as the economic activities of petty traders and hawkers.

While great strides have been made in developing gender-appropriate transport policies and universal design solutions, consistent implementation is still lacking. Moving towards greater equity in urban mobility is an essential prerequisite for achieving sustainable urban mobility systems. Concerted efforts must be made by decision-makers to establish mobility systems that address the needs of all population groups, especially the poor, the young, the elderly and the disabled.

The mere existence of gender-mainstreaming materials and official (international or national) policy documents alone does not mean that gender is successfully integrated in the transport sector. Particular attention needs to be paid to gender issues, and consideration given to the differential needs and demands arising from varying gender contexts. Similarly, it is increasingly being recognized that there is a need for an analysis of gender that acknowledges income differences, in order to assess how individuals experience urban mobility. Accordingly, it is crucial that women are represented in the planning, design and decision-making of all transport investments (including user panels).

As noted earlier in this report, urban mobility is primarily a means to an end: to provide access to basic goods, services and activities. In this context, the core social requirement for an urban mobility system is that it delivers its services equally to different localities, interest groups and across generations. Similarly, the negative impacts should be distributed fairly among all users. Granting equitable access for all will involve developing and implementing appropriate measures and control mechanisms, which include the following:

- Fare and pricing policies;
- Flexible routing and servicing;
- Establishing schedules that are considerate of people's activity patterns and time budgets;
- Acknowledging the importance of the services provided by the informal sector and by non-motorized transport;
- Introducing innovative transport services that also make use of opportunities provided by information and communication technologies;
- Addressing the safety and security concerns and other needs of transport users;
- Eliminating gender biases by integrating the transport needs of women into transport policy and planning processes.

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CHAPTER 7

URBAN MOBILITY AND THE ENVIRONMENT

The increasing mobility experienced in cities all over the world brings enormous benefits to society and also provides the essential means by which a city can function effectively. The increasing urban mobility is manifested in three major forms: an increase in the number of trips made, an increase in the length of each trip, and – last but not least – an increasing motorization of urban people and goods movement. The environmental consequences of the increased motorization – and in particular the use of private motorized vehicles (cars and motorcycles) – are cause for major concerns, not only locally in the city, but also globally, as the transport sector is one of the major contributors to greenhouse gas emissions, the major cause of climate change.

In the past, it has often been argued that transport is an essential prerequisite for economic growth, at least for cities at an early stage in their development. It has also been argued that this relationship is not so important for cities in developed countries where there is already an extensive network of routes and where levels of accessibility are already high.[1] Recent debates have argued for prosperity without growth,[2] meaning that economic growth (and transport) needs to be more closely aligned with environmental and social priorities.

It is increasingly being acknowledged that urban development has to be based not only on economic growth, but also on social equity (and equal access) and environmental sustainability. Thus interventions in urban mobility systems should not only address the economic benefits of higher levels of accessibility (and mobility), but at the same time take account of the social and environmental implications of following particular policy pathways.[3]

The purpose of this chapter is to highlight environmental sustainability concerns within urban mobility systems. This includes the identification of environmental costs and a discussion of the means by which their impacts can be reduced. The chapter acknowledges that urban mobility will always use resources and generate externalities,[4] but its impact on the urban environment can be substantially reduced, so that it remains within acceptable limits and makes a strong contribution to other aspects of sustainability, including intergenerational concerns.

The first section of the chapter identifies the main environmental challenges facing urban mobility, focusing on oil dependence, greenhouse gas emissions, sprawl and human health concerns. This is followed by five sections that discuss the policy responses to these challenges. The second to fourth sections focus on reducing the number of trips made, reducing travel distances in cities and changing the modal split towards non-motorized and public transport. The fifth section discusses the potential of technology in reducing the negative externalities of motorization by addressing the efficiency and age of the vehicle stock, standards of fuels used and emissions from vehicles and alternatives to oil-based fuels, and the need for increased efficiency in the use of vehicles. The sixth section argues that, in practical terms, a combination of several approaches is likely to be most effective. This is followed by a section that (briefly) discusses international funding mechanisms to achieve environmentally sustainable urban mobility systems. The final section contains a brief summary and some major lessons for policy.

The environmental consequences of the increased motorization . . . are cause for major concerns, . . . as the transport sector is one of the major contributors to . . . climate change

ENVIRONMENTAL CHALLENGES IN URBAN MOBILITY SYSTEMS

Environmental concerns have, over the last few decades, become central to the debates about sustainable urban mobility. Yet, in practice, developmental objectives seem to take priority over environmental concerns. A key message underpinning the discussion in this chapter is the need to find the means by which both developmental and environmental concerns can be addressed at the same time, in mutually supporting ways.

Environmental concerns have . . . become central to the debates about sustainable urban mobility. Yet, in practice, developmental objectives seem to take priority over environmental concerns

Motorized urban transport relies almost entirely (95 per cent) on oil-based products for its energy supply

The transport sector accounts for about 22 per cent of global energy use

Motorized urban transport relies almost entirely (95 per cent) on oil-based products for its energy supply, primarily in the form of petrol and diesel.[5] The shift in urban transport technology toward motorization has thus led to a significant increase in the global consumption of such oil-based products. While 45.4 per cent of global oil supplies were used in the transport sector in 1973, this figure had increased to 61.5 per cent in 2010. Thus, while the total amount of oil used globally increased by 63 per cent during the 1973–2010 period, the consumption by the transport sector increased by 120 per cent.[6]

It has been estimated that the transport sector accounts for about 22 per cent of global energy use. The bulk of this (about two-thirds) is accounted for by passenger transport, while the rest is consumed by freight transport. As can be seen from Table 7.1, cars and motorcycles (the bulk of which is private motorized transport) account for nearly half of the energy consumption of the entire transport sector.

The dependence on an oil-based energy supply means that there has been a direct correspondence between the amount of energy used in the transport sector and the emissions of CO_2, the main transport-related greenhouse gas. CO_2 emissions from the transport sector have remained constant at about 23 per cent of total energy-related CO_2 emissions during the 1973–2009 period.[7] Given the considerable growth in urban travel demand globally (as the world's urban population is projected to increase by 40 per cent between 2010 and 2030),[8] mitigation technologies and practices are urgently required to achieve a significant global reduction in carbon-based energy use for urban transport.

There are, however, a number of other significant impacts of oil-based transport energy on both the natural environment and the built environment. This section focuses on these impacts and related environmental challenges. The environmental conditions of cities vary significantly – both between and within cities. Yet, many of the problems arising from the transport sector affect all urban residents (although, in many cities, the poor suffer disproportionally from many of the negative externalities of urban transportation) and impacts upon health and the quality of life in cities in general. Four major clusters of challenges are discussed below, namely: motorization and oil dependence; mobility and climate change; dependence on motorized forms of transport and urban sprawl; and human health concerns.

Motorization and oil dependence

Despite the many negative impacts arising from dependence on oil-based energy products in the transport sector, the sector is likely to remain a premium user of such products. There are many reasons for this, the most prominent of which are listed below:

- Oil-based products have the highest energy density of all fuels.[9] Thus, any change to alternative fuels (e.g. biofuels, solar, hydrogen or electricity) needs to be examined with caution in light of the quantity of such alternative fuels required to travel a given distance.
- There are currently no substitutes to oil-based products that are available in the quantities required.
- Considerable investments have already been made in the infrastructure supporting oil-based transportation (i.e. fuel stations and oil refineries).[10]

However, global supplies of oil are not unlimited, and they are often subject to political interference. The politically induced oil shortages of the 1970s and the rapid price increases during the last decade (Figure 7.1) have exemplified the potential consequences of reductions in oil supply, as a component of national energy security.[11] The urban poor in developing countries are especially hit hard by increased petrol prices. In 2011, Kenya experienced a shortage in petrol supply, followed by a rise of

Table 7.1

World transport energy use and CO_2 emissions, by mode

Mode of transport	Share of total energy use (2000) (%)[a]		Share of CO_2 emissions (2000) (%)[b]	
	Passenger transport	Goods transport	Passenger transport	Goods transport
Road transport	77.3		74.7	
Cars	44.5	–	42.5	–
Buses	6.2	–	6.3	–
Other (two- and three-wheelers, etc.)	1.6	–	2.4	–
Heavy trucks	–	16.2	–	23.5
Medium trucks	–	8.8		
Rail transport	1.5		2.3	
Air transport*	11.6	–	12.4	–
Sea transport*	–	9.5	–	10.6

Note: * Air and sea transport has been allocated to passenger and goods transport respectively for simplicity.

Sources: [a] Kahn Ribeiro, 2007, p328 (citing Fulton and Eads, 2004); [b] OECD/ITF, 2011b, p17.

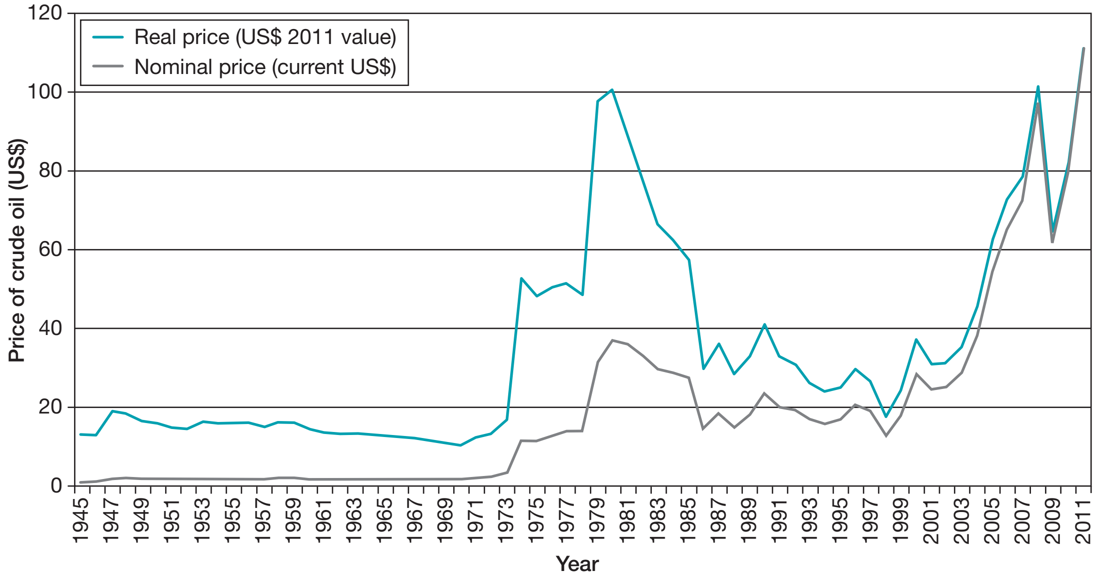


Figure 7.1

Crude oil prices (1945–2011)

Source: Based on BP plc, 2012.

30 per cent in petrol prices within a few months.[12] Car owners slowly decreased their number of trips; however the mounting prices had an immediate effect on public transport. Privately owned bus lines initially decreased the frequency of legs collecting passengers to maintain profitability, followed by the suspension of multiple public transport lines by owners, while at the same time demanding the government lower petrol prices. As a result, the urban poor living at the fringes of the city suffered the most, unable to travel long distances to earn a living.

In the short term, the transport sector is prepared to pay for the higher costs of energy, and most savings in the use of carbon-based energy sources will come from the use of more efficient technology within the conventional petrol and diesel vehicles. In the longer term, however, and irrespective of the wider environmental impacts, the transport sector needs to diversify its sources of energy and to de-carbonize the sources of fuel used.[13]

High and volatile prices have encouraged some countries to subsidize fuel prices to protect their own motorists from increasing world prices for petrol and diesel. Other countries impose various taxes on such commodities. Thus, the pump price for petrol varies considerably between (and also within) countries, from US$0.02 per litre in Venezuela to US$2.54 in Eritrea (Figure 7.2). The political rationale for subsidizing fuel prices varies dramatically from one country to another.[14] However, the perverse effect of fuel subsidies has been to encourage more car travel. And, it can be argued that fuel subsidies primarily benefit car owners. Targeted subsidies to public transport are a better alternative if the objective is to make transport more affordable to the urban poor. In general, fuel prices should not be subsidized for the sake of short-term political interest (Box 7.1), as it is important that the full environmental costs of fuels are paid by the user. This is known in international law as the 'polluter pays principle'.[15] It has been estimated that 'a universal phase-out of all fossil-fuel consumption subsidies by 2020 would cut global primary energy demand by 5%', with savings predominantly in the transport sector.[16] If fuel subsidies are to be retained, it is often argued that it would be better to subsidize renewable energy sources, to encourage a shift away from fossil fuels.[17]

The transport sector needs to diversify its sources of energy and to de-carbonize the sources of fuel used

The perverse effect of fuel subsidies has been to encourage more car travel

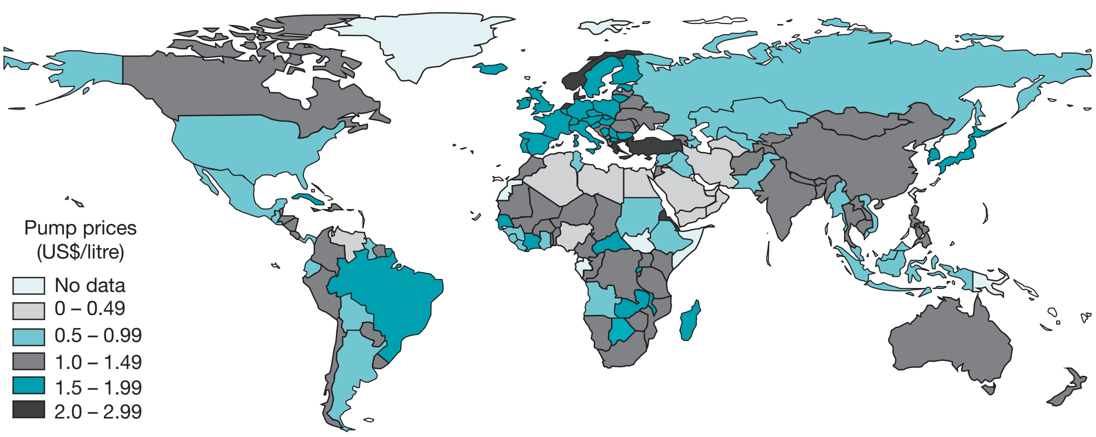


Figure 7.2

Worldwide retail prices of petrol (2010)

Source: http://data.worldbank.org/indicator/EP.PMP.SGAS.CD, last accessed 21 March 2013.

Box 7.1 Fuel subsidies

With high oil prices (over US$100 a barrel), many countries are not passing on these costs to users, as fossil fuels are needed for cooking, heating, electricity generation as well as powering engines and vehicles. The International Monetary Fund estimates the global bill for fuel subsidies reached US$250 billion in 2010, up from US$60 billion in 2003.[a] Some 40 per cent of this amount are subsidies for oil products (the rest being natural gas, electricity and coal).[b] Other sources quote even higher levels of fossil fuel subsidies, namely: '$523 billion in 2011, up almost 30% on 2010 and six times more than subsidies to renewables'.[c]

For oil-producing countries fuel subsidies are part of a social contract and can be managed. In Iran alone, the total value of oil subsides reached nearly US$25 billion in 2005.[b] But for non-oil producers it creates an additional fiscal burden and it means that investments in other sectors are delayed as foreign currency is used to pay for the oil. In India, it is estimated that fuel subsidies have added US$20 billion, or 1 per cent of GDP, to the national budget.[a]

Most of those that argue for the continuation of subsidies on fossil fuels argue that this is done to assist the poor. In practice, however, this is rarely the case; as 'only 8% of the subsidies to fossil-fuel consumption in 2010 reached the poorest 20% of the population'.[d] The figure is even lower for petrol and diesel, where only 6 per cent of the total subsidy went to the poorest 20 per cent of the population.[e]

For political reasons, 'Governments like to keep subsidies "off-budget" since "on-budget" subsidies are an easy target for pressure groups interested in reducing the overall tax burden. For this reason, subsidies often take the form of price controls that set prices below full cost, especially where the energy company is state-owned, or of a requirement on energy buyers to take minimum volumes from a specific, usually domestic, supply source. Subsidies may be aimed at producers, such as a grant paid for each unit of production, or at consumers, such as a rebate or exemption on the normal sales tax'.[f]

Sources: [a] Hook et al, 2011; [b] IEA, 2006, Figure 11.7; [c] IEA, 2012a, p1; [d] IEA, 2011c, p7; [e] IEA, 2011d; [f] UNEP, 2008, p9.

There is a significant potential to reduce . . . greenhouse gas emissions, by encouraging more people to use public transport

Cities make greater efficiency in their use of energy for transport than less densely populated locations, as more efficient public transport can replace the need to use a private car, and as distances are shorter. The relative energy efficiencies for different modes of transport in 84 cities are shown in Table 7.2. The occupancy rates for public transport vehicles are central to the interpretation of this table. The substantial differences in energy efficiency between cities in the different regions are partly due to the technology being used, but also to the occupancy levels. For example, China has high levels of efficiencies for all forms of public transport (except ferry), while the figures for the US are significantly lower. The general conclusion of the table, however, is that there is a significant potential to reduce energy use (and thus greenhouse gas emissions) by encouraging more people to use public transport.

Mobility and climate change

As a result of international policy concern during the 1970s and 1980s, the United Nations Framework Convention on Climate Change, also known as the

Table 7.2

Energy efficiency for urban transport, by mode of transport

Country/region	Transport energy use (megajoule per passenger kilometre)								Assumed occupancy rates for public transport in cities (%)
	Private vehicles	Public passenger transport							
		Total	Bus	Tram	Light rail	Metro	Suburban rail	Ferry	
World	**2.45**	**–**	**1.05**	**0.52**	**0.56**	**0.46**	**0.61**	**–**	**–**
US	4.6	2.63	2.85	0.99	0.67	1.65	1.39	5.41	10
Canada	5.0	1.47	1.50	0.31	0.25	0.49	1.31	3.62	15
Australia and New Zealand	3.9	1.49	1.66	0.36	–	–	0.53	2.49	10
Western Europe	3.3	0.86	1.17	0.72	0.69	0.48	0.96	5.66	17
High-income Asia	3.3	0.58	0.84	0.36	0.34	0.19	0.24	3.64	25
Eastern Europe	2.35	0.40	0.56	0.74	1.71	0.21	0.18	4.87	–
Middle East	2.56	0.67	0.74	0.13	0.20	–	0.56	2.32	–
Latin America	2.27	0.76	0.75	–	–	0.19	0.15	–	–
Africa	1.86	0.51	0.57	–	–	–	0.49	–	–
Low-income Asia	1.78	0.64	0.66	–	0.05	0.46	0.25	2.34	–
China	1.69	0.28	0.26	–	–	0.05	–	4.90	–

Notes: The table is based on data from a sample of 84 cities in different regions. '–' implies 'data not available'.

Sources: Newman and Kenworthy, 2011a (citing Kenworthy, 2008).

Climate Convention, entered into force in 1994. Its ultimate objective is to stabilize global greenhouse gas concentrations in the atmosphere at a level that will prevent human interference with the climate system. In order to achieve this, many developed countries committed (through the Kyoto Protocol) to reduce their overall greenhouse gas emissions by at least 5 per cent below 1990 levels by 2012.[18] Although some countries have managed to meet their commitments, many other countries (primarily those that did not commit to reductions) have increased their greenhouse gas emissions dramatically. Global emissions of CO_2 have increased by nearly 50 per cent between 1990 (20.97 billion tonnes)[19] and 2010 (30.6 billion tonnes).[20]

Globally, the CO_2 emissions from the transport sector have increased by 85 per cent from 3.593 billion tonnes in 1973 to 6.665 billion tonnes in 2007.[21] With respect to the targets of the Kyoto Protocol, the emissions have increased by over 47 per cent during the 1990–2007 period.[22]

There is considerable variation in the amounts of CO_2 produced by different countries and regions. A similar variation applies to the emissions from the transport sector. As can be seen from Table 7.3, the transport emissions per capita in North America are more than four times the global average, and more than double that in other OECD countries. The CO_2 emissions from transportation are much lower in developing countries. The emissions in most of Asia and Africa are about a third or a quarter of the global average, the notable exception is the Middle East, where the transportation emissions per capita are similar to those in Europe. Even more striking: while the overall CO_2 emissions per capita in the US are some 2.5 times higher than in China, the CO_2 emissions per capita from transportation in the US are 12 times as high as in China.

As indicated in Table 7.1, road and maritime freight accounts for about 25 per cent and 10.6 per cent of the CO_2 emissions, respectively. Aviation accounts for another 12.4 per cent, while the emissions from rail transport are insignificant. The remaining 52 per cent of CO_2 emissions are being produced from passenger road transport.[23] For all parts of the world, more energy (and CO_2 emissions) per capita is used in private than in public transport; in Africa the ratio is 3:1, while it is 50:1 in the US.[24]

At the city level, there is considerable variation in energy use between cities. For example, more than half the total energy consumption in Mexico City and Cape Town is transport based,[25] while the levels in many European cities (for example, London and Paris) are about a quarter.[26] This reflects the differences between cities in terms of their structure, their urban form, their densities, their levels of sprawl, the importance of public transport and the balance between energy use in transport and other sectors.

Globally, the CO_2 emissions from the transport sector have increased by 85 per cent from . . . 1973 to . . . 2007

Figure 7.3 shows variations in CO_2 emissions from passenger transport across cities in various parts of the world. The emissions are highest in US, followed by Canadian and Australian cities, with emissions in the range of 2–7.5 tonnes per capita. Most European cities have emissions in the range of 1–2 tonnes per capita. Most developing country cities, however, have significantly lower emissions. To provide a specific example: the mobility patterns of each resident of Atlanta, US, produce about 150 times as much CO_2 emissions as those of a resident of Ho Chi Minh City, Viet Nam. Figure 7.3 also shows that, in most cities, the emissions from public transport are insignificant compared to those from private motorized transport.

In most cities, the emissions from public transport are insignificant compared to those from private motorized transport

Nearly one-half of the world's cities are located on the coast or along major rivers. These locations have in the past been subject to occasional flooding, but these risks have increased as a result of more frequent storm surges and high winds, accentuated by global warming and sea-level rise. The vulnerability of these cities to flooding has thus been substantially

Table 7.3

CO_2 emissions levels overall and for transport (2009)

	Total CO_2 emissions		CO_2 emissions from transport		
	Total ($MtCO_2$)	Per capita (tCO_2)	Total ($MtCO_2$)	Per capita (tCO_2)	% of total emissions
World	**28,999**	**4.29**	**6,544**	**0.968**	**22.6**
OECD countries:					
North America	6,180	13.27	1,940	4.166	31.4
Asia and Oceania	2,099	10.00	418	1.996	19.9
Europe	3,765	6.85	957	1.742	25.4
Non-OECD countries:					
Africa	927	0.92	233	0.230	25.1
Asia (excl. China)	3,153	1.43	492	0.223	15.6
China	6,877	5.14	476	0.356	6.9
Middle East	1,509	7.76	329	1.689	21.8
Europe	2,497	7.46	346	1.032	13.9
Latin America	974	2.16	339	0.751	34.8

Source: Based on IEA, 2011a.

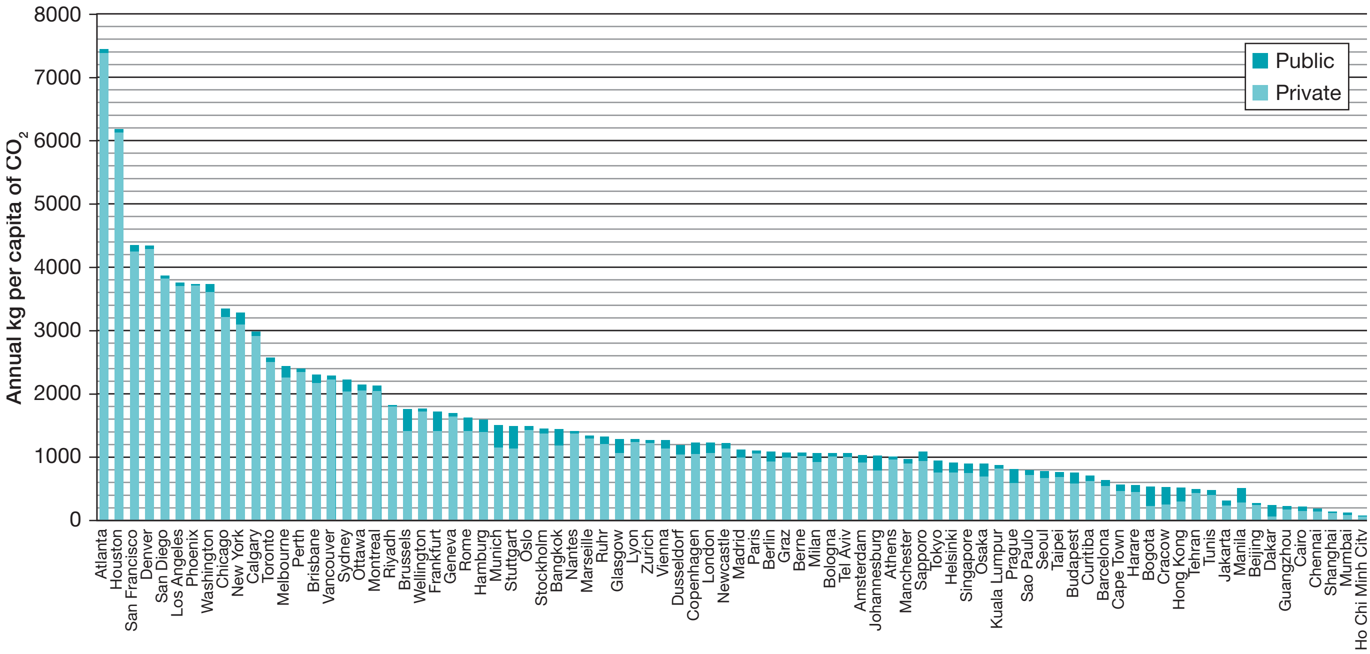


Figure 7.3

Per capita emissions of CO_2 from (private and public) passenger transport in 84 cities (1995)

Source: Kenworthy, 2003, p18.

increased, and some have taken action to reduce the potential impacts. However, some 40 million people are still exposed to a 1 in 100 year coastal flood event, and this will rise to 150 million in 2070.[27] A recent survey of 90 cities indicates that severe flooding and storm-water management is among the top three challenges facing cities.[28] Transport is central to the functioning of cities, and it is often the transport system that is initially affected by flooding and high temperatures. Yet, it is that same transport system that is required to provide access to the locations that have become isolated as a result of flooding. Furthermore, when urban transport infrastructure fails this can have far-reaching economic consequences, as people cannot get to work and goods cannot be distributed.[29]

There is . . . an immediate need for cities to take action to protect the existing transport infrastructure from the impacts of climate change

There is thus an immediate need for cities to take action to protect the existing transport infrastructure from the impacts of climate change. This includes continuous maintenance, but may also require additional investments in drainage, erosion control and protective engineering structures. At the same time, cities all over the world should integrate planning for climate change with general land-use planning to reduce vulnerability for new developments. This should include limitations on developments in flood-prone locations. The infrastructure itself can be designed to be more resilient to high temperatures (e.g. buckling of rail, effects on metallic bridges, etc.), and should be raised above the levels of the surrounding countryside to allow passage during flooding. Furthermore, drainage systems should be designed with a capacity to move flood waters away from the infrastructure.[30] Moreover, improvements to existing, or development of new, transport infrastructure should take into account the requirements of the whole urban population, including vulnerable and disadvantaged groups (see Chapter 6).[31]

Dependence on motorized forms of transport and urban sprawl

Increasing levels of motorization have, in most cities, resulted in lower densities and decentralization, with the second-round effect that suburban living has generally encouraged the ownership of a car. Motorization also exacerbates congestion, which can have the knock-on effect of increasing travel times on public transport, thus further encouraging travel by private cars. While, in many cities, buses tend to be unreliable (due partly to congestion),[32] the car seems to offer more control as alternative less congested routes can be used, giving the driver greater flexibility. For those with access to a car, mobility levels increase and many also want to live in lower density developments. This gives rise to urban sprawl. This in turn makes it difficult to provide alternatives to the car.[33] Such development has been common in locations where land is available and cheap.[34]

For [the poorest and most vulnerable] groups, urban sprawl often leads to social isolation

However, not everyone can afford a private car, leading (in many cities) to a social stratification of urban transport systems. The poorest and most vulnerable groups (including women, children, youth, elderly and disabled persons) cannot afford to (or are unable to use) private cars.[35] For these groups, urban sprawl often leads to social isolation.[36]

In addition to more space being taken up by low-density developments, transport systems in such settlements also use substantial amounts of space for roads, railways, car parks and other associated infrastructure. The loss of agricultural land and the changing local climate resulting from greater amounts of land being allocated to urban development (and motorized transport) mean that there may be increased fragmentation of natural habitats, reductions in biodiversity and impacts on local ecosystems as roads act as barriers.[37] An Australian study found that energy use in suburban households was 50 per cent higher than those in the urban centre, and this was explained primarily by greater car use and longer journeys.[38] Other countries (for example, China) now have the problem of loss of productive land as cities spread and as car ownership levels increase. In Hyderabad (India), which more than doubled its population between 1980 and 1999,[39] the urban land take increased from 9 per cent to 24 per cent of the total land available (1980–1999). This resulted in a 24 per cent reduction of the agricultural land area.[40]

Human health concerns

The increased motorization of urban transport is also causing serious challenges to human health. This section summarizes the main physical health concerns related to air and noise pollution, reduced physical activity, as well as issues related to community severance, open spaces and mental health. Road traffic accidents, which are perhaps the most prominent human health concern from urban mobility, are discussed in Chapter 6, as part of the discussion on urban safety and security.

■ *Air pollution*

The impacts of air pollution on air quality and human health are gaining increasing attention by residents and local governments alike.[41] Worldwide, it has been estimated that 'a record 3.2 million people died from air pollution in 2010, compared with 800,000 in 2000'.[42] The impacts of transport-related air pollution affect all urban residents, but there is substantial evidence that it affects the poor and vulnerable groups more than others. In fact, the social groups that are most seriously impacted are often not those that cause the pollution.[43] The main groups of local air pollutants – nitrogen oxides, volatile organic compounds, carbon monoxide and particulate matter (as well as some other pollutants) – are described in Box 7.2.

Trucks and other freight carriers emit disproportionate amounts of pollutants in cities. Even

An Australian study found that energy use in suburban households was 50 per cent higher than those in the urban centre, and this was explained primarily by greater car use and longer journeys

Box 7.2 Air pollutants

Nitrogen oxides (NO_x) when combined with other air pollutants can lead to respiratory difficulties and reduced lung functions, particularly in urban areas (where densities lead to higher concentrations). In the 32 member countries of the European Environment Agency, transport emissions of NO_x have reduced by 32 per cent (1990–2008) through the introduction of catalytic converters, but this reduction has been offset by some growth in traffic.[a] In many developing countries the add-on technology is not mandatory and traffic has been growing at a rapid rate.

Volatile organic compounds comprise a wide variety of hydrocarbons and other substances (e.g. methane and ethylene) that result from the incomplete combustion of fossil fuels. When combined with NO_x in heat and sunlight, hydrocarbons and volatile organic compounds generate low-level ozone, a main contributor to photochemical smog. Their impact has a measurable effect on respiratory functions and as an irritation, but these levels are declining as technologies improve.[b]

Carbon monoxide (CO) is an odourless and almost colourless gas, which is very toxic as it interferes with the absorption of oxygen. This in turn can lead to increased morbidity and can affect fertility and general levels of health. The transport sector is a major contributor as carbon monoxide comes principally from the incomplete combustion of fuel.[b]

Particulate matter consists of very small particles (under 10 microns in diameter: PM_{10}), that come mainly from diesel fuels, tyre particles and road dust. They can cause cancer, worsen heart and breathing problems for sensitive groups and may lead to premature mortality for all urban residents. Among 59 cities in Asia, Africa and Latin America, only two meet standards for PM_{10}, while 46 of the cities exceeded the standard by more than twice (WHO standard is 90 milligram per cubic metre).[c] Cities in developing countries are most at risk, partly due to minimal enforcement. In Beijing, China, the government shut down '103 heavily polluting factories and took 30% of government vehicles off roads to combat dangerously high air pollution . . . but the . . . air remained hazardous despite the measures' in January 2013. The reason was that the amount of $PM_{2.5}$ (particles with a diameter of less than 2.5 microns) reached more than 500 milligram per cubic metre, on a scale where 300 is considered hazardous, while the WHO recommends a daily level of no more than 20.[d] Similar high levels have also been reported in other Asian cities, such as New Delhi, India.[e]

Other pollutants – such as lead (Pb), ammonia (NH_3) and sulphur dioxide (SO_2) – have transport links but are less important than the four listed above, as they are being reduced through the switch to different and 'cleaner' fuels and new designs for catalytic converters. However, many cities still allow the use of leaded petrol, despite the known dangers for children and their mental development.

Sources: [a] EEA, 2011a; EEA, 2011b; [b] EC, 2006; [c] World Bank, 2007; [d] Reuters, 2013; [e] Stainburn and Overdorf, 2013.

In developed countries, about 130 million people are exposed to unacceptable noise levels

though they make up less than 10 per cent of road traffic in most European cities, large commercial vehicles can cause half of all nitrogen dioxide emissions, about a third of particulate matter, and more than 20 per cent of greenhouse gas emissions.[44]

■ *Noise pollution*

Noise and vibration are often cited as nuisances to people living in urban areas, but it is often the peak or unexpected noises that are most problematical. In developed countries, about 130 million people are exposed to unacceptable noise levels over 65dB(A), and 400 million to inconvenient levels of over 55dB(A).[45] In some 'quiet' countries (parts of Scandinavia) only 5 per cent of residents are exposed, while up to 30 per cent of residents in 'noisy' cities can be exposed.[46] Prolonged exposure to noise can lead to anxiety, depression and insomnia.[47] Vibration is caused by all vehicles, but it is heavy trucks that cause most intrusion and this again affects sleep, increasing levels of stress and anxiety.[48] Noises from horns are common in many cities, and car alarms also cause nuisance to residents. In Moscow, around three-quarters of the population live in areas with levels of transport noise that exceed WHO standards.[49]

The perceived danger of walking and cycling is a strong disincentive to non-motorized transport

■ *Human health and physical activity*

There are also major health effects resulting from the lack of physical activity that accompanies increased motorization. The perceived danger of walking and cycling is a strong disincentive to non-motorized transport.[50] As more people travel by motorized transport, the risks to vulnerable road users increase, and, as a result, fewer people walk and cycle. There is growing evidence of the links between physical inactivity and weight, and of the impacts that these two factors have on the risk of diabetes, heart disease, colon cancer, strokes and breast cancer.[51] Food-energy intake has not decreased in line with reductions in physical activity, and many countries are experiencing an epidemic in obesity.[52]

The links between health and non-motorized transport need to be emphasized through education programmes and the involvement of doctors

According to the Global Burden of Disease Study, overweight and obesity accounts for 36 million disability adjusted life years (DALYs) lost, with physical inactivity accounting for a further 32 million DALYs.[53] In the UK, about 66 per cent of adults do not get enough exercise, and the majority of the population is now overweight or obese.[54] The links between health and non-motorized transport need to be emphasized through education programmes and the involvement of doctors. Copenhagen, Denmark, is often cited as a good example of a cycling city as there are numerous initiatives, both private and public, to promote cycling.[55]

Community severance divides and fragments communities, and is often a result of heavily used transport infrastructure forming a barrier so that people cannot cross the road or rail track

In a study of 30,000 people over a 14 year period, it was found that cycling to work reduced the risk of mortality at a given age by 39 per cent relative to those that did not cycle, and over half of cyclists (54 per cent) cite speed and convenience as their main reason for cycling, meaning that their journey times were reduced.[56]

■ *Community severance, open spaces and mental health*

Community severance divides and fragments communities, and is often a result of heavily used transport infrastructure forming a barrier so that people cannot cross the road or rail track. It adversely affects the quality of life, the level of activities on the street and the amount of social interaction within communities. It is particularly important for young people who are trying to socialize, and who often come to the understanding that the urban space surrounding them belongs to motorized vehicles rather than people.[57]

The reallocation of space from people to cars means that roads are widened and the space available for non-motorized modes is reduced. Furthermore, the expansion of roads often competes with open and green spaces (as well as squares and other spaces that allow people to spend time together). These spaces are important for the quality of life, and for their role in providing the 'lungs' of the city. Much of these spaces are open to the public and can be used for recreational and sporting activities, as well as providing habitat for wildlife and for absorbing carbon.[58]

There is also evidence that traffic congestion can impair 'health, psychological adjustment, work performance and overall satisfaction with life'.[59] Research indicates that job satisfaction and commitment declines with increased road commuting distance (but not with public transit use), and that perceived traffic stress is associated with both lower general health status and depression.[60] According to the 2011 IBM commuter pain survey, 42 per cent of respondents stated that their stress levels (due to congestion) had increased and 35 per cent reported increased anger.[61] Additional environmental effects of traffic congestion include pedestrian/vehicle conflicts on congested streets, which cause safety concerns and traffic delays, visual intrusion caused by elevated roads, bus stations, etc., and distorted city image, which disturbs liveability and reduces tourism potential.[62]

REDUCING THE NUMBER OF MOTORIZED TRIPS

There are many opportunities to reduce the need to travel by motorized transport. One is to travel by non-motorized means instead (i.e. walking or cycling).[63] Cycling can be encouraged for many shorter trips (i.e. normally less than 10 kilometres), provided that the infrastructure is available, including space to securely

Box 7.3 A successful bicycle sharing system, Changwon, the Republic of Korea

The city of Changwon is working towards becoming Korea's leading 'eco-rich city', by improving the quality of life through sustainable mobility and non-motorized transportation. As a part of this effort, the 'Nubija' bicycle sharing system was introduced on 22 October 2008, with 20 parking stations (where bikes can be checked out and returned) and a total of 430 bicycles.

The system has since increased steadily, and by 2011 there were 163 parking stations (with 3300 bicycles). At that time, the membership of the scheme had reached 76,579, who ride an average of 4396 kilometres per day. By early 2012 it was reported that the number of parking stations had reached 230.

The bicycle sharing system has led to annual emissions reduction of more than 4000 tonnes of CO_2 by 2011. Other outcomes have been reduced energy consumption, lower levels of air pollution and better public health.

Sources: ICLEI, 2010; ICLEI and Changwon City, 2011; Rhee and Bae, 2011; Sociecity, 2011; Changwonderful, 2012.

leave the bicycle. More imaginative innovations are the cycle hire schemes that are now a feature of many cities (see for example Box 7.3), where old technology (the bicycle) has been matched up with the new technology (smartcards), so that bikes can be used on demand, either free for an initial period or for a reasonable charge. Another good example is that of Paris, France, which has introduced a popular bike sharing scheme (*vélib*) and aims to increase the city's network of bike lanes to some 700 kilometres by 2014.[64] The co-benefits are manifest for the user (healthy and fast) and for the transport system (less space is used). However, it should be noted that the potential for increased bicycle use is related to age and (dis)ability, as well as prevalent cultural constraints, that may, for example, limit the use of bicycles by women.

Unfortunately, in many cities of developing countries the promotion of cycling as an alternative to motorized travel is fraught with danger, due to lack of dedicated bicycle lanes, forcing riders into a rather uneven competition for road space with motorized vehicles. There are some positive developments though. The City of Buenos Aires, Argentina, for example has since 2010 developed a 94-kilometre network of protected bike lanes, and introduced a bike-share programme featuring more than 22 stations and over 850 bikes. The City intends to expand its bike lane network to 130 kilometres by 2013.[65] Similarly, the two Egyptian cities of Fayoum and Shebin El Kom are planning the construction of 14 kilometres of cycling tracks and improved sidewalks on major streets.[66]

Another means to reduce the number of trips is through trip-chaining, where several activities are undertaken on one tour (from home back to home) rather than as a series of several individual trips. This again reduces overall distance travelled, but needs to be matched by the location of destinations in close proximity to each other and by mixed-land uses.[67]

The most effective way of reducing the number of trips (at least in theory) is that a specific trip is no longer made as it has been replaced by a non-travel activity or substituted through technology, for example internet shopping (Box 7.4). For many years now there have been debates over the potential for teleworking, teleactivities and teleconferencing,[68] and the more recent advent of mobile technology has opened up many new possibilities.[69] Although there is a large substitution potential, the relationships seem to be symbiotic with a greater opportunity for flexibility in travel patterns, as some activities are substituted, while others are generated, and some replaced by fewer longer distance journeys.[70]

The introduction of new technology has extended to mobile phones, and these have become available worldwide, often changing lives through allowing social and business communications. It is unclear about the implications for travel, but the effects are likely to be positive for the environment, as less carbon-based energy will be used.[71] Conventionally, the impacts of mobile phones have been grouped into three categories: incremental (improving the speed and efficiency of what people already do), transformational (offering something new) and related to production (selling mobiles and related services). The impact of mobile phones has been most profound in developing countries, where telephone communications in the past were reserved for the rich.[72]

The most effective way of reducing the number of trips . . . is that a specific trip is no longer made as it has been replaced by a non-travel activity or substituted through technology

Box 7.4 Internet shopping

Sainsbury's is the third largest chain of supermarkets in the UK. Sainsbury's Online is the internet shopping brand, where customers choose their grocery items online and items are delivered to customers from a local store (165 stores operate an online service) by van. This service is available to nearly 90 per cent of the UK population.

In 2005, Sainsbury's Online tested Smith Electric Vehicles in its home shopping delivery applications in and around Central London. The year-long trial proved so successful that Sainsbury's placed an order for eight vehicles in 2007 and a further 50 in 2008. Each zero emission van will reduce emissions by 5 tonnes of CO_2 per year.

Source: London, undated.

REDUCING TRAVEL DISTANCES IN CITIES

Urban spatial structure (or urban form)[73] is important in determining transport mode and distance travelled, as it links the spatial distribution of population and jobs within the city to the pattern of trips. Thus, urban planning has a major role to play in organizing spatial activities in cities so that they are in close proximity to their users. Two important factors are at work here. First, if travel distances are reduced then accessibility is improved as activities can be undertaken with less travel. Second, if travel distances are short, then it becomes more attractive to walk and cycle – particularly if space is allocated for exclusive rights of way – and to use public transport, and this in turn reduces the energy use and the environmental impacts of transport.

Urban planning has a major role to play in organizing spatial activities in cities so that they are in close proximity to their users

Such an approach implies that the available street space in cities can be optimized for the highest number of users. An increased focus on urban planning means that the city operates more efficiently, but it also increases equity as services and facilities become accessible to the entire population. Optimization of street space, however, is not only a matter of urban planning. Efficient traffic engineering design, supply and demand management, enforcement of traffic law and efficient governance at the city level are necessary requisites for introducing and sustaining urban transport services and facilities in developing countries.

Regardless of the form of the city, it is important to develop around highly accessible public transport nodes so that the attractiveness of these areas is fully realized

Many cities in developing countries are growing rapidly, driven by inward migration and population growth. This implies a considerable potential for urban planning to keep travel distances as short as possible. Peripheral sprawl needs to be discouraged as it uses valuable agricultural land, because it increases travel distances and makes the provision of public transport more difficult. The arguments for high urban densities are strong on both transport and land take reasons, and cities should be encouraged to build upwards (higher buildings) and not outwards (suburban sprawl).[74]

Regardless of the form of the city, it is important to develop around highly accessible public transport nodes so that the attractiveness of these areas is fully realized. These areas integrate land use and transport through the promotion of high-density development around accessible points and interchanges on the public transport network, facilitating walking and cycling and increased use of public transport systems. Development needs to include mixed uses, covering housing, jobs, schools, shops, health facilities, educational services (e.g. crèches) and recreational opportunities, so that all activities can take place in one location. Such developments are particularly important for women, who often have quite complex travel patterns.[75]

Transport development areas often become the new mega nodes within cities where people meet to carry out their business and social activities, and they consequently promote social cohesion. These public transport interchanges can thus become the new commercial hubs for cities, for example in Canary Wharf, London (Box 7.5) and Shin Yokohama (Japan). Singapore (Table 7.4) has also constructed public housing close to the metro stations, and this allows lower income people access to both housing and transport.[76] Such public transport interchanges can often be financed by developers, as has been the case in Hong Kong, Singapore, Frankfurt and London.

Apart from the major contribution that transport development areas can play in encouraging sustainable mobility in cities, they are seen as central to the urban regeneration process that involves the creation of new city places and spaces, and there is usually strong community involvement so that the benefits can be widely distributed across all social groups.

Box 7.5 Transport accessibility to Canary Wharf, London, UK

Canary Wharf is a major business and financial district located in the eastern part of London. It contains around 1.3 million square metres of office and retail space and a workforce of around 93,000 people (in 2009). It is home to global or European headquarters of numerous major banks, professional services firms and media organizations.

Construction began on the old docks area in 1988 as part of a major urban regeneration programme. A key element of the planning was to ensure high-quality access by public transport through the extension of the Jubilee Line metro, the new Docklands Light Railway, improved bus services, river boat services and cycle routes. There is little parking available, but a substantial amount of residential development has taken place in the riverside areas surrounding Canary Wharf.

A survey was carried out in June/July 2009 within the local areas and Canary Wharf to measure the movement of people throughout the area and in particular those travelling to Canary Wharf. During the survey period only 5.1 per cent of workers at Canary Wharf travelled by car, down from 6.2 per cent in 2007. Cycling has increased in popularity across London and Canary Wharf is no exception. Nearly 4 per cent of workers cycled to work in 2009, up from 2.9 per cent in 2007.

Use of public transport, including the Jubilee Line and the Docklands Light Railway, continues to increase, especially from areas east of Canary Wharf, reflecting the area's rapid regeneration and the increased number of Canary Wharf-based workers living in East London. About 90 per cent of all people coming to Canary Wharf do so by public transport.

Source: Canary Wharf Group plc, undated.

Table 7.4

Planning and development measures taken in New York City and Singapore

New York City (population 8.2 million in 790km²)	Singapore (population 5 million in 700km²)
Background information: Manhattan (population 1.6 million) covers 53km² and has 35 per cent of the total regional jobs, with the Midtown having 2160 jobs per hectare.	**Background information:** Singapore has a compact urban structure supported by high-quality public transport.
Measures: • Strict zoning with 'floor area ratio' 11–15.[a] • Mixed zoning – office, commercial, recreational and housing. • Transit system operational throughout 24 hours. • Parking spaces taxed by municipality, and most parking is provided privately and off-street. • Increasing the subway network to 337 kilometres – transit density of 56 kilometres per million population. • Encourage walk and cycle – 21 per cent trips in New York City are walk and cycle and a further 55 per cent by mass transit. • Ensure the working environment is intellectual, fertile and innovative.	**Measures:** • Restraint on car ownership, use and costs through quota system, electronic road pricing, fuel taxation and parking controls. • Public housing areas some located at metro stations to give easy access to employment. • Some decentralization to regional centres to reduce travel distances. • Reductions in need to travel and dependency on car though providing high-quality alternatives. • Rail network to double from 138 kilometres to 278 kilometres by 2020 (US$14 billion) – transit density of 51 kilometres per million population (2020).

Note: [a] The floor area ratio refers to the ratio of floor space to the land area of the development – so a ratio of 11 means that 11,000 square metres of floor space can be built on a piece of land measuring 1000 square metres.

Source: Based on Bertaud et al, 2009.

CHANGING THE MODAL SPLIT

Transport policy has often been strongly orientated towards maintaining and increasing the levels of public transport use in the city. However, success has been limited, as other factors have intervened, such as increases in incomes and growing urban populations. These factors have meant that the car and the motorcycle have become dominant. It is important to the quality of life and to the environment that as much urban travel as possible is undertaken by non-motorized and public transport, as these modes are the most environmentally efficient. In many European cities up to 60 per cent of all trips are made by walking, cycling or public transport. A survey of 26 cities in four EU countries indicated that the proportion of trips by car ranges from 17 to 73 per cent. The interesting point to note from this survey is the variability in modal shares, and that there does not seem to be any direct relationship between population density (or size) and the prevalence of specific transport modes.[77] However, high-capacity public transport systems, such as BRT, can offer a viable alternative to car dependence in cities of developing countries (see Box 7.6).

It is essential that the full cost of the energy used in transport, including all externalities, is reflected in the price.[78] Real cost increases reduce the amount of energy used (and thus the greenhouse gases emitted) and reduce travel distances (as they encourage more local travel) and the greater use of non-motorized and public transport. This full economic price could be based on the carbon content of the fuel, but it also needs to include a number of other external factors.[79] There are three basic groups of strategies that can be used to encourage modal shift to more energy-efficient forms of transport, namely: regulatory measures, pricing measures and investments in public transport.[80]

Regulatory measures can place limitations on the numbers of vehicles on the road at any given time or day. Limitations can also be placed on the number of new vehicles that can be registered in the city. For example, both Beijing and Singapore use a quota system. In Singapore, the Land Transport Authority allocates quotas for each vehicle category according to the current traffic conditions and the number of vehicles taken off the roads permanently (Table 7.4). The vehicle quota for a given year is administered through the monthly release of 'certificates of entitlement' and the certificates are allocated

It is important . . . that as much urban travel as possible is undertaken by non-motorized and public transport, as these modes are . . . most environmentally efficient

Regulatory measures can place limitations on the numbers of vehicles on the road at any given time or day

Box 7.6 Promoting sustainable transport solutions in Eastern African cities

The 'Sustainable Transport Solutions in East African Cities' project (SUSTRAN) aims to reduce growth in private motorized vehicles, thus reducing traffic congestion and greenhouse gas emissions in the cities of Addis Ababa (Ethiopia), Kampala (Uganda) and Nairobi (Kenya). The project – which is implemented by UN-Habitat in collaboration with UNEP with financial support from the Global Environment Facility – includes support for the design and implementation of transport corridors featuring BRT, non-motorized transport and travel demand management measures. It also supports regional capacity building, including city-to-city learning. While collaborating with local metropolitan and transport authorities, the project has promoted the active involvement of current transport operators and other stakeholders. By 2035, it is projected that this initiative will have led to a reduction in greenhouse gas emissions amounting to more than 2.5 million tonnes.

Source: http://www.unhabitat.org/SUSTRAN, last accessed 6 August 2013.

Very few cities have introduced pricing as a mechanism to limit the numbers of cars coming into the central area

through an auction.[81] In Bogotá, Colombia, the *pico y placa* (Box 7.7) limits the numbers of vehicles on the road on a given day by allowing odd and even number plates to be used on alternative days.[82] However, this latter type of measure may encourage higher income-residents to buy a second car, often with an older, less efficient engine (thus leading to increased emissions).

Parking regulations are important as this relates to the allocation of space in cities by price and time of day, and it covers both on-street and off-street locations (Box 8.5). As part of the congestion charging scheme in London, UK (introduced in 2003), parking availability was reassessed both within the pricing area (to reduce it) and outside the area to encourage commuters to leave their cars at home.[83] Many cities have also introduced park-and-ride schemes where drivers leave their cars at the periphery and continue their journeys into the centre by public transport. A recent survey of 45 schemes in Europe found rather uneven implementation, but where deployment had taken place there was strong public support, as traffic levels and levels of pollution had been reduced.[84]

Pricing measures include electronic road pricing (Singapore), congestion charging or cordon pricing (London, UK, and Stockholm, Sweden),[85] and parking pricing to reflect the value of the space used. But very few cities have introduced pricing as a mechanism to limit the numbers of cars coming into the central area, and even in those cities that have introduced schemes, it has only covered a small part of the city. In addition, fuel prices are often taxed, although the levels vary considerably from country to country, as it relates both to the levels of duty imposed and the additional national and local taxes imposed.[86] Some countries have tried to use fuel duty escalators, so that the real price of petrol and diesel increase over time to reflect the full economic costs, but this has proved unpopular with the oil industry, car manufacturers, as well as motorists.[87] All of these measures have primarily been introduced to raise revenues[88] and to address congestion issues, even though it has been acknowledged that there are also environmental benefits.[89]

Public transport fare subsidies can have social objectives in increasing the mobility of low-income

Box 7.7 TransMilenio: Supporting sustainable mobility in Bogotá, Colombia

The first two phases of the TransMilenio BRT system in Bogotá, Colombia, were completed by 2003, and it has a total of 84 kilometres of median busways, about 25 per cent of which is completely segregated from other traffic. The final phase (of another 100 kilometres, which was due to be completed in 2012) has been delayed due to unresolved political issues (including plans to construct a metro).

By 2011, the BRT system included some 1190 articulated buses, 10 bi-articulated buses, 114 access stations (with prepayment), 6 terminals and 4 intermediate integrated stations. In addition there were 448 feeder buses, running on 61 feeder routes with 420 line-kilometres. TransMilenio is frequently cited as a 'good practice' BRT project, and it carries some 1.7 million passengers per weekday, with 43,000 passengers moving each hour in one direction. The uniqueness of Bogotá's system is the 'transformation of a busway corridor with severe pollution, safety problems and aesthetically displeasing into a new BRT system with significantly lower travel times, lower noise and fewer greenhouse gas emissions'.[a]

By drastically reducing existing travel times and acting on the radial corridors connecting residential areas to the central business district, TransMilenio has done much to reinforce the attractiveness of the city centre. Public acceptance of the project is over 70 per cent, but there have been complaints about overcrowding and the time taken for interchange from the feeder lines. Furthermore, many people still lack access to the system as the network does not extend to the locations where the poor are living. In 2005, the population located in the more remote parts of the city accounted for 65 per cent of the total population, as the land there was cheaper and thus more affordable for low-income people. In fact, land-use value increases around the TransMilenio corridors have been estimated to be close to 20 per cent.

While the TransMilenio system has played an important role in contributing to more sustainable mobility system in Bogotá, it is worth noting that it was introduced as part of wider policy package, which also included the following components:

- Development of 285,500 square metres of walkways, green spaces, road dividers, sidewalks and shaded promenades, with 11 metropolitan parks, 3149 neighbourhood parks and 323 smaller scale parks.
- Construction of 350 kilometres of bikeways contributed to an increase in bicycle use from 1 per cent in 1995 to 7 per cent in 2010, when there were a total of 1498 bike parking locations.
- In addition, the introduction of the *ciclovia* system implies that some 120 kilometres of main roads are closed to motor vehicles for seven hours every Sunday, so that streets can be used by people for walking, cycling, jogging and meeting each other.
- Peak and license plate (*pico y placa*) restrictions during peak hours (6–9 am and 4–7 pm) using plate numbers for 40 per cent of the private cars.
- Fees and taxes: 20 per cent petrol surcharge (revenue allocated to public transport infrastructure and road maintenance) and car-free weekday in February (approved by popular vote).

Sources: Bocarejo and Tafur, 2011; Hidalgo and Carrigan, 2010; Hidalgo et al, 2007; Rodriquez and Targa, 2004; [a] Estupiñán and Rodriquez, 2008, p299.

households, but it is important that such subsidy goes to the identified user. It is also important to make sure that the quality of the public transport fleet is maintained at a high environmental standard, and that operators are given an incentive to invest. But subsidies have much wider impacts on livelihoods, as illustrated by a study of public transport in Sub-Saharan Africa:

> 'Subsidies and other forms of compensation can help formal public transport but an integrated framework and a level playing field are also needed for all types of transport to flourish. Financial mechanisms should be put in place to support the system, integrating the different types of collective transport rather than allowing profits to be scooped up by the informal sector with no regard for the burden of costs they might place on local governments and society as a whole. This can include trust funds, better credit facilities, land-value capture and other sources of revenues that can be used to help build sustainable low-carbon transport systems that will allow Africa to flourish and develop economically.'[90]

As noted above, subsidization is a form of incentive to encourage people to change their behaviour, and it can also apply to cars. For example, incentives can be given to encourage the purchase of more efficient cars and electric vehicles, where purchase prices are subsidized, or where preferential parking is given, or exemption from paying the congestion charge is given. All three of these incentives have been introduced in the UK.[91]

Investment in public transport and public transport infrastructure are both central to make sure that priority is given to this transport mode, as it allows the greatest number of people to be carried most efficiently. Public transport has to share space on congested roads with other traffic, and this reduces its efficiency. Trams have provided one effective means to introduce 'clean' transport that has a clear priority through control (traffic signals) and exclusive tracks.[92]

More recently, BRT is seen as a flexible and cheap means to invest in high-quality public transport with a separate right of way.[93] As discussed in Chapter 3, BRT potentially offers a high-capacity, relatively inexpensive and flexible form of public transport in many cities. BRT systems have good environmental credentials and can be introduced in a variety of different forms. Box 7.7 looks at how BRT can be combined into part of an integrated set of measures that have the potential to change perceptions of public transport.

TECHNOLOGICAL INNOVATION AND VEHICLE EFFICIENCY

This section presents technological and other policy responses related to increasing the efficiency of motorized vehicles and the use of the best available technology. This implies that the use of carbon-based fuels should be substantially reduced and cleaner low-carbon fuels should replace them for all forms of motorized transport (freight and passenger). As noted earlier in this chapter, the amount of CO_2 produced by motorized vehicles is directly related to the amount of fuel used, and there is considerable potential for reductions.[94]

Public transport fare subsidies can have social objectives in increasing the mobility of low-income households, but it is important that such subsidy goes to the identified user

However, it should be remembered that efficiency gains must be set against the growth in traffic,[95] as this often outweighs those gains. The discussion below focuses on four main issues, namely: the efficiency and age of the vehicle stock, standards of fuels used in vehicles, the potential of alternative fuels, and vehicle occupancy.

It is here important to note that there is a substantial potential for technological 'leapfrogging'. Thus there is no reason why cities in developing countries have to follow the same high-motorization (and high-pollution) pathway as that followed in developed countries. Rapid urbanization in many developing countries thus presents an opportunity to invest in the low-carbon city transport system of the future. That having been said, it is important to note that this cannot be undertaken without substantial financial support from the developed countries. This means that effective mechanisms need to be established, such as the fuel security credits being tested by the Asian Development Bank,[96] or initiatives under the clean development mechanism of the Kyoto Protocol.[97]

Investment in public transport and public transport infrastructure are both central to make sure that priority is given to this transport mode

Efficiency and age of the vehicle stock

The scale of any emission reduction is dependent on a set of factors such as the efficiency and turnover rate of the vehicle stock, the distance driven by each vehicle, and the tendency to buy larger and heavier vehicles. New vehicle technology has reduced the fuel use per unit of power by 50 per cent over a 15 year period (1990–2005), yet most of that potential saving has been negated by the overall increase in power and weight, particularly in the US. Thus the net effect has been no change.[98]

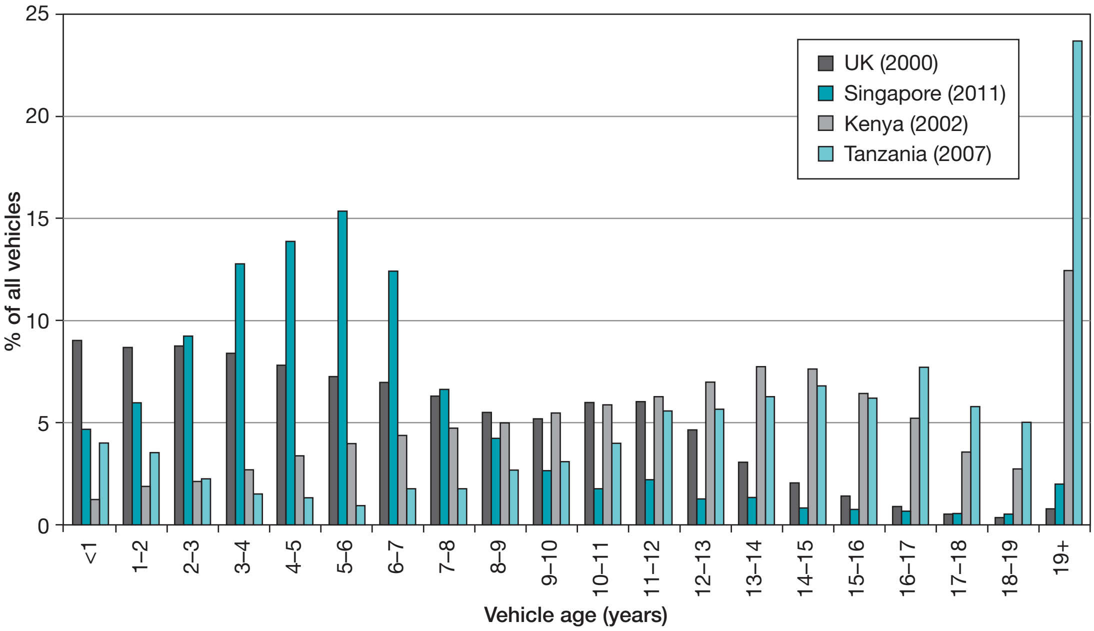
Efficiency gains must be set against the growth in traffic, as this often outweighs those gains

The introduction of new technologies does not, however, lead to immediate cuts in emissions. The efficiency of any single vehicle on the road is always lower than that of the newest technology. In general, this implies that overall emissions depend on the average age of the vehicle fleet in any particular country (or city). And, in the countries with the oldest

Figure 7.4

Vehicle age distribution, selected countries

Sources: Based on data from Kollamthodi et al, 2003 (citing DTLR Vehicle licensing statistics 2000); Government of Singapore, 2011; University of California at Riverside, 2002; UNEP, 2009 (citing data from Tanzania Revenue Authority).



Developed countries are exporting their less efficient and more polluting vehicles to developing countries

vehicle fleets, maintenance becomes a central issue. In general, the average age of vehicles in developed countries is lower than in developing countries, where the average age of vehicles can be more than 15 years[99] (Figure 7.4). There are some exceptions however, such as Brazil, which is one of the few developing countries with its own car manufacturing industry.[100] Some of the vehicles in developing countries operate for more than 40 years. These older vehicles are responsible for a disproportionately high percentage of air pollution, despite their relatively low numbers:

> 'The main reasons for the persistence of old technology include the high cost of new vehicles, the relatively low maintenance and support cost for older technology, and a lack of government fleet renewal incentives (including inspection and maintenance regimes).'[101]

However, there are examples, even from developing countries of successful schemes of upgrading the vehicle fleet. In Cairo, Egypt, for example, the government has initiated a scheme to renew the taxi fleet. The project started in 2007 with the introduction of 100 new air-conditioned (and metered) taxis, fuelled by CNG. In 2009, through a joint scheme with five car companies, three banks, advertising agencies (who were given the right to place advertisements on the taxis) and owners of scrapping yards, the scheme was launched at full scale. By 2013, a total of 43,000 old taxis had been replaced.[102]

Most developing and transitional countries – with the major exceptions being Brazil, India and China – do not have their own car manufacturing industry. The majority of developing countries are thus relying on imported vehicles. And, due to the cost of new vehicles, many of the imported vehicles are second-hand. In effect, developed countries are exporting their less efficient and more polluting vehicles to developing countries. Over the period 2005–2008, for example, 2.45 million vehicles were imported to Mexico from the US and Canada (with an average age of 11.4 years). The vehicles exported from the US to Mexico had higher emissions levels of hydrocarbons (4 per cent higher), carbon monoxide (4 per cent higher) and nitrogen dioxide (22 per cent higher) than the average vehicle in the US. Yet, the emissions of these vehicles were still lower than that of the existing fleet in Mexico.[103]

In order to address the issue of this 'dumping' of polluting vehicles, a number of countries have introduced technology- or age-restrictions on imported vehicles. In Kenya, for example, only models that are eight years old or less can be imported.[104] In Belarus, the government discourages the import of older cars through high import duties.[105]

Standards of fuels used and emissions from vehicles

The emission of pollutants from motorized vehicles is related to three main factors: the quality of the fuel, the fuel efficiency of the vehicle stock and the capture of pollutants before they escape from the vehicle. These are discussed in more detail below.

Considerable progress is being made in improving the quality of fuel used and the efficiency of the conventional petrol and diesel internal combustion engine, so that the typical car is now some 35 per cent more efficient than it was ten years ago. This improvement can be directly translated into reductions in CO_2 emissions.[106] The EU has introduced legislation (2009) for a reduction of the greenhouse gas intensity of fuels by up to 10 per cent by

2020 – a ‘low carbon fuel standard’. This will be achieved through the greater use of renewable energy in electric vehicles, and the use of biomass sources, such as bio ethanol that is already mixed with fuel (5 per cent).[107]

Even though diesel vehicles produce less CO_2 per unit of distance travelled, their increasing dominance in the vehicle fleet (both passenger and freight) has been negated by the greater distances travelled. Diesel vehicles also tend to have larger emissions of other pollutants, such as nitrogen oxides and particulate matter (Box 7.2). As a result, the WHO has recently stated that diesel exhaust causes cancer, and has called for tighter emission standards, comparing the risk of exhaust to second-hand cigarette smoke.[108]

In India, the fuel quality standards for transport fuels are legislated under the environmental Protection Act (which follows the EU specifications). New specifications have been introduced in two phases, first applied in 13 major cities[109] and then followed by nationwide implementation. India has used unleaded petrol nationwide since 2000.[110]

Reductions in the sulphur levels in diesel have major effects on emissions, as many developing countries have very high sulphur levels[111] in diesel fuels. Reducing sulphur to very low levels[112] also reduces the emissions of particulate matter, and it enables emission control technologies that provide even greater emission reductions (i.e. diesel oxidation catalysts and diesel particulate filters).[113] For petrol vehicles, low sulphur levels[114] in fuel improve the performance of catalytic converter systems that are standard in developed countries. Low sulphur levels are now being introduced in most developing countries as well, through the importation of new and second-hand cars.[115]

Governments are increasingly looking towards vehicle manufacturers to improve the fuel efficiency of the vehicle stock. Many governments are now setting more challenging mandatory targets for fuel efficiency in new vehicles, and this single action will substantially reduce CO_2 and other emissions from the transport sector.[116] The EU tried, unsuccessfully, to introduce voluntary agreements with the vehicle manufacturers during the last decade. It is only recently (2009) that mandatory targets have been set. However, the fact that good progress has already been made towards these targets may suggest that the targets are not tough enough. Figure 7.5 shows that there is a clear downward trend in the emissions of CO_2 from new vehicles and the fleet-wide mandatory targets set by the EU will be a benchmark for other manufacturers.

Governments are increasingly looking towards vehicle manufacturers to improve the fuel efficiency of the vehicle stock

Many pollutants can be filtered out through the use of catalytic converters, particulate traps and other technologies, although this means that additional costs are imposed on vehicle owners. It is, however, also important to ensure that the filters are working effectively, and this again relates to regular maintenance and testing of vehicles. Catalytic converters do not work when engines are cold, and so for many short journeys the pollutants are not being filtered out. Regulations in Europe have gradually been tightened up so that emissions levels for all vehicles (including freight vehicles) conform to EU standards.[117] These standards are also being adopted elsewhere, for example in Russia[118] and China.[119] The US and Japan have their own emissions standards that have been tougher than those in the EU until 2000, but all three have since followed essentially the same path and are converging towards zero emissions for all pollutants.

It takes a considerable time before [the] full benefits [of emission standards] are realized, as existing older vehicles have to be scrapped and replaced by new vehicles

Due to the fact that the emission standards only apply to new vehicles, it takes a considerable time before their full benefits are realized, as existing older vehicles have to be scrapped and replaced by new vehicles.[120] Despite the clear intentions to reduce

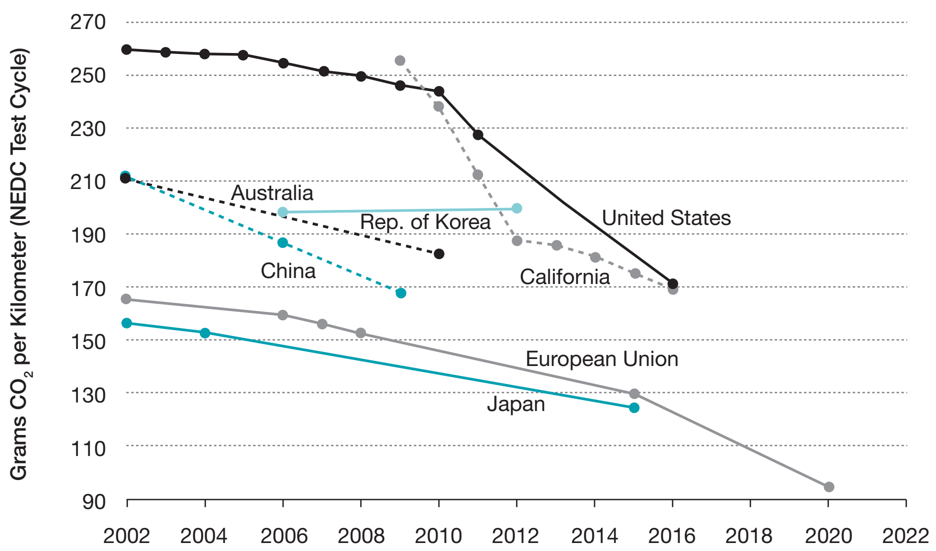


Figure 7.5

Actual and projected greenhouse gas emissions from new passenger vehicles, by country and region

Note: Solid lines are enacted; dotted lines are proposed or contested.

Source: UNEP, 2009.

The belief that add-on technology can 'solve' the air quality issue is too simple

In the near future, it is unlikely that any alternative fuel can replace the established oil-based sources of fuel, as they cannot be produced (or distributed) in the quantities required

The most positive developments have come from hybrid vehicles that combine conventional internal combustion engine with electric vehicle technology

key emissions from vehicles, in practice it will take 10–15 years to work its way through the entire vehicle stock in developed countries. In developing countries, with their considerably older vehicle stock it will take even longer.

Add-on technology (principally the catalytic converter), cleaner fuels and more efficient and lighter vehicles have helped reduce the levels of pollutants from petrol engine vehicles by 80 per cent. There are, however, questions about whether the technology is working efficiently and the rate of change in the existing vehicle fleet, particularly in those cities with the most rapid increase in levels of car ownership. Furthermore, there are still concerns over whether the same levels of air quality improvement can be achieved in diesel vehicles.[121] And, the problem of particulates is still present as this results from fuels (diesel), from tyres and from other sources, and this is much harder to control (and is a particular problem for freight trucks in urban areas).

The belief that add-on technology can 'solve' the air quality issue is too simple. As noted above, there are important limitations relating to whether the catalytic converters are working, whether diesel emissions can be controlled effectively, the time taken for all vehicles to be fitted, and the slow switch to alternative fuels. When set against the growth in car ownership and use, the catalytic converter really only gives a maximum of ten years 'breathing space' before pollution levels start to rise again. In the US, for example, the catalytic converter has been compulsory since 1979, and the full benefits have already worked their way into the entire car fleet. The CO_2 problem has not been addressed, as reduction in fuel use is the only means to reduce such emissions.[122]

Alternative fuels

In order to reduce the dependence on oil – and to reduce the emissions of greenhouse gases and other pollutants – there has been much debate over the introduction of alternative fuels in the transport sector. However, while searching for alternatives, it is important to keep in mind the fact that both petrol and diesel have very high energy densities,[123] and that there have already been substantial investments in support infrastructure in most countries (e.g. fuel stations). Thus, alternatives need to have a high energy output and they must be produced cleanly and cheaply, and in sufficient quantities.

In the near future, it is unlikely that any alternative fuel can replace the established oil-based sources of fuel, as they cannot be produced (or distributed) in the quantities required. This means that all alternative fuels are likely to be niche markets. However, these may in turn develop to mass-market options in the longer term. In situations where there is less established supporting infrastructure (e.g. in developing countries), the introduction of new fuels may happen earlier. This provides an opportunity to initiate new solutions to urban motorization in developing countries. This is already evident in some countries through the use of BRT and electric vehicles (including e-bikes).

In terms of policy, the EU seeks to halve the use of conventionally fuelled cars by 2030, to phase such cars out of cities by 2050, and to achieve carbon-free goods movement in cities by 2030. The EU believes that technological innovation will play a major role in this process, combined with regulations and standards being set by individual governments, demand management, road pricing and local city-level controls.[124]

The public discussion related to alternative fuels started with a focus on ***greater efficiency*** within existing internal combustion engines. As discussed above, efficiency levels have improved substantially, and a further halving of CO_2 emissions is expected over the next ten years (Figure 7.5). Public debate has since moved onto ***biofuels*** and ***hydrogen***. However, the potential of biofuels has been restricted by the conflicts arising from increasing food prices, as increasing production of energy crops has led to reduced areas of agricultural land producing food crops.[125] The production of liquid fuels from sugar, biomass and cellulose also requires huge amounts of water. Likewise, the potential of hydrogen as a clean fuel has been questioned because of the energy required in its production (often from carbon products, such as oil or coal), and because of issues related to the storage and distribution of the hydrogen.[126]

More recently, the ***electric vehicle*** has emerged as a more suitable alternative for urban transport. Such vehicles include hybrid electric vehicles, plug-in hybrid electric vehicles[127] and other electric vehicles (including battery-driven vehicles). Increased use of such vehicles would solve many of the local pollution problems. However, the energy still has to be generated (often from coal), and there are issues relating to the recharging infrastructure, the use of materials and the need for a lifecycle approach to energy use and emissions.[128]

The most positive developments have come from hybrid vehicles that combine conventional internal combustion engine with electric vehicle technology, as this allows both electric power at low speeds and a combination of internal combustion engine and electric power at higher speeds. In such hybrid vehicles, the conventional engine is supported by a battery that can be recharged while the vehicle is being used. Greenhouse gases and other pollutants are still being emitted, but these vehicles provide a direct substitute for the conventional car, but use only about 60 per cent of the fuel. Over the lifetime of the car it is likely that there are cost savings to

Box 7.8 Sustainable transport in Hangzhou, China

The city of Hangzhou (population 8.1 million in 2009) seeks to build a highly integrated and low-carbon intensive transport network that consists of metro, BRT, cycle and walking, water transport and electric vehicles. A key element of this strategy is the world's largest public bicycle programme. In 2009, some 67 per cent of all trips were by foot, cycle and electric bike. This accounted for 9.6 million out of 14.4 million trips made each day – the CO_2 emissions per trip are 250 grammes (about a third of the level in London). The sustainable transport strategy includes the following elements:

- A metro system of 69 kilometres (2011), to be extended to 278 kilometres by 2050.
- Nine BRT routes, with a further ten planned for 2020.
- Smart card operated systems for buses, taxis, bicycles and other forms of public transport.
- Seamless connections and zero interchange strategies for public transport transfers.
- Central city divided into eight walking areas with pedestrian priority.
- Free public bicycle service (for first hour or more if using public transport), with 17,342 bikes and 800 service points (June 2009).
- 1130 kilometres of bike routes by 2020.
- Subsidy for electric cars up to US$18,000 or about 50 per cent of purchase price and free charging initially.
- Four electric vehicle charging stations, 38 sub charging and battery swap stations and 3500 charging posts by 2012.
- Plans for 1100 electric vehicles to be used by the public sector, and electric buses and taxis are being tested.
- Electric bikes are cheap and flexible, costing US$150–300. The running costs are 2 per cent of those of a car, averaging at US$2.25 per 100 kilometres. In 2007 there were 600,000 electric bikes in Hangzhou.

Sources: Banister and Liu, 2011; Keirstead and Brandon, 2011.

the user, as the higher purchase prices are compensated for by lower fuel costs.

China has introduced a series of policies aiming to facilitate electric vehicle industrialization and commercialization, including pilot projects, standard announcements and purchase subsidies. In the industrial sector, a group of car manufacturers has announced mass production plans for electric vehicles.[129] In some cities, electric vehicles are beginning to make a significant impact in terms of their share of public transport and public service vehicle fleets. This includes delivery vehicles, buses and other services (e.g. taxis). In June 2010, six cities were chosen to implement electric vehicle purchase subsidies with a maximum of US$9000 per vehicle in the private car market.[130] One of these 'electric' transport cities is Hangzhou, where a variety of measures have been combined to achieve an innovative and environmentally beneficial transport pathway (Box 7.8).

Although, worldwide, most attention has been given to technological innovation for the private car, there is also considerable potential within cities to use electric power and hybrid technologies for public and freight transport. London, UK, for example, had more than 300 hybrid buses in operation by December 2012,[131] and similar initiatives are currently underway in Latin America (Box 7.9). Electric trucks have been used for local deliveries (Box 7.4) and hybrid vehicles have become more commonly used by global companies (Box 7.10). These vehicles are intensively used, and they can be recharged and maintained at the company's own sites.

There is . . . considerable potential within cities to use electric power and hybrid technologies for public and freight transport

Occupancy (load) factors

The range of technological solutions that can be used to address the issues of improved vehicle efficiencies and reduced levels of CO_2 emissions are extensive. However, technology cannot provide the whole

Box 7.9 The Hybrid and Electric Bus Test Programme, Latin America

The Hybrid and Electric Bus Test Programme was launched in June 2011 by the C40 Cities Climate Leadership Group in partnership with the Clinton Climate Initiative. In five participating cities – Bogotá, Curitiba, Rio de Janeiro, Santiago de Chile and São Paulo – the programme seeks to reduce the carbon footprint of public transportation and develop a market for fuel-efficient, low-carbon buses in Latin America.

Supported by the Inter-American Development Bank, the programme brings together cities, bus technology companies and local transport operators to test bus technology performance in city-specific driving conditions and duty cycles. Ultimately, the programme aims to catalyse the deployment of up to 9000 buses across Latin American cities over the next five years, with annual CO_2 emission reductions of 475,000 tonnes.

The programme compares hybrid diesel-electric technology and conventional diesel technology. Promising findings show that hybrid technology is at least 32 per cent more fuel efficient and produces fewer local air pollutants and greenhouse gases than conventional diesel buses; while electric buses have zero on-road emissions and are 250 per cent more fuel efficient than normal diesel buses.

Source: Manuel Olivera, Director, C40-CCI Hybrid and Electric Bus Test Programme (personal communication, 8 October 2012).

Box 7.10 Hybrid trucks

A number of global delivery companies (FedEx, DHL, TNT and UPS) have tested hybrid delivery trucks and these are slowly beginning to be introduced into their fleets. FedEx together with Eaton Corporation have developed a diesel hybrid electric vehicle delivery truck and launched a pilot project with 20 hybrid electric vehicle diesel trucks (in 2004). The Eaton truck is a medium weight pick-up delivery truck that operates in urban areas with many short stops for collection and delivery. By 2009 FedEx had a fleet of 264 hybrid electric trucks, and they have covered more than 4 million miles of service (2004–2009), reducing fuel use by more than 570,000 litres and CO_2 emissions by 1521 metric tonnes.

Source: FedEx, undated.

solution to the environmental impacts of urban mobility. Improved vehicle standards, better fuels, alternative fuels and innovation can all make an important contribution, but effective policy actions here need to be combined with strategies to reduce the need to travel, the distances travelled and the modes of transport used (see below).

Urban residents can live in a car-free environment, provided that: the right transport links are established . . .; there are local facilities and services; and there are sufficient reasons for not owning a car

Underlying all strategies, however, is the importance of vehicle occupancy (freight and passenger), and the efficiency figures illustrate the importance of occupancy (or load) (Box 7.11). Fully laden vehicles (public and private, freight and passenger) are far more efficient than empty ones. This also reduces environmental impacts, improves the quality of the urban area and contributes to reducing congestion.

'High-occupancy vehicle' lanes or car-pool lanes have been introduced in some cities (primarily in developed countries) to increase vehicle occupancies. Vehicles that travel in a high-occupancy vehicle lane must carry at least one (sometimes two) passengers in addition to the driver. Some high-occupancy vehicle lanes are in operation only during certain hours. Outside of those hours, they may be used by all vehicles.[132] High-occupancy vehicle lanes have also been introduced in some developing countries. On such example is South Africa where such lanes have been introduced to facilitate bus transport in particular.[133] According to critics, however, few buses are using these lanes – primarily because the lanes are on the wrong side of the road with respect to loading and off-loading of passengers, forcing buses to constantly change lanes – and, due to lack of controls, these lanes are now used primarily by private cars.[134]

Box 7.11 Freight loads and emissions standards

New regulations in many cities restrict access to the city centre based on the age and load of the vehicle:

- In Amsterdam (the Netherlands), a truck may make deliveries in limited access zones if it meets the following four conditions: it must be less than eight years old, meet the Euro II standard, have a maximum length of 10 metres, and load or unload at least 80 per cent of its merchandise in the central city.
- In London, the Low Emission Zone (set up in 2008) prohibits trucks older than the Euro III standard to enter the metropolitan area (the area surrounded by the M25 highway, totalling 1580 square kilometres).
- In Tokyo, since 2003, the most polluting diesel vehicles have been prohibited from the city centre.

Source: World Bank and DfID, 2009, p23.

THE COMPOSITE SOLUTION

The preceding sections have presented a number of examples of interventions to enhance environmentally sustainable urban mobility systems. Each of the examples has illustrated the impact of specific types of policies. In most cases of successful implementation, however, it is not a single policy that has been introduced – but rather a package of measures. Such 'packages' are more likely to gain public acceptance, and they allow a mixture of policies that may be seen as disadvantageous to individual users, but promote overall welfare gains to society (see for example Box 7.7). Yet, while policy packaging can certainly support effective and efficient policy-making (not least through enhancing interventions' implementation and the *ex-ante* mitigation of unintended effects), the packaging process requires a deep and holistic appreciation of policy subsystems, together with a structured approach, if its benefits are to be genuinely realized.[135]

To promote the environmental argument it is important to consider a wide range of effects that contribute co-benefits. For example, health can be viewed in three main ways, as less motorized traffic or 'cleaner' vehicles improve local air quality, as slower travel leads to improvements in road safety and as non-motorized transport has direct health benefits. In addition, these improvements are likely to have a positive effect on climate change through reductions in CO_2 emissions. All these factors lead to important co-benefits that need to be included in all environmental evaluation.

In order to achieve the EU 2050 target of zero carbon emissions from transport in cities[136] some communities have started moving towards the 'car-free city'. One such community is Vauban (in Freiburg, Germany). It was constructed on a scale that facilitates movement by local public transport, walking and cycling (Box 7.12). Vauban offers one example of how many of the different elements outlined in this chapter can be brought together into a coherent set of proposals. Based on this experience it seems that urban residents can live in a car-free environment, provided that: the right transport links are established (i.e. to the main station and the city

Box 7.12 Car-free living: Vauban, Germany

Vauban is a small community of 5500 inhabitants and 600 jobs, 4 kilometres south of the town centre of Freiburg (Germany). It was started in 1998 as 'a sustainable model district' on the site of a former military base. Although the Vauban community itself is small, it is mixed with considerable levels of involvement of the local people in helping to decide priorities and alternatives (the Forum Vauban). The guiding mobility principle has been to try to reduce the use of the car, but giving residents the flexibility to use a car where necessary. This is matched by high-quality public transport, walking and cycling facilities.

Within Vauban, movement is mainly by foot and bicycle, and there is a tram link to Freiburg (2006). Cycling is the main mode of transport for most trips and most activities, including commuting and shopping. The town is laid out linearly along the tracks so that all homes are within easy walking distance of a tram stop. The speed limit on the district's main road is 30 kilometres per hour, while in the residential area cars should not drive faster than 'walking speed' (5 kilometres per hour). About 70 per cent of the households have chosen to live without a private car (2009), and the level of car ownership (and use) has continued to fall. In the past, more than half of all households owned a car, and among those who are now living car free, 81 per cent had previously owned one and 57 per cent gave up their cars on or immediately after moving to Vauban.

The transport network in Vauban adopts a complex combination grid, with three types of streets: collector roads, local streets and pedestrian/bicycle paths. As indicated in the drawing, most local streets are crescents and *cul-de-sacs*. While they are discontinuous for cars, they connect to a network of pedestrian and bike paths that permeate the entire neighbourhood. In addition, these paths go through or by open spaces adding to the enjoyment of the trip.

Furthermore, most of Vauban's residential streets lack parking spaces. Vehicles are allowed to drive in these streets (at walking pace) to pick up and to deliver, but are not allowed to park, and enforcement is based on social consensus. Each year, households are required to sign a declaration indicating whether they own a car. If they do, they must buy a space in one of the multi-storey car parks on the periphery (at an annual cost of €18,000 in 2008).

The implementation of the traffic concept in Vauban meant that new laws were needed to accommodate the current building regulations in the federal state of Baden-Württemberg. The Association for Car-free Living in Vauban (*Verein für autofreies Wohnen*) was founded as a legal body for the implementation of the concept. For those that want the occasional use of a car, the car sharing company Freiburger Auto Gemeinschaft offers cars for occasional use by residents of Vauban, and they are parked in the community car park. Those in the car-sharing scheme have access to the shared cars and they also receive a one-year free pass for all public transportation within Freiburg, as well as a 50 per cent reduction on every train ticket for one year.

Sources: Forum Vauban, 1999; Scheurer, 2001; Nobis, 2003; Melia, 2006 and 2010.

centre of Freiburg); there are local facilities and services; and there are sufficient reasons for not owning a car (e.g. limited and costly parking).

Similarly, in order to improve public transport, a series of policy interventions are necessary to create a positive overall experience. This includes investments in new infrastructure (including vehicles, routes and maintenance), electronic ticketing (smart cards), 24-hour availability and the feeling of safety and security. Another essential requirement is organizational change that allows seamless travel and short interchanges between modes (including both route and fare integration). Furthermore, high levels of public transport occupancy[137] and use permits, lower fares and extensive networks for all users are central to sustainable urban mobility. All these factors increase the efficiency of transport in the city, and in turn result in environmental and other co-benefits (e.g. safety, health and noise). Complementary actions include the slowing down of urban traffic, the allocation of space to public transport, strong parking controls and road pricing. All of these interventions are likely to maximize the use of public transport.

In addition to prioritizing public transport, investment in separate cycle and pedestrian networks would strengthen the commitment to promoting non-motorized transport. The available transport space in the city should be determined and allocated based on prioritization of low-carbon transport, demand management and the identification of priority users (and uses). However, it is important to keep in mind that measures to encourage modal shift must be combined with strategies to make the best use of the 'released space' so that there is a net reduction in motorized traffic.[138] Such an approach introduces the much wider notion of the street, as road space is no longer considered only as a road but as a space for people, green modes and public transport. Creative use of that space at different times

The available transport space in the city should be determined and allocated based on prioritization of low-carbon transport, demand management and the identification of priority users (and uses)

Table 7.5

GlaxoSmithKline – 2010 corporate responsibility report

Freight transport	Employee transport
• Switching transport mode from air to sea. • Optimizing its European road freight network by improving vehicle load configuration to maximize use of the available capacity and using fewer trucks. • Warehousing improvements – lower stock levels. • Reducing the number of external warehouses to cut travel between sites and the warehouses. • Installing intelligent lighting controls and energy efficient lighting. • Consolidation of refrigerated storage units. • Using energy efficient forklift truck charging.	• Green travel plans are in operation at a number of sites to encourage employees to reduce the environmental impact of their travel by sharing vehicles, using public transport or by cycling to work. • The distance flown on company business fell by more than 200 million kilometres and nearly 85,000 fewer single flights were made in 2010 compared to 2009. • Significant investment has been made in videoconferencing systems, with over 500 videoconference rooms in 68 countries. Other technology includes teleconferencing, desktop and personal videoconference units and web conferencing. In 2010, there was a 40 per cent increase in the use of videoconferencing compared to 2009.

Source: GlaxoSmithKline, 2011.

of the day or days of the week means that new uses can be encouraged (e.g. street markets and play zones).

The experience of GlaxoSmithKline, one of the largest pharmaceutical companies in the world, exemplifies how private-sector companies can reduce their greenhouse gas emissions, and thus contribute to more environmentally sustainable urban transport. The fact that such initiatives are also of financial benefit to the company should provide additional encouragement for other companies to reduce some of the negative environmental externalities of their operations. Table 7.5 outlines measures implemented by GlaxoSmithKline in 2010 with respect to the company's freight and employee transport. However, more recent data indicate that the company's total transport emissions grew by 8.4 per cent in 2011, thus cancelling out the gains made in 2010.[139]

The existing carbon market is not appropriate for the transport sector, and a separate sector-based mechanism may be required

FUNDING MECHANISMS FOR ENVIRONMENTALLY SUSTAINABLE URBAN MOBILITY SYSTEMS

While Chapter 8 contains a more elaborate discussion of funding for urban transport investments, it is appropriate here to make a brief reference to global financial options that are directly related to environmental sustainability. So far, the mechanisms devised to address such funding have not been effectively used in cities or in the transport sector. Out of the 6660 clean development mechanism projects registered by 1 April 2013, only 28 were related to transport.[140] Another ten projects were under validation, or in the process of being registered.[141] The clean development mechanism is one of the three flexible mechanisms under the Kyoto Protocol. The clean development mechanism enables the implementation of emissions reduction projects in developing countries to earn 'carbon credits', which can then be sold internationally (thus being rewarded for having reduced emissions). By purchasing such carbon credits, developed countries can meet parts of their emissions reduction targets (by paying for the right to pollute).[142]

Unfortunately, such carbon emissions trading favours the cheaper projects, which may not have the greatest potential to reduce greenhouse gas emissions over the longer period. Most transport projects are expensive as they require up-front investment or the development of new fuels and technologies. Apart from the scale of change needed in the transport sector, the emissions are diffuse and hard to measure, as is the reliable baseline and the need to define project boundaries so that a consistent monitoring framework can be established. Thus, the existing carbon market is not appropriate for the transport sector, and a separate sector-based mechanism may be required.

Alternatively, there could be a greater role allocated to cities to reduce greenhouse gas emissions in transport and to adopt national appropriate mitigation actions[143] for city-scale application. Certainly, there is a strong case to integrate existing funding mechanisms available for climate change mitigation – such as the Global Environment Facility (GEF),[144] the environmental fiscal reform[145] and official development assistance – in the clean development mechanism.[146]

Furthermore, there may be considerable potential for emerging cities and countries to follow a less carbon-intensive pathway when it comes to transport. The Sustainable Fuel Partnership,[147] for example, is examining the rationale behind a new market mechanism to provide energy incentives for improving energy security in the Asia-Pacific region by treating energy security as a public good that can be valued and translated into a cash flow, and thereby to correct market inefficiencies. This will be achieved through 'fuel security credits' that are designed to reduce actual oil use and to invest in transport projects that are less energy intensive, to examine means by which trips can be avoided, to encourage mode shift to public and non-motorized transport, and to improve technologies.[148]

There are also considerable overlaps between many general development programmes – funded through official development assistance – and global public goods programmes, including climate change mitigations strategies such as public-sector investments in clean transportation.[149] Furthermore, although it is currently not mentioned specifically, there should be considerable scope to include funding for sustainable urban mobility – particularly in developing countries – in the discussions on innovative development financing mechanisms currently being explored in the global economic arena.[150] Thus, both of these sources of funding could be drawn upon to finance environmentally sustainable urban mobility systems.

CONCLUDING REMARKS AND LESSONS FOR POLICY

When sensitively planned and appropriately supported by sustainable infrastructure, compact cities are the world's most efficient settlement pattern. Urban density reduces the overall spatial footprint of development and allows for greater preservation of natural areas. It also allows for more efficient use of transport infrastructure, which reduces emissions and resource use. However, current trends in motorization and oil dependence – and the increased dependence on private motorized transport – pose major challenges to the development of environmentally sustainable urban mobility systems, namely:

- greenhouse gas emissions: the main cause of global climate change, which could have catastrophic impacts on urban transportation systems;
- urban sprawl: leading to increasing trip lengths and thus increased dependence on the private car to meet individual mobility needs;
- air and noise pollution, and decreased physical activity: have major negative impacts on the health of urban residents;
- road traffic accidents: are among the leading causes of premature deaths in cities all around the world;
- community severance: where major transport infrastructure disrupts neighbourhoods and serves as physical barriers to human interaction.

To address these challenges, there is a need for policy interventions that encourage change in five major areas, namely: a reduction of the number of motorized trips made (i.e. telecommuting, online shopping or a shift to non-motorized transport); reduced travel distances in cities (i.e. changes to the urban form); changes in the modal split (i.e. encouraging public transport); technological innovations that reduce the negative externalities of motorized transport (i.e. more efficient fuels and reduced emissions); and increased vehicle efficiency (i.e. higher occupancy rates).

Most policy interventions may be grouped in three categories: regulatory measures; pricing measures; and investments in public transport and public (and non-motorized) transport infrastructure. Regulatory measures may be used to limit the number of cars on the roads at any particular time, or to restrict the number of parking places in inner-city areas, both of which may encourage a modal shift towards public transport. Such measures may also be used to reduce emissions from motor vehicles to encourage the use of more energy-efficient vehicles, and to encourage more efficient use of infrastructure and vehicles, for example through the introduction of dedicated high-occupancy vehicle lanes.

There is a need for policy interventions that encourage . . .: a reduction of the number of motorized trips made . . .; reduced travel distances in cities . . .; changes in the modal split . . .; technological innovations that reduce the negative externalities of motorized transport . . .; and increased vehicle efficiency

Pricing measures may be used to discourage the use of private motorized transport – in the form of electronic road pricing, congestion charging, parking pricing, fuel taxes, etc. – or to encourage the use of more energy-efficient vehicles – for example sales duties related to engine size. Similarly, such measures may also be used in the form of subsidies to encourage the use of public transport (fare subsidies) and to encourage the purchase of more efficient vehicles (subsidies on low-emission fuels, vehicle purchase prices, exemptions from congestion or parking charges, etc.).

Investments in public transport, and infrastructure for public and non-motorized transport, may also play a major role in encouraging shifts to more sustainable modes of transport. Improved connectivity, increased capacity, enhanced quality and reduced travel times for such modes are major factors encouraging city residents to reduce their reliance on the private car.

However, the perhaps most effective approach (at least in the longer term) to reduce the environmental impact of urban mobility is to reconsider the urban spatial structure. As discussed in Chapter 5, urban form plays an important part in determining both transport mode and distance travelled, as it links the spatial distribution of population and jobs (as well as other destinations) to the pattern of trips. Through increased (population and job) densities and mixed-use developments, urban planning may play a major role in organizing spatial activities in cities so that they are in close proximity to their users. Well-planned, densely populated settlements can reduce the need for private motorization and decrease travel distances, thus making it more attractive to walk and cycle. Furthermore, urban planning based on transit-oriented development (or similar approaches) helps to maximize urban densities around transport nodes and encourages a modal shift to public transport. Such an integration of land-use and transport planning is a core component of a strategy to create environmentally sustainable urban mobility systems.

The perhaps most effective approach . . . to reduce the environmental impact of urban mobility is to reconsider the urban spatial structure

To ensure successful implementation of environmental policies, . . . public acceptability should be a major concern

While the above interventions are discussed separately in the report, it is essential to consider them as components of a package of measures. Such 'packages' are more likely to be publicly acceptable, as they allow a mixture of policies, some of which may be seen as disadvantageous to individual users, yet as a package they may be seen as supporting the public good. To ensure successful implementation of environmental policies, some of which may involve radical change, public acceptability should be a major concern. Communities and other stakeholders should thus be involved in all phases of policy development, including initial discussions, decision-making and implementation.

The strategic planning of the city, and the role played by transport systems, needs to be balanced by actions taken at the neighbourhood level, in a supportive government environment at all levels. It is at the neighbourhood level that cycling and walking become important modes of transport – for access to employment and other services and facilities – and these complement the need to travel longer distances by public transport to other parts of the city. City-wide decisions need to take account of the requirements of the population and businesses – i.e. to ensure access to destinations – so that movement can take place in an efficient and environmentally sustainable manner.

NOTES

1 Banister and Berechman, 2000.
2 Jackson, 2009.
3 Perrels et al, 2008.
4 Such externalities include the costs that are imposed by one set of users on other users and on society more generally, and where these costs are not paid by the polluter (Maddison et al, 1996).
5 Carpenter et al, 2008, p439; Banister, 2005.
6 IEA, 2012b. See Figure 1.5.
7 IEA, 2009. See also UN-Habitat, 2011; and Barker et al, 2007. For details on how these emissions distribute across modes, see Table 7.1.
8 UN, 2012a.
9 Energy density is the amount of energy per unit volume of fuel (Savage, 2011).
10 With respect to this last point, this indicates that developing countries may more easily find alternatives to oil-based transport, as these may have lower levels of investment in 'conventional' transport infra-structure. This might be seen as an opportunity for developing countries to make the transition to a low-carbon transport system.
11 Gilbert and Perl, 2010.
12 Afrique en ligne, 2011.
13 Banister et al, 2011. This is so despite recent development in terms of the extraction of unconventional oils, which have the potential to dramatically increase oil supply in short and medium term (Gordon and Tsay, 2013).
14 See for example UNEP, 2008.
15 See for example Principle 16 of the 'Rio Declaration on Environ-ment and Development', http://www.unep.org/Documents.Multilingual/Default.asp?documentid=78&articleid=1163, last accessed 30 January 2013. The removal of subsidies is necessary, but not sufficient, to ensure payment of the full environmental costs of fuels.
16 IEA, 2010, p569.
17 See IEA, 2010, pp571–572.
18 UN-Habitat, 2011, pp17–20.
19 IEA, 2011a, p13.
20 IEA, 2011b.
21 Yet, as noted earlier in this chapter, emissions from the transport sector have remained constant at about 23 per cent of total CO_2 emissions.
22 OECD/ITF, 2011b.
23 OECD/ITF, 2011b, Table 4.
24 UITP, 2001.
25 UN-Habitat, 2008.
26 UN-Habitat, 2008.
27 Nicholls et al, 2008.
28 LSE cities et al, 2013.
29 UN-Habitat, 2011.
30 For a more elaborate discussion on this, see UN-Habitat, 2011.
31 Due to the limited access to private modes of transport of the urban poor, evacuation plans should provide sufficient (and free) public transport services in case of evacuation.
32 BRT systems seem to provide an answer to the congestion problem, as these buses travel in dedicated lanes.
33 Banister, 2007.
34 See Chapter 5.
35 See Chapter 6.
36 Lucas, 2009. This issue is discussed at more length in Chapter 6.
37 Banister, 1998.
38 Perkins and Hamnett, 2002, p11.
39 From 2.5 million to 5.3 million (UN, 2012a).
40 From 42 per cent to 31 per cent of total land area (Ernst, 2011).
41 See for example the attention paid to air pollution ahead of the 2008 Olympic Games in Beijing China (UNEP, 2007a).
42 Vidal, 2013; citing Lim et al, 2012.
43 Walker, 2012.
44 EC-Environment, 2011.
45 UN, 1997. See also EEA, 2001. The WHO noise standard for traffic areas is 70 dB (Berglund et al, 1999, p65).
46 OECD, 1991.
47 OECD, 1991.
48 OECD, 1991; UN, 1997.
49 Suchorzewski, 2011.
50 Woodcock et al, 2007; Roberts and Edwards, 2010.
51 Bull et al, 2004.
52 Woodcock et al, 2007 and 2009.
53 James et al, 2004; WHO, 2009, Table A4.
54 Overweight and obesity increase with age. In England, the percentage of adults who are obese has roughly doubled since the mid-1980s (Oxford University, 2007).
55 See for example http://www.copenhagenize.com/, last accessed 6 February 2013.
56 Andersen et al, 2000.
57 Vasconcellos, 2011, p351.
58 Gehl, 1996; Gehl and Gemzøe, 2001.
59 Ontario College of Family Physicians, 2005, p3.
60 Ontario College of Family Physicians, 2005.
61 IBM Corporation, 2011.
62 Huzayyin, 2011.
63 This option is discussed in more detail in the section below on 'Changing the Modal Split'.
64 Pineau, 2010. See also Chapter 6.
65 Paula Bisiau, Director for Sustainable Transportation, City of Buenos Aires (personal communication, 8 October 2012).
66 Sustainable Transport Project for Egypt, 2011.
67 The relationship between travel behaviour and urban form is discussed in more detail in Chapter 5.
68 Banister and Stead, 2004.
69 Larsen et al, 2006.
70 Lyons and Kenyon, 2003.
71 See for example Hampshire et al, 2012; Porter, 2012.
72 Castells, 2000; Etzo and Collender, 2010. See also Economist, 2009.
73 See Chapter 5.
74 Glaeser, 2011.
75 Chew, 2011.
76 Chew, 2011.
77 ADONIS, 1999.
78 See note 4 above, and Chapter 8.
79 See the discussion above in the section on 'Environmental Challenges in Urban Mobility Systems'.
80 Note that governance issues are also important for effective implementation (see UN-Habitat, 2011, p108; and Chapter 9 below).
81 Barter and Dotson, 2011.
82 The *pico y placa* in Bogotá was introduced in 1998, and was later replicated in Medellín in 2005. A similar system (*hoy-no-circula*), which restricts drivers from using their vehicles one weekday per week, was introduced in Mexico City in 1989 (Gallego et al, 2011).
83 Banister, 2003.
84 Dijk and Montalvo, 2011.
85 US Department of Transportation, 2006.
86 See also the discussion on fuel subsidies in the section on 'Motorization and oil dependence' above.
87 The UK introduced such a scheme in 1993, but it was abolished in 2000 due to public discontent (Politics.co.uk, undated).
88 See discussion in Chapter 8.
89 Anas and Lindsay, 2011.
90 UITP, 2010, p22.
91 Office for Low Emissions Vehicles, 2011. Many other countries have introduced similar measures, see http://en.wikipedia.org/wiki/Government_incentives_for_

plug-in_electric_vehicles (last accessed 30 January 2013).
92 Hall and Hass-Klau, 1985. See also Bauer et al 2006; Dresdner Verkehrbetriebe AG, 2011.
93 Wright, 2010. See also Chapter 3 above.
94 See the section above on 'Motorization and oil dependence'.
95 Including increases due to the 'rebound effect', which implies that environmental policies do not achieve all of their stated aims, as people tend to travel more if they think that they are doing it more efficiently (Herring and Sorrell, 2008).
96 ADB, 2010a.
97 See the section below on 'Funding Mechanisms for Environmentally Sustainable Urban Mobility Systems'.
98 Schipper, 2011.
99 UNEP, 2009.
100 The average age of all motor vehicles in Brazil in 2010 was 8.7 years (Kliment, 2011), comparable to countries such as Switzerland: 8.2 years (Federal Statistical Office, Switzerland, 2012); and the Netherlands, 8.6 years (Central Bureau of Statistics, Netherlands).
101 UNEP, 2009, p17.
102 Huzayyin and Salem, 2013. Personal communication with Professor Ali Huzzayin, Cairo University, Egypt, March 2013.
103 Davis and Kahn, 2011.
104 Kenya Revenue Authority, undated.
105 UNEP, 2009.
106 UNEP, 2009.
107 See also the section on 'Alternative fuels' below.
108 Gallagher, 2012.
109 The 13 cities are Delhi, Mumbai, Kolkata, Chennai, Bangalore, Hyderabad, Ahmedabad, Pune, Surat, Kanpur, Agra, Lucknow and Sholapur.
110 ACFA, 2010.
111 Often more than 5000 parts per million.
112 i.e. 50 parts per million and less.
113 UNEP, 2007b, p8.
114 i.e. 500 parts per million and less.
115 UNEP, 2007b, p9.
116 The Obama administration in the US is suggesting a fuel-economy standard of 23 kilometres per litre average for an automaker's whole fleet by 2025, boosting the price of a new vehicle by at least US$2100 (Healey, 2011).
117 See DieselNet, 2012a and 2012b.
118 Regional Environmental Centre for the Caucasus, 2008.
119 An et al, 2011.
120 See also the previous section on 'Efficiency and age of the vehicle stock'.
121 Bleviss et al, 1996.
122 Banister, 1998.
123 See the section on 'Motorization and oil dependence' above.
124 EC, 2011.
125 The potential of biofuels may improve, subject to the successful development of 'second generation biofuels' – which seek to utilize local 'biomass consisting of the residual non-food parts of current crops, such as stems, leaves and husks that are left behind once the food crop has been extracted, as well as . . . non food crops' (http://en.wikipedia.org/wiki/Second_generation_biofuels, last accessed 6 February 2013).
126 Evenson, 2004.
127 A hybrid electric vehicle is a vehicle that uses both an electric motor and a petrol engine to power the vehicle. A plug-in hybrid electric vehicle is a hybrid electric vehicle that is capable of storing energy from the grid in onboard batteries.
128 The conventional approach has been to look at energy use and emissions from a 'tank-to-wheels' perspective only, i.e. only the energy used and the carbon emissions produced from the use of the vehicle itself (i.e. the petrol or the electricity from the onboard battery). A lifecycle approach implies a 'well-to-wheels' approach, i.e. all energy used and carbon emissions produced from the source of the energy to the final user (Graham and Reedman, 2010).
129 Liu, 2012.
130 Banister and Liu, 2011 (RMB60,000).
131 Transport for London, undated b.
132 Ministry of Transport, Ontario, 2007. For an overview of some cities that have introduced high-occupancy vehicle lanes, see http://en.wikipedia.org/wiki/High-occupancy_vehicle_lane, last accessed 30 January 2013.
133 De Vries et al, 2010.
134 Debra Roberts during the eighth meeting of the HS-Net Advisory Board, 20 November 2012.
135 Givoni et al, 2013.
136 See the section above on 'Alternative fuels'.
137 See the section above on 'Occupancy (load) factors'.
138 Banister and Marshall, 2000.
139 GlaxoSmithKline, 2012.
140 These 28 projects were categorized as follows: BRT (13 projects); motorbikes (4 projects); modal shift from road to rail (7 projects); more efficient vehicles (1 project); regenerative braking for railways (i.e. that the kinetic energy from braking is recovered and later reused) (1 project); biodiesel for transport (1 project); and cable cars (1 project) (UNEP Risø Centre, 2013).
141 UNEP Risø Centre, 2013.
142 See UN-Habitat, 2011, p20.
143 'National appropriate mitigation actions' (NAMAs) are a set of actions and policies that can be undertaken by countries as part of a commitment to reduce greenhouse gas emissions.
144 Under GEF, by 2011, there had been 45 'sustainable transport and urban systems' projects funded over 20 years, accounting for 6 per cent of total projects (GEF, 2011, p5). Within the country programmes, the Clean Technology Fund has allocated about 14 per cent of investment to transport, as of December 2011 (CIF, 2011, p14).
145 See World Bank, 2005.
146 Bertaud et al, 2009.
147 ADB, 2010a.
148 'The credits will give a value to the fuel security benefit arising from improvements in fuel consumption. Trading in the credits could help developing countries to access additional funds to carry out policies and technologies that may not otherwise meet investment requirements from a traditional cost–benefit analysis . . . Accounting for fuel consumption is far easier than accounting for greenhouse gas emissions . . . and, as with carbon emissions, reducing a tonne of oil-equivalent is less costly in Asia than in Europe or North America' (IntellAsia.Net, 2011).
149 UN, 2012b, p7.
150 See, for example, the discussions of the United Nations High-level Panel on Financing for Development and the Leading Group on Innovative Financing for Development (UN, 2012b).

CHAPTER

8

THE ECONOMICS AND FINANCING OF URBAN MOBILITY

This chapter seeks to provide an understanding of the economics and financial options that determine the success or failure of urban mobility systems. Each such system includes a range of mobility options, from walking to rail-based metro systems. In economic terms, the various modes of urban mobility are both complementary and competitive. They are complementary because residents typically avail themselves of more than one travel mode as they go about the daily activities of urban life. At the same time these modal alternatives often compete for passengers. If better-coordinated and sustainable transport systems are to evolve out of such complex systems, it is going to require an understanding of the incentives and disincentives faced by buyers and sellers of transport services.

The ways that urban transport options emerge and evolve depend heavily upon the costs of these options and the ways in which these costs are financed: either directly in fares, indirectly in taxes and fees or absorbed as pollution, climate change, congestion, road traffic deaths and injuries, or other social costs. Thus, this chapter reviews the economics and financing of urban mobility in light of its impacts on the ways the choices are made to explicitly pay for or implicitly absorb the costs.

In matters of urban transport economics, financial arrangements are always paramount. Finance systems can encourage (or discourage) the alignment of economic, environmental and social goals. Differentials in investments and operating funds among modal alternatives have social, spatial, environmental and equity impacts. These may be good or bad, as the various modes compete for scarce urban space and market shares. Whether by indecision or decision, such choices are made continually, and thus outcomes in this regard are results of – and impact upon – public policy.

To understand the financial dynamics, it is necessary to understand the economic relationships among and within urban travel modes. With the exception of rail-based modes (which travel on segregated rights of way) all other forms of urban movement – from walking to motorized travel – rely on access to a shared system of sidewalks, streets, roads and highways. Thus, while different modes of urban movement appear to be physically and financially ***independent*** of one another, they are nonetheless physically and financially ***interdependent*** because of their shared (and usually competitive) use of public infrastructure.

In economic terms, the various modes of urban mobility are both complementary and competitive

The improvement of urban mobility systems requires strategic choices regarding the structures through which the infrastructure and equipment that service urban ***public*** transport are financed. Public transport must be bolstered as both a viable alternative to private cars (and motorcycles) and a strong supportive and complementary supplement to non-motorized mobility. As a result, there is a need to address the incentives and disincentives built into current financial configurations.

In order to address the issues outlined above, the first section below presents a brief overview of the conditions and trends that determine the economics of urban mobility. This is followed by discussions on the economic role of transport in the functioning of an urban economy, and the need to move away from economics of mobility towards economics of access. The fourth section develops an understanding of the systems of incentives and disincentives built into the current methods used to finance urban transport systems. Based on this discussion, the fifth section proposes policies and plans that permit urban transport to make a major contribution to the realization of socially and environmentally sustainable cities, while the final section contains some concluding remarks and lessons for policy.

Differentials in investments and operating funds among modal alternatives have social, spatial, environmental and equity impacts

THE ECONOMIC AND FINANCIAL CHALLENGES OF URBAN MOBILITY

Data on the relationship between rising income levels and rising rates of car ownership are strongly positive; as income rises, car ownership increases.

This section discusses the key economic characteristics of urban transport. It begins by examining trends in private car ownership and use, since private motorized transport is the least environmentally sustainable, most land-intensive modal option. It then compares user costs and the cost to build and operate various urban transport modes.

The global dominance of private motorized transport

The central challenge is to ensure that financing for public transport and non-motorized transport infrastructure and service delivery is at least comparable to efforts for accommodating the car

The global dominance of the private car as the preferred means of urban transport is setting global urbanization on a collision course with the world's pressing equity and environmental concerns.[1] As indicated in Chapter 2, the forecasts for the future in terms of non-motorized and public transport are not promising, if current car-ownership trends continue.[2]

Data on the relationship between rising income levels and rising rates of car ownership are strongly positive; as income rises, car ownership increases. Within countries, wealthier residents are much more likely to own motor vehicles. For example, modal split is closely correlated with socioeconomic groups in Bogotá (Colombia) and Santiago (Chile). Seventy per cent of the high-income group in Bogotá and 80 per cent in Santiago use private cars compared with 70 and 60 per cent of low-income groups using public transportation, respectively.[3]

In China, with only 44 passenger cars per 1000 people in 2010,[4] estimates indicate that for every 1 per cent increase in average disposable income, car ownership in Chinese cities is expected to increase by 1.8 per cent.[5] São Paulo is another example of the trend; bus ridership declined by nearly half (from 6.7 million to 3.8 million passengers per day) during the 1990s. At the same time, car use and road congestion increased, and bus speeds slowed from 19 to 12 kilometres per hour.[6]

Figure 8.1 illustrates the same relationship globally by comparing per capita income and the number of cars. Although the relationship between income levels and car ownership is relatively weak in countries with high incomes, it is strong among low-income countries. As the majority of the world's population live in low-income countries, an overall increase in income in these countries could have a significant impact on car ownership.[7]

These data convey an ironic message: as living standards in developing countries rise, their cities will find themselves under ever-greater pressure to accommodate private motorized transport, with all its other negative side effects. Where economic development policies are successful[8] economic growth will stimulate demands to acquire valuable land for use as roads and parking spaces. The simple reason for this is that given the contemporary state of urban public transport, private motorized transport is almost universally considered to be the superior alternative whenever people can afford the choice.[9] One result of this perception is the support for transport finance policies that privilege expanded street and road networks to accommodate expanded reliance on car-based travel, while other options languish.

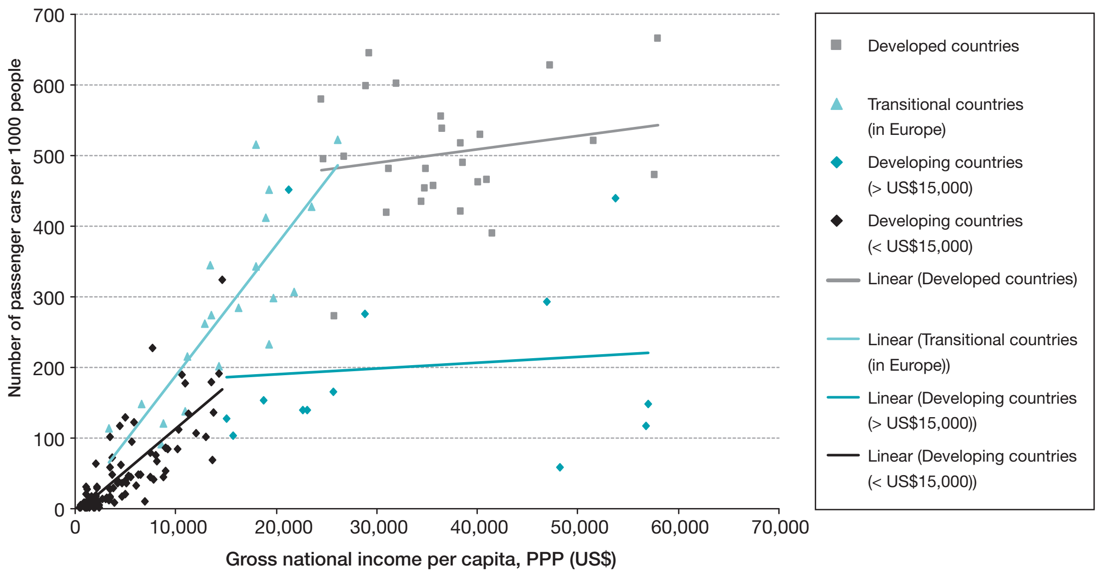
Thus, from an economic point of view, the central challenge is to ensure that financing for public transport and non-motorized transport infrastructure and service delivery is ***at least*** comparable to efforts for accommodating the car. To do less is

Figure 8.1

Car ownership as a function of gross national income (2010)

Note: The figure includes data for 150 countries. Data are from the latest year available during the period 2005–2010, and refer to road motor vehicles, other than two-wheelers, intended for the carriage of passengers and designed to seat no more than nine people (including the driver). The gross national income per capita is based on PPP in 2010.

Source: Based on data from http://data.worldbank.org/indicator, last accessed 23 January 2013.



to virtually ensure that public transport remains an inferior choice.

Economic characteristics by mode and context

As noted in Chapter 2, non-freight transportation can be divided into non-motorized transport (walking and bicycling), public transport, informal motorized transport and private motorized transport. Each of these modes has different economic characteristics, which largely depend on contextual features, such as city size and density, geography, demographics, institutional framework and history.

In many cities, there is a wide gap between modal use, infrastructure allocation and modal funding. That is, a large share of the population uses non-motorized or public transport, while a disproportionate amount of infrastructure and funding supports private motorized transport. For example, in Dhaka, Bangladesh, almost 80 per cent of trips are by walking, bus or informal motorized transport, yet 70 per cent of the road space is dedicated primarily to private vehicles.[10] In some Eastern African cities, walking accounts for more than half of all trips but less than 1 per cent of total costs, while accommodating private vehicles incurs 50 per cent of total system costs.[11] This section presents an overview comparing the economics of the various modes in a variety of contexts.

Non-motorized transport

Non-motorized modes are highly cost effective as they entail the lowest capital and operating costs, because they require only sidewalks and dedicated street lanes. They also cost the least for users who expend only calories and can use relatively inexpensive bicycles. In many developing country cities, non-motorized transport is thus the predominant modal choice.[12]

Despite its relatively low cost, infrastructure for non-motorized transport (pedestrian bridges, paths, sidewalks and crossings) is sorely lacking in many urban areas, making it a relatively unsafe and often inconvenient mode of travel.[13] Financing for such infrastructure is usually limited to central government funds, yet the historic nature of urban transportation policy has a distinct bias towards motor vehicles. This has resulted in non-motorized transport being completely ignored or allocated an insufficient budget. This is a paradox, as most trips contain at least one segment of walking.[14] The main factor related to the lack of financing of non-motorized transport facilities in cities of developing countries is that they are not 'revenue generating' and, hence, private investors and international lending agencies are not keen to provide finance, while the cost is, in many cases, beyond city capabilities.[15]

Public transport

In general, public transport can provide excellent access within urban areas when it is affordable to the user, frequent, predictable, safe and integrated within a comprehensive network.[16] However, public transport often entails high capital and operating costs compared with private cars, although it is considerably more environmentally sustainable.[17] To make a comparison between the real cost of public versus private motorized transport, it is essential that the full cost include social costs, local pollution and

In many cities . . . a large share of the population uses non-motorized or public transport, while a disproportionate amount of infrastructure and funding supports private motorized transport

Public transport can provide excellent access within urban areas when it is affordable to the user, frequent, predictable, safe and integrated within a comprehensive network

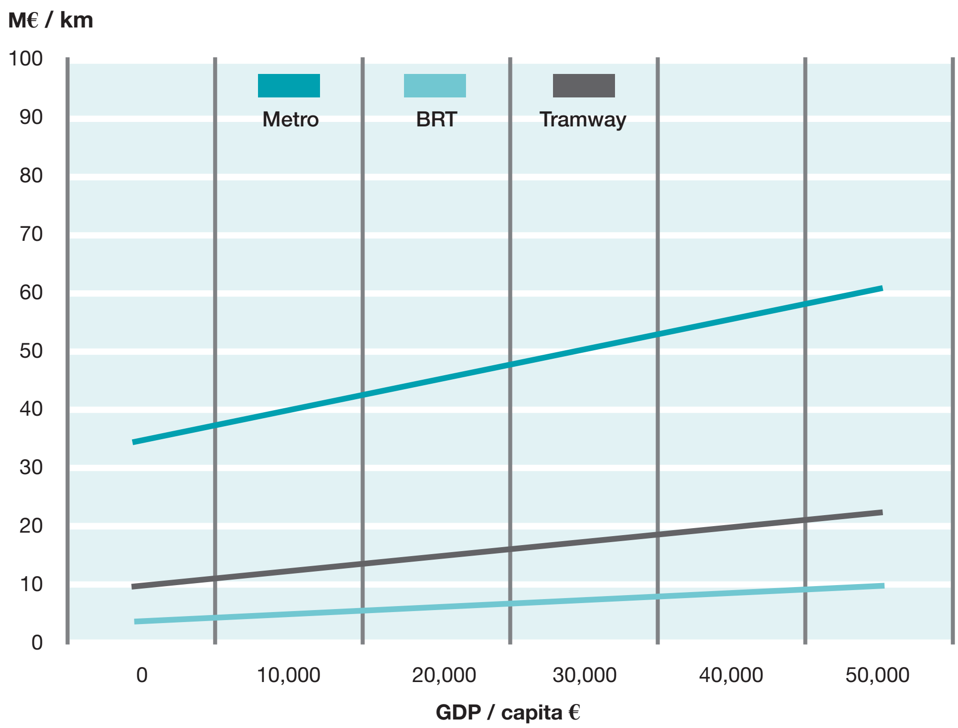


Figure 8.2

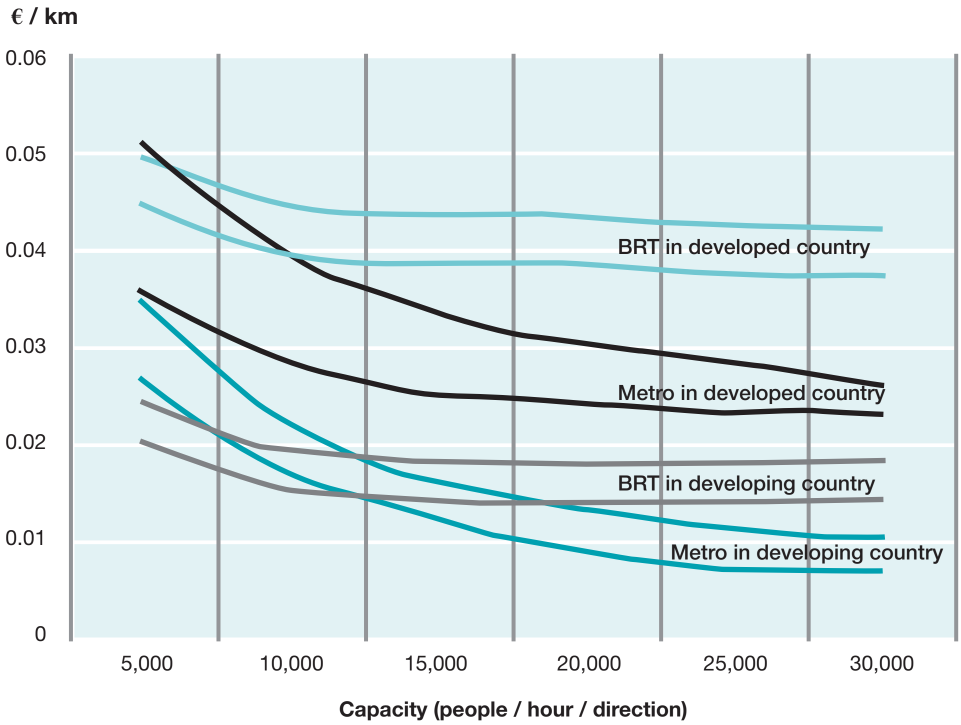
Average capital costs (infrastructure and rolling stock) of major public transport modes, as a function of GDP per capita

Source: CODATU, 2009, citing Lasserre, 2008.

Figure 8.3

Average operating costs (operation, maintenance and replacement) of major public transport modes, as a function of GDP per capita

Source: CODATU, 2009, citing Lasserre, 2008.



Public transport is primarily financed through fares, subsidies and value-capture arrangements

In recent years, 'value capture' . . . has emerged as an attractive political approach to the challenge of creating sustainable revenue sources for public transport

global greenhouse gas emissions as well as the economic cost of congestion.

Rail has the highest capital costs of all public transport modes, irrespective of per capita national incomes (Figure 8.2). While the capital costs range widely, they are consistently higher than for other modes. It has been estimated that the total per kilometre capital cost for metros generally ranges between US$50 million and US$150 million (2002 US$ values).[18] BRT capital costs (i.e. stations and dedicated lanes) are considerably lower and the systems are built faster than rail. A US study (from 2001) found the average capital cost per kilometre of BRT lines to be about US$8.4 million, compared to US$21.6 million for light rail.[19] Similarly, in India, the first phase of the BRT system in Ahmedabad cost only 5 per cent of the capital cost of the Delhi Metro (US$1.4 million and US$30 million per kilometre, respectively).[20] A major reason for the high cost of metro construction is related to tunnel excavation. Construction of each kilometre of metro underground lines has been estimated to be between four and six times more costly than for lines above the ground.[21] However, BRT does generally entail higher maintenance and operation costs than rail (Figure 8.3).

Public transport is primarily financed through fares, subsidies and value-capture arrangements. ***Fares*** are perhaps the most contested component of public transport financing. Cost recovery from fares ranges widely (Box 8.1). In many cases, fares are not affordable to large segments of the population. Box 8.3 shows that fares and other transport costs can comprise a sizable share of income for low-income and poor populations.[22] When fares increase, riders may protest, and ridership may decline to the effect of precluding any revenue increases – as in Ouagadougou (Burkina Faso) in 2004 and Lomé (Togo) in 2009.[23]

Thus, international aid and/or broader-based ***subsidies*** must be sought to support public transport systems.[24] These range from taxes on individuals and employers, to industry and sales. Public transport can also be supported by tolls collected on bridges and tunnels in the adjoining metropolitan region.[25] In London (UK), public transport is supported in part by congestion charges paid by drivers of private cars entering into the central business district. Subsidies may also be tied to real estate transactions (as in New York, US).[26] In general, the mix of public transport subsidies should produce a stream of revenue that is steady and reliable over time, and not subject to political and economic shifts. Strong regulatory and governing institutions are necessary to collect and distribute funds for public transport at a large scale.

In recent years, '***value capture***', the practice of linking fees and taxes on the indirect but real beneficiaries of transport access, has emerged as an attractive political approach to the challenge of creating sustainable revenue sources for public transport.[27] It is typically presented as a third method of finance, though the congestion charges and real estate transaction fees described above could fairly be interpreted as forms of value capture. The most frequently cited contemporary example of value capture is the system of sustainable finance that supports public transportation in Hong Kong (Box

Box 8.1 Public transport cost recovery from fares

In general, the situations where fare-box recovery is adequate to support the public transport system are in places where density of use is high, public transport runs on exclusive rights of way and where affluent users prefer public transport to private cars. Two types of situation fit this scenario:

- Certain Asian cities such as Hong Kong,[a] Singapore,[b] Tokyo[c] and Osaka[c] and Taipei.[d] The fare-box recovery ratio in Hong Kong in 2007 was 149 per cent.[a]
- High-speed rail lines that connect major airports to city centres, such as the Heathrow Express in London (UK); the Arlanda Express in Stockholm (Sweden); the Brussels Airport Train (Belgium); Schipol–Amsterdam train (the Netherlands) and the Shanghai Maglev (China).[e]

For cities in Europe the modal fare-box recovery ratios are in the range 30–50 per cent. The fare-box recovery ratios in North American cities with high density and strong fixed rail systems are comparable to those in Europe. However, in the lower density North American cities the rates go down to as little as 9 per cent.[d] In Burkina Faso, the public-private bus system, SOTRACO, covers 59 per cent of operating costs from fare revenues.[f]

Sources: [a] Chow, 2008, p21; [b] Hale and Charles, 2008; [c] Shoiji, 2001; [d] http://en.wikipedia.org/wiki/Farebox_recovery_ratio, last accessed 30 January 2013; [e] Crozet, 2006; [f] Godard, 2011b, p12.

8.7). The policy notion of value capture in Hong Kong is to ensure that all or a portion of the value created and embedded in the location value of land parcels that is attributable to transport is directed towards investment in transport infrastructure or operation.[28]

Public–private partnership[29] concessions have met with limited success in public transportation projects (see, for example, the experience of the London Underground,[30] New Delhi's failed privatization of buses in the early 1990s, and similar failures in Pakistan).[31]

■ *Informal motorized transport*

Informal motorized transport (minibuses, shared taxis, motorbike taxis, etc.) can operate much like public transport from the user's perspective, but is usually managed by private, for-profit companies or individuals. Each informal transport system may have its own fare structure that is not integrated with the rest of the public transport system. And, as mentioned in Chapter 6, in Tanzania (and several other countries), informal transport buses refuse to provide rides to free-fare students.[32]

Fare regimes within the informal transport system often vary by market segments and the perceived price sensitivities of customers. A study of Malaysia's trishaw industry for example found that different fare structures were charged to regular customers (lowest), casual customers, goods, prostitute runs, tourists (highest).[33] Differentiated pricing is also seen as weather or road conditions change. For instance, in Nairobi, Kenya, fares are often increased during heavy rains, as is the case in much of South-Eastern Asia during the monsoon season.[34]

Informal motorized transport uses collectively provided infrastructure, namely roads. They usually do not have built stations but avail themselves of roadside stops that often cause other traffic to be delayed and backed up. Their capital costs are thus relatively low, while operating costs are kept low through low wages and minimal administration. Motorcycle taxis are even less expensive to operate than minibuses, since fuel and repairs cost less. Due to these implicit subsidies, lack of administrative overhead and freedom from regulations (that might forestall safety and environmental problems), informal motorized transport is able to earn a profit from rider fares although profit margins may be low.[35]

Due to . . . implicit subsidies, lack of administrative overhead and freedom from regulations . . ., informal motorized transport is able to earn a profit from rider fares although profit margins may be low

Situations such as these illustrate the ways in which uncompensated social costs subsidize the financial viability for informal sector transport providers. Legally collecting fees and taxes from informal transport modes has proven to be bureaucratically difficult, as in Cotonou, Benin,[36] although police and other officials are known to regularly extort fees from informal transport operators. Many cities in developing countries struggle with formalizing the informal public transportation sector to improve service and safety.

■ *Private motorized transport*

Private motorized transport, including cars and motorcycles, is often the most expensive mode for the traveller. As shown in the previous section, the use of private cars increases with income. Private vehicle use ranges from 7 per cent of residents of Addis Ababa[37] (Ethiopia) to 87.9 per cent of work trips in the US.[38] Travellers must purchase or lease a vehicle, buy insurance and registration, pay tolls and charges, buy fuel and maintain the vehicle.

Finally, there is a choke point of congestion when each private vehicle reduces space and diminishes the quality and speed of the trip for all other vehicles. Depending on system design, private vehicles can also interfere with the operation of public transportation. The cost of congestion is however difficult to measure.[39]

ECONOMIC VALUE OF THE TRANSPORT SECTOR

Urban transportation is a vital urban public service and an integral input into the economic life of its city-region. While the overall size of the transport sector varies from economy to economy it tends to account for a small but significant proportion of GDP. In the US, for example, transport accounted for about 8.5 per cent of the GDP in 2009,[40] compared to between 3 and 8 per cent in the countries of Asia and the Pacific.[41]

The demand for transport is what economists call a derived demand: a demand generated in pursuit of another goal. Transportation of people and goods is rarely undertaken as an end in itself.

Transportation of people and goods is rarely undertaken as an end in itself

The direct and indirect contribution of transport spending to overall productivity and employment creation is valuable. Thus, it is important to create transport systems that are as efficient and effective as possible in terms of both their monetary and social costs. In Houston (US) where over 70 per cent of commuting is done by private cars, the costs of urban transport absorb 14 per cent of GDP. The comparable proportion for New York City (US), where over 50 per cent of commuting is done by public transport, is about one-third less of regional GDP or about 9.4 per cent.[42]

Table 8.1

Number of people employed by public transport operators, by region (2009)

Region	Number of operators (millions)
Developing countries	**4.3**
Asia-Pacific	2.8
Latin America	1.2
Middle East and North Africa	0.2
Sub-Saharan Africa	0.1
Developed countries	**1.8**
Europe	1.4
North America	0.4
Transitional countries	**1.2**
World total	**7.3**

Note: These estimates are conservative as they mainly focus on formal transport and do not provide an estimate for the significant number of jobs supported by the informal transport sector, particularly prevalent in urban areas of Asia and Africa. In addition, the estimates do not include taxi services (formal or informal), interurban and long-distance transport.

Source: UITP, 2011a.

Table 8.2

Projected transport infrastructure investment, road and rail (2005–2030)

Region	US$ billions
North America	940
Latin America	1,010
Europe	3,120
Asia-Pacific	2,110
Africa	310
Middle East	310
World total	**7,800**

Source: Morgan Stanley, 2009, p3.

In addition to being a major factor of production and urban consumption, urban transport is a major source of employment. It has been conservatively estimated that in 2009 the formal public transport sector accounted for about 13 million full-time equivalent jobs (as transport operators) worldwide.[43] Of these jobs, some 7.3 million represent direct employment by public transport operators (Table 8.1). The rest are employed directly by public authorities (300,000 people) or involved in the provision of goods and services to public transport operators and authorities[44] (5 million people). Public transport operators are the largest employers in Amsterdam (the Netherlands), Barcelona (Spain), Brussels (Belgium), Genoa (Italy) and Dublin (Ireland). In Paris (France), Budapest (Hungary), Porto (Portugal), Madrid (Spain), Turin (Italy) and Tallinn (Estonia), public transport operators rank among the city's top-five employers.[45]

However, in many developing countries transport is primarily characterized by informal sector employment.[46] In most cities of Sub-Saharan Africa, employment in the informal urban transport industry is a mainstay of the local urban economy. In Kenya, some 40,000 *matatus* (minivans) provide 80,000 direct and 80,000 indirect jobs, mostly in urban areas.[47] In South Africa, the 'Kombi taxi' (the urban minivans) created approximately 185,000 direct jobs and 150,000 indirect jobs in 2003. In Kampala, it is estimated that the informal minivan industry employs between 40,000 and 60,000 people.[48] These numbers are suggestive of the high importance of informal transport sector employment in many developing countries.

The transport sector also often creates higher overall levels of income. In Geneva, it is estimated that for every US$1 invested, another US$3.8 of value added is created.[49] Worldwide, it has been estimated that every US$1 of value created by public transport is linked to the further value creation of US$4. In addition, 'every direct job in public transport is linked to four jobs in other sectors of the economy'.[50] Similar multipliers are observed in the US with more than 36,000 jobs created for every US$1 billion invested in public transport.[51]

Transportation is a service produced through the creation of networked infrastructure, sidewalks, streets, roads, highways and railways. The process of producing this infrastructure is thus both a contribution to present employment and future productivity. It has been estimated that some US$7.8 trillion will be spent on transport infrastructure projects globally between 2005 and 2030 (Table 8.2). Although all transport investments are creating employment, it is worth noting that the creation of public transport infrastructure in the US appears to have almost twice as much job stimulus as a comparable amount spent on highway infrastructure.[52] What is perhaps most striking about the data in this table is that the regions with the lowest projected infrastructure investments are the ones that are likely to experience the most severe urban mobility challenges, due to rapid urbanization.[53] The two regions with the lowest projected investments for example (i.e. Africa and the Middle East), are likely to more than double their urban populations between 2005 and 2030, compared to an increase of only 16 per cent in developed countries.[54]

The costs associated with road traffic accidents are often overlooked in the context of transport economics but should always be accounted for in policy-making.[55] The total annual cost of road traffic accidents has been estimated at US$518 billion, or about 1–3 per cent of global GDP.[56]

The costs associated with road traffic accidents are often overlooked in the context of transport economics but should always be accounted for in policy-making

FROM ECONOMICS OF MOBILITY TOWARDS ECONOMICS OF ACCESS

One of the most powerful justifications for the disproportionate funding of private motorized transport is that it saves time. This in turn leads to the evolution of urban transport policies that promote extensive reliance on ever more mobility to solve the urban congestion and access problems. However, in the context of urban living, mobility is just one of two means for achieving access. As noted earlier in this report, access can also be achieved through co-location of urban activities. As a practical challenge of policy-making, the attraction of enhanced mobility is that it is easy to measure and hence to value, while co-location – or mixed-use urban land arrangements – is difficult to monetize. This methodological constraint has skewed cost–benefit analyses to favour mobility-oriented infrastructure projects over ones that might enhance co-location.

In the context of urban living, mobility is just one of two means for achieving access

This section shows how (and why) the value of mobility over access leads to the promotion of private motorized transport over more sustainable modes, and revisits the framing of cost–benefit approaches to transport project evaluation.

What has time saving got to do with it?

As a result of the problems in measuring the benefits of co-location, much of the treatment of urban transport as an economic good focuses on its mobility value, usually measured as travel time saved.[57] The presumption behind this is that if mobility promotes access, measuring the value of time saved in travel is a good proximate measure for the ultimate end product, i.e. more time in other pursuits.

Because time spent in motion (i.e. mobility) is such a relatively straightforward concept to understand and to measure, it provides a powerful basis for valuing transport improvements. If the value of the benefits exceeds the cost of the project, it is deemed worthwhile. It is from this insight that modern cost–benefit analysis for transport decision-making evolved.[58]

Cost–benefit analysis is now the primary tool through which governments, international financial institutions and bilateral donors make decisions on major public works projects. Its elements have become so standardized that few question the shortcomings of using enhanced mobility as a proxy for urban access. But at a time when the economic and environmental costs of mobility are becoming difficult to sustain, it is important to rethink this approach.

A recent look at a cross-section of transport cost–benefit analyses across the UK concluded that approximately 80 per cent of the identified benefits in transport derive from the monetary value assigned to time savings. However, the amount of time spent in urban travel in the UK has remained constant at around one hour per day for three decades. Travel diary studies demonstrate that the benefit of transport improvements provide a greater range of spatial access within the same travel time budget over time.[59] If this is the case, there is a need to better assess 'the value of access' as distinct from the hypothesized benefit of 'time saved' in considering transport investments.

There is [thus] a need to better assess 'the value of access'

Measuring the value of access

To the extent that transport improves the ability of an urban area to maximize the agglomerative benefits of access – i.e. the economies of market density and supplier density – it adds significant value to the local economy. A working definition of the benefits of agglomeration would be the increase in individual per worker productivity that results from improved access. A recent study of London's Crossrail project (Box 8.2) uses such calculation methods on a large-scale public transport project, in order to capture access benefits along with travel-time saving benefits. Adding these agglomerative benefits to the more traditional time-cost savings benefits raised the traditional time savings based benefit–cost ratio between 36 and 93 per cent. While the methodologies used to measure these effects can be debated – and have led to considerable discussion – the important point is that these estimates provide an empirical sense of the sizable benefits that access conveys. Most important for matters of economic sustainability, they open up the possibility that access and hence economic wellbeing can be improved upon via the co-locational characteristics of places. This includes more reliance on pedestrian and bicycle access, as well as more and better public transport options, both of which are critical to an economics of sustainable urban transport.

Access and hence economic wellbeing can be improved upon via the co-locational characteristics of places

Box 8.2 Crossrail and agglomeration benefits, London, UK

Crossrail is a new addition to the London Underground, which is scheduled to start operations in 2018. It is intended to increase carrying capacity by 10 per cent in the portion of the system serving central London. Using conventional analysis, Crossrail yielded a strong traditional benefit–cost ratio of 2.55. Fifty-four per cent of the benefit takes the form of travel-time saving and 43 per cent from increased network carrying capacity.

By including the wider economic benefits of agglomeration, a second benefit–cost ratio was calculated. In the latter instance the ratio increases to between 3.47 and 4.91. About one-third of this increased benefit is due to higher worker productivity, due to the higher levels of urbanization and localization economies created by improved access. The remainder of the added benefit is linked to increased tax revenue generated from the transformation of less productive to more productive jobs plus the improved locational value of the areas served and increased labour force participation.

Comparing the initial benefit–cost ratio with the benefit–cost ratios that include the wider economic benefits of access and agglomeration, the ratio increases between 36 per cent (at a benefit–cost ratio of 3.47) and 93 per cent (at a benefit–cost ratio of 4.91).

Source: Jenkins et al, 2010 (see also http://www.crossrail.co.uk/).

The standard economic analysis of supply and demand . . . is a limited tool for establishing useful financial models to support urban mobility

Urban mobility is both a private and a public good

An economic analysis of sustainable urban mobility must consider the complex nature of mobility as an economic good. Mobility as a commodity lends itself to the standard economics of supply and demand, as it is conceivable in the context of private markets where buyers and sellers agree upon quantities and prices. Even the presence of 'externalities' is correctable via disincentives, such as taxes on negative externalities (like air pollution) and congestion charging and parking fees (Box 8.5) to discourage excessive car use and incentives for positive externalities, such as access to 'free' bicycles and well-designed and walkable streets.

As physical realities, cities are the co-location of activities to avoid the need to travel

In the language of economics, mobility has the two distinguishing characteristics of a private good, rivalry in consumption and excludability in ownership. Rivalry refers to the notion that what one individual consumes cannot also be consumed by another. If one individual buys a ticket to a certain seat on a train, a second individual cannot occupy the same seat for the same trip. Excludability means that the owners of the vehicle can deny entry to those not purchasing a ticket to ride.

Car users in most countries do not pay a high enough price to cover the full cost to society of this travel mode

While the case for mobility as a private good is powerful, the case for the access that it creates as a public good is more compelling, and for the same reasons. Turning the two characteristics of a private good around implies a public good: non-rivalry in consumption and non-excludability in ownership. Access is characterized by both non-rivalry and non-excludability. When one person accesses the city by working or living there, she does not harm another's ability to access the city. In fact, she increases the value of another person accessing the city. Although one can conceive of exceptions, access to a city's opportunities is likewise non-excludable, because there is no entry fee to a city. The mobility option one must use to get there, however, may be characterized by both rivalry and excludability, depending on congestion and fares. This means that the standard economic analysis of supply and demand, based as it is on the presumption of private goods, is a limited tool for establishing useful financial models to support urban mobility.

The working formulation for an economics of sustainable urban mobility is one in which the planning and policy target is maximum access and minimal mobility. An ideal sustainable city is one where the need to expend resources in movement of people and goods is at the lowest possible level. The co-locational properties of the city – the opportunities for specialization and innovation made possible by the density and diversity of people and firms – are the desired social good. Mobility serves as the means to access these goods. The economic sustainability of urban mobility relates the value created by transport in enhancing accessibility even as it minimizes the environmental and social costs of mobility. Thus, as physical realities, cities are the co-location of activities to avoid the need to travel.[60]

Road pricing is necessary but normally not sufficient to improve urban accessibility

There is considerable evidence that car users in most countries do not pay a high enough price to cover the full cost to society of this travel mode.[61] In practical terms, this implies that the society at large is in effect subsidizing private motorized transport (through the costs of addressing economic, social and environmental externalities). From the point of view of conventional microeconomics, the standard diagnosis is that the market for urban car travel is inefficient. The policy solutions to correct that inefficiency call for 'getting prices right'.

The policy recommendations that flow from 'right' pricing are the creation of methods to effectively raise the cost of car usage to better reflect the environmental and social costs that this travel mode imposes on society. 'Full cost pricing', as this approach is known, seeks to impose licenses and fees via taxes on drivers that approximate the economic value of the social and environmental costs. An example of this can be seen in Singapore where the government has implemented a number of financial disincentives to curb car ownership,[62] and encourage a modal shift to non-motorized and public transport.

However, even if this policy worked as predicted, it is at best a partial solution, as the goal of such pricing is to decrease the use of cars. Unless the revenues raised are sufficient to cover the costs of added public transport to provide substitute service, such pricing is at best a necessary and not a sufficient condition in terms of meeting the access needs of a city-region. Furthermore, such a policy has significant risks in terms of social equity. The drivers that it prices out of the market will be the ones with the least ability to pay the higher costs. Moreover, it does nothing to meet the ongoing needs of the large mass of lower-income residents who were not driving in the first place. Thus, policies are also required that directly address the underlying reasons for urban travel, and that address the problems of those for whom, even at comparatively low market prices, car travel is out of reach.[63]

The private car versus public transport: Markets and modal choices

If one considers the data presented in Figure 8.1 and nothing else, it is easy to conclude that there is strong universal urban desire for car-based travel. If that is the wish of the world's urban population, shouldn't policy and planning goals aim to satisfy this market demand in a manner that is as environmentally sound and socially equitable as possible? It is difficult to argue with that policy interpretation given the globally poor state of public transport alternatives.

The problem with this view is technological reality. The idealized promise of the car can only be achieved in cities if certain unlikely technological changes are made: if vehicles cost little to own and maintain, use little energy, do not pollute and emit greenhouse gases, and lack the physical need for expanded road space and parking places. Lacking these conditions, pressing social and environmental concerns will continue to render the dream of personal freedom of mobility as theoretical fantasy – or as an unrelenting urban nightmare – if attempted in practice.

As the evidence presented in this report makes exceedingly clear, there are public transport alternatives – as well as pedestrian and other non-motorized forms of travel – that can make a scalable difference in terms of both personal mobility and urban sustainability. The experiences in some Asian and European cities – where public transport trip speeds exceed those of private cars – exemplify the potential of enhanced public transport.[64] In light of this, a more realistic interpretation of Figure 8.1 is that it reflects things as they are: a less than ideal choice between an often unreliable and unsafe public system and being stuck in slow-moving traffic in a car-based system.

However, it is public finance, and not private market decisions, that is the final arbiter of the quantity and quality of the urban transport options. The reason that public finance becomes the crucial determinant of the choices that define private markets is that once one moves beyond walking and other forms of non-motorized transport, motorized transport modes are never fully supported by charges to travellers. Motorized transport requires funding beyond what users pay directly, as discussed in the section below. In order to develop urban public transport systems that are of sufficient quality and quantity, and that also reduce environmental and social equity problems, policy-makers must confront the reality that user charges will never be sufficient.

There are public transport alternatives . . . that can make a . . . difference in terms of both personal mobility and urban sustainability

THE PERENNIAL FINANCIAL PROBLEM: COSTS EXCEED REVENUES

The continual fiscal challenge for any urban public transport supplier is avoiding a negative cash flow: attaining either a zero balance between income and expenditure, or a positive cash flow to finance future improvements. This requires bridging the difference between fare revenues and the full costs of service while encouraging efficient operations in a manner that is sustainable over time. This challenge is not easy nor are the solutions free of controversy. This section explores the dimensions of this chronic funding gap. The next section explores potential solutions.

Policy-makers must confront the reality that user charges will never be sufficient

User charges are never sufficient to finance public transport

There is no obvious theoretical reason that prevents urban public transport from covering its full costs via charges on its users. But in practice, as noted in Box 8.1, there are only a handful of instances where fares represent both full cost recovery and sufficient profit to permit a private market to sustainably meet the needs of passenger travel.[65] The experience in some transitional countries, such as Poland, in the early 1990s captures the essence of the problem:

> '. . . cost recovery in major cities appeared to be too low to generate sufficient funds for replacing and modernizing bus and tram fleets. It led to worsening of the quality of public transport and was another reason . . . for undesirable modal shifts.'[66]

This experience highlights the two ways that policy-makers have attempted to 'solve' the cash-flow problem: fare increases and competitive tendering. These solutions typically fall short because policy-makers are often not clear about their policy goals. Is urban transport a private good with some public benefits or is it a public good with private benefits? Depending on how one chooses to answer that question, the policy outcomes are very different. This report is built around the clear premise that urban transport, because it facilitates access, is fundamentally a public good. The policy goal is to strengthen the use of public (and non-motorized) transport. Its private good's features can be leveraged to provide some of the needed revenue, but that, by itself, will not be adequate.

Urban transport, because it facilitates access, is fundamentally a public good

If public transport is viewed solely as a means of private conveyance to satisfy private demands, it has a higher chance of success, but such success has a price. The transport system either does not operate at sufficient volume to positively impact urban spatial patterns in a sustainable or equitable manner, or – if the volume is adequate – the quality is exceedingly low and everyone who can avoid it does. Rising rates of car ownership and car use for work and education trips are the result. The starting point for confronting the financial challenge is to recognize that if urban public transport is to generate its valuable public goods benefits (i.e. to promote access), revenue sources beyond the fare box are needed.

The value of urban transport is directly related to its quality as an integrated system, distinct from a collection of independent modal options and specific routes

No matter how hard policy-makers and officials try to make public transport self-supporting through the fare box and reorganizational moves, such as competitive tendering to improve efficiency, these reforms always fall short. It is not that fare policy and organizational form are unimportant; on the contrary, they are exceedingly important. By themselves these second-order conditions are not sufficient if accessibility is the policy goal. The policy challenge is to broaden both the sustainable mass usage of the service and encourage revenue sources that go beyond the fare box. The goal is to create viable financial models that align organizational forms for service delivery with the unique transport needs of each metropolitan area.

The high private cost of transport

As discussed above,[67] the problem on the consumer side is that while travellers in developing countries do pay high transport prices relative to their income, the amount paid is insufficient relative to the revenue sums required at full cost recovery. Transportation costs for urban and low-income populations are always high, measured either in terms of money or time (Box 8.3). In developed countries, the costs tend to be in money terms. In developing countries, people tend to spend more hours of the day in moving from place to place.

Poor-quality transportation entails high costs that are often not distributed equally across the city or within households. For example, women may become stranded as they attempt to link trips for childcare and employment; the elderly may reduce the number of trips they make; and children may have dangerous or tedious trips to school. Only counting the monetary expenditure of travel, measured in terms of personal or household incomes, these costs can account for anywhere from one-tenth to one-fifth of income for high-income individuals and households. For the poor, it can account for nearly half of their income.

These income constraints limit the amount of revenue that users can contribute to the costs of maintaining the urban transport system. This problem is especially acute in developing countries. Attempts to resolve revenue shortfalls by increasing the costs to populations that are already paying a fare that severely taxes their ability to pay is clearly an extremely inequitable approach, and is thus not likely to succeed.

Good quality urban transport: The system is the solution

The value of urban transport is directly related to its quality as an integrated system, distinct from a collection of independent modal options and specific routes. The more options that urban residents have to access work, education, shopping, social connections, etc., the more value-added the city creates.[68]

Box 8.3 The high personal cost of urban transport: Anglophone Sub-Saharan Africa

Studies from Nairobi (Kenya), Lagos (Nigeria) and South Africa show that lower-income households pay from 15 to 54 per cent of their income in transportation costs. Public transportation fares are high and poorly regulated. In Lagos, for example, bus drivers often force riders to exit and re-board paying an additional fare to continue their trip. Riders must often bargain with drivers for the price of the fare. For the poor, high transport costs diminish their access to basic needs. It erodes the efficiency of individual economic activities as well as reducing national and municipal economic efficiency.

Furthermore, a 1990 study of four Eastern African cities showed that non-motorized transport – walking and cycling – was inadequately accommodated. Walking meets up to half the transport demand and accounts for only 1 per cent of the total transport costs. In contrast, private motorized transport meets less than 10 per cent of demand, yet accounts for over half the costs.

Source: Pirie, 2011.

The financial danger is that in a quest for saving money, specific routes are at times valued on an individual basis and not as part of a system. Individual routes can at times cover operating costs and occasionally some or all of their capital cost when travel demand is sufficiently intense. This typically occurs along major public transport routes serving the highest density portions of urban central business districts. Singapore and Hong Kong are the best examples of this. However, the public goods value of access derives from the existence of entire urban transport systems and not just travel on its densest routes.[69] Less-dense routes that make the entire system viable often cost more to operate than the revenue from fares can cover. But without these feeders, the diversity of opportunities that contribute to the creation of urban value would be lost. The greater the degree of system integration within and across modes, the higher the degree of valuable access the system creates. To achieve that valuable goal requires public-led investments in infrastructure, equipment and service delivery.

EXPANDING THE FINANCIAL OPTIONS FOR PUBLIC AND NON-MOTORIZED TRANSPORT

In what direction should the public sector proceed in order to expand financial support for urban public and non-motorized transport beyond user-generated revenues? This section examines four possible approaches (as well as combinations of these), namely:

- Direct allocations from general municipal and national revenues (i.e. from general taxations);
- Other allocations from government sources;
- Financial arrangements that allow the transport system to capture a portion of the value that they create through urban access (i.e. value capture);
- Other arrangements that allow public–private partnerships to capture the value created by transport systems.[70]

General revenue models

The most common way in which governments meet the funding gap for urban transport is via allocations from general tax receipts. It reflects a general belief in the public goods value that the service creates. To the extent that governments treat public transport as just one among many public services such as police protection and education, this arrangement can work well. This approach is widespread in China, for example. Urban transport there is typically supported through general revenue allocations from the local municipal government, with rail-based more favoured than bus-based. In Shanghai, as part of its accommodation of World Expo, the government allocated an additional US$541 million[71] to ensure smooth operations in 2009.[72]

In virtually every city there are some general revenues used to support the urban transport system in one way or another. In Curitiba, Brazil, the fares on the BRT system cover the operating costs for the private companies that supply services, including reduced and free tickets for some categories of riders. Nonetheless, the user-generated revenue does not cover all of the infrastructure costs. The municipality supports the construction and maintenance of the street-based exclusive rights of way on which the system operates from its general revenue sources.[73]

One of the weaknesses of general revenue as a financial source is its political vulnerability. In cities where public transport is viewed as a largely private good, any forms of public support are often looked upon as temporary and easily dispensed with in the belief that the fiscal problems are the self-inflicted wounds of an incompetent industry. This is especially the case in austere fiscal times (such as the current global financial crisis), when politicians can adopt this rationale as they search for a politically easy place to cut public spending. These losses of support always cause cuts in services and higher fares, just when more people need mobility to find work and have less money to spend on it.

Another form of political vulnerability that should be mentioned here is that related to changes in political leadership at the city and national level. This applies not only to changing political directions related to the rise and fall of support for specific political parties, but also to the departure of individuals that may have championed specific initiatives in the transport sector.

Figure 8.4 provides an overview of sources of operating revenue for public transport in five developed country cities. The figure indicates that three of the public transport operators – TriMet in Portland (US), Translink in Vancouver (Canada) and Sytral in Lyon (France) – collect more than three-quarters of their operating revenues from either fares or dedicated tax revenues (over which they exert some degree of control). Operators that rely on direct funding from local, provincial or national governments for their revenue streams may more easily be subject to the negative effects of changing political climates.

Ideally, funding for non-motorized transport should come from normal operative budgets from departments dealing with transportation and public works.[74] However, funding for such infrastructure investments could also be drawn from revenues from advertising, road pricing/taxes and private-sector

The public goods value of access derives from the existence of entire urban transport systems and not just travels on its densest routes

The greater the degree of system integration within and across modes, the higher the degree of valuable access the system creates

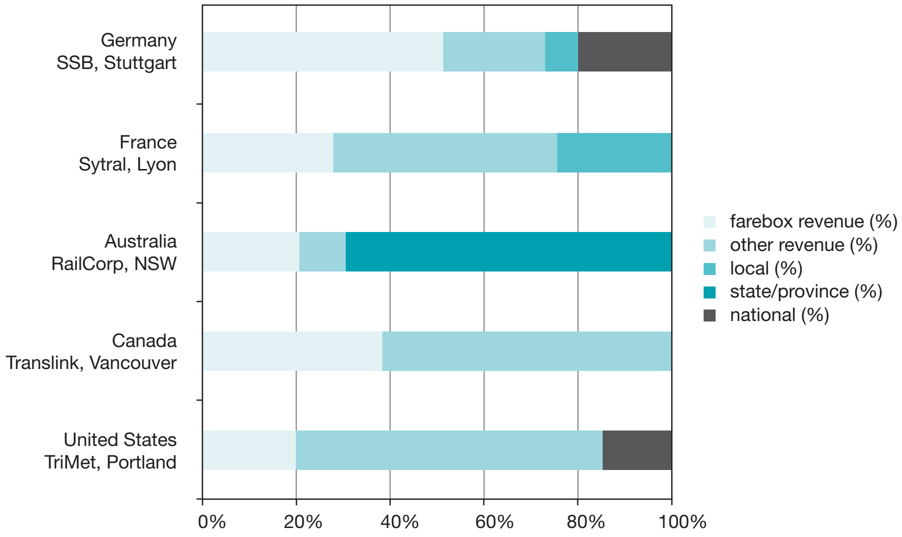
The most common way in which governments meet the funding gap for urban transport is via allocations from general tax receipts

One of the weaknesses of general revenues as a financial source is its political vulnerability

Figure 8.4

Sources of operating revenue, selected cities

Source: World Bank, 2011a.



participation. It should, however, be noted that many low-income people in developing countries are so poor that they find even the cheapest bicycles prohibitively expensive. Thus, policies to encourage non-motorized transport in such countries should include funding options to enable the poorest urban residents to purchase bicycles.

Other allocations of public funds

Given the limitations of public funds to finance public transport, many governments have also appropriated funds from other revenues and tax incomes, mainly from indirect beneficiaries, i.e. individuals and organizations who are not necessarily users of public transport, but are understood to benefit from the

Box 8.4 Urban road pricing initiatives

The primary objective of most urban road pricing initiatives is to reduce congestion levels during periods of peak travel demand. However, such initiatives may have additional goals, such as generating revenue, reducing environmental impacts and encouraging public transport use. When financing is the main purpose of road pricing, the aim is to design a system that provides steady and reliable revenues. Quite often the purpose may be to finance the cost of new infrastructure, for example a new road or bridge. The manner in which these revenues are used is often the key to obtaining public acceptance for the scheme – even if the primary goal is congestion management. An overview of different types of road pricing initiatives is included in Figure 8.5.

The first modern road pricing system in the world was implemented in Singapore in 1975. The purpose of the system is to regulate traffic, by achieving a target speed that gives improved accessibility. Every three months the fees are revised upward or downward, based on whether the travel speeds are above or below the desired speed. In 2001, the project sponsors introduced an environmental component to the scheme by charging a reduced fee for electric or hybrid cars.

Oslo, Norway, introduced an electronic road toll system in 1990, with 19 tolling stations that control access to the city 24 hours a day, 7 days a week. Emphasis was placed on the generation of revenues necessary to finance new road and public transport projects. As a result, the traffic impacts of the toll system itself have been minimal, with only a 3–4 per cent reduction in traffic. The annual operating costs of the toll system account for approximately 10 per cent of annual revenues, while the remainder is used to support road and public transport investments.

Other systems have since been introduced in a number of cities around the world. In developing countries where traffic levels are low, or where construction costs are high, it is unlikely that the tolls will cover more than operation and maintenance, and perhaps a part of the construction cost. In Mexico, for example, the main reasons for the failure of road concession projects have been attributed to: lower than expected revenues due to traffic shortfalls; excessively high toll rates; and the currency crisis of 1994.

Even though urban road pricing initiatives are designed to generate socially desired benefits, experience shows that there are major obstacles encountered during the planning phases related to public acceptance, equity, politics, economics, technology and the design of the pricing scheme. In the 1980s, the city of Hong Kong considered the introduction of an electronic congestion scheme. The public response, however, was unfavourable, as there were significant privacy concerns about the government's ability to track users' movements and identities, and the initiative failed.

Sources: Transportation Research Board, 2005; Eliasson and Lundberg, 2002; Tanaka et al, 2005. See also http://en.wikipedia.org/wiki/Road_pricing, last accessed 15 February 2013.

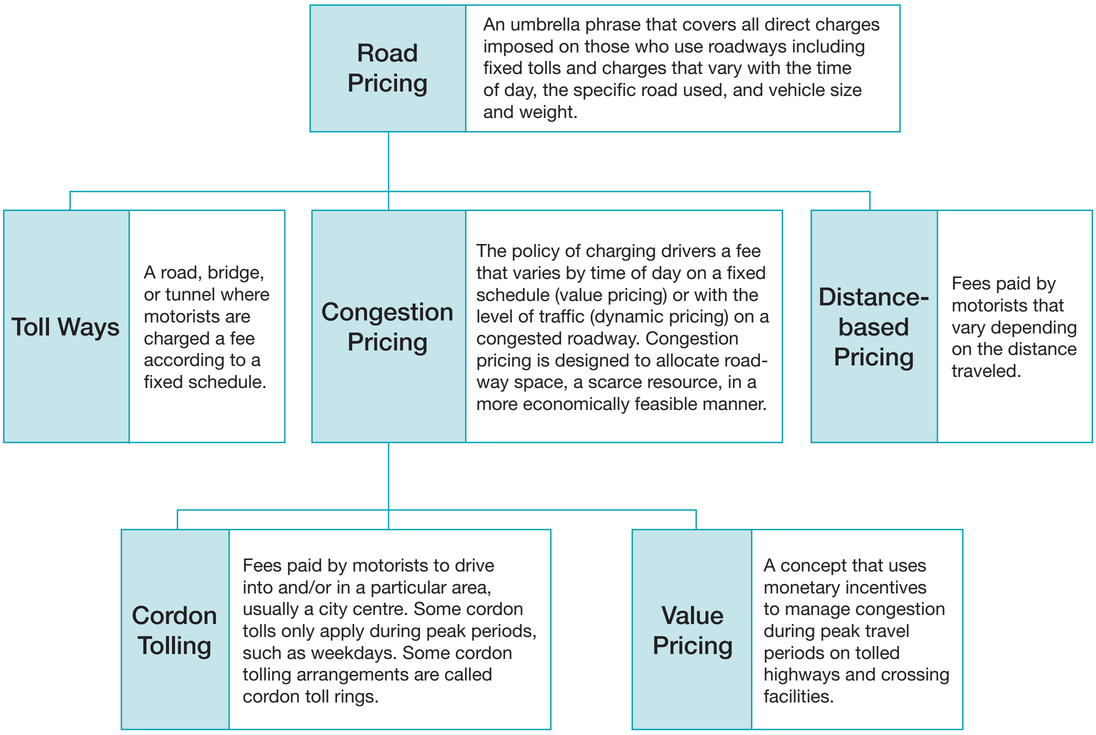


Figure 8.5

Urban road pricing terminology

Source: Aecom Consult, 2006.

availability of urban transportation services. Examples of such funding (which are in effect cross-subsidies to public and non-motorized transport[75]) include, *inter alia*: various forms of road pricing (Box 8.4 and Figure 8.5); parking fees (Box 8.5); advertising; sales taxes (Box 8.12); taxes on fuels and vehicle ownership; employer contributions (Box 8.6); and grants from international funding agencies.[76] However, the allocation of such public funding is also frequently exposed to political considerations, and may get diverted to other purposes, particularly during periods of economic austerity or changes in leadership.

A well-known example of such economically derived revenue charges is the *versement transport* implemented in France, a tax levied directly on employers within the urban area (Box 8.6) on the rationale that they benefit from increased productivity as a result of employees and customers having better access to work and commercial locations.[77] Other

Public funding is . . . frequently exposed to political considerations, and may get diverted to other purposes, particularly during periods of economic austerity or changes in leadership

Box 8.5 Parking charges: A promising source of finance for public and non-motorized transport

Parking charges have been introduced in many local authorities in cities across the world, as a source of revenue to finance local transport services. In Milton Keynes (UK), revenues from parking fees are dedicated to supporting public transport. Similar implementations worldwide include Aspen (Colorado, US), Miami (Florida, US), La Spezia, Verona and Milan (Italy).

Current parking planning practices tend to favour generous parking supply and minimal parking places, which have unintended and undesirable consequences: they increase development costs, reduce housing affordability, increase private car use and contribute to urban sprawl. As result, everyone but the motorist pays for parking. Consequently, problems such as traffic congestion, road infrastructure costs, road traffic accidents and pollution emissions are further exacerbated.

Recognizing the need for parking planning and management reforms, urban planners have proposed the introduction of various forms of parking fees and taxes. Such taxes can help raise funds and achieve various planning objectives, including more compact development and increased use of alternative modes. In Barcelona (Spain), 100 per cent of the revenue gathered from parking tariffs goes to operate 'Bicing', the city's public bike system.

Parking is increasingly being linked to public transport, and park-and-ride schemes have been introduced in many cities across the world, as an efficient means of managing car travel demand. This also allows for increased flexibility and enhanced intermodality for travellers, in particular women who tend to have several destinations for their trips, as they may need the car to drop off their children at school, but might prefer to use public transport to get to work. In Prague (Czech Republic), park-and-ride facilities are established near metro and railway stations. These car parks offer low all-day prices, which include the fare for the public transport system.

Sources: Shoup, 2005; Litman, 2006b; Victoria Transport Policy Institute, 2011.

Box 8.6 *Versement transport*, Paris, France

Versement transport was first introduced in 1971 for the Ile de France (Paris) region, with the purpose of providing a consistent funding base to operate and invest in public transport. *Versement transport* is a compulsory tax levied on public and private companies with more than nine employees, with rates collected as a percentage of a company's total payroll costs (although with a fixed ceiling imposed by the state). Over the years, the geographical coverage of this scheme has extended to all metropolitan areas with a public transport authority. The tax rate is determined by local authorities but varies from region to region, ranging from 0.5 per cent to 2.6 per cent.

Before this tax was implemented, public transport in France was mainly funded through user fares. However the revenue base generated from *versement transport* now represents a major source of finance, which has lowered the costs of public transport while also supporting large-scale infrastructure projects, such as Strasbourg's light-rail system and the implementation of the metro in Marseille. In 2007, the incomes from *versement transport* in the Paris region accounted for a third of all funds allocated to public transport.

However, critics believe that *versement transport* adds more to the cost of labour, something which is undesirable given the high rates of unemployment. It has also been criticized for encouraging urban sprawl, as companies relocate their business outside the main urban area to avoid paying such taxes.

Sources: CODATU, 2009; Cabinet Alain Thomas, undated; Bouf and Hensher, 2007; Allen, 2011b.

benefits include increased property values where land is serviced by public transport and for other road users who experience less congestion.

Value-capture models

Since direct public funding is almost always politically vulnerable (particularly in periods of financial austerity), it is preferable to link publicly sponsored forms of financial support as directly as possible to the benefits urban mobility bestows upon indirect beneficiaries. It is within that context that location-based taxes and assessments to support transport service have become popularly labelled as value-capture systems. The term reflects the reality that urban transport does, via external benefits, create value for parties not directly using the service. This approach is politically appealing because it is able to explain how the charge relates to the benefit and to provide qualitative support commensurate with the needs of a growing city.

Value-capture approaches work best in cities where there is initially low per capita car use and where the population is growing

Hong Kong is undoubtedly the best-known instance where a provider of public transport covers the full costs and attains a profit through the use of a value-capture model.[78] The essential elements of this unusual situation result from the unique, public-private, corporate structure of the service provider, i.e. the Mass Transit Railway Corporation (MTRC) (Box 8.7). It has both a public mission to provide transport to a major city, but at the same time (thanks to the public trading of its minority shares) it is strongly governed by the earnings considerations of the private market. This arrangement bestows important urban access benefits on the entire Hong Kong region. And, due to a direct linkage to the ongoing real estate yields, the MTRC is able to sustain urban public transport via the process of value capture.

The practice as it has evolved in Hong Kong is unique to the institutional arrangements there. However, the underlying principle has widespread applicability. Although the term value capture is of recent vintage, the principle has long been understood as an important element in the creation of urban public transportation (Box 8.8). The lesson learned from the Hong Kong experience is that it is possible to practice value capture in service to the public interest. However, other cities also have a tradition of financing transportation projects by taxing real estate that benefits from infrastructure projects. In Bogotá, Colombia, for example, road expansion, improvement of public space, bicycle paths and TransMilenio lines have all benefited from this kind of financing.[79]

It is the principle of creating an agency that is capable of bridging the land use and transport divide in the service of enhanced urban access that is the important lesson to draw from the experience. The range of experiments with parking fees, highway tolls, congestion charges and land taxes are all variations on the principle of value capture (Box 8.4). Tax-increment financing also works according to the same principle: when a site's value increases due to the implementation of new transport infrastructure, the government can anticipate an additional increment in real estate taxes, and can borrow against this anticipated tax revenue to finance implementation of the transport infrastructure.[80] Similarly, private investors may provide capital for transportation projects in exchange for a share of revenue over time.[81]

Value-capture approaches work best in cities where there is initially low per capita car use and where the population is growing.[82] The first condition means that there is less resistance to overcoming car dependence and the second means that there is a strong potential customer base for the system. These conditions hold almost universally in the rapidly growing cities of Sub-Saharan Africa and Asia. In cities where population growth is stable or even

Box 8.7 Hong Kong and its Mass Transit Railway Corporation, China

Hong Kong's MTRC builds, owns and operates all the rail lines in Hong Kong. MTRC is unique among public transportation providers, in that it is a private for-profit corporation that is 76.7 per cent owned by the Hong Kong Special Administrative Region, which in turn owns all land in Hong Kong. The rest of the shares are publicly traded on the Hong Kong stock exchange. Due to its relationship with MTRC, the government is able to capture the monetary value of the access and agglomeration economies that its transport service generates.

Hong Kong's unique financial model works as follows. The Hong Kong government makes land around future station stops available to the MTRC on long-term lease at pre-transport development prices. The MTRC then sells the rights to develop these sites – at post-development prices – to designated private developers, who leverage the station locations for the creation of shopping malls and housing. The substantial difference between the two prices pays for the capital cost of the new rail infrastructure.

Furthermore, and most importantly, MTRC also negotiates a share of future property-development profits and/or a co-ownership position from the highest bidder, i.e. the MTRC retains a long-term claim on the rental income stream of these projects. Thus, MTRC is paid up front for land, plus a post-development share of the development's revenues, in addition to collecting fares. It is that long-term claim on urban value that turns this enterprise from just another struggling provider of public transport into a sterling corporate performer.

Between 2001 and 2005, property developments – i.e. development, investment and management – produced 62 per cent of MTRC's revenues. Railway income, made up mainly of fare-box receipts, generated 28 per cent of total income. The remaining 10 per cent of income was generated from advertisement and ownership of other assets (i.e. telecommunication leases and convenience retail shops).

One of the strong factors in the success of MTRC is that – in addition to satisfying initial conditions (there is a strong financial disincentive to car ownership, and population density is quite high) – more than 40 per cent of Hong Kong's population resides within 500 metres of an MTRC station and one in five households live within 200 metres of a station.

Sources: Pan et al, 2011; Cervero and Murakami, 2008b; MTRC, undated.

Box 8.8 Value capture has a long history to ensure private sector profits

In the early days of modern public transport, the late nineteenth and early twentieth centuries, private developers who built the first street railway systems understood the connection between the public transport improvements they were creating and land values in the streets that abutted the systems. They purchased land at the outskirts of the city and gained franchises to operate public transport over the streets running through the parcels of land they owned. They then installed the street rail infrastructure and as soon as the land had been developed and sold, the revenue-losing public transport routes were abandoned to the public sector to maintain from that time forward.

Starting in the 1910s, these systems began to falter and because they were by then vital public services, they soon became publicly owned and operated systems with the difference between costs and fare revenues provided by municipal general funds. The history of urban public transport in North America is replete with examples of this. In 1917, for example, the Commonwealth of Massachusetts passed its first public control act, taking over the public transport routes running through the City of Boston to its suburbs.

Sources: Edel et al, 1984; Schrag, 2000; Schaeffer and Sclar, 1980.

declining and car use is extensive – as is the case in many cities of North America and Europe – value capture via claims on rising real estate revenues will typically be disappointing, no matter how well they are organized.

Assuming that the right demographic and modal use conditions exist, the next most critical factor is the distance between places of residence and public transport stops, whether they are BRT or rail. It has been estimated that for every 10 per cent increase in distance from a public transport station, there is a 1 per cent decline in property values.[83] Hence the closer the target population is to the public transport stops, the higher is the relative real estate value and the larger is the potential base of support for the system (Box 8.7).

Three institutional factors in particular are vitally important in the successful deployment of value-capture mechanisms:

- Municipal governments need strong capability to value land and levy land taxes as well as impose fees on car users in the form of congestion charges and parking fees.
- These governments need a strong ability to regulate (if not control) the assembly of land parcels that line up with plans for building transport infrastructure.

- The capacity of government to act as a knowledgeable business partner is critical if the public–private partnership's ability to manage the attendant real estate developments is to be sustainable.

Other public–private partnerships

Value capture as practised in Hong Kong is a highly specific application of a more general approach to the provision of public services, called public–private partnerships. A public–private partnership is a contractual agreement between a public sector entity – such as a ministry, a department or agency – and a private sector partner to deliver a specific facility or service that is a public responsibility. A public–private partnership model is not a single model. Rather it is a flexible concept that runs across a continuum of contractual arrangements ranging from traditional forms of government procurement all the way to total private ownership of publicly used infrastructure (Box 8.9).[84]

Public–private partnership . . . is a flexible concept that runs across a continuum of contractual arrangements

In terms of infrastructure, these arrangements can include design, construction, renovation operation, maintenance or financing of practically any public facility or public service. In terms of urban mobility, the purpose of these arrangements – from the perspective of the public partner – is to obtain the benefits of expensive elements of networked transport infrastructure, while avoiding the costs and risks inherent in both construction and maintenance. For the private partner the ultimate goal is a healthy return on the capital invested. Such arrangements involve contracts that may extend over decades.

However, economists term such contractual situations as 'incomplete contracts'[85] because it is impossible to write a binding legal agreement that can foresee all the possible permutations of circumstance in which the parties to the arrangement might find themselves. As a result, the parties usually make provisions such as requiring arbitration or some other form of third-party governance to (hopefully) resolve differences of opinion and circumstance, as they will inevitably arise over the term of the agreement. Nonetheless the difficulty of negotiating such changing circumstances makes these arrangements far less stable in practice than they appear in theory. As a result this requires that public partners ask careful questions before engaging in such arrangements.

One major unstated but powerful motivation for the public partners in such situations is to pass the risks of construction and maintenance off to the private party. The private party's motivation for incurring the risk is to gain a positive return on their investment. Because the private party has a significant amount of capital at risk they go to great lengths to limit the extent of their risk and liability.[86]

In a typical infrastructure public–private partnership the private partner is actually a consortium of firms that form what are known as 'special purpose vehicles', which are independent, stand-alone entities tailored to the specific public-sector request. These vehicles help insulate and contain the scope of project-related risk to the parent companies. The basic problem from a public perspective is that ultimately the public sector can never fully off-load the risk (see also Box 8.10). The private party always has the option of bankruptcy to unburden themselves of an untenable situation. But because the investment involves vital elements of public infrastructure, the public partner can never walk away. The result is that

Box 8.9 Types of public–private partnerships

Public-private partnership projects attempt to provide options between the extremes of full public and full private control. There are a wide variety of potential public–private partnerships, as shown in the table below. In fact, a 'partnership' begins whenever the government decides to allow the private sector to control one or more of the activities that it traditionally managed on its own.

	More public ←			→ More private
	Traditional government procurement	Private operation with: public financing	Private operation with: private financing	Totally private ownership
New facilities	Separate bids for design and for construction	Private sector designs and builds facility in one bid	Private sector finances, designs and builds facility	Private sector controls entire process
Existing facilities	Operated by public agency	Operation and maintenance contract	Long-term lease	Private sector buys facility from the public
Hybrid	N/A	Contract to develop and operate facility		N/A
Ownership	Public	Public	Public	Private sector

Source: Office of the State Comptroller, New York State, 2011, pp3–5.

Box 8.10 Economic rationale for using public–private partnerships

How can a public agency know if a public–private partnership is a better arrangement than the more traditional way of creating public infrastructure? The typical valuation process employed to provide a proximate answer to this question is a process called value-for-money analysis.

As public sector borrowing costs are normally less than those of private parties, a straight comparison of construction costs alone almost always favours public construction over a public–private partnership. To avoid this problem, value-for-money analysis justifies the use of a public–private partnership when it can be shown that the discounted financial costs, over the life of the project, are lower than the costs of conventional procurement.

However, it is virtually impossible to know if these lifecycle costs will be lower. To get around this challenge, public agencies often construct a hypothetical projection of what the operation would cost if it remained public (based on comparable past experiences from elsewhere). The basic problem for such a comparative cost analyst is deciding which partner bears that risk over time; the more risk that can be apportioned to the public sector, the higher are the costs of the public sector comparator. Public–private partnership proponents argue that risk should be borne by the party most able to carry it. Invariably, that is the public sector, so value-for-money analysis almost always demonstrates that the public–private partnership is less costly.

In practice, there are no ways to know in advance if a specific public–private partnership will be cost effective. In effect, public–private partnerships ***proceed more often as a matter of faith than experience***. However, this having been said, it is important to also note that a 'value for money assessment should also take into account the potential non-financial benefits of PPPs [public–private partnerships] such as the accelerated and enhanced delivery of projects'.[a]

Sources: ACCA, 2004; Central PPP Unit in the Department of Finance Government of Ireland, 2007; [a] EPEC, 2012.

the public sector often finds itself in the position of buying out the private partner at great cost to the public treasury (Box 8.11).

In 1997, the UK Government decided to overhaul the London Underground, the world's oldest metro system, through a public–private partnership (Box 8.11). When the public–private partnership was put in place in 2002, the net present value of the 30 years long arrangement was estimated at £15.7 billion.[87] However, within just a few years, the private sector partners went bankrupt.[88] It has been estimated that the legal and other consulting costs

Box 8.11 The use of a public–private partnership to upgrade the London Underground, UK

When the UK government decided to upgrade the London Underground in 1997 it was decided to undertake this infrastructure upgrading as a public-private partnership. The government believed this was a sensible move following years of underfunding and financial instability. Furthermore, it was also believed that while the weak management of London's underground led to cost and time inefficiencies, the operation of trains had been satisfactory.

A complex public–private partnership structure was developed, whereby the three public–private partnership consortia were set up to carry out different parts of the maintenance and rehabilitation of the underground infrastructure. The public sector retained ownership and responsibility for the delivery of transportation services.

Specific and carefully written contracts meant that the infrastructure 'companies' (infracos) would be fully invested through performance-based incentives and penalties, tied to the specifications of the contracts. To account for possible unanticipated costs, as a result of age of the metro system, a public arbiter was appointed to adjudicate claims for such unforeseen costs during the maintenance and renewal of train systems. Provisions were also made for a periodic review of contractual arrangements every 7.5 years.

However, the project was at a disadvantage from the outset as infracos used private capital to finance the public–private partnership that was to be repaid through the annual loan payments made by the government. This was a more costly option as the cost of private borrowing was greater than raising capital through public bonds. In addition private lenders demanded a public guarantee of 95 per cent on their loans. Thus, as the risk borne by lenders was minimal, there was little or no incentive to review the efficiency of infracos or hold them accountable for the use of the money given to them. If the project failed, which it eventually did, risk fell upon the public sector.

Two major problems undermined this public–private partnership agreement. The first was the fragmentation of operations and construction between public and private partners. The infracos were seeking to carry out work that maximized their profits but didn't necessarily address London Underground's mission of service delivery. Construction work, for example, was continually carried out at inconvenient times. The second problem was the lack of coordination and fragmentation between the two main consortiums involved. This resulted in inefficient implementation, without a clear corporate governance structure. In hindsight it may thus be said that the long-term survival of this project was doomed from the outset.

Sources: National Audit Office, 2004; House of Commons Transport Committee, 2008; Wolmar, 2009 and 2010.

involved in designing the structure for this public–private partnership amounted to almost £500 million.[89] Between these start-up transactions costs and losses caused by guarantees to private banks, plus cost overruns on the contracts, it is estimated that this public–private partnership cost UK taxpayers over £2 billion of unnecessary loss, and left London with a large number of subway stations in various states of disrepair. This was the result of a 'deal that was forced on their city by the central government . . . And this is just the beginning: costs for the City of London are . . . expected to grow by an additional £1 billion'.[90]

The underlying generic problem is that public–private partnerships . . . are dealing with situations in which information is always incomplete and future situations uncertain and changing

As a result of the care put into constructing the public–private partnership model, this project exemplifies the forethought required to implement such major urban transport public works via public–private partnerships. At the same time, the fact that this 30-year project was completely dissolved one quarter of the way through, in 2010, also makes it an important cautionary experience about the inherent limits of such an approach to major public works. Presently the refurbishment of the London Underground is proceeding as an in-house project of transport for London, the London Underground's parent agency. All indications are that it is generally proceeding on time and on budget.[91]

This London experience is instructive on several levels:

- It demonstrates the problems that arise when the public and private partners have different perceptions of the mission.
- It demonstrates the fact that the start-up costs of establishing a public–private partnership – in terms of consultant and operating costs – can be much higher than expected when these processes begin. These transaction costs are typically either ignored or badly underestimated when the public–private partnership is being designed and politically promoted.
- One of the promises of bringing in private partners to manage public infrastructure is that they will introduce new and innovative technology. Although that can happen in some cases, in general once contracts are signed, entities (be they public or private) become risk averse and seek to protect profits from assured revenue streams.
- Finally, it demonstrates that even when there is an attempt to overcome the problems of incomplete contracting with highly specified contract terms, in regard to deliverables, dates and penalty clauses, the problem of contract compliance becomes a serious impediment.

Finance for most urban transport systems is typically a combination of sources that resemble value capture in some aspects and general revenue funding approaches in others

The most important lesson from this experience is that the simpler and clearer the terms of engagement in a public–private partnership are, the more likely it is for the public sector to achieve its goals.

When public–private partnerships fail, they always do so for reasons unique to the individual situation. This leads to a temptation to say that the next effort will avoid those problems and everything will go as planned. Indeed international consulting firms publish 'how to' guides in which they state that there is a need for knowledge and transparency all around.[92] However, the underlying generic problem is that public–private partnerships, if they are dealing with significant urban transport challenges, are dealing with situations in which information is always incomplete and future situations uncertain and changing.

Combination models

Finance for most urban transport systems is typically a combination of sources that resemble value capture in some aspects and general revenue funding approaches in others. It is likely that for most systems some combination of these along with direct user charges is the most realistic financial arrangements. The specific financial structure of any particular system will depend greatly on the historic context in which it operates and local norms and values with regard to the structure of the public sector. The challenge is to understand how models that combine elements of user and public revenues can successfully operate in practice. This section reviews experiences from New York and India.

The New York Metropolitan Transportation Authority (MTA) provides an example of ways in which diverse revenue sources can be collected by a single agency and focused on providing a multi-modal regional transport system (Box 8.12). The agency relies on a diverse mix of revenues from federal, state and local governments and a collection of taxes earmarked for transportation. Lastly, the revenue surplus from tolls on bridges and tunnels is an important part of the MTA finances and an implicit cross-subsidy from car and truck users to public transport customers.

The attractiveness of New York's regionally and modally integrated urban transport system is that it facilitates an easy distribution of costs and revenues across modes. This in turn provides a potentially easily used policy tool with which to encourage the pursuit of a sustainable urban mobility system. However, it is important to understand that timing and institutional context matter greatly. The first decade of the New York experience was fraught with many political difficulties, as each agency fought to protect its existing autonomy within the new organizational format. Hence while the model provides some promise for the potential of integration and movement towards a true 'urban transport system', it also requires strong governmental administrative capacity and dedication to succeed.

Responding to the poor quality of public transport in India, the Government of India is actively

Box 8.12 Multiple funding sources: The New York Metropolitan Transportation Authority, US

New York has one of the oldest and largest urban transport systems in the world and its evolution over the past century is instructive in terms of how metropolitan systems can adapt over time to multiple funding streams. In 1968, New York State consolidated the administration and financing of all transport infrastructure and rolling stock in the metropolitan region into a single transport agency, the MTA. The main motivation for this administrative consolidation was to consolidate the planning and finances for all modes.

The MTA is responsible for regional transport for an area extending over 130,000 square kilometres and containing a population of about 20 million. The responsibilities include New York City's metro system comprised of both elevated and subway lines and fixed-route bus system, suburban buses, Long Island Railroad, Metro-North Railroad, Long Island Bus and the principal bridges and tunnels that carry car and truck traffic in and around the region.

As metro fares cover only 60 per cent of operations, other revenue sources are required. The MTA collects tolls on its bridges and tunnels too, but incomes are still insufficient. As a result, the State of New York permits the MTA to derive other revenues from four different taxes:

- a small (0.25 per cent) tax on all transactions in the 12 counties of the MTA region;
- a regional franchise tax levied on certain business activities;
- a transportation-oriented tax called the 'long lines tax', which is levied on trucking, telegraph and telecommunications companies;
- a 'petroleum business tax', which is levied on refining or selling petroleum state-wide.

The first two of these are regional taxes, which provide the majority of non-fare revenue operating funds. Such taxes are, however, not good sources of stable funding, as they are highly sensitive to fluctuations in the economy during recessionary times. The last two taxes are imposed state-wide, and as a result, the MTA gets only a portion of them: 48 per cent of the long lines revenue and 55 per cent of the petroleum tax.

Source: King, 2011.

Box 8.13 Funding of public transport investments: Lessons from Delhi and Ahmedabad, India

India's National Urban Transport Policy (NUTP) explicitly shifted the focus of transport policy away from reactive congestion relief through road and highway expansion to the proactive promotion of non-motorized transport and improvement of public transport systems. NUTP is funded under the seven-year (2005–2011) JnNURM, which provided centrally financed grants to urban transport projects in specific cities that complied with NUTP guidelines. The Janmarg BRT in Ahmedabad and the Delhi Metro (Phase II) are among the first projects funded under this programme.

At the level of practice, several key principles for investing in economically sustainable urban transport development can be extracted from this experience. These include:

- ***Local buy-in***: Both Janmarg and Delhi Metro demonstrate the importance of local ownership of projects. Political commitment at all levels is vital to implementation success, but local-level buy-in – particularly at the agency and bureaucratic level – is also essential. Local ownership can generate cost savings through better utilization of local resources, and improves the responsiveness of the design and construction process to local conditions. A firm belief by local implementation teams in the benefits of their schemes is also important in building public acceptance.
- ***Multi-tiered financing***: Financing of urban transport systems should be multi-tiered, combining various funding options according to the relative comparative advantages of different funding actors and the short-term and long-term financing needs of the schemes (e.g. capital investment versus recurrent expenditures). Delhi in particular was effective in drawing in alternative financing options from a variety of international, national, state and local stakeholders.
- ***Dedicated agency***: The creation of a single purpose agency to implement and operate public transport schemes minimized the need for coordination across multiple agencies. However, under this arrangement extra care needs to be taken to ensure proper integration with other modes of mobility.
- ***Incremental implementation***: There are both physical and financial advantages to carefully planned, incremental implementation. Pay-offs include improved design, time savings, cost savings through feedback and modification as well as greater public acceptance and increased ridership. Ahmedabad provided a particularly effective example of this.
- ***Innovative technology***: Technology can play an important role in public acceptance of a scheme. Modern communication and ticketing technology has the potential to greatly facilitate integration of different modes of transport. But the value of 'modernization' also lies in its visual association with cleanliness, safety and comfort. This is particularly important in developing countries where aspirations for modernization are often synonymous with the use of private cars (or motorbikes).
- ***Affordability/equity***: Affordable fares are absolutely critical and should never be sacrificed in a quest for financial cost recovery.

Sources: Rizvi, 2011; Mohan, 2008.

promoting sustainable urban transport development, formalized in the National Urban Transport Policy (of 2006), through the use of strong financial incentives targeted at local governments. The Janmarg BRT and Delhi Metro projects present two alternative responses to this new policy (Box 8.13). Although they differ in terms of scale, mode and specific approaches, the different solutions made by the two projects reflect similar common successful principles for financing sustainable urban mobility systems.

The two Indian projects illustrate the ways in which national governments can organize finance to stimulate local investments in urban public transport. Both cases show how supportive national policies, accompanied by financial incentives, can play a critical role in the adoption and implementation of more sustainable forms of urban transport. Furthermore, both experiences were backed by significant grant contributions towards capital costs. The experiences demonstrate the importance of inter-governmental cooperation and the need for a clear local public authority over the operation of public transport systems.[93]

Overall, there is an important lesson here concerning the need to ensure that – as a general rule of thumb – operating costs should be tied to fares, but capital costs need a broader source of revenues, a source that relates to the broader access values that the system creates. The MTRC in Hong Kong provides a good example of this (Box 8.7).

CONCLUDING REMARKS AND LESSONS FOR POLICY

In order to be sustainable, urban mobility systems must be organized by a financial model that is designed to protect the important public goods aspect of public transport. As the experiences recounted in this chapter make clear, there is a wide and flexible range of ways in which these models can be organized. However, there is no simple 'best-practice' approach to designing such financial models. Instead, one should look beyond the individual experiences and look for principles that can be replicated in another setting. This section presents seven principles that should inform the evolution of sustainable urban transport finance.

The goal of an urban mobility system, as a public good, is to promote ***access and not mobility***. Mobility is merely one means to the achievement of that larger end. Consequently, policies should reflect the value of access and not the time saved through enhanced mobility systems.

High-density and mixed-use locations reduce the need for mobility and provide access through co-location of important urban activities

High-density and mixed-use locations reduce the need for mobility and provide ***access through co-location*** of important urban activities. In terms of modal options, it is important that these be integrated so that users can move easily from one mode to another. For example, park-and-ride lots at the periphery of a dense urban settlement can allow travellers to easily leave cars and enter public transport for the final legs of journeys into these places.

An urban area with good public transport is more likely to also have urban spaces conducive to pedestrian access and non-motorized transport. Only ***public transport developed as a public good*** can make this happen. Once that is in place, the challenges from private motorized transport are reduced to a point where they are practically solvable.

Urban public transport should aim to be a high-quality service. An urban public transport system that is viewed largely as a system for the use of the poor quickly becomes a poor system. If government is seeking to induce car drivers to use public transport, it is important that the alternative be safe, reliable, comfortable and plentiful. A system used by residents from all walks of life is a system that is politically (as well as economically) sustainable.

Cities should strive towards full cost pricing for cars

Cities should strive towards full cost pricing for cars. Cars do not pay prices that match the full value of the economic and social costs that they impose in the pursuit of access. Revenues collected via congestion pricing and licensing fees should reflect the costs that private car use imposes on urban life. However, it is both short sighted and ineffective to attempt to sustain public transport systems via monies raised by car-based charges. These monies alone will almost never be sufficient to allow for the creation and financial sustainability of high-quality urban public transport.

Schemes that successfully permit urban transport to be supported by the value of the access that they create can provide a strong basis for sustainable urban mobility

Schemes that successfully permit urban transport to be supported by the value of the access that they create can provide a strong basis for sustainable urban mobility. ***Value capture*** can be done via real estate taxes that reflect the value of location as well as through complex land investments. The more exclusive and high density the modes of travel, such as rail and BRT, the higher will be the captureable values. Furthermore, in terms of land use, the closer the places of residence and other activities are to terminals, the higher values and volume of use can be expected. Value capture does not work as well on more ordinary bus routes or in places where car use is already very high and/or where populations are stagnant or shrinking.

Good public transport requires a capable public sector. The debate about the relative efficiency of public and private agents in the production of public transport has been an irrelevant distraction. Regardless of organizational form, the key to success in creating effective urban mobility systems is always a capable public governing authority operating in a transparent manner.

NOTES

1 See discussion in Chapters 6 and 7.
2 See Chapter 2.
3 Jirón, 2011, pp3–4.
4 http://data.worldbank.org/indicator, last accessed 23 January 2013.
5 Darido et al, 2009.
6 Jirón, 2011, p8.
7 It should here be noted that the number of car registrations may overstate the number of cars in regular use. Individuals may use public transportation for daily trips and still own cars that they use only occasionally. Residents of cities with high-quality public transport systems, amenable land uses, and tolls or congestion charges (such as in Stockholm, Sweden, for example) may own cars, but may not use those cars for their journeys to work or other regular travel.
8 And without active efforts to improve both the quality and quantity of urban public transport.
9 Crozet, 2006.
10 Jain, 2011, p16.
11 Pirie, 2011, p35.
12 See Chapter 2.
13 Pirie, 2011.
14 The issue of co-modality is highlighted in other chapters of this report.
15 World Bank Independent Evaluation Group, 2007.
16 See Chapter 2.
17 See section below on 'The Perennial Financial Problem: Costs Exceed Revenues'.
18 Flyvbjerg et al, 2008; Railway-technology.com, undated; Chandran, 2010.
19 Capital costs for buses using 'high occupancy vehicle lanes' and arterial streets were found to be US$5.6 million and US$0.4 million, respectively. However, the study also showed that BRT capital costs vary considerably – from US$4.3 million to US$34.2 million – due to factors such as cost of the roadway, station structures, park-and-ride facilities, traffic signal systems and vehicles (United States General Accounting Office, 2001).
20 Chandran, 2010.
21 Flyvbjerg et al, 2008.
22 Chapter 6 discusses the issue of fare affordability as part of the wider discussion on equitable access to urban mobility.
23 Godard, 2011b, p52.
24 See the section below on 'General revenue models'.
25 The section below on 'Other allocations of public funds' provides a further discussion on various forms of road pricing.
26 King, 2011.
27 See the section on 'Value-capture models'.
28 Value capture is discussed in more detail below in the section in 'Value-capture models'.
29 Public–private partnerships are discussed in more detail below in the section in 'Other public–private partnerships'.
30 See Box 8.11.
31 Jain, 2011, p33.
32 Pirie, 2011, p4.
33 Rimmer, 1982.
34 Cervero, 1991.
35 Pirie, 2011, p13.
36 Godard, 2011b, p21.
37 Pirie, 2011, p18.
38 Pucher and Renne, 2003.
39 As discussed in the section on 'From Economics of Mobility Towards Economics of Access' below, cost–benefit analyses often measure the value of time according to average wages. Using similar methods, the cost of vehicle congestion has been estimated at US$0.845 per litre of petrol in the US, and US$0.190 in the UK. By comparison, pollution contributes comparatively less to the total marginal external cost of driving (US$0.048 and US$0.053, in each country respectively) (Parry and Small, 2005).
40 US Census Bureau, 2012.
41 UN-ESCAP, 2006b.
42 Vivier and Mezghani, 2001.
43 UITP, 2011a.
44 Such as management, technical/maintenance, ticket inspectors, customer advisors and other tasks.
45 UITP, 2011.
46 See Chapter 6.
47 Chitere and Kibua, 2004.
48 Pirie, 2011.
49 Mueller, 2011.
50 UITP, 2009, p3.
51 Weisbrod and Reno, 2009, p31.
52 SmartGrowthAmerica, 2010.
53 See Chapter 1.
54 UN, 2012a.
55 See also discussion on road traffic accidents in Chapter 6.
56 WHO, 2009.
57 See for example Small and Verhoef, 2007; Goméz-Ibañez et al (eds), 1999.
58 Two studies in particular played a major role, both of which were completed in 1962: the comprehensive study of transport and land-use planning for post-War Chicago (see for example Black, 1990) and the cost–benefit analysis of London's Victoria Line (see Foster and Beesley, 1963; Beesley and Foster, 1965).
59 Metz, 2008.
60 Jacobs, 1970; Schaeffer and Sclar, 1980; Glaeser, 2011.
61 Parry and Small, 2005.
62 Bertaud et al, 2009; CODATU, 2009.
63 Typically, advocates for raising the cost of car usage also argue for transferring the revenues received to public transport. While this is a reasonable step, it has never been demonstrated that these revenues alone are sufficient to address the full costs of adequately enhanced public transport. Furthermore, by only going that far in policy terms, these advocates avoid the more politically charged but still underlying substantive issues of urban equity.
64 Crozet, 2007.
65 The case of the Hong Kong transport system is discussed in Box 8.7 below. It does make a profit, but that comes largely from its ability to leverage the value of the real estate around its stations. See also Figure 8.4.
66 Suchorzewski, 2011, p40.
67 See the section on 'Public transport' above.
68 Schaeffer and Sclar, 1980; Glaeser, 2011.
69 It is import to note that this problem is endemic to passenger transport in general and not to urban public transport in particular. Intercity passenger rail systems do not cover full costs through fares. Individual airlines do make profits on individual routes, though even these are not steady. Profits fluctuate with fuel costs and business cycles. Most importantly, the air traffic control system, on which individual private routes depend, is publicly maintained.
70 This chapter does not include a discussion of the role of official development assistance and foreign direct investments for the financing of urban transport, although this may play an increasing role in the future. 'A global development partnership should promote the flow of longer-term investment, including FDI [foreign direct investment], to a greater number of developing countries and into critical sectors such as transport' (UN System Task Team on the Post-2015 UN Development Agenda, 2013, p10). However, from an analytical point of view, such finance should be considered primarily as direct public allocation, subject to considerations beyond the control of local authorities, or subject to arrangements similar to those of private–public partnerships. Chapter 7 includes a discussion on international funding mechanisms for environmentally sustainable transport.
71 Cost in local currency was RMB 3.7 billion. Exchange rate of US$1 = RMB 6.83 (in 2009).
72 Pan et al, 2011.
73 Interview with Mayor Cássio Taniguchi in the spring of 2004 at Curitiba City Hall. See also CODATU, 2009, p37.
74 Hook, 2005.
75 This is discussed in Chapter 7, from the perspective of changing the modal split.
76 CODATU, 2009; Hook, 2005. In developing countries, there may also be some potential for funding through the clean development mechanism discussed in Chapter 7.
77 See also Figure 8.4, which indicates that *versement transport* funding contributes about a quarter of the total revenue stream for the public transport company Sytral, in Lyon, France.
78 As noted earlier, only a handful of public transport providers worldwide are making a profit (Box 8.1).
79 Bocarejo and Tafur, 2011.
80 See, for example, Denver Urban Renewal Authority, undated; Dye and Merriman, 2006. The City of Chicago, US, for example, has a large number of tax increment districts (http://en.wikipedia.org/wiki/Tax_increment_financing, last accessed 30 January 2013).
81 Jain, 2011.
82 Salon and Shewmake, 2011.
83 Salon and Shewmake, 2011.
84 This report does not provide a detailed analysis on how public–private partnerships in the transport sector work. For that, see, for example: EPEC (2012); Office of the State Comptroller, New York State (2011); EC (2003); Central PPP Unit in the Department of Finance Government of Ireland (2007).
85 Salanie, 2005; Sclar, 2000.
86 See for example Sullivan and Burris, 2006; Holeywell, 2011; Wolf, 2011.
87 National Audit Office, 2004, p1.
88 Metronet in 2007 and Tube Lines in 2009 (House of Commons Transport Committee, 2008, p5).
89 House of Commons Transport Committee, 2008, p15.
90 Sanger and Crawley, 2009.
91 Transport for London, 2011.
92 See for example, http://www.deloitte.com/partneringforvalue, last accessed 29 July 2013.
93 Rizvi, 2011; Mohan, 2008.

CHAPTER 9

INSTITUTIONS AND GOVERNANCE FOR URBAN MOBILITY

Institutional and governance frameworks are the structures through which political, technical and financial decisions are translated into resource allocation and priority setting for implementing urban mobility plans, programmes and projects. No matter how good the policy recommendations, their implementation is dependent upon how fit-for-purpose these institutional and governance frameworks are to direct, manage, resource and deliver them. Visions of sustainable urban mobility cannot be translated into plans, nor can plans be successfully implemented, without addressing the very sustainability of the key organizations involved and their institutional and governance frameworks.

Institutional and governance frameworks and their related networks are critical to how well (and how fast) urban transport infrastructure and services are planned, appraised, delivered and operated. They are also essential to how well joined-up urban mobility planning is with land-use developments, and how consistent both are with the declared goals of sustainable development.

In many cities, formal institutions that affect the transport sector frequently operate in a less than desirable manner. This is particularly the case in developing countries. Notwithstanding this, people and goods continue to circulate, and indeed in many cases traffic continues to rise. The issue here, however, is with what suboptimum level of efficiency is this achieved, at what opportunity cost and at whose cost does this growth take place?

The chapter starts with a clarification of the main terms used in the discussion of urban mobility institutions and governance. This is followed by a regional review of current conditions and trends of institutional and governance developments that affect urban mobility policy-making, planning and management and ultimately, many aspects of urban land-use developments. A number of key institutional and governance challenges and underlying influences facing cities are then drawn from this review. The chapter also contains a discussion of policy responses to these challenges, with some detailed examples drawn from good practice. It ends with concluding remarks and lessons for policy makers.

Institutional and governance frameworks and their related networks are critical to how well . . . urban transport infrastructure and services are planned, appraised, delivered and operated

UNDERSTANDING INSTITUTIONAL AND GOVERNANCE FRAMEWORKS FOR URBAN MOBILITY

The interaction of the institutional structure and agency actors is characterized by both formal dimensions (i.e. rules and laws) and informal dimensions (i.e. customs and traditions), which impact relations between different branches of government.[1] In some instances, there are institutions (such as trade unions, city chambers of commerce and industrial lobbying groups) that – although not formally part of the urban transport decision-making processes – possess varying degrees of influence. The extent they do reflects their political influence and often the power of their purse. Enlightened institutional and governance frameworks seek to make these influences transparent.

Well-functioning institutions and a high level of political support are essential for creating and maintaining good quality infrastructure and services for urban mobility.[2] Urban mobility is also impacted by parties from outside the transport sector associated with land use and social and environmental impacts. In developing countries in particular, powerful non-specialist stakeholders can exert influences that seriously undermine efforts at achieving integrated development between urban movement and land use.[3]

Well-functioning institutions and a high level of political support are essential for creating and maintaining good quality infrastructure and services for urban mobility

The practice of policy-making and planning for urban mobility generally rests with institutions at the level of an urban area. However, as this may not coincide with the administrative boundary of the dominant city, organizations at a national (and sometimes regional/provincial) government level also set frameworks that can significantly influence policies that are (and are not) adopted.[4] These influence the extent of the institutional integration of transport modes in an urban area, as well as the arrangements for their integration with other sectors. This is particularly the case with respect to land use, emissions, climate change, safety and finance. In some major cities of developing countries – where national (or regional/state) governments involve themselves extensively in urban transport policy decisions – many problems can arise. This is so because such levels of government are typically more powerful and exert more influence/control over budgets assigned to the urban level. Furthermore, city authorities typically lack the strong management and professional staff capabilities necessary to tackle the challenges that confront them. As a result, while they may be fully aware of what needs to be done, coordination between the two levels of government is often not easy and frequently unequal.

Even in the well-ordered cities of many developed countries, the informal sector and NGOs play an increasingly important role in facilitating and encouraging sustainable urban mobility

The role of informal structures and organizations in the urban transport sector needs to be emphasized. These are especially relevant to public transport, freight movement and non-motorized transport. Even in the well-ordered cities of many developed countries, the informal sector and NGOs play an increasingly important role in facilitating and encouraging sustainable urban mobility. The involvement of such informal structures and organizations is essential for good governance and a 'bottom-up' decision-making process that enables all stakeholders to participate. In the case of urban mobility, such decision-making should ideally embrace all key stakeholders involved in the provision of urban transport infrastructure and services, as well as those impacted by decisions the sector makes.

Likewise, institutional and governance frameworks should address concerns regarding obstacles to the effective participation of the private sector. Thus, enabling and regulative mechanisms need to be put in place by government to ensure that information employed to support urban transport proposals are comprehensive, accurate, impartial and transparent.

By and large, European cities possess a well-educated interdisciplinary professional class to serve the needs of urban mobility in particular and urban development in general

CONDITIONS AND TRENDS

Different parts of the world have different governance structures for urban mobility delivery, with various institutional stakeholders influencing urban development and mobility trends. It is particularly important to note that the policy and planning challenges of urban mobility in developing countries and in countries with economies in transition differ significantly from those found in urban areas of developed countries. In general, the resources (human, technical and financial) and institutional frameworks at the disposal of policy-makers and planners in such cities are typically less well developed. Thus, the sections below focus on selected conditions and trends of institutional developments and governance, and their underlying influences, in developed countries, countries with economies in transition and developing countries.

Developed countries

The institutional and governance frameworks for urban mobility in most of Europe reflect the circumstances of mature developed economies and institutional and governance arrangements. By and large, European cities possess a well-educated interdisciplinary professional class to serve the needs of urban mobility in particular and urban development in general. The larger more populated countries all have strong, multi-tier governments, as do the smaller northern European countries. Significant differences remain, however, particularly with respect to funding levels, technical capacities and organizational efficiencies among many of the Southern European countries. In these countries, institutional and governance arrangements and technical capacities are less well developed and resourced. There is, nevertheless, cross-fertilization of ideas between all these countries through numerous EU initiatives, with some significant improvements observed.[5]

The city of Nantes, France, has succeeded to integrate the decision-making agencies in and around the city into one body.[6] These arrangements provide various capabilities with the agency responsible for highway and public spaces, housing, town planning and land-use development. This body also has the competence for all aspects of organizing public transport in the metropolitan area in which it has made some notable advances. Since 2008, there has been only one agency responsible for all mobility matters in Nantes.[7] This organization is 'responsible for strategy as well as operational management of a whole range of aspects of sustainable mobility, including roads and highway planning, traffic management, traffic and public road management, cycling and parking policies, and management including all off-street parking such as multi-storey car parks, park and rides and other sustainable mobility services such as car-pooling and car sharing'.[8]

Similar developments are currently underway in London, where surface and underground rail systems in the metropolitan region are increasingly integrated as part of the Mayor's Transport Strategy for the Greater London Authority, which comes directly under the office of the mayor.[9]

Sixty years of private car-orientated transport infrastructure investment and suburbanization in the US have contributed to widespread urban traffic congestion[10] and created a significant urban mobility divide, which has seriously affected the mobility of those who cannot afford the ownership of a private car.[11] This car dependency has been accentuated by an institutional emphasis on the importance of personal mobility – whether related to distances that need to be travelled or to the general limited availability of public transport, particularly in lower-density cities.[12]

Given the history of motorization in the US, it is perhaps unexpected that the country has introduced legislation seeking to introduce a revolution in the way urban transportation investments are planned and implemented.[13] This legislation looked to a hierarchy of supporting transportation plans and programmes introduced and carried out by metropolitan planning organizations in cooperation with states for major urban areas. However, the act does not give these planning organizations any new legal authority in this area. Instead it emphasises 'partnerships' between all relevant agencies, in order to promote area-wide interests and goals.[14]

In Canada, the federal government acknowledges that insufficient funding, accompanied by fragmented planning and implementation of urban mobility systems and related land use, are the major obstacles to establishing efficient urban transportation networks.[15] As a result, the Greater Toronto Transportation Agency was set up. This provided 'the governance mechanism to plan, fund and deliver integrated transportation and related land use for the entire urban region comprehensively and consistently over time'.[16] Similarly in Vancouver, the governance structure for urban transport attempts to coordinate and achieve integration and a balance between different modes. To this end the Government of British Columbia created TransLink to assume many transportation responsibilities previously held by the provincial government (in 1998). TransLink is responsible for the regional transportation network of Metro Vancouver in British Columbia, including public transport and major roads and bridges.[17]

Australia has a federal governance structure, with responsibility for the integration of land use and transport largely resting with state and local governments. Although all recent major transport infrastructure investments in its main cities have been made within the same federal institutional context, the responses to urban mobility challenges have been quite diverse.[18] In the city of Perth, transport and land-use planning portfolios reside within the Western Australian Department of Planning and Infrastructure, which has its own minister in the state government. Public transport is the responsibility of the Public Transport Authority, a government agency whose responsibilities cover public transport (bus, train and ferry services) in Perth and regional centres. Two other agencies (Main Roads and Department of Transport) are responsible for other transport matters (i.e. major and minor roads, transport safety, etc.).[19]

New Zealand has seen several new developments in the institutional and governance structure of its major cities. From the perspective of the integration of urban transport, 'the restructuring of metropolitan Auckland is one of the most substantial and far-reaching local government restructurings in recent years. [It offers a] unique governance framework for local authorities' to manage council-controlled organizations.[20] The capital city of Wellington has also employed a regional approach to the planning and delivery of its transport infrastructure and services.[21]

Metropolitan Auckland . . . offers a unique governance framework for local authorities to manage council-controlled organizations

Countries with economies in transition

Democratization, privatization and decentralization have been the three main institutional change processes occurring in countries that emerged from communism in Central and Eastern Europe. At the end of communist rule in the early 1990s, these countries had strong, centralized decision-making systems, and a tradition of state planning of urban land use and transportation. They also had a relatively well-educated professional class working in secure formal institutions, a dominance of public transport over private car use, and a relatively deferential civil society.[22]

With democratization, the strength of influence of different stakeholders changed. The voice of the citizenry became more fragmented, as wealthier residents abandoned their dependency on public transport systems. At the same time, many public transport operators found themselves unable to extend their service to low-density developments on the periphery. Operators simultaneously suffered from drastic reductions of subsidies that made public transport more expensive to provide and unaffordable to many potential users.[23] The sharp reductions in government subsidies in Poland, for example, forced public transport services to raise fares drastically. Meanwhile, under-spending led to poorer public transport services, lower operational efficiencies and a reduction in public transport hardware and related infrastructure investment. This resulted in a gap developing between revenue and expenditure to a point that became exceedingly difficult to bridge.[24]

The sharp reductions in government subsidies in Poland . . . forced public transport services to raise fares drastically

Privatization and neoliberal influences have resulted in much more complex institutional decision-making developments. Together with the absence of an understanding of how market forces operate, there has been an (unintentional) gradual undermining of economic, social and environmental dimensions of sustainability by governments, as a result of their extending the time between plan-making and implementation.

Decentralization – in the form of transfer of responsibility for regional and local infrastructure and public transport services to provincial and local governments – has in some cases been excessive.

In the case of Poland, 'the State has gone too far in decentralizing all public transport responsibilities to the cities and has not faced squarely the complicated issues related to urban roads' and traffic issues.[25] The situation in Russia and many other countries (e.g. Latvia, Lithuania) is similar. Here the municipal sector has remained fragmented and suffers from poor administrative capacity, which has contributed to weak cooperation between independent local governments. This is particularly harmful in efforts to address transport problems in metropolitan areas where good cooperation between central city and suburban municipal governments is crucial.[26]

Developing countries

In most of Africa, . . . the fact that (too) many ministries are involved in the urban transport sector at the local level contributes to actions that can prove contradictory

In most developing countries, urban transport institutions and governance systems have been unable to keep pace with growth in urban population and mobility needs. The urban transport sector is characterized by its rapid motorization, deficient public transport supply, informality in its mobility systems, congestion, pollution and high traffic fatalities – with differentiated impacts, in different cities and between trip-makers (according to income groups, gender, age, disability and level of education).[27]

■ *Africa*

In most of Africa, and notwithstanding positive developments – such as the setting up the Executive Council of Urban Transport in Dakar, Senegal (Box 9.1), the Lagos Metropolitan Area Transport Authority in Nigeria (Box 9.14), and the introduction of coordinated urban mobility plans in South Africa[28] – poor coordination between the numerous institutions in urban transport prevail. This has led to problems in developing unified and integrated urban mobility policies. The fact that (too) many ministries are involved in the urban transport sector at the local level contributes to actions that can prove contradictory. There is also a widespread underfunding of urban public transport and rarely any significant formal involvement of transport users (or civil society) in the governance of cities. This is reflective of the widespread absence of decentralization in the transport sector, which remains controlled by national governments. In countries such as Senegal or Burkina Faso, for example, urban transport is not included in the sectors concerned by the decentralization process.[29] In the case of Egypt, efforts to centralize responsibilities for urban transport have recently taken place in greater Cairo where a Public Transportation Regulatory Authority was established by presidential decree in 2012, to control all urban transport modes in the city.[30]

■ *Latin America and the Caribbean*

The institutional and governance frameworks in the field of urban land use and transport in Latin America and the Caribbean are strongly influenced by those of developed countries (particularly, North America).[31] Apart from some urban highway investments, the major new institutional initiatives in the region relate to efforts to formalize public transport modes and to improve formal public transport services through the introduction of new BRT systems and metro extensions. As noted in previous chapters, 'cities like Curitiba, Brazil, have a long history in implementing innovative and integrated forms of transport. Bogotá and Medellin in Colombia are continuously incorporating new and increasingly participative forms of transport decisions'.[32]

However, in Santiago, Chile, 'urban transportation is managed through a disparate and fragmented institutional framework, distributed among public institutions of distinct levels with distinct areas of responsibility . . . structured across . . . three . . . levels of government' involving several agencies at each level.[33] Santiago's 2000–2010 urban mobility plan was prepared in response to this disparate and

Box 9.1 The Executive Council of Urban Transport (CETUD), in Dakar, Senegal

CETUD was established to resolve the dispersion of jurisdiction between various central and local institutions concerned by urban transport in Dakar, and to coordinate urban transport policy-making. CETUD has been assigned the following responsibilities:

- Decide which routes to be served, the corresponding authorization quotas for public transport and their technical operating terms.
- Prepare 'call for tender' documents, sign agreements with the registered transporters and control implementation of contracts.
- Propose tariff policies to the appropriate authorities.
- Identify the constraints of the public service and determine the relative financial compensation.
- Develop criteria for admission to the profession of public transporters.
- Implement studies and initiatives for training, information and promotion for urban public transport.
- Coordinate the different types of public transport; and in particular, arbitrate the division of profits in the case of tariff integration.
- Develop and support the creation of shares and investment programmes to improve infrastructure, traffic and road safety services.
- Improve the condition and quality of the transport fleet to reduce pollution.

Source: Godard, 2011b, p57.

fragmented institutional set-up (Box 9.7). Comprised of 12 programmes, one included the modernization of the public transport system and the coordination and integration of decisions relating to urban development and transport – known as Transantiago.[34] This programme sought the creation of a new institutional, operational and legal framework for an urban public transport system that restructured the bus network on a trunk-feeder basis. It was not, however, assigned the necessary executive powers, nor was it adequately resourced.[35]

Western Asia

The institutional and governance structures for urban transport in Western Asia are as diverse as the different governance systems found there. Notwithstanding the differences, 'a decentralized model of urban transport governance appears to be emerging . . . throughout the region, as a result of recent decentralization reforms related to rapid urbanization'.[36]

Oil-rich countries, including the Gulf States and Saudi Arabia, confront urban land-use and transport developments spawned by dramatic increases in affluence. This wealth has enabled their governments to develop urban transportation systems similar to those found in developed countries. This has been accompanied by the establishment of some well-resourced, sophisticated new institutional and government frameworks for urban mobility, such as the Urban Planning Council in the United Arab Emirates. Populous countries, such as Turkey and Iran, are much less well-resourced. They have weaker and more stressed institutional capacities. Poorer countries, such as Yemen, have inadequately developed institutions for urban mobility, more akin to those of the poorer parts of South Asia or Sub-Saharan Africa.[37]

Within Western Asia, it is common that competition or rivalry prevail between government agencies responsible for different aspects of urban transport and land-use development. A frequent response to such challenges is for government to create independent public agencies devoted to the planning and delivery of projects. In Istanbul, for example, there are several such dedicated urban transport authorities whose responsibilities are not well integrated and often compete.[38]

Within Western Asia, it is common that competition or rivalry prevail between government agencies responsible for different aspects of urban transport and land-use development

South Asia

The institutional frameworks for urban transport and land-use development in cities of South Asia generally exhibit a strong multi-tier set of national, regional and local government plus quasi-government institutions, accompanied by a significant growth of private-sector transport operators and investors. With fast-growing demand for urban mobility in the region, transport institutions in cities face a host of challenges (Box 9.2). Such institutions are largely geared to address formal traffic and transport concerns, leaving informal and non-motorized modes to fend for themselves.[39] The lateral links between the institutions – in functional as well as geographical terms – are typically poor compared to their vertical institutional links. So much so, that 'it is being increasingly realized that the gap between planning and implementation can not be bridged without the institutional reorganization, capacity building and streamlining of the procedures'.[40]

In cities of Southern Asia . . . the lateral links between the institutions – in functional as well as geographical terms – are typically poor compared to their vertical institutional links

However, in several Indian cities – including Delhi, Mumbai, Jaipur, Hyderabad, Chennai and Bangalore – unified metropolitan traffic and transport authorities have been set up (Figure 9.1).[41]

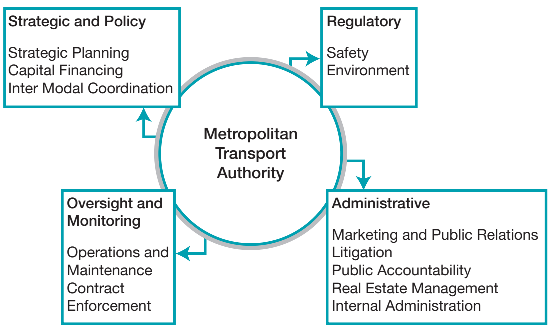


Figure 9.1

Functions of unified metropolitan transport authorities in India

Source: Jain, 2012, p591.

Box 9.2 Typical challenges of urban transport institutions in South Asia

Under-resourced institutions, lacking in overall capacity to plan, execute, maintain and deliver affordable sustainable urban transport.

Fragmented policy formulation and implementation with lack of cooperation among multiple ministries and transport agencies.

Lack of finances for transport infrastructure and public transport services resulting in extensive institutional and governmental support, concessions and subsidies.

Insufficient financial procedures and accounting/audit systems.

Bureaucratic procedural constraints that impede the delivery of urban transport infrastructure and services.

Inadequate legal and enforcement frameworks and capacities needed for urban transport and land-use developments.

Absence of comprehensive information systems, disclosures and public participation, leading to corruptive practices.

Source: Jain, 2011, p37.

These have been introduced to promote a more effective response to city transport and related land-use challenges. There has been much less success to rationalize urban transport institutions and governance in other countries in South Asia.

South-Eastern Asia

South-Eastern Asia presents a very mixed picture in terms of institutional development and governance for urban transport. This is due to the very different forms and levels of governments that prevail, their different colonial histories and subsequent evolution of their political processes.[42] It is, however, common that many of the responsibilities related to urban movement in the region are entrusted to a range of different national ministries, as in the case of Jakarta, Indonesia.[43]

In Thailand and the Philippines, strong regional political differences complicate the situation for transport ministries attempting to work with city governments

In Thailand and the Philippines, strong regional political differences complicate the situation for transport ministries attempting to work with city governments. Manila's institutional arrangements have remained virtually unchanged for generations. Although the Metro Manila Development Authority is responsible for development planning, transportation and traffic management, as well as urban renewal and land-use planning, it does not have full jurisdiction for the transport sector.[44]

In terms of possessing institutional arrangements that enhance the integration of land use and transportation, as well as the integration of modes within the transport sector, Singapore is perhaps the exception in South-Eastern Asia. Much of the effectiveness of this integration 'is greatly assisted by [Singapore's] two key agencies for planning and policy, namely: the [Urban Regional Authority] . . . for spatial development and land use, and the [Land Transport Authority] . . . for all modes of transport'[45] (Box 9.3).

Box 9.3 The Land Transport Authority of Singapore

Established in 1995, the Land Transport Authority is responsible for planning, policy and regulation of all urban transport modes in Singapore. This made Singapore one of the pioneers of integrating many urban transport responsibilities within one organization. The Land Transport Authority also constructs and maintains roads, the metro system and other public transport infrastructure, in accordance with the provisions of the concept plans.

Source: Barter and Dotson, 2011, p4.

Eastern Asia

In Eastern Asia, the influence of the strong institutional and governance frameworks for urban mobility in Hong Kong and Singapore has been particularly noticeable in mainland China.[46] Table 9.1 summarizes three main institutional models for the management of urban mobility in mainland China.

Strong political support for key urban transportation projects has helped achieve some aspects of long-term policy-making and planning in China. Tensions, however, exist in some instances between central and local interests, as well as between public and private sector interests. On occasion, these have prevented the emergence of an integrated institutional approach to land-use and transport development.[47]

With the increasing technical sophistication of local professional cadres there are several prom-

Table 9.1

Institutional models for urban mobility, mainland China

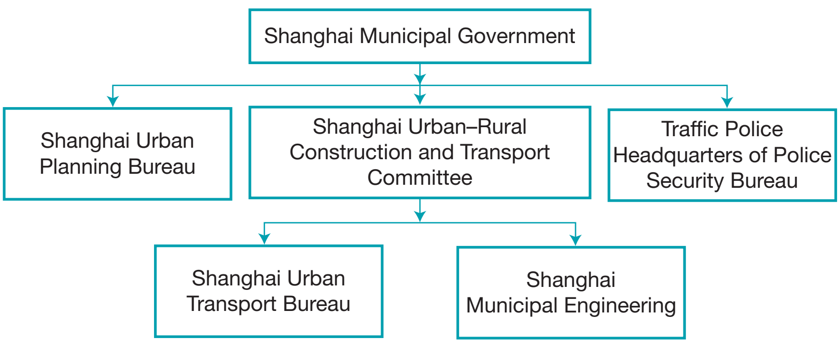
Management systems model	Examples of cities
Multiple regulations on transport managed collectively by the Urban Transport Bureau, the Municipal Engineering Bureau, the Urban Construction Department, the Police Security Bureau, etc.	Chengdu, Fuzhou and Nanning.
Overall regulation on urban and rural transport, managed only by the Urban Transport Bureau.	Shenyang, Harbin, Hangzhou, WuLuMuqi, Xining, Changsha and Lanzhou.
General regulation on transport, managed by only one department, typically the Urban Transport Commission, which has municipal government responsible for the regulation of transport plans, highways, public buses, taxis, urban railways, air transport and other land-based mobility modes.	Beijing, Shanghai, Guangzhou, Chongqing, Shenzhen and Wuhan.

Source: Zhou and Szyliowicz, 2005.

Figure 9.2

Organizational structure of transport and land-use institutions in Shanghai, China

Source: Pan et al, 2008.



ising innovations in urban-mobility planning in China. Shanghai exemplifies this with its rationalization of urban land-use and mobility management structures. Here urban transport and related land-use development functions are divided among three departments: the Urban Planning Bureau; the Urban-Rural Construction and Transport Committee; and the Traffic Police Headquarters (Figure 9.2). Rail and water transport – which are highly significant in most Chinese cities – however, are usually outside of city control and are administered regionally or at the state level.[48]

CHALLENGES AND UNDERLYING INFLUENCES

This section describes the main challenges and underlying influences related to urban transport institutions and governance worldwide. These have been organized below under four main categories, namely challenges of adaptation; administration and governance; mobility policy, plan-making, management and regulation; and resourcing and capacity-building. Even though the challenges are presented below as separate themes, it is important to appreciate the interconnectivity among them. For example, the challenge posed by fragmented decision-making applies virtually across all themes.

Adaptation challenges

There is a slow-growing ***acceptance among governments*** (and many other stakeholders) ***of the need to change*** institutions and governance if sustainable mobility goals are to be delivered. The acceptance of this need for transformation varies greatly in different cultural and development contexts, and between countries, cities, as well as different levels of government. There are, however, major deficiencies in the establishment of this capacity for change, and in understanding how to change. The transformation implies embracing a broad definition of 'governance' and managing the demand for movement that favours vulnerable and disadvantaged groups and the environment.[49]

There is a slow-growing acceptance among governments . . . of the need to change institutions and governance if sustainable mobility goals are to be delivered

The ***increased globalization and politicization of the environmental debate*** brings challenges that can have major local manifestations. Where manifestations are negative this generates tensions, which have influenced the thinking of many urban mobility stakeholders, as well as those engaged in urban land-use policy and planning. There are many examples of urban transportation policy documents that express what changes need to occur and how 'smart growth' can propel more sustainable urban mobility planning.[50] The degree to which this has resulted in action, however, has been limited due to the resistance to change within many institutions. Successful implementation of programmes based on more holistic thinking typically requires strong political leadership. Without such leadership, aspirations of more holistic thinking tend to flounder.[51]

There is increasing recognition that the ***integration of land-use and transport planning*** is necessary to ensure the efficiency of urban mobility systems.[52] However, it is important to recognize the commonalities as well as differences between the nature and roles of participants in both fields, as well as the limits to integration possible between the two (Box 9.4).[53] The issue is not so much the difference in perspective, but rather the influence and power that accompanies these perspectives and their ability to affect outcomes. Consultations in land-use developments are more about proposed one-time changes of use, whereas changes to urban mobility tend to take place on a continuous basis. Land-use planning may, as a result, require structural changes in institutional and governance frameworks of a more permanent kind than for urban transportation.[54]

Integration of land-use and transport planning is necessary to ensure the efficiency of urban mobility systems

In developing countries, where urban land ownership and management policy and participatory

Box 9.4 Key challenges in integrated land-use and transport planning

As transportation is a function of land use, one way of effectively reducing urban movement is by imposing tighter land-use controls and increasing densities. There are, however, a number of problems that can prevent this from materializing:

- Many agencies that influence and/or regulate land use have little or no responsibility for mobility policies. The result is a serious institutional 'land-use/transportation disconnect' that prevents integrative actions, especially in cities that have a weak tradition of urban land-use planning and control.
- The skill-sets required by the two principal professions involved are very different and employ very different premises and logic. Obliging these professions to employ more joined-up thinking, as required in transit-orientated development projects, is a good way of achieving this.
- Competitive forces among cities often have one city pitching against another, encouraging 'sweetener deals' to potential major investors in the form of exceptions and leniency in land-use policies and development control.
- Urban growth can prove impervious to local public policies.

Sources: Mitchell and Rapkin, 1954; Dimitriou, 2011; Hajer, 1995; Downs, 1992.

processes are generally less well developed,[55] there is typically a lack of consultation in both urban land-use and mobility planning. There is, nonetheless, an increased understanding of the close links between urban mobility and land-use planning as a result of the land-value impact of transport infrastructure on land use.[56] These circumstances call for a more holistic approach to urban mobility planning, irrespective of cultural and development contexts.

Administrative and governance challenges

Privatization and neoliberal influences . . . have produced more complex institutional decision-making arrangements

As earlier indicated, ***democratization, privatization and decentralization*** have been the three main challenges to the institutional changes occurring in Eastern Europe during the last two decades.[57] The abandonment or gradual dismantling of previous centralized decision-making and planning has transformed the functions of many key transportation infrastructures and services. Meanwhile, the earlier dominance of public transport over private car use has been reversed. This has spawned new urbanization and motorization challenges at a scale not seen before. Similar developments can also be found in some developing countries. This has brought new challenges reflecting changes in the types and influences of stakeholders involved in urban infrastructure developments and provision of transport services. Together with the advance of privatization and neoliberal influences, such developments have produced more complex institutional decision-making arrangements, particularly with regard to transport infrastructure and service investment deliveries associated with private-finance initiatives and public–private partnerships.[58]

The identification of a lead authority to provide strategic direction in decision-making is . . . a pre-requisite of coordinated action

Urban growth generally results in cities spilling over beyond their original administrative boundaries – absorbing neighbouring settlements in a greater metropolitan area. The discussion in the previous section illustrates the ***complications associated with urban administrative boundaries***, when rail- and road-based transport services extend well beyond city boundaries into their hinterland as intercity carriers for passengers and goods. Thus decision-making is not only fragmented as a result overlapping institutional responsibilities; it also faces major challenges in terms of horizontal coordination between lower tier governments and, more significantly, in terms of vertical integration.[59] The identification of a lead authority to provide strategic direction in decision-making is thus a pre-requisite of coordinated action.

Of all challenges confronted by efforts to promote integrated urban land-use and mobility planning, perhaps the most corrosive is a bias against integrated planning and management

Changes in organizational arrangements of agencies are frequently made to address urban mobility challenges. Such changes are particularly made when a new administration comes to power, either at the national or municipal level. These changes, however, have too often acquired a reputation for doing little more than 'moving the boxes around' on an organizational chart and renaming them. This negative perception of organizational reform can be attributed to: a failure to improve organizational culture; a failure in business processes; and a failure in staff skills development. To achieve effective organizational change, all three need to be tackled together.

Of all challenges confronted by efforts to promote integrated urban land-use and mobility planning, perhaps the most corrosive is a ***bias against integrated planning and management***. This bias is encountered within many institutions (both public and private). While it is apparent that joined-up thinking and actions are prerequisites to the successful pursuit of sustainable development outcomes, there is growing evidence to suggest that severe tensions emerge in contexts that also promote neoliberal free market 'solutions' to public domain problems. This is because free-market advocates frequently view integrated planning and management as synonymous to top-down comprehensive planning and management – which restricts innovation and is potentially wasteful due to its noncompetitive high transaction costs.

Mobility policy, plan-making, management and regulatory challenges

The ***mainstreaming of the mobility needs of the socially and economically disadvantaged*** is a major challenge, and includes ***gender concerns, as well as the needs of the disabled, the elderly, children and youth***.[60] As noted in Chapter 6, the challenges relate to their dependence on non-motorized movement, their restricted access to motorized public and private transport (especially on grounds of affordability and their capacity restrictions), their vulnerability to traffic accidents, and other safety and security concerns. Addressing these issues requires extensive investigations to better ascertain the nature, distribution and scale of these concerns, to provide a basis for deciding how best to improve the future design, management and delivery of public transport services, including for security enforcement.

The issue of ***how best to plan, manage, operate and regulate urban public transport*** – and the extent this involves enterprise operator functions for building the needed roads or railways or operating buses – is a major international challenge, especially where non-nationalized models of public transport governance exist. Some stakeholders advocate that these enterprises must over time be transformed into self-sustaining businesses operating on commercial lines.[61] Other stakeholders, however, do not consider it desirable (or inevitable) that public transport should always be commercially operated, and look to a more welfare-orientated approach instead.[62]

In addition to the kinds of formal urban public transport systems referred to above, informal public transport services ply the roads of many (if not most) cities of developing countries. While some urban institutional arrangements show some accommodation toward informal sector operators, the culture of city officials throughout developing countries is typically dismissive of informal modes of mobility. This is despite the widespread prevalence of poverty in cities with a large majority of inhabitants for whom these modes of travel are vital.[63]

Freight movement is critical to the economies of all cities. There is thus an ongoing call for increased private investments to ***address the needs of freight movement***, in terms of infrastructure and operations. Although significant world-wide, such investment is particularly important for cities with major ports and/or airline hubs in developing countries and countries with economies in transition, where globalization has opened up many new opportunities. Private investment in freight movement has seen major developments in information and communications technologies, which in turn have spawned dramatic changes to logistic services in the continued search to reduce costs.

A major challenge to freight movement in metropolitan areas of developing countries has to do with the location of logistics facilities, and the unpredictability of changes to land uses resulting from the absence of land-use zoning protection of existing logistic centres. This has led many freight companies to move their logistic facilities to the periphery, where land is cheaper and more freely available.[64] Such developments have contributed to a growing 'logistics sprawl' of freight logistic and distribution centres.

Challenges of multi-modal integration are numerous and varied in urban areas globally. They are exceedingly important with respect to provision of efficient public transport and freight movement. A common challenge for urban institutions is the integration of the planning, management and operation of railways with road-based public transport services and other traffic. A larger challenge for fast-growing cities in developing countries is the more urgent task of facilitating convenient rail-road interchanges for peak commuter journeys and ensuring integration of fares.

Inter-agency collaboration among the organizations responsible for the planning, management and operation of various urban modes of transport – and the city planning organizations responsible for land developments – is also essential. Establishing such collaboration is among the most fundamental challenges for municipal and government authorities, especially where silo-thinking too often prevails.

There is a clear need to ***mainstream environmental concerns***[65] in institutional and governance frameworks for urban mobility.[66] Transport and non-transport engineering and environmental departments tend to compete over resources, funding and for pre-eminence within governance structures. While the mainstreaming of transport disciplines is a useful premise within organizational restructuring, the transport department is often part of a bigger engineering or environmental department that has other priorities to balance. In practice, transport is often given greater importance where there are particular pressures on the availability or value of land that constrain the distribution of people and jobs/goods/services.

Inter-agency collaboration among the organizations responsible for the planning, management and operation of various urban modes of transport . . . is . . . essential

Resourcing and capacity-building challenges

Perhaps the most pervasive challenge for urban transport institutions globally is the ***lack of sustained funding for transportation infrastructure and services*** – not least for the institutional infrastructure. Combined with a poor understanding of urban economics and the complex interplay between infrastructure investment, land-use planning and the value that the 'public good' of efficient mobility can provide, these challenges together can pose 'wicked problems'.[67] As noted in Chapter 8, cities can be self-financing in transportation and other essential infrastructure if economic rent from land value-added through investment in infrastructure is captured by the city and 'recycled'.[68] However, few cities come close to practising the theory. As a result, cities are forced to develop plans for public transport improvements that depend overwhelmingly on the fare box to finance fixed assets.

Perhaps the most pervasive challenge for urban transport institutions globally is the lack of sustained funding for transportation infrastructure and services

The ***development of information and communications technologies***[69] can enhance the performance of the urban transportation sector. The fast-changing world of such technologies offers numerous possibilities – primarily through the internet and mobile communication – to help address the current lack of sustained funding for urban transportation infrastructure and services (Box 9.5). These tools, however, are too often poorly understood and/or present numerous technological and funding challenges (especially initially) to many conventional civic institutions, particularly in developing countries.

This remains an important challenge as the opportunity costs of not employing such tools mount. In recognition of the potential for urban transport institutions of information and communications technologies, the United Nations has sought to promote tools that can monitor urban land and infrastructure developments (including land values) so as to enhance the ability of government decision-makers to better plan, manage and finance future urban development as part of online capacity-building efforts.[70]

Institutional capacity-building and training of staff in the urban transport sector are always critical, regardless of the level of development

Box 9.5 The potential of social media and open source material

The evolving frontier of web 2.0, social media, open source material and volunteered geographic information needs to be considered, addressed and potentially embraced with respect to the development of urban mobility systems. Until relatively recently, the public sector, the private sector, or a partnership between the two, were responsible for planning, design, implementation and operation of urban mobility systems, with civil society actors being consulted at times as a routine part of the process of planning or implementation. Engineers, planners, bankers, architects and urban designers were the 'professionals' whose expertise informed transportation efforts.

Today, however, civil society groups and individuals are vocal advocates for, and increasingly consider themselves to be 'experts' in, sustainable mobility efforts. While geospatial mobility and logistics data are largely proprietary in nature, civil society groups and individuals request and sometimes demand access to government-owned data sets. Furthermore, crowd-sourced and/or volunteered geographic information data sets are now emerging as open source alternatives to proprietary and private data, and are increasingly seen as having the potential to enhance the sustainability of urban mobility systems.

Open source material is currently being used for non-motorized vehicle mobility planning in many cities around the world to expand infrastructure for walking and cycling and to improve the conditions and connectivity of existing networks. Furthermore, groups such as 'seeclickfix.com' crowd-source tips on problems that need fixing in communities (including mobility-related issues) and then direct feedback and comments to local governments or agencies with the power to fix these problems. Likewise, mobile applications such as 'Moovit' help riders make public-transport system-access decisions based on crowd-sourced data about system effectiveness, efficiency and temporary problems that might cause delays or disruptions. Moreover, the World Bank, in partnership with federal and local transportation agencies in the Philippines, is piloting an open data system of public transport routes, schedules and fares.

Source: Personal communication with Professor Pamela Robinson, Ryerson University, Canada. See also http://seeclickfix.com/; www.moovitapp.com/; http://blogs.worldbank.org/transport/open-data-urban-transport, last accessed 1 March 2013.

When training and capacity-building are provided as part of foreign aid technical assistance, participants are frequently not up to the required level to receive the course, nor are they originally trained/educated to work in the field of their employment

Institutional capacity-building and training of staff in the urban transport sector are always critical, regardless of the level of development and the gender of trainee.[71] These efforts are frequently required for pilots of new planning and management processes, so that teething troubles and difficulties can be resolved before moving to their widespread introduction.

Institutional capacity-building typically seeks to address issues raised at the local level. In so doing, it frequently includes: the training of local professional and technical staff, as well as political leaders; facilitating political–professional dialogue; enhancing communications of the public sector with the private sector; and improving government dialogue with local communities and the non-government sector.

Cities in developing countries and countries with economies in transitions have additional capacity concerns – related to a backlog of long-term and structural institutional-capacity shortages.[72] It should be noted that many deprived cities in developed countries as well are in need of such attention. Both contexts confront institutional capacity-building challenges with regard to the introduction of new approaches and tools, many of which are increasingly based on information and communications technologies. They are also confronted with challenges associated with the introduction of a more holistic understanding of transport and urban development, as in the case of efforts to operationalize the sustainability vision in the urban transport sector.

At the international level, enhanced global information and communications technologies now facilitate knowledge-sharing and lesson-learning not only from developed to developing countries, but also between developing countries.[73] The challenge here is in making judgements about the appropriateness of the knowledge acquired/shared from an overseas source to one's own developmental circumstances and aspirations.

However, it should be noted that when training and capacity-building are provided as part of foreign aid technical assistance, participants are frequently not up to the required level to receive the course, nor are they originally trained/educated to work in the field of their employment. Furthermore, in many instances, particularly in developing countries, it is the wrong individuals that are being trained. The ones invited for training courses are not the ones that are actually doing the work; and in some cases (particularly when funded by overseas agencies), attendance on training courses is seen as a fringe benefit and a means to access travel, extra allowances, etc. Moreover, course organizers are frequently not aware of the realities of the working environments of the trainees and the training course is often inadequately designed to meet the real needs of the participants.[74]

POLICY RESPONSES AND INNOVATIVE AND 'SUCCESSFUL' PRACTICES

This section presents a selection of innovative and successful institutional and governance responses to many of the challenges discussed in the previous section. It should be stressed, however, that each example cited does not necessarily incorporate all facets of good practice, more likely only selected dimensions.

Integrated urban land-use and mobility planning

It is often argued that integration – in terms of land-use and transport planning and/or intermodal integration – can only be achieved if the agencies responsible are themselves integrated into one agency. However, in the case of Singapore, the mechanism of cross-agency committees is used instead. This has been successful as 'the Singapore Government as a whole is relatively integrated, with less of the departmental silos culture frequently seen in other national and city governments' in the region.[75] The integration is also achieved by virtue of a large percentage of its land being in government ownership. This permits the Singapore government to 'use land release strategically as a proactive means to guide the implementation of [its] Concept and Land Use Plans' and for any other uses deemed to be in the public benefit.[76] These arrangements facilitate the acquisition of land around metro stations before construction. Singapore's metro system has attracted 70 per cent of trips of all motorized modes within 25 years of its inauguration in 1987. This represents a major achievement that has been largely attributed to its effective institutional and governance arrangements.[77]

The integration of urban land-use and mobility planning functions is also well reflected in other countries. In the city of Seoul (Republic of Korea) for example, the institutional structure for land use and transport is directed by the mayor, with transportation responsibilities overseen by a vice mayor (who heads the City Transportation Headquarters) and land-use planning overseen by another vice mayor (who heads the Urban Planning Bureau). The mayor has an additional third arm of governance (the Management and Planning Office) that oversees and looks to manage and plan the integrative aspects of both.[78] In Japan, the national and regional institutional structure is especially conducive to the development of rail-orientated urban development.[79] This falls under the overall responsibility of the Ministry of Infrastructure, Transport and Tourism, which includes five departments responsible for urban transport, including the Railway Bureau.[80]

In Canada, the regional governance models that facilitated the set-up of the TransLink in Vancouver;[81] the transportation arms of the Capital Region Board in Edmonton;[82] and Metrolinx for the Greater Toronto and Hamilton Area[83] have been applauded. All of these authorities 'encourage region-wide coordination of land-use and transportation planning and decision-making'.[84] This includes attempts to coordinate and integrate different modes of transport.[85]

The city of Nantes in France is at the forefront of sustainable mobility planning

The city of Nantes in France is at the forefront of sustainable mobility planning. This is largely due to its long-term vision and commitment to an integrated approach to urban planning and transport over some 30 years (Box 9.6).[86] Nantes' approach to provide an integrated network of multi-modal transport services has, to some extent, helped the city manage the growth of private car use, simultaneously retaining a high level of mobility for its citizens and preserving their quality of life. The city is also a good example of how an employer tax on public transport provision (*versement transport*) has been widely employed across France.[87] The city has furthermore been a pioneer in drawing up urban mobility plans.[88] The latest of these (2010–2020) 'sets out transport policy for the next ten years and thematic action plans are elaborated on topics such as public transport,

Box 9.6 Main causes for the sustainable mobility planning achievements of Nantes, France

The achievements are attributed to the city administration's:

- ***long-term city-wide vision*** and strategy;
- ***competence across required areas*** to enable integration of decisions and actions to implement (i.e. pricing and availability of parking, integrated ticketing, infrastructure, etc.);
- ***ability to build consensus*** with surrounding municipalities, gain political support and implement integrated policies and plans, gaining the advantages of a wide service area;
- ***capability to make intelligent choices*** regarding: the integration of modes and the use of a wider set of mobility possibilities over and above the car, including bike-sharing, car-pooling and walking options (such as pedestrian-only zones);
- ***sustained investment*** in quality infrastructure and vehicles, thus providing attractive alternatives to private car use;
- ***provision of a high-quality public transport service*** at an affordable price.

Source: Allen, 2011b, pp15–17.

non-motorized transport . . . parking, traffic and road safety and inter- and multimodality aspects'.[89]

Privatization, decentralization and centralization

In Chile, and in some other South American countries, there is evidence that greater awareness of the rights of urban residents can positively influence the governance structures of urban transportation. Citizen participation has played a role (to varying degrees) in a number of major urban public transport developments in the region, including the TransMilenio (Box 7.7 and Box 9.12) and Transantiago projects. The characteristics of the innovative institutional framework established for the latter are outlined in Box 9.7. Notwithstanding the innovative ideas behind this initiative, however, it has been argued that the resultant institutional architecture has become weak and predominantly reactive rather than proactive, with decisions taken mainly by central government. This has partly been explained by the fact that there is no mayor with jurisdiction over all districts of the city and that Transantiago staff are not public officials, and mainly work on short-term contracts with no clear individual responsibilities.[90]

Greater awareness of the rights of urban residents can positively influence the governance structures of urban transportation

The institutional and governance framework for urban transport in Barcelona, Spain, is innovative in that it allows a mix of public and private public transport operators to operate in the metropolitan area. Apart from cities in Scandinavia, Barcelona is one of the few cities in Europe where public and private operators coexist within the same jurisdiction. Such 'mixed systems' are believed to be capable of increasing competition in the local market, providing better information on costs, and ensuring that governments can guarantee a fail-safe service or reverse its privatization decision if contracts fail. Under these arrangements, Barcelona has made it possible to outsource bus services in certain municipalities, even though the transportation authorities in the centre of Barcelona have chosen to retain delivery of their services. The main shortcoming of this model, however, is that the public transport provider (Transports Metropolitans de Barcelona) retains a great deal of autonomy from the regulator (Metropolitan Entity of Transport), which makes it difficult to regulate the former.[91]

Barcelona is also providing a good example of how to enhance public participation, with its 'mobility pact' between the main stakeholders in the transport sector (Box 9.8). This initiative has since been copied in a number of other cities. Barcelona's mobility pact encourages participation by all actors in the field of urban mobility in Barcelona, and related activities are canalized in both formal and informal ways. Several newspapers do for example publish daily columns on mobility-related problems in the section on 'letters from our readers', often with a photo, with an opportunity for the responsible institution(s) to respond.

The city of Amman, Jordan, provides an example of a successful decentralized model of institutional development and governance for the urban transport sector, due to its multi-stakeholder structure.[92] The Greater Amman Municipality is responsible for policies and transportation system stewardship. At the national level, the Ministry of Transport is responsible for all intermediate and long-term plans and studies, while the Public Transport Regulatory Commission is responsible for public transportation. This Commission is affiliated with the Ministry of

Box 9.7 Institutional framework for urban mobility in Santiago de Chile

This institutional framework for Santiago de Chile has the following characteristics:

- Profound political, economic and regulatory changes (particularly in terms of ***liberalization and privatization***) in national governance that have taken place since the 1970s have greatly limited the role of government in urban services provision.
- A wide-ranging approach to the improvement of public transportation has included ***new regulations for the bus system*** with respect to, among other things, its levels of service.
- An extensive construction programme of urban and suburban highways has been delivered via ***public–private partnerships***.
- The city-wide *Transantiago* programme introduced a ***bus rapid transport*** system that has become a centrepiece of integrating the city's overall public transport system.
- Although there has been strong technical and institutional ***capacity-building*** within the involved organizations, the accumulated experience has unfortunately not resulted in entirely successful implementation. This is primarily attributed to limitations within the institutions involved and issues of governance relating to, among other things, the integration of land-use and urban transport developments.
- There is an almost total compartmentalization between organizations in the city, leading to ***problems of coordination***. This has limited the institutional capacity for integrated management in urban transport and land use. It has also encouraged a tendency toward 'reactive management' providing a context where decisions are predominantly taken by a national authority.

Source: Figueroa and Rodriguez, 2011.

Box 9.8 Social participation in decision-making: The 'mobility pact' in Barcelona, Spain

In 1998, the City of Barcelona defined a 'mobility pact' among its 62 mobility-related stakeholders (i.e. users, operators, manufacturers, providers, etc.). What started as media-oriented performance and a 'politically correct' initiative has turned out to be a great tool to reach agreements and consensus about priorities for how to use the city's limited street space. The initiative involves thematic meetings, two annual general meetings (with the presence of the mayor) and follow-up of key performance indicators.

The 'ten commandments' of the mobility pact are:

1. High-quality, integrated public transport.
2. Maintain traffic speeds and improve the speed of surface public transport.
3. Increase the surface area and quality for pedestrian use.
4. Increase the number of parking spaces and improve their quality.
5. Improve citizens' information and road signals and signs.
6. Legal regulations to be suited to the mobility of the city of Barcelona.
7. Improve road safety and respect among users of various transport modes.
8. Less polluting fuels, and reduce air and noise pollution caused by traffic.
9. Promote the use of bicycles.
10. Efficient and orderly distribution of goods and products throughout the city.

Sources: Ajuntament de Barcelona (not dated); and personal communication with Professor Francesc Robusté, Centre for Innovation in Transport (CENIT) and Technical University of Catalonia.

Box 9.9 Institutional developments for urban mobility in Hanoi, Viet Nam

The positive aspects of institutional development and governance in Hanoi include:

- ***The creation of a single local government area*** by the extension of the administrative boundary to create a 'Greater Hanoi', which includes all areas likely to undergo urbanization up to 2050.
- ***The establishment of a Department of Transport*** by bringing together most functions of urban transport within Greater Hanoi in a single agency.
- ***The introduction of strategic planning***, thus reflecting the decision of the central government to decentralize responsibility for the preparation of construction master plans for Hanoi.
- ***The intention to establish a public transport authority*** to be responsible for all aspects of public transport in Hanoi, and to undertake studies to clarify the roles and responsibilities of this authority.

However, a number of issues still remain to be addressed, including:

- adopting enabling legislation for decentralization;
- undertaking institutional development of the Department of Transport;
- providing resources for training and capacity building in the transport sector;
- establishing a more integrated sector-wide approach to meet the challenges facing transport institutions.

Source: Phin and Dotson, 2011, pp14–15.

Transport but has its own financial and administrative independence.[93]

In contrast, a centralized model of institutional development and governance for urban transport is showing promise in Viet Nam. A relatively simple line of authority between national and local government has helped the establishment of strong city-wide transport authorities of the kind recently proposed for Hanoi (Box 9.9). The city offers good illustrations of progress toward good practice (albeit slowly) in institutional development and governance in urban transport policy-making, land-use/transport strategic planning and in public transport planning and management.

Addressing urban boundary complications

As noted earlier in this chapter, Auckland, New Zealand, has recently seen the implementation of a far-reaching reorganization of its governing structure. As a result, a new council-controlled organization, Auckland Transport, was established in November 2010, working under the new amalgamated Auckland Council. The new organization combines the expertise and functions of eight former local and regional councils and a regional transport authority (ARTA). All transport functions and operations in Auckland are now the responsibility of one organization.[94] The establishment of Auckland Transport assumes that 'the Long-Term Council Community Plan and District Plan will continue to guide Auckland Council

A centralized model of institutional development and governance for urban transport is showing promise in Viet Nam

decision-making, pending decisions on a spatial plan and infrastructure investment plan.' These new arrangements anticipate that 'local boards will have an advisory role in identifying local service needs and a budget for planning and 'place-shaping'.[95]

The decision that the local authority transport network for Auckland is best managed as a single network by Auckland Transport was premised on the belief that it will provide a level of focus that could not be provided by the full Auckland Council with its multiplicity of responsibilities. The governance framework allocates the main transport roles to Auckland Transport with Auckland Council being responsible for its long-term council community plan. This establishes council transport funding for the Auckland Transport, while the Auckland regional land transport strategy sets out the transport outcomes that the region wishes to achieve over a 30-year period. Under these arrangements, Auckland Transport is responsible for planning and delivering local 'roads and footpaths . . . parking and train, bus and ferry services',[96] including the preparation of the Auckland regional land transport programme, which sets out the transport projects anticipated over the next three years.

Continued urban growth in Stockholm, Sweden, has provided the impetus for the formation of a single regional transport body, *Storstockholms Lokaltrafik* in 1967. This agency assumed the public transport responsibilities that had been previously distributed among individual municipalities. The integration of services and tariffs was a primary goal of this institution – with bus, metro, regional rail, and ferry services all procured for the city by *Storstockholms Lokaltrafik*. Owned by the Stockholm City Council, *Storstockholms Lokaltrafik* is the parent company for four operating companies, two dormant subsidiaries and six associated companies. The organization's activities include providing:[97]

- an operational 'overview' of the region's public transport system and services;
- an overall service quality of the region's public transport system and simultaneously being responsible for the supervision of maintenance;
- initiatives for the development of the system;
- services for the purchases and procurements of the region's public transport system.

Mobility policy, plan-making and management

The State of Victoria, Australia, offers a good example of promoting institutional system integration and sustainability for urban mobility through its recent legislative reforms spawned by the State of Victoria Transport Integration Act of 2010.[98] Whereas Victoria's urban transport governance was in the past dispersed among different parties with differing objectives and interests, preventing the recognition of the interconnected nature of transport and land use, the Act provided a common state policy framework. This framework seeks to:

- unify all elements of the transport portfolio to ensure that transport agencies work together towards an integrated and sustainable transport system;
- recognize that the transport system needs to be sustainable in both economic, social and environmental terms;
- enable the transport system to be conceived and planned as a single system rather than as separate or competing transport modes;
- provide a universal framework for integrated and sustainable transport policy and operations;
- integrate land-use and transport planning and decision-making by extending the coverage of the Act to land-use agencies whose decisions are likely to have a significant impact on the transport system;
- align the charters of transport agencies with the overarching policy framework to increase the modal share of public transport.

Box 9.10 Climate change activity at the state level, US

State climate action plans: As of April 2010, 33 US states had developed state climate action plans, with several others in the process of doing so. Some have been formally adopted by the respective governor or state legislature; others were prepared as reports without any official action being taken. Many state departments of transport have developed strategies or policies for implementing the transportation elements of these plans. Yet others are taking a range of additional actions to reduce greenhouse gas emissions.

Local government climate activities: Nearly 800 mayors have signed the US Conference of Mayors Climate Protection Agreement, agreeing to reduce greenhouse gas emissions to at least 7 per cent below 1990 levels by 2012.

Climate planning by metropolitan planning organizations: Many metropolitan planning organizations, especially larger ones, are analysing greenhouse gas emissions from transportation in their metropolitan areas, developing transportation greenhouse gas inventories and baseline protections, as well as identifying possible strategies to reduce greenhouse gas emissions from transport.

Source: AASHTO, 2012.

Mainstreaming environmental concerns

Although the Federal Government of US has not enacted climate change legislation, there is a great deal of climate change activity at the level of the states. These reveal significant advances being made that perhaps defy the international impression of the US federal government's negative attitudes to the climate change agenda (Box 9.10).

In the UK, London 'considers itself an exemplar in moving towards a low carbon economy'. It views sustainability 'primarily as an environmental quality with reductions in [carbon dioxide] and local pollutants being the major objectives'.[99] In order to reduce its greenhouse gas emissions, London has focused on 'investment in higher density developments and the use of transport development areas at key interchanges that are public transport accessible. It is now considering alternative fuels and has taken the lead in investing in an electric vehicle infrastructure, in cycle hire schemes and in cycle highways'.[100] Major infrastructure investment is seen as a significant part of the Mayor's 2010 Transport Strategy, in order to enhance the capacity and connectivity of the capital's public transport system following a history of underinvestment.[101]

Mainstreaming mobility needs of the socially and economically disadvantaged

The EU's plans to introduce a framework for the preparation of urban mobility plans are among the most innovative measures to promote institutional development and governance within the urban transport sector. This represents a major pan-European effort at promoting walking, cycling and public transport in urban areas. The European Commission recommends:[102]

- the establishment of procedures and financial-support mechanisms at the European level for preparing urban mobility audits and urban mobility plans;
- the examination of the possibility of a mandatory approach to such plans for cities of a certain size;
- the linking of EU regional development and cohesion funds to cities and regions that have submitted a current, and independently validated 'urban mobility performance and sustainability audit' certificate;
- the examination of the possibility of a European support framework for a progressive implementation of urban mobility plans.

South Africa's efforts to promote urban mobility plans since 1999 do in some respects reflect these developments in Europe.[103] The 'Moving South Africa' Project attempted to develop a strategic framework for transport in the country. It called for transparent decision-making, funding and pricing for the transport sector and looked to the reorientation of transport towards customer needs. The government's role was to provide a clear vision, the establishment of strong institutions, the setting of clear rules for reinforcing the vision, the development of human capacity, and the measuring and monitoring of performance. The project considered customers of the South African (urban) 'transport system to be disempowered and weakly organized'. It also considers 'the upgrading of customer power [as] a precondition for improvement to the transport system'.[104]

Another innovative international measure that has the potential to impact urban transport institutional development and governance is initiatives to increase the engagement of youth. With this in mind, the Youth for Public Transport Group was set up as part of UITP's Youth Project.[105] 'The group was formed to recognize innovative public transport projects that include youth and to start a dialogue between youth groups and government through more formal mechanisms so that young voices can be heard'.[106] Yet, another initiative in this area is the Tanzanian initiative to introduce a regulatory framework and a Consumer Consultative Council to represent the interests of all public transport users (including the disabled).[107] Hong Kong, China, is already undertaking a systematic monitoring and enforcement, against very clear requirements and goals with respect to the mobility rights of the disabled.[108]

EU's plans to introduce a framework for the preparation of urban mobility plans are among the most innovative measures to promote institutional development and governance within the urban transport sector

Addressing freight movement needs

The city of Paris has employed an explicit transport policy for freight since the early 2000s, and has promoted a Charter for freight movement (Box 9.11). Notwithstanding some disappointments, 'Paris can be considered one of the most active European cities in the field of urban freight management'.[109] Some 'two-thirds of shipments coming in and going out of the metropolitan area of Ile-de-France go through a regional terminal in order to be transhipped and reorganised',[110] demonstrating the strategic role of logistics terminals in large metropolitan areas.

The 'National Programme for Freight in Cities' established by the French Ministry of Transport in 1993 carried out surveys of freight movement in France and established a database for urban freight demand in the entire country. Based on this information it built a simulation model of future movements. A second phase of the surveys started in 2010. The surveys revealed the characteristics of 'logistics sprawl' and that freight transport generates a large proportion of local transport-based pollution in Ile-de-France. As a result, in 2011 the city of Paris was designated as one of six 'zones for priority' to address air pollution produced by commercial vehicles, targeting especially the restriction of access by old commercial vehicles.[111]

Hong Kong, China, is already undertaking a systematic monitoring and enforcement, against very clear requirements and goals with respect to the mobility rights of the disabled

Box 9.11 The Freight Charter, Paris, France

Since 2001, urban goods transport, long neglected in Paris' mobility policies, has been brought to the municipal agenda as part of a new approach in transport planning, with the main aim of alleviating the negative environmental impacts of freight movement.

In 2002 a consultation brought together the deputy mayor with the various freight transport stakeholders – as well as rail operators, energy providers and other public agencies – with a view to informing each other of their respective challenges and priorities. In 2006, as a result of these consultations, a Freight Charter was signed by all parties. While not a legally binding document, it identified commitments made. The most salient of the conclusions of this charter were that it:

- declared that consultation helped defuse conflicts before they break out, between parties that (previously) usually never met;
- introduced enforcement of truck access and delivery regulations;
- highlighted the land scarcity for logistic activities, especially in the inner suburbs;
- suggested that experimenting with new forms of city logistics organizations is an effective way of spreading new ideas:
- concluded that the relevant jurisdiction for policies is regional rather than local given that freight flows traverse all local boundaries.

Source: Dablanc, 2011, pp8–10.

Box 9.12 Land-use and transport planning, Bogotá, Colombia

Colombia carried out an ambitious ***decentralization*** process in the mid-1980s, whereby mayors and governors previously chosen by the president of the republic have since been elected by universal suffrage and have become the authority in charge of the principal economic, social and environmental developments of their territory. These developments were facilitated by legislation introduced in the early 1990s that, in the case of Bogotá, provided for a new organization to be set up (the Distrito Capital) giving more autonomy to the executive power (the mayor) and contributing to a better fiscal organization. The 'Territory Development Law', introduced in 1991, sought to harmonize former legislation, instructing every municipality and district in Colombia to autonomously develop long-term plans.

In Bogotá, the mayor of the Distrito Capital was given wide responsibilities in policy and planning, and in the development of projects in land use, transportation, health, environment, education, public services as well as other relevant domains, on the understanding they were consistent with legal frameworks defined at a national level.

Enrique Peñalosa (who was mayor 1998–2001) oversaw the development of the TransMilenio BRT system, which commenced operations in 2000 (Box 7.7). Following its success, mobility plans were prepared for Bogotá and its region in 2006. These built on many of the ideas and visions of the TransMilenio, and ensured complementarity and consistency with the overall land-use plan.

Sources: Bocarejo and Tafur, 2011; EcoPlan, 2000.

The formal institutional link between TransMilenio and Bogotá's municipal authorities means that the influence of citizens (as users of transport) is strong

Public transport planning and service delivery

The TransMilenio system provides mass public transport services – in the form of a BRT system – for the city of Bogotá, Colombia. It not only provides strategies to improve public transport but also seeks to recuperate public space, discourage the use of cars and encourage cycling (Box 7.7). Devolving power from national to newly created city governments with directly elected city mayors was an important precondition for TransMilenio (Box 9.12). A 1998 law created a public entity with a mandate to manage, plan and control passenger urban transport services in the metropolitan area of Bogotá.[112] By this law, the state builds and maintains the infrastructure, while private companies acquire and operate the fleets of buses and other public transport vehicles. TransMilenio itself has no contracts with these operating companies. Instead, the municipal authority places the contracts and TransMilenio provides the management service for infrastructure (including cycle paths) and transport operations. The formal institutional link between TransMilenio and Bogotá's municipal authorities means that the influence of citizens (as users of transport) is strong. The result is that there is 'political leadership and authority to make the appropriate decisions necessary to implement the transport system'.[113]

Numerous institutional arrangements have also recently been set up in India to deliver and operate BRT systems, including in Ahmedabad where Ahmedabad Janmarg Ltd. was constituted to run/operate the system. While the Ahmedabad Municipal Corporation remains the chief executing authority of the system, the 'use of local expertise in lieu of international consultants not only ensured responsiveness to local conditions and technology transfer, but was also effective in keeping cost low'.[114] With state and national level support provided through a steering committee under the State Urban Development and Urban Housing Ministry, together with financial and other incentives at the national level, this strong political commitment across several levels of government was instrumental to the implementation of the project.

As in the case of the Janmarg BRT, the Delhi metro was financed from multi-tiered funds and planned as an integral part of a larger multi-modal transport system. It similarly enjoyed widespread political support in central government, even though the larger scale of the Delhi project presented greater challenges. What is most significant about the institutional arrangements for this project is that it is being promoted as a viable public transport model for other South Asian cities.[115]

The rail-oriented urban development strategy employed throughout Japan is also interesting. This is supported by national and city governments, promoted by influential private rail companies and reinforced by the country's government. The rail companies are part of large Japanese commercial and industrial consortia that also have real estate and retailing interests, as well as construction and banking interests. These seek to take advantage of land developments around stations so as to ensure maximum use of their rail networks. They do this by acquiring large areas of land along proposed rail extensions prior to any development. Japan's rail-orientated development strategy has especially benefited from the country's land readjustment programme. Here irregular patterns of agricultural land holdings were in the past rearranged into regular building plots and equipped with basic urban infrastructure, with a small percentage of each landowner's holding providing land for roads and parks to cover the costs of the project.[116]

Throughout the US, the perception of urban public transport is largely poor. The improvement of the image and performance of this mode of travel thus has major governance dimensions. In response to this, new investments have been made in light rail and BRT, especially in some of the smaller but rapidly growing cities, such Portland, Oregon and Salt Lake City, Utah. In the case of Portland (Box 9.13), governance of land use and transport policy have been employed as twin pillars for the creation of additional capacity and as a stimulus for growth.

Multi-modal integration

The city of Stockholm and its surrounding region are regarded as having one of Europe's best public transport systems. Together they are renowned for their progressive approaches to integrated urban land use and transport planning, and multi-modal integration, with its public transport services being of special interest to those concerned about sustainable urban mobility.[117] The current development plan for the Stockholm region foresees a polycentric structure of seven new 'cores' for urban growth, with public transport recognized as key to meeting the increased mobility demands spawned by these new growth centres (Figure 5.16).[118] It is envisaged that these cores will eventually function as independent multi-modal urban transport hubs that will enhance the overall efficiency of the utilization of transportation and land use within the region.

To enhance multi-modal integration of passenger services, in August 2012 *Storstockholms Lokaltrafik* appointed Deutsche Bahn Arriva to provide a new regional transport service that involves planning and operating an integrated and complex system of ***bus and rail***. This is the largest multi-modal transport contract of its kind in Sweden, and after implementation of the second phase of the contract[119] it is estimated that these services will carry some 94 million passengers per year.[120]

There are also some encouraging developments in some African cities where metropolitan transport authorities have recently been established to integrate the governance of disparate modes. An example is the establishment (in 2002) of the Metropolitan Area Transport Authority in Lagos

Japan's rail-orientated development strategy has . . . benefited from the country's land readjustment programme

There are . . . some encouraging developments in some African cities where metropolitan transport authorities have recently been established to integrate the governance of disparate modes

Box 9.13 Institutional and governance framework in support of light rail in Portland, Oregon, US

Strategy to improve public transport: As part of a broader strategy for Portland, a light rail system – comprised of 38 closely spaced stations – has increased walking trips and reduced the demand for parking.

Revenue earning system to finance the project: To help finance the project, city parking charges were increased, and the city issued bonds backed by future parking revenues predicted to raise US$28.5 million. Property owners along the line also agreed to form a 'local improvement district' that looked to generate a further US$10 million, while a tax increment and mix of other sources generated another US$11 million.

Accompanying urban revitalization strategy: The Portland Development Council was set up to stimulate the private market by investing – prior to the project – in new housing, commercial opportunities and open space in locations near the light rail stations. This permitted the city to leverage public improvements necessary to support a more balanced, higher density development that in turn generated a significant stream of tax revenue.

Source: Ong et al, 2010, pp97–98.

Box 9.14 The Lagos Metropolitan Area Transport Authority (LAMATA), Nigeria

The LAMATA project, funded by US$100 million of World Bank credit in 2002, involves re-regulation of the informal sector, and using road rehabilitation as a lever and an instrument to reduce poverty through employment on road works.

Public transport service franchises have been introduced on roads improved by the project while other (non-franchise) operators are prohibited from using these roads.

On the institutional side, the project has helped to create a regulatory authority (LAMATA), with a financial capacity through a new Transport Fund. The fund is fed by budget transfers from the Lagos state government, and a share of road user charges.

No provision has been made to seek street space exclusivity for public transport vehicles, reflecting a sober assessment of what was 'politically feasible'.

The project design is unusual in that investments in one mode (road infrastructure) are used to leverage regulatory changes for another mode (public transport services). This was possible because the client government (Lagos state) has jurisdiction over both modal systems.

Source: Mitric, 2008, p50.

Hong Kong . . . is widely considered to have a successfully organized and sustained funding of its urban transport system

In the face of . . . infrastructure investment challenges, some national governments . . . have established national agencies specifically assigned responsibilities for the planning, appraisal and funding of critical infrastructure

(Nigeria) (Box 9.14), and (in 1997) the Executive Council of Urban Transport in Dakar (Senegal) (Box 9.1).[121] In Abidjan (Côte d'Ivoire), in 2002, a state board (AGETU) was established for the management and coordination of public transport, with the management of the minibuses and taxi licences among its principal tasks. This organization has, unfortunately, from the outset been hampered by its conflict with the municipalities of Abidjan who have been reluctant to transfer the funds obtained from the fees and taxes levied on shared taxis.[122]

Other cities have also made – or are in the process of proposing – important changes to their public transport and mobility systems. The municipality of Montevideo, Uruguay, has since 2005 sought to transform its public transport, freight and commercial developments to offer greater connectivity to ports, airports and rail termini, simultaneously emphasizing the importance of non-motorized movement.[123] Similarly, the city authority of Rosario, Argentina, has after a ten year experience in strategic planning decided to strategically invest in pedestrian access to public transport services and cycle routes. It has also imposed tight parking controls. This demonstrates how small cities can function in the broader territorial context.[124]

Sustainable funding

Like Singapore, Hong Kong (China) is widely considered to have a successfully organized and sustained funding of its urban transport system. The ingredients of Hong Kong's success can be attributed to its progressive transport policies maintained over the last 30 years; its 'effective regulatory and co-ordination mechanisms that subjugated all agencies and transport operators to basic policy objectives', and financial discipline maintained by all undertakings, both privately owned or run on commercial lines.[125] As noted in Chapter 8, Hong Kong's metro projects have always been self-financing, due to its successful policy of value capture, made possible thorough a full integration of land-use and transportation planning. The income generated by the MTRC from its highly profitable rail-orientated property development, together with its fare-box revenues from the very high patronage levels its services enjoy, makes MTRC one of the few profitable railway companies in the world.[126]

Mainland China has retained state ownership of land, which has enabled its urban public authorities – as in the case of Hong Kong and Singapore – to capture far more of the land-value increases associated with transportation and other urban infrastructure investments than in most cities elsewhere. The adoption of land leases in China (generally of 70 years) for urban transport-related mixed-use developments offers huge scope and potential for similar financial rewards for the public sector. However, in some cases such rewards are not materializing at the scale expected. It has been suggested that this is due to the excessively close links that have developed between some city mayors and leading entrepreneurs, involving non-transparent transactions and conflicts of interests.[127]

The mayoral supervision responsibilities provide the mayor in Greater London (UK) with the mandate and power to rapidly design and implement congestion charging, which has both improved the mobility into and through central London, and proved popular at the same time.[128] Furthermore, in March 2012, the mayor was given the power[129] to raise money for infrastructure projects through the introduction of the community infrastructure levy. These revenues will be charged on most developments in London at differential rates depending on zones, ranging from £20 to £50 per square metre.[130] Despite these initiatives, however, the investment demands look set to remain challenging due to a backlog of infrastructure investment over the last 50 years.

In the face of such infrastructure investment challenges, some national governments (principally in developed countries) have established national agencies specifically assigned responsibilities for

Box 9.15 Functions of 'Infrastructure Australia'

Infrastructure Australia is a statutory body, established under the Infrastructure Australia Act of 2008. It advises governments, investors and infrastructure owners on a wide range of issues that include:

- Australia's current and future infrastructure needs;
- Mechanisms for financing infrastructure investments;
- Policy, pricing and regulation and their impacts on investment and on the efficiency of the delivery, operation and use of national infrastructure networks.

Infrastructure Australia's focus is on assisting Australian governments to develop a strategic blueprint for unlocking infrastructure bottlenecks and to modernize the country's economic infrastructure. Infrastructure Australia reports regularly to the Council of Australian Governments through the Federal Minister for Infrastructure and Transport. Infrastructure Australia has 12 members, appointed by the Federal Minister for Infrastructure and Transport.

Source: Infrastructure Australia, 2011.

the planning, appraisal and funding of critical infrastructure, including major urban transport schemes. In Australia, for example, 'Infrastructure Australia', provides advice to the Treasury on budget priorities and allocations in major infrastructure investments (Box 9.15) and how best to engage with the private sector in financing such projects.

CONCLUDING REMARKS AND LESSONS FOR POLICY

The challenges of urban mobility systems can only be addressed if they are seen as political challenges, requiring political consultation, decision and implementation, as opposed to seeing them as purely technical challenges requiring the 'right' technical solutions. Thus, urban governance and related institutional and regulatory frameworks are at the heart of developing sustainable urban mobility systems, and, indeed, sustainable cities. The primary purposes of such frameworks should be to remove obstacles to the effective participation of all stakeholders in the decision-making process; ensure that information employed to support urban transport proposals is comprehensive, accurate, impartial and transparent; and facilitate effective implementation of political decisions.

The development of effective urban governance and institutional frameworks is a complex issue. There are no universal solutions. However, this does not imply that the identification of 'good practice' is futile. Urban transport agencies and related organizations need to be aware of lessons of urban mobility planning 'successes' (and 'failures') from elsewhere (and other times). Furthermore, the concept of sustainable development is increasingly acknowledged as a key determinant of funding by international development agencies in their dealings with local decision-makers. Thus, it is expected that the 'success' in attracting external funding to achieve more sustainable outcomes in urban transport will, over time, lead to a spreading of good practice.

The challenges of urban mobility systems can only be addressed if they are seen as political challenges, requiring political consultation, decision and implementation

The institutional architecture for urban transport planning interventions and investments should facilitate holistic thinking and integrated actions consistent with strategies for sustainability. Thus, and due to their high costs, ad hoc, short-term, politically expedient decision-making should be avoided. In practice, political champions have played a critical part in creating integration in urban governance. Strong ***political leadership*** does play an important part in the planning and delivery of major transport infrastructure projects in particular.[131] It is important that such leadership is ***transparent and accountable***, to ensure that it doesn't become personal and transitional. This may not only enhance people's trust in the institutions and governance structures, but also ensure that these do not collapse once their champion leaves office.

The objectives, political will, processes and effectiveness of public engagement undertaken by urban transport organizations are context dependent. Without effective participation, proper stakeholder influence cannot be brought to bear. Measures need to be introduced that ensure that the mobility needs and 'accessibility rights' of vulnerable and disadvantaged groups are addressed. Participation and consultation should also be extended to informal sector transport operators (and their organizations), in particular due to their essential role in providing affordable mobility options for low-income groups in most developing countries.

Participation and consultation should also be extended to informal sector transport operators (and their organizations)

In urban areas where no single governance authority exists, this has proved a major impediment to integration in the field of urban transport. The development of sustainable urban mobility systems requires a ***matching of authority with territory***. 'Effective' institutions for governing integrated transport systems require empowerment that permits them to execute their responsibilities within their designated area boundaries. Evidence suggests that if institutions are matched to location – circumstances that encourage public transport systems, political institutions, existing policy frameworks, etc., to evolve in a mutually supportive manner – the task of integration is largely a matter of operational

The value of integrated policy-making, planning and management is increasingly being acknowledged

coordination. Where there has been a history of intense inter-agency competitiveness, the task of integration is far more problematic.

Experience indicates that there is a positive relationship between effective integrated transport systems and jurisdictions that have experience in dealing with 'regional' types of transport. Many of the cities with experience in dealing with issues of regional governance have over time developed improved multi-modal working relationships in the transport sector. Likewise, the extent of centralization and the degree of effectiveness of urban transportation institutions are very often positively correlated to the detriment of sustainable mobility planning. Thus – where 'centralization' represents the extent to which each mode has its own organizational cultures, constituencies as well as powerful interest groups that benefit from a modal focus – organizations are frequently focusing on the interests of the operator of a specific mode, rather than looking to intermodal integration.

Effective institutional development and governance for urban mobility requires good land-use planning, good public transport planning and good demand management – designed wherever possible to minimize the need to travel and to increase the modal shift toward public and non-motorized transport. To facilitate this, urban transport and land-use planning authorities require ongoing capacity-building designed to keep abreast of key issues at all levels and for all sectors of the population. Despite the increasing need for ***integrated land-use and mobility planning***, most cities and countries still separate the functions of land-use and transport planning at almost every level of government. However, the value of integrated policy-making, planning and management is increasingly being acknowledged, particularly (but not exclusively) in developed countries.

NOTES

1 Hudson and Lowe, 2004, p149.
2 Imran, 2010; Low et al, 2003.
3 Huzayyin, 2002.
4 Dotson, 2011.
5 Marshall and Banister, 2007.
6 Nantes Métropole.
7 Autorité Organisatrice de la Mobilité Durable.
8 Allen, 2011b, p5. See also Box 9.6.
9 GLA, 2010.
10 See Schrank et al, 2012; and Chapter 2. See also Chapter 7 on the environmental effects of this car dependency.
11 See, for example, Box 6.5.
12 Replogle and Kodransky, 2010, p1.
13 The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA).
14 Cullingworth and Caves, 2009.
15 Canadian Urban Transit Association, 2010.
16 Irwin, 2003, p2.
17 CBC News, 2007.
18 Sayeg, 2009, pp23–27.
19 Glover and Low, 2004.
20 McKinlay, 2011, p1. The restructured Auckland Council came into being on 1 November 2010. See also the section on 'Addressing urban boundary complications' below.
21 Greater Wellington Regional Council, 2009, p3.
22 Suchorzewski, 2011.
23 See World Bank, 2002b, p2.
24 Suchorzewski, 2011.
25 World Bank, 1999b, piii.
26 Suchorzewski, 2011.
27 Pirie, 2011; Jirón, 2011; Jain, 2011; Pan et al, 2011; Chin, 2011; Balassiano and Alexandre, 2011.
28 Ministry of Transport, 1999.
29 Godard, 2011b, p54.
30 Ragheb, 2010; personal communication with Professor Ali Huzzayin, Cairo University, Egypt, in March 2013.
31 Figueroa and Rodriguez, 2011.
32 Jirón, 2011, p2.
33 Figueroa and Rodriguez, 2011, pp6–7.
34 Figueroa and Rodriguez, 2011, p12.
35 Jirón, 2011, p57.
36 El-Geneidy et al, 2011, p40.
37 El-Geneidy et al, 2011.
38 Houpin, 2011, p96.
39 Arora, 2011, p5.
40 Jain, 2011, p38.
41 These bodies were created by government – for cities with populations in excess of 1 million – to put in place or review legal frameworks for urban mobility planning, provide overall urban transport policy guidance and introduce the implementation of regulations to facilitate local governments to formulate policies, plans and programmes for the sector.
42 Chin, 2011.
43 In Jakarta, Indonesia, the responsibilities for urban transport planning, financing and development processes are divided among the Ministry of Public Works, the Ministry of Home Affairs, the National Land Agency, the Ministry of Trade and Industry and the Ministry of Agriculture and the National Planning Agency (Susantono, 1998).
44 Meakin, 2002.
45 Barter and Dotson, 2011, p8.
46 Pan et al, 2011.
47 Pan et al, 2011.
48 Pan et al, 2011.
49 See Chapters 6 and 7.
50 See, for example, the set of sourcebooks for policy-makers on urban transport produced by GTZ (see http://www.sutp.org/index.php, last accessed 19 February 2013) and ITDP's numerous publications, especially those advocating sustainable urban transport promoted by BRT schemes (see http://www.itdp.org/library/publications/, last accessed 19 February 2013).
51 Failures to commit to urban transport as an 'important' part of policy-making are often attributed to political expediency. Where democracies exist, votes are sought, won and lost on a shorter timeframe than most transport investments can yield tangible benefits.
52 World Bank, 2011a, p4.
53 See Grieving and Kemper, 1999; ISIS, 2003.
54 The integration of land-use and transport planning poses major organizational concerns; such as 'can traffic management be linked with transport planning into one institutional entity?' and 'should this be within a technical division (i.e. the City Engineering Department) rather than with Highways Engineering (with the latter being an entity in its own right taking care of road expansion and maintenance works)?'. There is also the issue of different time horizons: the long term (requiring strategic planning) and the short/immediate term (covering traffic management, public transport (bus) planning and designs, as well as truck movement management) (UNCHS, 1990). Furthermore, transport developments involve a category of 'transport service operator' (as distinct from 'user'), which is somewhat different from the 'owner' and 'occupier' stakeholder categorizations one finds with land-use changes.
55 UN-Habitat, 2009.
56 See Chapters 5 and 8.
57 See the discussion above on conditions and trends in the section on 'Countries with economies in transition'.
58 Martin, 1993.
59 World Bank, 2011a.
60 See Peters, 2011; Frye, 2011; McMillan, 2011.
61 Such as the World Bank (Dotson, 2011).
62 Glover and Low, 2004. For a discussion on different governance models for public transport, see PTUA, 2011.
63 Pirie, 2011, p6.
64 Dablanc and Lozano, 2011, pp11.
65 See Chapter 7.
66 Zegras, 2011.
67 'Wicked problems' describe problems that are exceedingly difficult or impossible to resolve on account of their incomplete, contradictory and changing features that make them typically difficult to identify

and/or define. They are products of interdependent factors that lead efforts to solve one dimension of a 'wicked problem' to reveal other problems (Churchman, 1967; Rittel and Webber, 1973).
68 See Arnott et al, 1994; Shoup, 2003.
69 Such as GPS, GIS, mobile telephony, relational databases, computerized map displays, automated road-user charging and enhanced digital infrastructure systems.
70 Vickers, 2009.
71 It is important to note that a common 'quick fix' solution to the absence of trained professionals in developing countries – namely the importation of foreign professionals to undertake the work at hand – is unsustainable, as such professionals tend to leave with their skills once their contracts expire.
72 Huzayyin, 1995.
73 Dotson, 2011.
74 Huzayyin, 1995. Such realities have seriously hindered the efforts of many international agencies, such as the World Bank (World Bank Independent Evaluation Group, 2007).
75 Barter and Dotson, 2011, p8.
76 Barter and Dotson, 2011, p8.
77 Barter and Dotson, 2011.
78 City of Seoul Government, 2009.
79 Pan et al, 2011, p43.
80 See http://www.mlit.go.jp/en/index.html, last accessed 19 February 2013.
81 See http://www.translink.ca/en/About-Us.aspx, last accessed 19 February 2013.
82 See http://capitalregionboard.ab.ca/, last accessed 19 February 2013.
83 See http://www.metrolinx.com/en/, last accessed 19 February 2013.
84 Canadian Urban Transit Association, 2010, p11.
85 See for example Archdeacon, 2008; Metrolinx, 2008.
86 As a result, the city of Nantes has benefited from both national and international recognition awards. The city was, for example, the winner of the CIVITAS City of the Year award in 2009, and was named as the European Green Capital for the year 2013 (Allen, 2011b).
87 See Box 8.6.
88 A discussion of these plans is included in the section on 'Mainstreaming mobility needs of the socially and economically disadvantaged'.
89 Allen, 2011b, p4.
90 Figueroa and Rodriguez, 2011.
91 Albalate, et al, 2012.
92 El-Geneidy et al, 2011, p41.
93 Kingdom of Jordan, undated.
94 Auckland Transport, 2012.
95 Offices of the New Zealand Minister of Transport, 2009, p1.
96 Auckland Transport, 2012.
97 Glover and Low, 2004.
98 See http://www.thinkingtransport.org.au/state-programs/victorian-transport-integration-act-2010, last accessed 19 February 2013.
99 Banister and Fitch, 2011, p3.
100 Banister and Fitch, 2011, p3.
101 GLA, 2010.
102 EC, 2001.
103 Ministry of Transport, 1999, p21.
104 Kane, 2002, p21.
105 See www.youthforpt.org, last accessed 19 February 2013.
106 McMillan, 2011, p29.
107 Kikoyo, undated.
108 Lai, 2010.
109 Dablanc, 2011, p3.
110 Dablanc, 2011, p4.
111 Dablanc, 2011, p8.
112 Jirón, 2011, p56.
113 Jirón, 2011, p56.
114 Rizvi, 2011, p7.
115 Rizvi, 2011, p9.
116 Pan et al, 2011. This form of self-financing for urban land and infrastructure is known as the '*genbu* contribution'.
117 Gullberg and Kaijser, 2004.
118 Stockholm County Council, 2006; Ingo and Viehhauser, 2005. The development plan covers the period up to 2030.
119 Scheduled to start in January 2013.
120 Deutsche Bahn, 2012.
121 Godard, 2011b, p57.
122 Godard, 2011b, p55.
123 Jirón, 2011, p48.
124 Jirón, 2011, pp48–49.
125 Meakin, 2002, p21.
126 See Box 8.7.
127 Zhao, 2010.
128 Leape, 2006, p173.
129 Under the Planning Act of 2008.
130 Mayor of London, 2012. These revenues will be collected by the London boroughs.
131 However, it should be noted that strong political leadership in many countries has coincided with rather authoritarian regimes.

CHAPTER

10

TOWARD SUSTAINABLE URBAN MOBILITY

Global trends, such as rapid urbanization and motorization, pose tremendous challenges to urban mobility and accessibility. Yet, the changing context within which these are occurring, and the experience it is generating, present new opportunities for advancing innovative policies and programmes for sustainable development as a whole. The previous chapters have discussed the scope and depth of numerous contemporary challenges and best practices in urban mobility and accessibility worldwide. This closing chapter ties the analysis together and focuses on practices, policies and strategies that can be implemented, not only by local authorities but also by national governments. The crux of this chapter is an elucidation of the concrete ramifications of key messages espoused in the report pertaining to the shift from focusing on improving the efficiency of urban transportation to enhancing accessibility in the city as a whole.

Before embarking on policy recommendations it is appropriate, first, to revisit some of the dysfunctional trends that were highlighted in the preliminary chapters and that necessitate the paradigmatic shift reiterated throughout this report. Indeed, the most prominent trend emerging from Chapters 2 to 4 is that, generally, it is becoming more difficult to access places, opportunities and services in many cities of the world. Owing to urban sprawl, distances between functional destinations have become longer; widespread congestion has increased travel time; and high capital, as well as operating, expenses have led to increasing costs of accessibility. As a result, a number of social groups are structurally discouraged from accessing many parts of the cities where they live, and a number of city residents are therefore deprived of the full benefits offered by urbanization. Furthermore, poor accessibility has reduced the efficiency and functionality of many cities in the world.

Another trend highlighted in this report is the steady increase in the share of private motorized transport, including the extremely high motorization rates in developing countries. This also occurs in regions where the dominant mode of mobility remains non-motorized transportation, such as in the case of Africa and Asia. Apart from the inherent inequity associated with private motorized transport, the negative externalities it generates are quite substantial. It has been revealed that there is a relative stagnation and even decline of public transport in cities of developing countries, even though it constitutes a most effective means of enhancing urban accessibility, as well as of promoting sustainable urban development.

A number of social groups are structurally discouraged from accessing many parts of the cities where they live

The report also reveals that the configuration of cities in terms of form, structure and function has been highly influenced by the dominance of private transport infrastructure, facilities and services. The embedded imperative of private motorization as the dominant mobility mode has dictated the layout and design of streets and neighbourhoods; dispersion of densities; and location of functions. Perpetuation of this model in much of the past century has generated a self-replicating crisis of urban accessibility: more vehicles, necessitating more infrastructure, compelling a need for more vehicles, fostering more spatial expansion, calling for additional infrastructure and vehicles, with the vicious circle continuing *ad infinitum*. At the same time, in most cities, the neglect of urban freight distribution and management of freight transport, both in land-use and transport planning tends to make goods transportation a major impediment to sustainable urban mobility and to accessing the city.

The configuration of cities . . . has been highly influenced by the dominance of private transport infrastructure, facilities and services

Underlying all the above challenges has been a marked distortion in the institutional structures, management systems, as well as legal and regulatory frameworks. Fragmentation among institutions dealing with different aspects of mobility and accessibility is rife. The management principles and norms guiding planning, design and even delivery tend to compound the problems instead of ameliorating them. Moreover, the regulatory instruments are not fully compatible with the demands of sustainability.

The neglect of urban freight distribution and management of freight transport tends to make goods transportation a major impediment to sustainable urban mobility

Value generation through accessibility has not been optimally utilized in many cities of . . . developed and developing countries

The report has highlighted that the world market for railway infrastructure and equipment has been growing at 3.2 per cent a year, and is set to grow at around 2.7 per cent annually.[1] However, the global distribution of metro systems shows a concentration of metros in Europe, Eastern Asia and the eastern part of the US. It is further noted that in mega-cities of developing countries where the mobility demand on major corridors is appropriately high, metros remain the only economically and environmentally viable public transport system. For cities which do not have the passenger threshold for metros and the economic capacity to invest in them, bus rapid transit (BRT) has become a viable option, at least in the short and medium term.

Urban mobility and accessibility are key for promoting sustainable urban development

On the whole, the report acknowledges the critical importance of accessibility for enhancing the economies of agglomeration and urbanization. It analyses how the urban function is improved and potential of value enhancement realized through accessibility. However, the report shows that the process of value generation through accessibility has not been optimally utilized in many cities of both the developed and developing countries. In the latter case this has been largely due to the separation and sectoralization of land use and transportation, as well as the inadequate integration among transport modes. In the case of some cities in developed countries, delays and procrastinations in investments and expansion have led to lost opportunities.

Urban mobility is finely woven into the spatial, social, economic, political and environmental fabric of cities

The report underlines that urban mobility and accessibility are key for promoting sustainable urban development. They are also directly connected to urban stock and flows – in terms of spatial development and consolidation of the built form. They are therefore associated with value creation, improvement of welfare and enhancement of citizenship. Furthermore, urban mobility systems have the potential to positively impact on material and energy flows. However, these systems have not adequately contributed to the desired outcomes owing to their prevailing shortcomings. This report therefore emphasizes that there is an urgent need to reframe urban mobility policies and practices in order to address these shortcomings.

It is essential that travel is recognized as a 'derived demand' – i.e. derived from the need for people to socially and economically 'interact'. . . . this distinction shifts the focus to 'people' and 'places' and away from 'movement'

POLICIES AND PRACTICES FOR REFRAMING URBAN MOBILITY

The overall challenges as well as positive experiences and practices discussed in this report form the basis for key lessons to be drawn for adaptation and replication. They underline the multi-dimensional nature of sustainable urban mobility in terms of both policy and operational implications. Coherence in strategic interventions and linkages among processes are some of the essential principles that emerge from the preceding chapters. It is reckoned that the ultimate enhancement of accessibility is neither a function of hardware – be it highways, rail or vehicles – nor an outcome of ad hoc spatial delocalization and decongestion.

This report advocates for a paradigm shift in addressing urban mobility. The signposts of how to make the shift are written throughout the report. The discussion below summarizes some of the key attributes for a recalibration of how cities are designed and planned and how urban transport services are organized and delivered in the quest for more sustainable mobility.

Holistic and systemic thinking and action

Urban mobility is finely woven into the spatial, social, economic, political and environmental fabric of cities. In charting a path for sustainable urban mobility, it is essential to apply an ecological and systems framework that recognizes this. Many of the contemporary challenges facing cities – for example auto-dependent sprawl, persistent poverty, lack of accountability and participatory decision-making – are structural in nature, rooted in current regulatory, institutional and economic systems and approaches. Only by recognizing the systemic nature of problems (mispricing leads to overconsumption of roads in peak periods; sprawling settlement patterns render public transport systems ineffectual; urban design for machines rather than people creates cities for cars rather than people) can significant headway be made in charting a sustainable mobility future.

Transport as a means, not an end

It is essential that travel is recognized as a 'derived demand' – i.e. derived from the need for people to socially and economically 'interact'. The end or objective of most travel is to meet a friend, earn income, attend school or purchase a good, not movement per se. Cars, trains, buses and bikes are simply the means to achieve these ends. Making this distinction shifts the focus to 'people' and 'places' and away from 'movement'. This realization envisages cities, neighbourhoods, regions and mobility systems as tools that promote desired societal outcomes – such as liveability and affordable access – with transport playing a supportive role. Operationally, this can take the form of compact, mixed-use communities that dramatically shorten trip distances and improve pedestrian and bicycling infrastructure. Compact cities are less reliant on private cars and minimize distances travelled, thereby conserving energy, land and environmental resources. They are also more resilient, enabling them to better adapt to the vagaries and uncertainties of climate change and other global unknowns.

Accessibility as a priority rather than transport

Related to this notion of travel as a derived demand and transportation as a means to an end is the core principle of accessibility. Accessible cities not only put places (e.g. homes and workplaces, or 'trip origins and destinations') closer to each other, but also provide safe and efficient pedestrian and cycling corridors and affordable, high-quality public transport options. That is, they are ***accessible to all***. Recasting the sector's primary objective as one of enhancing accessibility invariably leads to a different set of policies and strategies, like transit-oriented development and the provision of highly interconnected bikeway networks. These strategies not only conserve land, energy and financial resources, but also help the poor and those without private motorized vehicles to access goods and services within the city. In short, accessible cities are inclusive, resourceful and pro-poor.

POLICY AND OPERATIONAL ENTRY POINTS

From the above normative framework, the following section presents six policy and operational areas that can be developed to suit different settings and through which accessibility-based sustainable mobility can be achieved. These are: enhancing the linkage between land use and transport; revitalizing urban planning and transport engineering designs; realigning transport infrastructure investment and development; integrating urban transport facilities and service operations; streamlining urban institutions and governance framework; and readjusting legal and regulatory instruments. Each of these is discussed in some more detail in the sections below.

The generic designation of the above categories reflects everyday policy processes. These policy areas have been adopted for this conclusion for two reasons. First, to underscore the fact that the shift being advocated in this report is mainly viable when undertaken within existing institutional structures and processes. Second, to highlight that since these are generic proposals, they would have to be slightly adapted to each city's unique circumstances prior to actual implementation. Furthermore, the categories are also deemed appropriate because they allow for encompassing a variety of settings and levels of development. However, the overall logic of the six categories lies in their strategic linkage and their cumulative potential for triggering policy and operational change.

Enhancing the linkage between land use and transport

While the pitfalls of overreliance on technological and supply-side solutions to urban mobility are acknowledged, the important role of transport cannot be discounted. The missing ingredient causing the observed pitfall has been the disconnect between the essence of land use and the logic of transport. This connection needs to be re-established for sustainable urban mobility to be achieved; and it can only be effectively initiated at the highest level – through national urban policy initiatives.

Indeed, the national urban policy is given prominence for this connection mainly because of its role as a statutory instrument that not only articulates a vision for urban development, but also defines the relationship among sectors, agencies and stakeholders. When properly articulated, national urban policy offers the most authoritative instrument for elevating the linkage between land-use and transport planning beyond the bureaucratic and political compromises often reached. As elaborated in Chapter 5, the integration is not simply a technical exercise at the local level. It represents a totality of how cities are at a given time, while also identifying the parameters of their future growth. Substantive guidelines are therefore required to ensure effective harnessing of the dynamic synergy of a given national urban system. These guidelines should then subsequently be translated at the sub-national level – from region, through metropolitan area, to the municipality and ultimately at the neighbourhood and street level.

An integrated approach to land use and transport harmonizes planning of the two processes out of the bounded confines of specific ministry and departmental mandates, turning them into a coordinated and integrated exercise at policy and operational levels. It shifts the focus of planning from placement of structures and designation of land use to that of enabling the realization of people's needs and everyday functions in the most efficient and sustainable manner. Within this approach, the key challenge is therefore not merely to overcome the separate handling of transport and land-use planning; or even to ensure a juxtaposition of the two. Rather, it is to foster an organic integration of the entire continuum of a multi-modal mobility within a holistic and sustainable land-use system where dynamic synergies are harnessed; interconnections are promoted; and functionality optimized. In the whole process, the aspect of design serves as a main bridge linking the key dimensions and attributes for ensuring sustainability and accessibility.

In many cities of the world, particularly those in developing countries, there is a persisting challenge of identifying whose responsibility it is to take the integration of land use and transport (and ideas such as those mentioned above) from theory to a practical

Accessible cities . . . put . . . trip origins and destinations closer to each other, [and] provide safe and efficient pedestrian and cycling corridors and affordable, high-quality public transport options

When properly articulated, national urban policy offers the most authoritative instrument for elevating the linkage between land-use and transport planning

An integrated approach to land use and transport . . . shifts the focus of planning from placement of structures and designation of land use to . . . enabling the realization of people's needs and everyday functions

Sustainable densities are essential for sustainable mobility

The value of access is enhanced by increasing the functionality of each place, thus reducing . . . distances [and] the number of trips

Practices that . . . can contribute to reducing the prevailing shortcomings of freight distribution in cities . . . include: rationalization of delivery, improving freight facilities and promoting modal adaptation

The choice of infrastructure investments are central in determining the choices and options for sustainable mobility

level. This is particularly the case in view of existing constraints of land geography, activity distribution and evolution, economic and financial constraints, and institutional and regulatory limitations.

The comprehensive integration of land-use and transport needs to be thematically cross-cutting and multi-sectoral. This reflects the co-dependence of urban systems – for example urban growth induced by a world-class high-capacity public transport investment increases the demand for electric power and water capacity, new housing construction and business centres. Multi-sectoral planning also exploits opportunities for economizing on the costs of urban services and infrastructure outlays, such as using rights of way reserved for a new fixed-guideway public transport line to also lay broadband cable, storm-runoff channels and utility lines.

Revitalizing urban planning and transport engineering designs

The strong connection between transport 'supply and demand' and urban form is a key theme highlighted throughout this report. These influence and reinforce each other both in positive and negative ways. The various cases highlighted in the report demonstrate that the convenience of mobility and the degree of accessibility in cities are determined by the processes emanating from the relationship between the patterns of transport and urban form in the given setting. From the analysis of Chapter 5 on urban form, and the elaboration of sustainability pillars in the subsequent chapters, an important organizing principle can be deduced. Namely, the linkage between urban form and transport is realized through the optimization of density, enhanced proximity and co-location, as well as improvements in the functionality and inclusiveness of places and facilities.

Sustainable densities are essential for sustainable mobility; not only because of its minimum energy consumption and smaller environmental footprint, but also because it contributes to increasing proximity and co-location. Density can be optimized through the use of regulatory instruments, such as zoning laws and the application of locational incentives, such as infrastructural investments, as well as through design interventions. Compact configurations complemented with transport-oriented development minimize private motorization while making it viable for cities to invest in different modes of public transportation. Different density configurations and gradients are discussed in the report demonstrating the range of options in promoting compactness for sustainable mobility. However, a caution is also registered that while density is necessary, it is not a sufficient condition especially for moderating private car use and for arresting urban sprawl.

The notion of sustainable density is applied in the report in the strict sense of making a distinction with the condition of overcrowding or with slum-like concentration of populations. The planned optimization of density advocated in this report enables the attainment of economies of scale, making it viable to provide a range of facilities at the least cost. The compactness engendered allows for more public space while also exerting a minimum impact on the environment. Coupled with appropriate design it encourages non-motorized and public transportation, fosters conviviality and strengthens a sense of place.

A related attribute is the need to ensure diversity and mixed-use neighbourhoods. Through the use of planning, a variety of housing types is provided, the location of jobs and housing is balanced and a range of everyday amenities are located within easy reach. Mixed-land use promotes non-motorized transport by increasing proximity and reducing the need to travel, thus allowing for accomplishing many activities with shorter and fewer trips. All this is achieved through the creative deployment of planning and design and innovative transport engineering and planning designs.

The quality of the connection between points of origin and destination is enhanced by the functionality and inclusiveness of those places and facilities. The value of access is enhanced by increasing the functionality of each place, thus reducing not only distances but also the number of trips. Also, the fostering of inclusiveness and a sense of place removes inhibitions and promotes identity and conviviality. Transport engineering design and urban design are central tools at this level and, as demonstrated in Chapter 5, street configurations, transport nodes and neighbourhood layouts are the main areas where interventions take place.

While a lot more research is needed on integrating freight distribution into the framework of sustainable urban mobility through planning and design, there are a few practices that have been developed and that can contribute to reducing the prevailing shortcomings of freight distribution in cities. These include: rationalization of delivery, improving freight facilities and promoting modal adaptation. However, it has been noted in the report that the commercial logic of freight distribution tends to be at variance with most of the principles of sustainable urban development.

Realigning transport infrastructure investment and development

This report acknowledges that the choice of infrastructure investments – particularly budgeting and financing aspects – is central in determining the choices and options for sustainable mobility. It is important that gradual steps are taken to correct the current imbalance in funding and investments between private and public modes of transport. More public resources need to be allocated to facilities that cater to the needs of the majority of people in both developed and developing countries. The current bias towards roads and highways needs to be corrected so that more funding is assigned to developing and expanding non-motorized and high-capacity public transport infrastructure.

It is particularly important that cities investing in metro, light rail and high-end BRT systems direct larger shares of future growth to public transport corridors. Transport-oriented development can reverse the kind of car-based sprawl that eats into the green agenda of cities. However, it is important that a proper alignment between land-use and transport layout is maintained, otherwise the reverse – i.e. urban sprawl – can be further extended by high-capacity public transport systems.

It is also important that the urban transport sector is treated as an integrated whole through systems financing and pricing. This is best accomplished by pooling fiscal resources into a central fund and distributing them among modes and programmes in accordance with well-defined objectives, such as air-quality improvements and reduced traffic congestion. Such coordinated and centralized financing is today practised throughout the US, Canada, Singapore and Japan. Dedicated, long-term funding is also essential to allow strategic, forward-looking planning, such as preserving rights of way for future infrastructure investments. However, it is important to note that in some cities of developing countries it is easier to negotiate and secure funding for metro, light rail or BRT systems than for meeting the (very marginal) cost of implementing integration facilities with other urban transport modes – such as buses, informal share taxis and cars – at metro, light rail or BRT stations.

Owing to the financial constraints of local governments and increased interest by private investors, the global urban transport sector has witnessed a surge in public–private partnerships. These partnerships are managed through contracts, franchises, concessions and, in some instances, the transport services have undergone full privatization. Public–private partnerships have the potential to inject efficiencies in the urban transport sector and also stimulate innovations, such as market-based pricing and automated toll collection. They may also draw in private capital where public funding is restricted. Public–private partnerships have generally worked best in rapidly growing and urbanizing countries and regions – such as the Republic of Korea and Taiwan (China) – and where there is the institutional capacity to oversee and regulate private actors. This underscores the need to achieve both economic and institutional sustainability. However, this report also highlights the potential dangers of using public–private partnerships in urban mobility projects,[2] as experiences from a number of cities indicate that the financial risks in such projects tend to be carried by the public at large rather than by the private sector partners involved.

The implementation of principles of economic efficiency is essential to the urban public transport sector, since it has major financial implications on local governments. For instance, while urban rail systems handle large loads, they do so at very high, and potentially financially crippling, costs. The high capital investments and subsequent operating costs needed to support a metro investment must be carefully examined to ensure that local and national governments have the financial capacity to maintain its services. Unless a city's urban densities are comparatively high and financial resources are plentiful, lower-cost BRT investments – as recently implemented by cities such as Jakarta (Indonesia), Ahmedabad (India), Lagos (Nigeria) and Chiang Mai (Thailand) – present a more practical option for investment in high-capacity public transport.

A key point made in this report is that the sustainability of urban mobility systems is highly dependent on the financial models designed to protect the public goods dimension of both land use and the transport system. Among other financing sources, the option of value capture is highly recommended as a complement to public funding. Through recouping the increase of value in adjacent land and converting it into public finance for reinvestment in urban mobility systems, the linkage between land use and transport is reinforced. This approach is also politically appealing as it directly demonstrates the linkage between charges levied and the benefits provided.

More funding [needs to be] assigned to developing and expanding non-motorized and high-capacity public transport infrastructure

Transport-oriented development can reverse . . . car-based sprawl

The sustainability of urban mobility systems is . . . dependent on the financial models designed to protect the public goods dimension of . . . land use and the transport system

Value capture is highly recommended as a complement to public funding

Integrating urban transport facilities and service operations

The linkage of transport to land use is not only limited to the hardware and the physical dimensions of the two processes. Transport-oriented development and traffic-calming interventions discussed in this report also involve the systemic and managerial aspects of ensuring convenience, efficiency, aesthetics and safety of mobility. The operation of multi-modal neighbourhood stations; the ambiance surrounding flow of vehicles, bicycles and pedestrian in streets; and the procedures at toll-collection points, have to be synchronized in a manner that ensures a pleasant mobility experience.

The urban transport sector must ascribe to the principle of economic efficiency for the simple reason that waste and unsound expenditures could imply that scarce financial resources are directed to other productive and beneficial societal uses, be they education, healthcare or private consumption. Efficient land-use patterns (e.g. compact, mixed and walkable) allow for less reliance on expensive mobility systems in general. Properly designed transport systems also contribute to business expansion, increased economic output and employment generation. Indeed, mobility is indisputably a necessary (though not a sufficient) precondition to economic growth and expansion.

Mobility is indisputably a necessary . . . precondition to economic growth

Efficiency must underpin management, operational and system design practices throughout the urban transport sector. In the case of high-capacity public transport systems, this can take the form of redeploying buses and equipment to high-ridership markets that produce the highest fare-box returns. In doing so, it is necessary to adopt the regulations that allow operators to develop 'out of fare-box' financing resources such as value capture, advertising at stations, stops and vehicles, etc., in order to cross-subsidize services, thus, reducing or eliminating government subsidies. For non-motorized transport, it might mean building bikeway overpasses at busy junctions where careful cost–benefit calculations reveal a net societal gain. The report highlights the difficulties faced by cities of developing countries in securing funding to cover construction and maintenance costs of non-motorized transport infrastructure, from both public and other sources. As non-motorized transport facilities are not revenue generating, they are rarely attractive to international funding agencies or the private sector. Efforts are needed to reach innovative ideas that point out the environmental and societal gains made from non-motorized transport.[3] For urban goods movement, night or off-peak deliveries, freight stations and consolidation centres that allow shared-use of delivery vehicles, and bicycle carriers suited to the constraints of urban circulation, might be called for. For parking, efficiency might be achieved by installing sensors in parking stalls to monitor occupancy so that charges can be varied according to demand and motorists can be real-time navigated to the closest available parking space.[4]

Because transportation is both a private and a public good, . . . a combination of user charges and public support is often needed to efficiently and equitably finance transport infrastructure and services

Because transportation is both a private and a public good – conferring benefits to both individual users and society at large – a combination of user charges and public support is often needed to efficiently and equitably finance transport infrastructure and services. User fees, such as public transport fares and road charges, encourage efficient behaviour. When fuel taxes rise, increased prices encourage motorists to acquire more fuel-efficient vehicles or switch to public transport. Funding transport facilities through general sales, income taxes or borrowing provides no incentive to be efficient or socially responsible; as such charges are completely unrelated to the cost imposed on the transport system or the benefits received.

Integrated transportation and urban development must occur at all geographic scales

Integrated transportation and urban development must occur at all geographic scales. At the micro level, much is to be gained from advancing the model of 'complete streets', an acknowledgement that streets serve numerous purposes, not just moving cars and trucks. The 'complete streets' movement, gaining steam throughout Europe, much of North America and in parts of Eastern Asia, views road right of way as 'public spaces', managing and even slowing movements in favour of public transport, walking and cycling. One example is multi-way boulevards that provide spaces for cars, buses, pedestrians and sometimes even tramways – packaged with good designs that emphasize high-quality spaces and safety.[5] Non-motorized modes of transport such as walking and cycling, enliven a city, promote social interaction and allow a more physically active lifestyle. Some cities have gone one step further, reclaiming land once given over to motorways and freeways to pedestrians, cyclists and public transport. Seoul's Cheng Gye Cheon freeway-to-greenway conversion, made possible in part by expanded BRT services to absorb lost roadway capacity, has not only reduced inner-city traffic congestion but has also been credited with spurring central-city redevelopment and urban infill. The 6-kilometre inner-city greenway laced with bike paths and urban art is today Seoul's second most popular tourist destination.[6]

Progressive projects and programmes – such as green transport-oriented development and complete streets – do not suddenly appear, but rather begin with thoughtful plans and visions. Transport planning needs to be well integrated with land-use planning at all levels of government. Through both carrots (e.g. financial aid) and sticks (e.g. regulatory requirements), national governments are uniquely positioned to encourage state/provincial, regional and local institutions to link transport investment and urban development strategies in master plans, zoning practices and infrastructure design standards. Integrated transport and land-use planning development must also be emphasized in national urban development policies and plans. India's national urban transport policy of 2006, for example, embraces integrated transport and land-use planning as its number-one priority. In fact, half the cost of preparing integrated transport and land-use plans in Indian cities is covered by the central government.[7]

Streamlining urban institutions and governance framework

Innovative ideas and policies geared towards sustainable mobility require strong institutional and governance structures to oversee their successful implementation

Innovative ideas and policies geared towards sustainable mobility require strong institutional and governance structures to oversee their successful implementation. Political will, sound leadership, transparency and accountability are essential in building public trust. Also vital to the entire process are the planning institutions, as these are capable of creating compelling visions of urban futures. Moreover, participatory mechanisms must be in place to ensure that planning and investment decisions are socially inclusive and representative of all segments of society. This implies giving non-state actors and city residents, such as neighbourhood associations, a place at the negotiating table when making important urban mobility decisions. In strengthening institutions, it is essential that financial resources be channelled into training and capacity-building of the concerned personnel in order to empower them to take on the complex challenges of the urban transportation sector.

The development of a fully integrated and sustainable multi-modal urban transportation system requires a robust regional governance structure, which gives rise to inter-municipal cooperation. This fosters accountability and provides a territorial context for coordinating growth and services within a region's travel-shed. Regional institutions need to be endowed with the power of regulatory oversight and funding capacities to finance transportation investments and service management.

As noted above, while most of the innovations introduced in urban transport will come from local and regional actors, higher levels of government also have a crucial role to play. National urban transport policies that promote integrated planning and provide capital loans and technical assistance can help smaller cities chart a sustainable urban transport course.[8] Brazil has had a national urban transport policy for over 25 years, helping nurture sustainable transport practices in BRT-served cities such as Curitiba and Belo Horizonte. India's Ministry of Urban Development is today actively promoting transport-oriented development along planned and existing BRT corridors through financial support for forming unified metropolitan transport authorities.[9]

Technology itself can be an enabler of more grassroots and inclusive policy-making in urban transport. Social media, for example, allows like-minded individuals to coalesce and shape public discourse. In 2008, during a period when the TransMilenio BRT system in Bogotá, Colombia, was suffering from problems of extreme overcrowding and long queues at ticket offices, residents turned to social media to organize a large public protest. Active media coverage led to even louder public outcries, eventually prompting local leaders to introduce various capacity-expansion initiatives, including lengthening some of the key modular stations, expanding services and introducing more articulated buses.[10]

There is also a need to inject efficiencies, accountability and transparency into the urban transport decision-making process. This requires the development and institutionalization of planning processes and evaluation approaches that are based on objective measures of performance and tied to well-articulated goals and hoped-for outcomes. This promotes both transparency and accountability. At the same time, there is need for an open and democratic planning and decision-making process, in particular given the broad reach of the urban transport sector and its merits. This will not only bring the voices of all citizens – women and men, children, the elderly, the disabled, businesses, governments, NGOs and civil society at large – to the table, but will also ensure that the needs of the least advantaged are clearly recognized and fully acted upon.

Responsibilities for the urban transport sector are being decentralized across the world, from Eastern Europe, to Sub-Saharan Africa and South-Eastern Asia. Human and financial resources are needed for the successful handover of functions and investment responsibilities from central to local governments. There is a need for metropolitan planning and operating authorities that reflect regions as 'ecological units' – i.e. by allowing planning and governance over a geographic territory that mimics commute-sheds, trade-sheds and air basins. Human resource development plans and integrated, viable and dependable urban transport funding programmes are also needed.

A fully integrated and sustainable multi-modal urban transportation system requires a robust regional governance structure

While most of the innovations introduced in urban transport will come from local and regional actors, higher levels of government also have a crucial role to play

Readjusting legal and regulatory instruments

The interventions highlighted above call for changes in the management of space, the built form, the engineering of transport, social behaviour, as well as in the institutional and financing arrangements related to urban development. These elements are built upon the legacy of a legal foundation that has perpetuated mobility systems which this report has found to be severely wanting. Any transformation would therefore entail major reform in the legal and regulatory framework relating to urban management. For example, the ordinances guiding the planning process have to be amended away from often applied segregation of use and rigid zoning towards fostering more mixed-use and compactness. The same applies to building codes and standards, mandates and authority allocated to different institutions, and also sanctions directed at reducing negative externalities.

While significant progress has been achieved in some cities, in terms of incorporating the necessary laws and regulation for realizing some of the above objectives, much remains to be done. The dire need for fostering inclusiveness and environmental protection not only calls for the enactment of a comprehensive set of statutes, but also requires the consolidation of enforcement capacity to ensure that the laws and regulations are abided by.

The interventions highlighted [in this report] call for changes in the management of space, the built form, the engineering of transport, social behaviour, . . . [and] in the institutional and financing arrangements related to urban development

CONCLUDING REMARKS

Urban sustainable mobility as a development issue cuts across the intersection of the most urgent challenges confronting the global community today. Neither the efforts towards reducing greenhouse gas emissions, nor the measures being taken to arrest the growing economic inequalities among and within nations, can be tackled without also addressing the

Urban sustainable mobility . . . cuts across the intersection of the most urgent challenges confronting the global community today

It is possible to initiate and promote interventions that can effectively enhance the accessibility of cities today

issue of sustainable mobility. Similarly, the quest towards eliminating poverty and fostering shared prosperity cannot succeed without also redressing the prevailing distortions in urban mobility systems and existing impediments on accessing the modern city.

This report has demonstrated that mobility systems contribute to the morphology of the city, both in terms of the spatial layout as well as in the configuration of its built form. In so far as these two elements are related to the productivity and dynamism of the city in the broader setting, the impact of urban mobility is therefore local as well as macro. The report suggests that along the three key pillars of sustainable development – and within the foundations of robust, integrated and participatory institutions – it is possible to initiate and promote interventions that can effectively enhance the accessibility of cities today.

NOTES

1 Economist, 2013.
2 See Chapter 8.
3 Beldean et al, 2007.
4 Shoup, 2011.
5 Jacobs et al, 2002.
6 Kang and Cervero, 2009.
7 Government of India, 2006.
8 Gakenheimer, 2011.
9 Cervero, 2013.
10 Parra, 2012.

STATISTICAL ANNEX

GENERAL DISCLAIMER

The designations employed and presentation of the data do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

TECHNICAL NOTES

The Statistical Annex comprises 17 tables covering such broad statistical categories as demography, households, housing, economic and social indicators. The Annex is divided into two sections presenting data at the regional, country and city levels. Tables A.1 to A.5 present regional-level data grouped by geographic distribution. Tables B.1 to B.9 contain country-level data, while Tables C.1 to C.3 are devoted to city-level data. Data have been compiled from various international sources, from national statistical offices and from the United Nations.

EXPLANATION OF SYMBOLS

The following symbols have been used in presenting data throughout the Statistical Annex:

category not applicable	..
data not available	. . .
magnitude zero	–

COUNTRY GROUPINGS AND STATISTICAL AGGREGATES

World major groupings

Developed countries: All countries and areas of Europe and Northern America, as well as Australia, Cyprus, Israel, Japan and New Zealand.[1]

Developing countries: All countries and areas not listed under 'developed countries' above.[1]

Least developed countries: Afghanistan, Angola, Bangladesh, Benin, Bhutan, Burkina Faso, Burundi, Cambodia, Central African Republic, Chad, Comoros, Democratic Republic of the Congo, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gambia, Guinea, Guinea-Bissau, Haiti, Kiribati, Lao People's Democratic Republic, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Myanmar, Nepal, Niger, Rwanda, Samoa, São Tomé and Príncipe, Senegal, Sierra Leone, Solomon Islands, Somalia, Sudan, Timor-Leste, Togo, Tuvalu, Uganda, United Republic of Tanzania, Vanuatu, Yemen, Zambia.[1]

Sub-Saharan Africa: Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Côte d'Ivoire, Democratic Republic of the Congo, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mayotte, Morocco, Mozambique, Namibia, Niger, Nigeria, Réunion, Rwanda, Saint Helena, São Tomé and Príncipe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, Swaziland, Togo, Uganda, United Republic of Tanzania, Zambia, Zimbabwe.[1]

Sub-regional aggregates

■ *Africa*

Eastern Africa: Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mayotte, Mozambique, Réunion, Rwanda, Seychelles, Somalia, South Sudan, Uganda, United Republic of Tanzania, Zambia, Zimbabwe.

Middle Africa: Angola, Cameroon, Central African Republic, Chad, Congo, Democratic Republic of the Congo, Equatorial Guinea, Gabon, São Tomé and Príncipe.

Northern Africa: Algeria, Egypt, Libyan Arab Jamahiriya, Morocco, Sudan, Tunisia, Western Sahara.

Southern Africa: Botswana, Lesotho, Namibia, South Africa, Swaziland.

Western Africa: Benin, Burkina Faso, Cape Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Saint Helena, Senegal, Sierra Leone, Togo.

Asia

Eastern Asia: China, Hong Kong SAR of China, Macao SAR of China, Democratic People's Republic of Korea, Japan, Mongolia, Republic of Korea.

South-Central Asia: Afghanistan, Bangladesh, Bhutan, India, Iran (Islamic Republic of), Kazakhstan, Kyrgyzstan, Maldives, Nepal, Pakistan, Sri Lanka, Tajikistan, Turkmenistan, Uzbekistan.

South-Eastern Asia: Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor-Leste, Viet Nam.

Western Asia: Armenia, Azerbaijan, Bahrain, Cyprus, Georgia, Iraq, Israel, Jordan, Kuwait, Lebanon, Occupied Palestinian Territory, Oman, Qatar, Saudi Arabia, Syrian Arab Republic, Turkey, United Arab Emirates, Yemen.

Europe

Eastern Europe: Belarus, Bulgaria, Czech Republic, Hungary, Moldova, Poland, Romania, Russian Federation, Slovakia, Ukraine.

Northern Europe: Channel Islands, Denmark, Estonia, Faroe Islands, Finland, Iceland, Ireland, Isle of Man, Latvia, Lithuania, Norway, Sweden, United Kingdom.

Southern Europe: Albania, Andorra, Bosnia and Herzegovina, Croatia, Gibraltar, Greece, Holy See, Italy, Malta, Montenegro, Portugal, San Marino, Serbia, Slovenia, Spain, The former Yugoslav Republic of Macedonia.

Western Europe: Austria, Belgium, France, Germany, Liechtenstein, Luxembourg, Monaco, Netherlands, Switzerland.

Latin America and the Caribbean

Caribbean: Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, British Virgin Islands, Cayman Islands, Cuba, Dominica, Dominican Republic, Grenada, Guadeloupe, Haiti, Jamaica, Martinique, Montserrat, Netherlands Antilles, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos Islands, United States Virgin Islands.

Central America: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama.

South America: Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Falkland Islands (Malvinas), French Guiana, Guyana, Paraguay, Peru, Suriname, Uruguay, Venezuela (Bolivarian Republic of).

Northern America

Bermuda, Canada, Greenland, Saint-Pierre-et-Miquelon, United States of America.

Oceania

Australia/New Zealand: Australia, New Zealand.

Melanesia: Fiji, New Caledonia, Papua New Guinea, Solomon Islands, Vanuatu.

Micronesia: Guam, Kiribati, Marshall Islands, Micronesia (Federated States of), Nauru, Northern Mariana Islands, Palau.

Polynesia: American Samoa, Cook Islands, French Polynesia, Niue, Pitcairn, Samoa, Tokelau, Tonga, Tuvalu, Wallis and Futuna Islands.

NOMENCLATURE AND ORDER OF PRESENTATION

Tables A.1 to A.5 contain regional data, grouped in geographic aggregates. Tables B.1 to B.9 and C.1 to C.3 contain country- and city-level data, respectively. In these tables, the countries or areas are listed in English alphabetical order within the macro-regions of Africa, Asia, Europe, Latin America, Northern America and Oceania. Countries or area names are presented in the form commonly used within the United Nations Secretariat for statistical purposes. Due to space limitations, the short name is used – for example, the United Kingdom of Great Britain and Northern Ireland is referred to as 'United Kingdom'.

DEFINITION OF TERMS

Access to electricity: percentage of households that, within their housing unit, are connected to electricity.

Access to piped water: percentage of households that, for source of drinking water, are connected to piped water within their housing unit, tap placed in the yard or plot outside the house.

Access to telephone: percentage of households that, within their housing unit, are connected to telephone.

Access to mobile: percentage of households with mobile phone.

Gini index: the extent to which the distribution of income (or, in some cases, consumption expenditure) or assets (such as land) among individuals or households within an economy deviates from a perfectly equal distribution. A Lorenz curve plots the cumulative percentages of total income received against the cumulative number of recipients, starting with the poorest individual or household. The Gini index measures the area between the Lorenz curve and a hypothetical line of absolute equality, expressed as a percentage of the maximum area under the line. Thus, a Gini index of 0 represents perfect equality, while an index of 1 implies absolute inequality.

Gross national income: the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad. Data are in current US dollars converted using the World Bank Atlas method.

Gross national income per capita: gross national income (GNI) divided by mid-year population. GNI per capita in US dollars is converted using the World Bank Atlas method.

Gross national income PPP: gross national income converted to international dollars using purchasing power parity (PPP) rates. An international dollar has the same purchasing power over GNI as a US dollar has in the United States of America.

Household: the concept of household is based on the arrangements made by persons, individually or in groups, for providing themselves with food or other essentials for living. A household may be either:

1. A one-person household: a person who makes provision for his or her own food or other essentials for living without combining with any other person to form a part of a multi-person household.
2. A multi-person household: a group of two or more persons living together who make common provision for food or other essentials for living. The persons in the group may pool their incomes and may, to a greater or lesser extent, have a common budget; they may be related or unrelated persons or constitute a combination of persons both related and unrelated. This concept of household is known as the 'housekeeping' concept. It does not assume that the number of households and housing units is equal. Although the concept of housing unit implies that it is a space occupied by one household, it may also be occupied by more than one household or by a part of a household (e.g. two nuclear households that share one housing unit for economic reasons or one household in a polygamous society routinely occupying two or more housing units).

Household connection to improved drinking water: percentage of households that, within their housing unit, are connected to any of the following types of water supply for drinking: piped water, public tap, borehole or pump, protected well, protected spring or rainwater.

Improved drinking water coverage: percentage of people using improved drinking water sources or delivery points. Improved drinking water technologies are more likely to provide safe drinking water than those characterized as unimproved. **Improved drinking water sources**: piped water into dwelling, plot or yard; public tap/standpipe; tube well/borehole; protected dug well; protected spring; rainwater collection. **Unimproved drinking water sources**: unprotected dug well; unprotected spring; cart with small tank/drum; bottled water;[2] tanker-truck; surface water (river, dam, lake, pond, stream, canal, irrigation channels).

Improved sanitation coverage: percentage of people using improved sanitation facilities. Improved sanitation facilities are more likely to prevent human contact with human excreta than unimproved facilities.

International poverty line: based on nationally representative primary household surveys conducted by national statistical offices or by private agencies under the supervision of government or international agencies and obtained from government statistical offices and World Bank country departments. **(Population below US$1.25 a day** and **Population below US$2 a day)**: percentages of the population living on less than $1.25 a day and $2 a day at 2005 international prices. As a result of revisions in PPP exchange rates, poverty rates for individual countries cannot be compared with poverty rates reported in earlier editions

Level of urbanization: percentage of the population residing in places classified as urban. Urban and rural settlements are defined in the national context and vary among countries (the definitions of urban are generally national definitions incorporated within the latest census).

National population below national poverty line: percentage of the country's population living below the national poverty line. National estimates are based on population weighted subgroup estimates from household surveys.

Persons in housing units: number of persons resident in housing units.

Population, rural: mid-year estimates and projections (medium variant) of the population residing in human settlements classified as rural (see also '**Population, urban**' below).

Population, total: mid-year population estimates and projections for the world, region, countries or areas. The Population Division of the United Nations Department of Economic and Social Affairs updates, every two years, population estimates and projections by incorporating new data, new estimates and new analyses of data on population, fertility, mortality and international migration. Data from new population censuses and/or demographic surveys are used to verify and update old estimates of population or demographic indicators, or to make new ones and to check the validity of the assumptions made in the projections. Population rate of change (calculated by UN-Habitat) refers to the average annual percentage change of population during the indicated period for each country, major regions and global totals. The formula used throughout the annex is as follows: $r = [(1/t) \times \ln(A2/A1)] \times 100$, where 'A1' is a value at any given year; 'A2' is a value at any given year later than the year of 'Al'; 't' is the year interval between 'Al' and 'A2'; and 'ln' is the natural logarithm function. **Population, urban**: mid-year population of areas defined as urban in each country and reported to the United Nations. Estimates of the world's urban population would change significantly if China, India, and a few other populous nations were to change their definition of urban centres. According to China's State Statistical Bureau, by the end of 1996 urban residents accounted for about 43 percent of China's population, while in 1994 only 20 percent of the population was considered urban. In addition to the continuous migration of people from rural to urban areas, one of the main reasons for this shift was the rapid growth in the hundreds of towns reclassified as cities in recent years. Because the estimates in the table are based on national definitions of what constitutes a city or metropolitan area, cross-country comparisons should be made with caution.

Population density: mid-year population divided by land area in square kilometres.

Pump price for fuels: refer to the pump prices of the most widely sold grade of petrol and of diesel fuel. Prices have been converted from the local currency to US dollars.

Railways: length of railway route available for train service, irrespective of the number of parallel tracks. Passengers carried by railway are the number of passengers (in millions) transported by rail multiplied by kilometres travelled (m-p-km). Goods hauled by railway are the volume of goods transported by railway, measured in metric tons multiplied by kilometres travelled (m-t-km).

Road motor vehicles: include cars, buses and freight vehicles but not two-wheelers.

Road traffic deaths: any person killed immediately or dying within 30 days as a result of a road traffic accident.

Passenger cars: refer to road motor vehicles, other than two-wheelers, intended for the carriage of passengers and designed to seat no more than nine people (including the driver). **Other motor vehicles**: road motor vehicles exclusive of passenger cars.

Roads: motorways, highways, main or national roads, and secondary or regional roads. A motorway is a road specially designed and built for motor vehicles that separates the traffic flowing in opposite directions. **Total road network**: includes motorways, highways and main or national roads, secondary or regional roads, and all other roads in a country. **Paved roads**: roads surfaced with crushed stone (macadam) and hydrocarbon binder or bitumized agents, with concrete or with cobblestones, as a percentage of all of the country's roads measured in length. Passengers carried by roads are the number of people (in millions) transported by road multiplied by kilometres travelled (m-p-km). Goods hauled by road are the volume of goods transported by road vehicles, measured in millions of metric tons multiplied by kilometres travelled (m-t-km).

Survey year: the year in which the underlying data were collected.

Urban poverty rate: percentage of the urban population living below the national urban poverty line.

Urban slum dwellers: individuals residing in housing with one or more of the following conditions: inadequate drinking water; inadequate sanitation; poor structural quality/durability of housing; overcrowding; and insecurity of tenure.

Urban agglomerations and capital cities: the term 'urban agglomeration' refers to the population contained within the contours of a contiguous territory inhabited at urban density levels without regard to administrative boundaries. It usually incorporates the population in a city or town plus that in the suburban areas lying outside of but being adjacent to the city boundaries. Whenever possible, data classified according to the concept of urban agglomeration are used. However, some countries do not produce data according to the concept of urban agglomeration but use instead that of metropolitan area or city proper. If possible, such data are adjusted to conform to the concept of urban agglomeration. When sufficient information is not available to permit such an adjustment, data based on the concept of city proper or metropolitan area are used. The sources listed online indicate whether data were adjusted to conform to the urban agglomeration concept or whether a different concept was used. Table C.1 contains revised estimates and projections for all urban agglomerations comprising 750,000 or more inhabitants.

SOURCES OF DATA

The Statistical Tables have been compiled from the following UN-Habitat databases:

United Nations Human Settlements Programme (UN-Habitat), Global Urban Indicators Database 2012

United Nations Human Settlements Programme (UN-Habitat), Urban Info 2010

In addition, various statistical publications from the United Nations and other international organizations have been used. These include:

United Nations, Department of Economic and Social Affairs, Population Division (2010), *World Population Prospects: The 2009 Revision*, United Nations, New York

United Nations, Department of Economic and Social Affairs, Population Division (2012) *World Urbanization Prospects: The 2011 Revision*, United Nations, New York

World Bank (2001) *World Development Indicators 2001*, World Bank, Washington, DC

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World Bank (2006) *World Development Report 2006*, World Bank, Washington, DC

World Bank (2012) *World Development Indicators 2012*, World Bank, Washington, DC

World Bank (2012) *World Development Indicators Online database*, http://data.worldbank.org/indicator

World Health Organization (WHO) (2004) *World Report on Road Traffic Injury Prevention 2004*, WHO, Geneva

World Health Organization (WHO) (2013) *Global Status Report on Road Safety 2013*, WHO, Geneva

World Health Organization (WHO) and United Nations Children's Fund (UNICEF) Joint Monitoring Programme for Water Supply and Sanitation (JMP) (2012) *Progress on Sanitation and Drinking-Water 2012 Update*, WHO and UNICEF, Geneva and New York, www. unicef.org/media/files/JMPreport2012.pdf

NOTES

1 United Nations Inter-Agency and Expert Group on the Millennium Development Goals Indicators (official email communication, 28 March 2012).

2 Bottled water is considered improved only when the household uses water from an improved source for cooking and personal hygiene.

DATA TABLES

REGIONAL AGGREGATES
TABLE A.1

Total Population Size, Rate of Change and Population Density

	Estimates and projections ('000)				Rate of change (%)			Population density (people/km²)	
	2000	2010	2020	2030	2000–2010	2010–2020	2020–2030	2000	2030
WORLD	6,100,834	6,872,673	7,633,251	8,298,474	1.19	1.05	0.84	45	61
World Major Aggregates									
Developed Countries	1,195,767	1,244,422	1,283,324	1,307,207	0.40	0.31	0.18	23	25
Developing Countries	4,905,067	5,628,251	6,349,927	6,991,267	1.38	1.21	0.96	59	84
Least Developed Countries	655,365	822,381	1,022,347	1,240,660	2.27	2.18	1.94	32	61
Other Developing Countries	4,249,702	4,805,870	5,327,580	5,750,607	1.23	1.03	0.76	68	93
Other Developing Countries, excluding China	2,980,585	3,464,534	3,939,789	4,357,531	1.50	1.29	1.01	57	83
Sub-Saharan Africa	669,123	856,327	1,088,812	1,353,772	2.47	2.40	2.18	28	56
Geographic Aggregates									
Africa	811,101	1,022,234	1,278,199	1,562,047	2.31	2.23	2.01	27	52
Eastern Africa	258,215	333,993	431,733	542,799	2.57	2.57	2.29	37	78
Middle Africa	96,187	126,689	161,689	200,021	2.75	2.44	2.13	15	30
Northern Africa	169,535	199,511	231,210	259,029	1.63	1.47	1.14	21	33
Southern Africa	51,442	57,780	61,187	64,126	1.16	0.57	0.47	19	24
Western Africa	235,722	304,261	392,379	496,071	2.55	2.54	2.34	38	81
Asia	3,697,108	4,141,036	4,542,243	4,844,835	1.13	0.92	0.64	116	152
Eastern Asia	1,473,345	1,550,754	1,599,404	1,602,558	0.51	0.31	0.02	125	136
South-Central Asia	1,515,563	1,764,872	2,009,512	2,215,897	1.52	1.30	0.98	140	205
South-Eastern Asia	523,831	593,415	655,940	705,987	1.25	1.00	0.74	117	157
Western Asia	184,369	231,995	277,387	320,394	2.30	1.79	1.44	38	66
Europe	726,777	738,199	744,177	741,233	0.16	0.08	–0.04	32	32
Eastern Europe	304,172	294,771	289,165	279,544	–0.31	–0.19	–0.34	16	15
Northern Europe	94,347	99,205	104,524	109,254	0.50	0.52	0.44	52	60
Southern Europe	145,147	155,171	158,478	158,548	0.67	0.21	0.00	110	120
Western Europe	183,111	189,052	192,010	193,888	0.32	0.16	0.10	165	175
Latin America and the Caribbean	521,429	590,082	652,182	701,606	1.24	1.00	0.73	25	34
Caribbean	38,441	41,646	44,322	46,363	0.80	0.62	0.45	164	198
Central America	135,555	155,881	176,389	193,747	1.40	1.24	0.94	55	78
South America	347,433	392,555	431,471	461,496	1.22	0.95	0.67	19	26
Northern America	313,289	344,529	374,394	401,657	0.95	0.83	0.70	14	18
Oceania	31,130	36,593	42,056	47,096	1.62	1.39	1.13	4	5
Australia/New Zealand	23,022	26,637	30,065	32,982	1.46	1.21	0.93	3	4
Melanesia	6,996	8,748	10,660	12,670	2.23	1.98	1.73	13	23
Micronesia	496	536	602	661	0.78	1.16	0.93	160	213
Polynesia	615	673	728	783	0.90	0.79	0.72	73	93

Note: Lists of countries/areas in aggregates are presented in the Technical Notes.

Sources: United Nations Department of Economic and Social Affairs, Population Division (2012) World Urbanization Prospects: The 2011 Revision, United Nations, New York, United Nations Department of Economic and Social Affairs, Population Division (2011) World Population Prospects: The 2010 Revision, United Nations, New York. Figures in regional, income or development aggregates are calculated on the basis of country/area level data from Table B.1.

TABLE A.2

Urban and Rural Population Size and Rate of Change

	Urban population							Rural population						
	Estimates and projections ('000)				Rate of change (%)			Estimates and projections ('000)				Rate of change (%)		
	2000	2010	2020	2030	2000–2010	2010–2020	2020–2030	2000	2010	2020	2030	2000–2010	2010–2020	2020–2030
WORLD	2,843,288	3,541,671	4,272,170	4,965,868	2.20	1.88	1.50	3,257,546	3,331,002	3,361,081	3,332,606	0.22	0.09	–0.09
World Major Aggregates														
Developed Countries	887,477	964,839	1,027,257	1,074,398	0.84	0.63	0.45	308,290	279,583	256,066	232,809	–0.98	–0.88	–0.95
Developing Countries	1,955,811	2,576,832	3,244,913	3,891,471	2.76	2.31	1.82	2,949,256	3,051,419	3,105,015	3,099,797	0.34	0.17	–0.02
Least Developed Countries	159,504	232,025	335,523	473,101	3.75	3.69	3.44	495,861	590,356	686,824	767,560	1.74	1.51	1.11
Other Developing Countries	1,796,307	2,344,807	2,909,390	3,418,370	2.66	2.16	1.61	2,453,395	2,461,062	2,418,190	2,332,237	0.03	–0.18	–0.36
Other Developing Countries, excluding China	1,340,982	1,684,521	2,063,027	2,460,721	2.28	2.03	1.76	1,639,603	1,780,013	1,876,762	1,896,810	0.82	0.53	0.11
Sub-Saharan Africa	215,277	309,519	441,203	615,463	3.63	3.54	3.33	453,846	546,808	647,610	738,309	1.86	1.69	1.31
Geographic Aggregates														
Africa	288,402	400,651	551,552	744,485	3.29	3.20	3.00	522,699	621,583	726,647	817,562	1.73	1.56	1.18
Eastern Africa	53,124	77,954	117,761	175,620	3.83	4.13	4.00	205,092	256,039	313,972	367,179	2.22	2.04	1.57
Middle Africa	34,775	51,861	74,510	102,336	4.00	3.62	3.17	61,412	74,828	87,179	97,686	1.98	1.53	1.14
Northern Africa	82,079	102,249	125,030	148,941	2.20	2.01	1.75	87,455	97,262	106,180	110,088	1.06	0.88	0.36
Southern Africa	27,647	33,778	38,372	42,770	2.00	1.28	1.09	23,795	24,003	22,816	21,356	0.09	–0.51	–0.66
Western Africa	90,777	134,810	195,879	274,819	3.95	3.74	3.39	144,946	169,452	196,500	221,253	1.56	1.48	1.19
Asia	1,376,888	1,830,826	2,287,067	2,684,485	2.85	2.23	1.60	2,320,221	2,310,210	2,255,176	2,160,350	–0.04	–0.24	–0.43
Eastern Asia	613,013	838,931	1,034,323	1,146,920	3.14	2.09	1.03	860,333	711,823	565,081	455,638	–1.89	–2.31	–2.15
South-Central Asia	446,100	574,038	727,577	907,839	2.52	2.37	2.21	1,069,462	1,190,834	1,281,936	1,308,058	1.07	0.74	0.20
South-Eastern Asia	200,179	261,532	328,024	393,340	2.67	2.27	1.82	323,652	331,883	327,916	312,647	0.25	–0.12	–0.48
Western Asia	117,595	156,325	197,144	236,386	2.85	2.32	1.82	66,773	75,670	80,243	84,007	1.25	0.59	0.46
Europe	514,545	536,611	557,585	573,494	0.42	0.38	0.28	212,232	201,588	186,592	167,739	–0.51	–0.77	–1.07
Eastern Europe	207,473	203,040	204,182	203,745	–0.22	0.06	–0.02	96,700	91,731	84,983	75,799	–0.53	–0.76	–1.14
Northern Europe	73,492	78,323	84,122	89,927	0.64	0.71	0.67	20,855	20,882	20,402	19,326	0.01	–0.23	–0.54
Southern Europe	95,014	105,019	111,486	116,472	1.00	0.60	0.44	50,133	50,152	46,992	42,076	0.00	–0.65	–1.11
Western Europe	138,567	150,229	157,795	163,350	0.81	0.49	0.35	44,544	38,823	34,215	30,538	–1.37	–1.26	–1.14
Latin America and the Caribbean	393,619	465,246	531,235	585,347	1.67	1.33	0.97	127,810	124,836	120,947	116,260	–0.24	–0.32	–0.40
Caribbean	23,575	27,725	31,361	34,312	1.62	1.23	0.90	14,866	13,921	12,961	12,050	–0.66	–0.71	–0.73
Central America	93,245	112,339	132,090	149,832	1.86	1.62	1.26	42,310	43,542	44,299	43,915	0.29	0.17	–0.09
South America	276,800	325,183	367,785	401,202	1.61	1.23	0.87	70,633	67,372	63,686	60,294	–0.47	–0.56	–0.55
Northern America	247,911	282,480	314,905	344,444	1.31	1.09	0.90	65,378	62,049	59,488	57,213	–0.52	–0.42	–0.39
Oceania	21,924	25,857	29,825	33,614	1.65	1.43	1.20	9,206	10,736	12,230	13,482	1.54	1.30	0.97
Australia/New Zealand	20,010	23,594	26,998	29,929	1.65	1.35	1.03	3,012	3,042	3,067	3,053	0.10	0.08	–0.04
Melanesia	1,335	1,621	2,098	2,861	1.94	2.58	3.10	5,662	7,127	8,562	9,810	2.30	1.83	1.36
Micronesia	325	358	412	464	0.96	1.42	1.18	171	178	190	197	0.43	0.63	0.37
Polynesia	254	284	317	360	1.14	1.09	1.28	361	388	411	422	0.72	0.57	0.27

Note: Lists of countries/areas in aggregates are presented in the Technical Notes.

Sources: United Nations Department of Economic and Social Affairs, Population Division (2012) World Urbanization Prospects: The 2011 Revision, United Nations, New York. Figures in regional, income or development aggregates are calculated on the basis of country/area level data from Table B.2.

TABLE A.3

Urbanization and Urban Slum Dwellers

	Level of urbanization							Urban slum dwellers[2]				
	Estimates and projections (%)				Rate of change (%)			Estimates (%)				
	2000	2010	2020	2030	2000–2010	2010–2020	2020–2030	2000	2005	2007	2010	2012
WORLD	46.6	51.5	56.0	59.8	1.01	0.83	0.67	...	...	...	...	...
World Major Aggregates												
Developed Countries	74.2	77.5	80.0	82.2	0.44	0.32	0.26	...	...	...	...	...
Developing Countries	39.9	45.8	51.1	55.7	1.38	1.10	0.85	39.4	35.6	34.3	32.6	32.7
Least Developed Countries	24.3	28.2	32.8	38.1	1.43	1.51	1.50	...	...	...	...	...
Other Developing Countries	42.3	48.8	54.6	59.4	1.43	1.13	0.85	...	...	...	...	...
Other Developing Countries, excluding China	45.0	48.6	52.4	56.5	0.78	0.74	0.76	...	...	...	...	...
Sub-Saharan Africa	32.2	36.1	40.5	45.5	1.16	1.14	1.15	65.0	63.0	62.4	61.7	61.7
Geographic Aggregates												
Africa	35.6	39.2	43.2	47.7	0.97	0.96	0.99	...	...	...	...	...
Eastern Africa	20.6	23.3	27.3	32.4	1.26	1.56	1.71	...	...	...	...	...
Middle Africa	36.2	40.9	46.1	51.2	1.24	1.18	1.05	...	...	...	...	...
Northern Africa	48.4	51.2	54.1	57.5	0.57	0.54	0.61	20.3	13.4	13.4	13.3	13.3
Southern Africa	53.7	58.5	62.7	66.7	0.84	0.70	0.62	...	...	...	...	...
Western Africa	38.5	44.3	49.9	55.4	1.40	1.19	1.04	...	...	...	...	...
Asia	37.2	44.2	50.4	55.4	1.72	1.30	0.96	...	...	...	...	...
Eastern Asia	41.6	54.1	64.7	71.6	2.63	1.78	1.01	37.4	33.0	31.1	28.2	28.2
South-Central Asia	29.4	32.5	36.2	41.0	1.00	1.07	1.24	...	...	...	...	...
South-Eastern Asia	38.2	44.1	50.0	55.7	1.43	1.26	1.08	39.6	34.2	31.9	31.0	31.0
Western Asia	63.8	67.4	71.1	73.8	0.55	0.53	0.37	20.6	25.8	25.2	24.6	24.6
Europe	70.8	72.7	74.9	77.4	0.26	0.30	0.32	...	...	...	...	...
Eastern Europe	68.2	68.9	70.6	72.9	0.10	0.25	0.32	...	...	...	...	...
Northern Europe	77.9	79.0	80.5	82.3	0.13	0.19	0.22	...	...	...	...	...
Southern Europe	65.5	67.7	70.3	73.5	0.33	0.39	0.43	...	...	...	...	...
Western Europe	75.7	79.5	82.2	84.2	0.49	0.34	0.25	...	...	...	...	...
Latin America and the Caribbean	75.5	78.8	81.5	83.4	0.43	0.33	0.24	29.2	25.5	24.7	23.5	23.5
Caribbean	61.3	66.6	70.8	74.0	0.82	0.61	0.45	...	...	...	...	...
Central America	68.8	72.1	74.9	77.3	0.47	0.38	0.32	...	...	...	...	...
South America	79.7	82.8	85.2	86.9	0.39	0.29	0.20	...	...	...	...	...
Northern America	79.1	82.0	84.1	85.8	0.35	0.26	0.19	...	...	...	...	...
Oceania	70.4	70.7	70.9	71.4	0.03	0.04	0.06	24.1[3]	24.1[3]	24.1[3]	24.1[3]	24.1[3]
Australia/New Zealand	86.9	88.6	89.8	90.7	0.19	0.14	0.10	...	...	...	...	...
Melanesia	19.1	18.5	19.7	22.6	–0.29	0.60	1.37	...	...	...	...	...
Micronesia	65.6	66.7	68.5	70.2	0.18	0.26	0.25	...	...	...	...	...
Polynesia	41.2	42.3	43.5	46.0	0.25	0.30	0.56	...	...	...	...	...

Notes:

(1) Lists of countries/areas in aggregates are presented in the Technical Notes.

(2) Developing regions.

(3) Trends data are not available for Oceania. A constant figure does not mean there is no change. Data are for Melanesia, Micronesia and Polynesia only (i.e. it excludes Australia and New Zealand).

Sources: United Nations Department of Economic and Social Affairs, Population Division (2012) World Urbanization Prospects: The 2011 Revision, United Nations, New York. Figures in regional, income or development aggregates are calculated on the basis of country/area level data from Table B.3 United Nations Human Settlements Programme (UN-Habitat), Global Urban Indicators Database 2012.

TABLE A.4

Number of Urban Households, Rate of Change and Mean Household Size

	Number of households								Mean household size Estimates and projections			
	Estimates and projections ('000)				Rate of change (%)	Ten year increment ('000)						
	2000	2010	2020	2030	2000–2010	2000–2010	2010–2020	2020–2030	2000	2010	2020	2030
WORLD	822,938	1,102,486	1,511,258	1,788,493	2.92	279,547	408,772	277,235	3.46	3.21	2.83	2.78
World Major Aggregates												
Developed Countries	343,813	395,493	459,211	496,155	1.40	51,680	63,718	36,944	2.58	2.44	2.24	2.17
Developing Countries	476,653	754,830	1,049,577	1,289,579	3.91	228,177	344,747	240,001	4.10	3.66	3.09	3.02
Least Developed Countries	28,259	46,303	70,762	114,814	4.94	18,044	24,460	44,052	5.64	5.01	4.74	4.12
Other Developing Countries	442,670	657,629	963,328	1,154,665	3.96	214,959	305,699	191,337	4.06	3.57	3.02	2.96
Other Developing Countries, excluding China	299,167	428,275	595,807	562,346	3.59	129,108	167,531	−33,460	4.48	3.93	3.46	4.38
Sub-Saharan Africa	46,280	74,563	114,138	147,345	4.77	28,283	39,575	33,207	4.65	4.15	3.87	4.18
Geographic Aggregates												
Africa	61,650	95,503	142,836	179,920	4.38	33,854	47,333	37,084	4.68	4.20	3.86	4.14
Eastern Africa	12,318	18,646	30,068	41,342	4.15	6,328	11,422	11,274	4.31	4.18	3.92	4.25
Middle Africa	5,930	10,019	17,221	22,885	5.24	4,089	7,202	5,664	5.86	5.18	4.33	4.47
Northern Africa	16,750	22,824	31,192	35,941	3.09	6,075	8,368	4,748	4.90	4.48	4.01	4.14
Southern Africa	7,661	13,899	16,007	17,867	5.96	6,238	2,108	1,860	3.61	2.43	2.40	2.39
Western Africa	18,991	30,115	48,348	61,886	4.61	11,124	18,233	13,538	4.78	4.48	4.05	4.44
Asia	354,832	525,259	786,095	964,985	3.92	170,427	260,836	178,890	3.88	3.49	2.91	2.78
Eastern Asia	196,978	297,593	454,529	563,768	4.13	100,615	156,937	109,238	3.11	2.82	2.28	2.03
South-Central Asia	88,888	127,962	188,080	228,738	3.64	39,074	60,118	40,658	5.02	4.49	3.87	3.97
South-Eastern Asia	44,499	64,491	93,735	113,231	3.71	19,991	29,244	19,496	4.50	4.06	3.50	3.47
Western Asia	24,468	35,214	49,752	59,249	3.64	10,747	14,537	9,497	4.81	4.44	3.96	3.99
Europe	202,164	225,267	253,878	270,617	1.08	23,102	28,611	16,739	2.55	2.38	2.20	2.12
Eastern Europe	75,198	79,420	84,794	88,159	0.55	4,222	5,374	3,365	2.76	2.56	2.41	2.31
Northern Europe	31,474	34,121	37,122	38,773	0.81	2,647	3,001	1,650	2.33	2.30	2.27	2.32
Southern Europe	33,960	40,858	49,651	54,723	1.85	6,899	8,793	5,072	2.80	2.57	2.25	2.13
Western Europe	61,533	70,867	82,310	88,962	1.41	9,335	11,443	6,652	2.25	2.12	1.92	1.84
Latin America and the Caribbean	97,774	132,179	179,752	210,416	3.01	34,404	47,573	30,664	4.03	3.52	2.96	2.78
Caribbean	6,478	8,255	10,981	12,800	2.42	1,777	2,725	1,819	3.64	3.36	2.86	2.68
Central America	21,470	29,477	40,655	48,235	3.17	8,007	11,178	7,580	4.34	3.81	3.25	3.11
South America	69,827	94,447	128,117	149,381	3.02	24,620	33,670	21,265	3.96	3.44	2.87	2.69
Northern America	95,337	111,362	130,080	140,589	1.55	16,024	18,719	10,508	2.60	2.54	2.42	2.45
Oceania	7,986	9,510	11,388	12,519	1.75	1,524	1,878	1,131	2.75	2.72	2.62	2.68
Australia/New Zealand	7,650	9,126	10,888	11,893	1.76	1,476	1,762	1,005	2.62	2.59	2.48	2.52
Melanesia	216	270	357	464	2.23	54	87	108	6.19	6.01	5.88	6.16
Micronesia	72	56	68	73	−2.48	−16	12	5	4.55	6.41	6.05	6.33
Polynesia	48	59	75	89	1.93	10	17	13	5.25	4.85	4.21	4.06

Note: Lists of countries/areas in aggregates are presented in the Technical Notes.

Source: United Nations Human Settlements Programme (UN-Habitat), Global Urban Indicators Database 2012.

TABLE A.5

Urban Agglomerations

	Number of urban agglomerations Estimates and projections ('000)			Distribution of urban population by size of agglomerations (%)			Population Estimates and projections ('000)		
	2000	2010	2020	2000	2010	2020	2000	2010	2020
WORLD									
10 million or more	17	23	35	8	10	13	242,814	352,465	560,211
5 to 10 million	27	38	48	7	7	8	187,768	266,078	323,877
1 to 5 million	311	388	506	21	21	23	597,943	759,919	999,814
500,000 to 1 million	396	513	647	9	10	11	269,117	353,802	450,436
Fewer Than 500,000	...	...	...	55	51	46	1,560,991	1,826,313	1,955,479
World Major Aggregates									
Developed Countries									
10 million or more	5	6	7	10	11	12	85,279	103,678	123,096
5 to 10 million	5	8	14	4	6	9	36,472	52,800	86,820
1 to 5 million	98	104	109	22	22	20	195,572	207,153	208,075
500,000 to 1 million	117	127	148	9	9	10	78,807	85,356	100,046
Fewer Than 500,000	...	...	...	55	53	49	485,215	508,264	500,327
Developing Countries									
10 million or more	12	17	28	8	10	13	157,535	248,787	437,115
5 to 10 million	22	30	34	8	8	7	151,296	213,279	237,057
1 to 5 million	213	284	397	20	21	24	402,372	552,767	791,740
500,000 to 1 million	279	386	499	10	10	11	190,310	268,445	350,390
Fewer Than 500,000	...	...	...	54	51	44	1,075,776	1,318,049	1,455,151
Least Developed Countries									
10 million or more	1	1	2	6	6	10	10,285	14,930	32,387
5 to 10 million	1	2	5	3	6	9	5,414	13,484	31,846
1 to 5 million	19	27	39	22	24	24	35,031	56,701	79,521
500,000 to 1 million	18	25	37	8	8	7	12,645	17,941	24,745
Fewer Than 500,000	...	...	...	61	56	50	97,224	130,746	169,664
Other Developing Countries									
10 million or more	11	16	26	8	10	14	147,250	233,857	404,729
5 to 10 million	21	28	29	8	8	7	145,882	199,794	205,210
1 to 5 million	194	257	358	20	21	24	367,340	496,066	712,219
500,000 to 1 million	261	361	462	10	11	11	177,665	250,504	325,644
Fewer Than 500,000	...	...	...	54	50	44	978,553	1,187,304	1,285,488
Other Developing Countries, excluding China									
10 million or more	10	13	21	9	10	14	133,414	193,525	326,790
5 to 10 million	16	19	22	7	7	6	109,889	137,470	150,493
1 to 5 million	156	204	276	19	21	23	290,616	400,581	555,300
500,000 to 1 million	189	244	300	9	9	9	130,398	171,781	210,685
Fewer Than 500,000	...	...	...	56	53	48	835,106	1,013,181	1,155,716
Sub-Saharan Africa									
10 million or more	—	1	2	—	4	7	—	10,788	28,148
5 to 10 million	2	1	3	6	3	4	12,695	8,415	19,128
1 to 5 million	28	40	62	24	29	32	48,911	85,592	135,105
500,000 to 1 million	31	44	52	11	10	8	21,670	30,783	36,098
Fewer Than 500,000	...	...	...	60	55	49	123,046	162,823	208,042
Geographic Aggregates									
Africa									
10 million or more	1	2	3	4	5	8	10,170	21,820	41,402
5 to 10 million	2	1	5	4	2	6	12,695	8,415	30,673
1 to 5 million	34	47	68	22	26	27	63,751	104,350	148,291
500,000 to 1 million	39	55	71	9	10	9	26,967	38,317	49,440
Fewer Than 500,000	...	...	...	61	57	51	174,820	227,750	281,747
Eastern Africa									
10 million or more	...	...	...	...	...	...	...	...	...
5 to 10 million	—	—	1	—	—	5	—	—	5,677
1 to 5 million	9	9	15	26	24	27	13,837	18,866	31,981
500,000 to 1 million	3	11	12	4	10	7	1,877	7,703	8,367
Fewer Than 500,000	...	...	...	70	66	61	37,410	51,385	71,736
Middle Africa									
10 million or more	—	—	1	—	—	17	—	—	12,322
5 to 10 million	1	1	1	16	16	10	5,414	8,415	7,555
1 to 5 million	4	8	10	19	31	27	6,454	16,010	20,070
500,000 to 1 million	8	6	9	15	8	8	5,299	4,389	6,266
Fewer Than 500,000	...	...	...	51	44	38	17,608	23,046	28,296
Northern Africa									
10 million or more	1	1	1	12	11	11	10,170	11,031	13,254
5 to 10 million	—	—	2	—	—	9	—	—	11,545
1 to 5 million	6	7	6	18	18	11	14,840	18,758	13,185
500,000 to 1 million	8	11	19	6	7	11	5,296	7,534	13,341
Fewer Than 500,000	...	...	...	63	63	59	51,773	64,926	73,705

continued . . .

TABLE A.5

continued

	Number of urban agglomerations Estimates and projections ('000)			Distribution of urban population by size of agglomerations (%)			Population Estimates and projections ('000)		
	2000	2010	2020	2000	2010	2020	2000	2010	2020
Southern Africa									
10 million or more	...	...	...	...	...	...	...	...	...
5 to 10 million	...	...	...	...	...	...	...	...	...
1 to 5 million	5	7	7	41	51	53	11,227	17,231	20,327
500,000 to 1 million	2	1	5	7	2	8	1,855	632	2,970
Fewer Than 500,000	...	...	...	53	47	39	14,565	15,914	15,075
Western Africa									
10 million or more	—	1	1	—	8	8	—	10,788	15,825
5 to 10 million	1	—	1	8	—	3	7,281	—	5,896
1 to 5 million	10	16	30	19	25	32	17,393	33,484	62,727
500,000 to 1 million	18	26	26	14	13	9	12,640	18,059	18,495
Fewer Than 500,000	...	...	...	59	54	47	53,464	72,478	92,935
Asia									
10 million or more	9	13	21	10	11	15	135,210	210,301	351,773
5 to 10 million	17	25	25	9	10	8	119,676	176,045	183,013
1 to 5 million	142	188	269	19	19	23	269,214	353,443	522,319
500,000 to 1 million	189	274	370	9	10	11	127,618	189,845	257,622
Fewer Than 500,000	...	...	...	53	50	43	740,513	918,098	989,990
Eastern Asia									
10 million or more	4	6	9	11	12	15	69,736	103,624	161,037
5 to 10 million	7	12	13	8	10	9	51,324	85,559	96,413
1 to 5 million	70	95	139	22	22	26	141,247	185,009	275,030
500,000 to 1 million	106	156	215	11	12	14	70,253	106,508	150,333
Fewer Than 500 000	...	...	...	47	44	35	295,777	375,136	369,159
South-Central Asia									
10 million or more	5	5	8	15	15	19	65,473	84,070	140,613
5 to 10 million	5	7	6	7	9	6	29,700	50,249	46,505
1 to 5 million	41	53	70	15	16	18	68,057	93,857	132,010
500 000 to 1 million	49	65	93	8	8	9	34,879	45,786	63,869
Fewer Than 500 000	...	...	...	56	52	47	247,991	300,077	344,581
South-Eastern Asia									
10 million or more	—	1	3	—	4	11	—	11,654	36,331
5 to 10 million	3	4	3	12	11	6	24,709	29,119	19,755
1 to 5 million	13	16	28	14	11	15	27,706	28,634	48,392
500 000 to 1 million	15	24	25	5	7	5	9,711	17,822	17,090
Fewer Than 500 000	...	...	...	69	67	63	138,054	174,303	206,455
Western Asia									
10 million or more	—	1	1	—	7	7	—	10,953	13,791
5 to 10 million	2	2	3	12	7	10	13,944	11,118	20,340
1 to 5 million	18	24	32	27	29	34	32,205	45,943	66,888
500 000 to 1 million	19	29	37	11	13	13	12,775	19,730	26,330
Fewer Than 500 000	...	...	...	50	44	35	58,690	68,582	69,796
Europe									
10 million or more	1	2	2	2	4	4	10,005	21,988	24,159
5 to 10 million	3	3	4	4	4	5	22,978	20,816	28,843
1 to 5 million	49	49	54	16	15	16	83,230	81,960	88,881
500 000 to 1 million	75	83	90	10	10	11	49,707	54,649	59,093
Fewer Than 500 000	...	...	...	68	67	64	348,626	357,199	356,608
Eastern Europe									
10 million or more	1	1	1	5	6	6	10,005	11,472	12,478
5 to 10 million	—	—	1	—	—	2	—	—	5,065
1 to 5 million	23	21	21	16	16	15	34,034	32,615	29,980
500 000 to 1 million	29	35	35	9	11	11	18,556	22,811	23,143
Fewer Than 500 000	...	...	...	70	67	65	144,878	136,143	133,516
Northern Europe									
10 million or more	—	—	—	—	—	—	—	—	—
5 to 10 million	1	1	1	11	11	12	8,225	8,923	9,796
1 to 5 million	7	8	9	14	15	17	10,501	12,011	14,461
500 000 to 1 million	9	10	13	9	9	10	6,618	6,885	8,795
Fewer Than 500 000	...	...	...	66	64	61	48,149	50,504	51,071
Southern Europe									
10 million or more	...	...	...	...	...	...	...	...	...
5 to 10 million	1	2	2	5	11	13	5,014	11,893	13,982
1 to 5 million	9	8	9	24	18	19	23,254	18,885	21,184
500 000 to 1 million	18	18	21	12	12	13	11,826	12,158	14,290
Fewer Than 500 000	...	...	...	58	59	56	54,919	62,083	62,030

continued . . .

TABLE A.5

continued

	Number of urban agglomerations Estimates and projections ('000)			Distribution of urban population by size of agglomerations (%)			Population Estimates and projections ('000)		
	2000	2010	2020	2000	2010	2020	2000	2010	2020
Western Europe									
10 million or more	—	1	1	—	7	7	—	10,516	11,681
5 to 10 million	1	—	—	7	—	—	9,739	—	—
1 to 5 million	10	12	15	11	12	15	15,441	18,448	23,256
500 000 to 1 million	19	20	21	9	9	8	12,707	12,794	12,866
Fewer Than 500 000	...	...	...	73	72	70	100,680	108,470	109,992
Latin America and the Caribbean									
10 million or more	4	4	6	15	14	18	57,771	65,029	94,653
5 to 10 million	3	4	4	5	6	4	18,925	28,818	23,371
1 to 5 million	43	55	66	21	24	26	83,787	110,142	137,484
500,000 to 1 million	54	60	64	10	9	9	37,445	42,039	46,873
Fewer Than 500,000	...	...	...	50	47	43	195,693	219,219	228,855
Caribbean									
10 million or more	...	...	...	...	...	...	...	...	...
5 to 10 million	...	...	...	...	...	...	...	...	...
1 to 5 million	4	4	4	35	32	32	8,201	8,903	10,022
500,000 to 1 million	1	2	2	2	4	4	580	1,143	1,312
Fewer Than 500,000	...	...	...	63	64	64	14,794	17,679	20,028
Central America									
10 million or more	1	1	1	19	18	18	18,022	20,142	23,239
5 to 10 million	—	—	2	—	—	8	—	—	10,405
1 to 5 million	11	16	22	20	25	25	18,461	28,228	33,682
500,000 to 1 million	22	28	26	16	18	15	15,335	19,721	19,417
Fewer Than 500,000	...	...	...	44	39	34	41,427	44,247	45,346
South America									
10 million or more	3	3	5	14	14	19	39,749	44,887	71,414
5 to 10 million	3	4	2	7	9	4	18,925	28,818	12,966
1 to 5 million	28	35	40	21	22	25	57,124	73,010	93,781
500,000 to 1 million	31	30	36	8	7	7	21,530	21,175	26,144
Fewer Than 500,000	...	...	...	50	48	44	139,472	157,293	163,481
Northern America									
10 million or more	2	2	3	12	12	15	29,659	33,327	48,226
5 to 10 million	2	5	9	5	11	17	13,494	31,984	52,723
1 to 5 million	37	43	44	34	34	29	85,310	95,452	90,683
500,000 to 1 million	39	39	50	11	10	11	27,380	27,857	36,053
Fewer Than 500,000	...	...	...	37	33	28	92,068	93,860	87,221
Oceania									
10 million or more	...	...	...	...	...	...	...	...	...
5 to 10 million	—	—	1	—	—	18	—	—	5,254
1 to 5 million	6	6	5	58	56	41	12,652	14,573	12,156
500,000 to 1 million	—	2	2	—	4	5	—	1,095	1,356
Fewer Than 500,000	...	...	...	42	39	37	9,272	10,189	11,059
Australia/New Zealand									
10 million or more	...	...	...	...	...	...	...	...	...
5 to 10 million	—	—	1	—	—	19	—	—	5,254
1 to 5 million	6	6	5	63	62	45	12,652	14,573	12,156
500,000 to 1 million	—	2	2	—	5	5	—	1,095	1,356
Fewer Than 500,000	...	...	...	37	34	30	7,358	7,926	8,232
Melanesia									
10 million or more	...	...	...	...	...	...	...	...	...
5 to 10 million	...	...	...	...	...	...	...	...	...
1 to 5 million	...	...	...	...	...	...	...	...	...
500,000 to 1 million	—	—	—	—	—	—	—	—	—
Fewer Than 500,000	...	...	...	100	100	100	1,335	1,621	2,098
Micronesia									
10 million or more	...	...	...	...	...	...	...	...	...
5 to 10 million	...	...	...	...	...	...	...	...	...
1 to 5 million	...	...	...	...	...	...	...	...	...
500,000 to 1 million	...	...	...	...	...	...	...	...	...
Fewer Than 500,000	...	...	...	100	100	100	325	358	412
Polynesia									
10 million or more	...	...	...	...	...	...	...	...	...
5 to 10 million	...	...	...	...	...	...	...	...	...
1 to 5 million	...	...	...	...	...	...	...	...	...
500,000 to 1 million	...	...	...	...	...	...	...	...	...
Fewer Than 500,000	...	...	...	100	100	100	254	284	317

Note: Lists of countries/areas in aggregates are presented in the Technical Notes.

Sources: United Nations Department of Economic and Social Affairs, Population Division (2012) World Urbanization Prospects: The 2011 Revision, United Nations, New York. The figures in regional aggregates are not consistent with city data in table C.1.

COUNTRY LEVEL DATA

TABLE B.1

Total Population Size, Rate of Change and Population Density

	Estimates and projections ('000)				Rate of change (%)			Population density (people/km²)	
	2000	2010	2020	2030	2000–2010	2010–2020	2020–2030	2000	2030
AFRICA									
Algeria	30,534	35,468	40,180	43,475	1.50	1.25	0.79	13	18
Angola	13,926	19,082	24,780	30,801	3.15	2.61	2.18	11	25
Benin	6,518	8,850	11,523	14,630	3.06	2.64	2.39	58	130
Botswana	1,758	2,007	2,206	2,344	1.32	0.95	0.61	3	4
Burkina Faso	12,294	16,469	22,150	29,112	2.92	2.96	2.73	45	106
Burundi	6,374	8,383	10,057	11,441	2.74	1.82	1.29	229	411
Cameroon	15,678	19,599	24,117	28,811	2.23	2.07	1.78	33	61
Cape Verde	437	496	544	588	1.26	0.93	0.78	108	146
Central African Republic	3,702	4,401	5,343	6,365	1.73	1.94	1.75	6	10
Chad	8,222	11,227	14,469	18,437	3.11	2.54	2.42	6	14
Comoros	562	735	933	1,160	2.67	2.39	2.18	302	623
Congo	3,136	4,043	5,003	6,169	2.54	2.13	2.10	9	18
Côte d'Ivoire	16,582	19,738	24,503	29,823	1.74	2.16	1.96	51	92
Democratic Republic of the Congo	49,626	65,966	85,054	105,956	2.85	2.54	2.20	21	45
Djibouti	732	889	1,066	1,263	1.94	1.82	1.70	32	54
Egypt	67,648	81,121	94,810	106,498	1.82	1.56	1.16	68	106
Equatorial Guinea	520	700	905	1,102	2.97	2.56	1.96	19	39
Eritrea	3,668	5,254	6,848	8,394	3.59	2.65	2.04	31	71
Ethiopia	65,578	82,950	101,046	118,515	2.35	1.97	1.59	59	107
Gabon	1,235	1,505	1,818	2,146	1.98	1.89	1.66	5	8
Gambia	1,297	1,728	2,242	2,818	2.87	2.60	2.29	115	249
Ghana	19,165	24,392	30,325	36,537	2.41	2.18	1.86	80	153
Guinea	8,344	9,982	12,765	15,946	1.79	2.46	2.22	34	65
Guinea-Bissau	1,241	1,515	1,863	2,263	2.00	2.07	1.94	34	63
Kenya	31,254	40,513	52,564	65,928	2.59	2.60	2.27	54	114
Lesotho	1,964	2,171	2,395	2,566	1.00	0.98	0.69	65	85
Liberia	2,847	3,994	5,166	6,533	3.38	2.57	2.35	26	59
Libyan Arab Jamahiriya	5,231	6,355	7,083	7,783	1.95	1.08	0.94	3	4
Madagascar	15,364	20,714	27,366	35,333	2.99	2.78	2.56	26	60
Malawi	11,229	14,901	20,677	28,174	2.83	3.28	3.09	95	238
Mali	11,295	15,370	20,537	26,784	3.08	2.90	2.66	9	22
Mauritania	2,643	3,460	4,298	5,200	2.69	2.17	1.90	3	5
Mauritius[1]	1,196	1,299	1,361	1,394	0.83	0.47	0.24	586	684
Mayotte	149	204	271	342	3.16	2.82	2.35	398	915
Morocco	28,793	31,951	35,078	37,502	1.04	0.93	0.67	64	84
Mozambique	18,201	23,391	29,177	35,907	2.51	2.21	2.08	23	45
Namibia	1,896	2,283	2,672	3,042	1.86	1.57	1.30	2	4
Niger	10,922	15,512	22,071	30,841	3.51	3.53	3.35	9	24
Nigeria	123,689	158,423	203,869	257,815	2.48	2.52	2.35	134	279
Réunion	739	846	936	1,006	1.35	1.01	0.73	294	401
Rwanda	8,098	10,624	14,042	17,579	2.71	2.79	2.25	307	667
Saint Helena[2]	5	4	4	4	–2.06	–0.18	0.30	41	34
São Tomé and Príncipe	141	165	200	235	1.60	1.89	1.61	146	243
Senegal	9,506	12,434	15,998	19,963	2.69	2.52	2.21	48	101
Seychelles	79	87	90	92	0.95	0.38	0.28	173	203
Sierra Leone	4,143	5,868	7,178	8,532	3.48	2.02	1.73	58	119
Somalia	7,399	9,331	12,237	16,360	2.32	2.71	2.90	12	26
South Africa	44,760	50,133	52,573	54,711	1.13	0.48	0.40	37	45
South Sudan	6,631	9,948	13,096	16,102	4.06	2.75	2.07	11	26
Sudan	27,556	33,604	41,823	50,755	1.98	2.19	1.94	15	27
Swaziland	1,064	1,186	1,341	1,462	1.09	1.23	0.86	61	84
Togo	4,794	6,028	7,343	8,684	2.29	1.97	1.68	84	153
Tunisia	9,456	10,481	11,518	12,212	1.03	0.94	0.59	58	75
Uganda	24,213	33,425	45,424	59,846	3.22	3.07	2.76	100	248
United Republic of Tanzania[3]	34,038	44,841	61,081	81,852	2.76	3.09	2.93	36	87
Western Sahara	315	531	718	805	5.20	3.03	1.14	1	3
Zambia	10,202	13,089	17,918	24,482	2.49	3.14	3.12	14	33
Zimbabwe	12,509	12,571	15,543	17,627	0.05	2.12	1.26	32	45
ASIA									
Afghanistan	22,856	31,412	42,141	53,266	3.18	2.94	2.34	35	82
Armenia	3,076	3,092	3,146	3,105	0.05	0.17	–0.13	103	104
Azerbaijan[4]	8,111	9,188	10,231	10,807	1.25	1.08	0.55	94	125
Bahrain	638	1,262	1,508	1,654	6.82	1.78	0.93	920	2,384
Bangladesh	129,592	148,692	167,256	181,863	1.37	1.18	0.84	900	1,263
Bhutan	571	726	829	899	2.40	1.33	0.81	12	19

continued . . .

TABLE B.1

continued

	Estimates and projections ('000)				Rate of change (%)			Population density (people/km²)	
	2000	2010	2020	2030	2000–2010	2010–2020	2020–2030	2000	2030
Brunei Darussalam	327	399	465	522	1.99	1.54	1.15	57	91
Cambodia	12,447	14,138	15,893	17,363	1.27	1.17	0.88	69	96
China[5]	1,269,117	1,341,335	1,387,792	1,393,076	0.55	0.34	0.04	132	145
China, Hong Kong SAR[6]	6,783	7,053	7,803	8,483	0.39	1.01	0.84	6,172	7,719
China, Macao SAR[7]	432	544	654	742	2.30	1.85	1.26	16,610	28,550
Cyprus[8]	943	1,104	1,218	1,301	1.57	0.99	0.66	102	141
Democratic People's Republic of Korea	22,894	24,346	25,355	26,180	0.61	0.41	0.32	190	217
Georgia[9]	4,746	4,352	4,080	3,760	–0.87	–0.65	–0.82	68	54
India	1,053,898	1,224,614	1,386,909	1,523,482	1.50	1.24	0.94	321	463
Indonesia	213,395	239,871	262,569	279,659	1.17	0.90	0.63	112	147
Iran (Islamic Republic of)	65,342	73,974	81,045	84,439	1.24	0.91	0.41	40	51
Iraq	23,857	31,672	42,684	55,257	2.83	2.98	2.58	54	126
Israel	6,015	7,418	8,666	9,816	2.10	1.55	1.25	272	443
Japan	125,720	126,536	124,804	120,218	0.06	–0.14	–0.37	333	318
Jordan	4,827	6,187	7,366	8,415	2.48	1.74	1.33	54	94
Kazakhstan	14,957	16,026	17,680	18,873	0.69	0.98	0.65	5	7
Kuwait	1,941	2,737	3,394	4,012	3.44	2.15	1.67	109	225
Kyrgyzstan	4,955	5,334	6,012	6,666	0.74	1.20	1.03	25	33
Lao People's Democratic Republic	5,317	6,201	7,045	7,754	1.54	1.28	0.96	22	33
Lebanon	3,742	4,228	4,516	4,701	1.22	0.66	0.40	360	452
Malaysia[10]	23,415	28,401	32,986	37,266	1.93	1.50	1.22	71	113
Maldives	273	316	356	383	1.45	1.20	0.74	917	1,286
Mongolia	2,411	2,756	3,186	3,524	1.34	1.45	1.01	2	2
Myanmar	44,958	47,963	51,688	54,331	0.65	0.75	0.50	66	80
Nepal	24,401	29,959	35,164	39,943	2.05	1.60	1.27	166	271
Occupied Palestinian Territory[11]	3,199	4,039	5,317	6,755	2.33	2.75	2.40	531	1,122
Oman	2,264	2,782	3,290	3,603	2.06	1.68	0.91	7	12
Pakistan	144,522	173,593	205,364	234,432	1.83	1.68	1.32	182	294
Philippines	77,310	93,261	109,742	126,321	1.88	1.63	1.41	258	421
Qatar	591	1,759	2,199	2,371	10.91	2.23	0.75	54	216
Republic of Korea	45,988	48,184	49,810	50,335	0.47	0.33	0.10	462	506
Saudi Arabia	20,045	27,448	33,535	38,481	3.14	2.00	1.38	9	18
Singapore	3,919	5,086	5,597	5,978	2.61	0.96	0.66	5,738	8,753
Sri Lanka	18,745	20,860	22,344	23,094	1.07	0.69	0.33	286	352
Syrian Arab Republic	15,989	20,411	24,079	27,859	2.44	1.65	1.46	86	150
Tajikistan	6,173	6,879	7,961	9,016	1.08	1.46	1.24	43	63
Thailand	63,155	69,122	72,091	73,321	0.90	0.42	0.17	123	143
Timor-Leste	830	1,124	1,510	1,989	3.03	2.95	2.76	56	134
Turkey	63,628	72,752	80,753	86,665	1.34	1.04	0.71	81	111
Turkmenistan	4,501	5,042	5,675	6,165	1.13	1.18	0.83	9	13
United Arab Emirates	3,033	7,512	9,174	10,489	9.07	2.00	1.34	36	125
Uzbekistan	24,776	27,445	30,776	33,375	1.02	1.15	0.81	55	75
Viet Nam	78,758	87,848	96,355	101,483	1.09	0.92	0.52	237	306
Yemen	17,723	24,053	32,232	41,342	3.05	2.93	2.49	34	78
EUROPE									
Albania	3,072	3,204	3,294	3,290	0.42	0.28	–0.01	107	114
Andorra	65	85	98	112	2.72	1.48	1.27	138	239
Austria	8,005	8,394	8,515	8,590	0.47	0.14	0.09	95	102
Belarus	10,058	9,595	9,282	8,883	–0.47	–0.33	–0.44	48	43
Belgium	10,176	10,712	11,001	11,242	0.51	0.27	0.22	333	368
Bosnia and Herzegovina	3,694	3,760	3,647	3,473	0.18	–0.30	–0.49	72	68
Bulgaria	8,006	7,494	7,001	6,455	–0.66	–0.68	–0.81	72	58
Channel Islands[12]	145	153	156	157	0.54	0.17	0.06	745	805
Croatia	4,506	4,403	4,311	4,185	–0.23	–0.21	–0.30	80	74
Czech Republic	10,243	10,493	10,741	10,798	0.24	0.23	0.05	130	137
Denmark	5,340	5,550	5,736	5,885	0.39	0.33	0.26	124	137
Estonia	1,371	1,341	1,329	1,296	–0.22	–0.09	–0.25	30	29
Faroe Islands	46	49	51	53	0.63	0.45	0.45	33	38
Finland[13]	5,173	5,365	5,526	5,619	0.36	0.30	0.17	15	17
France	59,048	62,787	65,874	68,467	0.61	0.48	0.39	107	124
Germany	82,349	82,302	80,988	79,469	–0.01	–0.16	–0.19	231	223
Gibraltar	27	29	29	29	0.67	0.06	–0.08	4,558	4,865
Greece	10,987	11,359	11,569	11,621	0.33	0.18	0.05	83	88
Holy See[14]	1	0	0	0	–5.41	–0.07	–0.16	1,789	1,018
Hungary	10,211	9,984	9,825	9,644	–0.22	–0.16	–0.19	110	104
Iceland	281	320	358	390	1.30	1.11	0.86	3	4
Ireland	3,804	4,470	4,968	5,356	1.61	1.06	0.75	54	76
Isle of Man	77	83	86	87	0.76	0.38	0.14	134	153

continued . . .

TABLE B.1

continued

	Estimates and projections ('000)				Rate of change (%)			Population density (people/km²)	
	2000	2010	2020	2030	2000–2010	2010–2020	2020–2030	2000	2030
Italy	56,986	60,551	61,290	60,851	0.61	0.12	–0.07	189	202
Latvia	2,385	2,252	2,169	2,073	–0.57	–0.38	–0.45	37	32
Liechtenstein	33	36	39	42	0.92	0.76	0.66	205	260
Lithuania	3,500	3,324	3,190	3,068	–0.52	–0.41	–0.39	54	47
Luxembourg	435	507	577	638	1.53	1.28	1.01	168	247
Malta	397	417	428	431	0.47	0.27	0.07	1,258	1,363
Moldova[15]	4,107	3,573	3,358	3,147	–1.39	–0.62	–0.65	121	93
Monaco	35	35	35	36	0.08	0.02	0.03	23,574	23,870
Montenegro	633	631	636	633	–0.02	0.07	–0.05	46	46
Netherlands	15,863	16,613	17,039	17,311	0.46	0.25	0.16	382	417
Norway[16]	4,491	4,883	5,230	5,574	0.84	0.69	0.64	12	14
Poland	38,302	38,277	38,375	37,835	–0.01	0.03	–0.14	118	117
Portugal	10,336	10,676	10,623	10,309	0.32	–0.05	–0.30	112	112
Romania	22,192	21,486	20,970	20,291	–0.32	–0.24	–0.33	93	85
Russian Federation	146,758	142,958	141,022	136,429	–0.26	–0.14	–0.33	9	8
San Marino	27	32	33	34	1.56	0.49	0.22	442	555
Serbia[17]	10,134	9,856	9,718	9,479	–0.28	–0.14	–0.25	115	107
Slovakia	5,405	5,462	5,545	5,547	0.11	0.15	0.00	110	113
Slovenia	1,985	2,030	2,066	2,059	0.22	0.18	–0.03	98	102
Spain[18]	40,288	46,077	48,661	49,998	1.34	0.55	0.27	80	99
Sweden	8,860	9,380	9,924	10,379	0.57	0.56	0.45	20	23
Switzerland	7,168	7,664	7,942	8,094	0.67	0.36	0.19	174	196
TFYR Macedonia[19]	2,009	2,061	2,073	2,043	0.25	0.06	–0.14	78	79
Ukraine	48,892	45,448	43,047	40,515	–0.73	–0.54	–0.61	81	67
United Kingdom	58,874	62,036	65,802	69,314	0.52	0.59	0.52	242	285
LATIN AMERICA AND THE CARIBBEAN									
Anguilla	11	15	17	18	3.28	1.30	0.45	122	201
Antigua and Barbuda	78	89	97	105	1.33	0.93	0.72	176	237
Argentina	36,931	40,412	43,856	46,761	0.90	0.82	0.64	13	17
Aruba	90	107	111	112	1.75	0.29	0.08	502	620
Bahamas	298	343	383	415	1.41	1.10	0.81	21	30
Barbados	268	273	279	281	0.22	0.20	0.06	622	653
Belize	251	312	377	439	2.18	1.90	1.52	11	19
Bolivia	8,307	9,930	11,591	13,391	1.78	1.55	1.44	8	12
Brazil	174,425	194,946	210,433	220,492	1.11	0.76	0.47	20	26
British Virgin Islands	20	23	25	27	1.26	0.88	0.64	136	179
Cayman Islands	40	56	60	63	3.36	0.73	0.42	152	239
Chile	15,420	17,114	18,540	19,536	1.04	0.80	0.52	20	26
Colombia	39,764	46,295	52,185	56,856	1.52	1.20	0.86	35	50
Costa Rica	3,919	4,659	5,272	5,694	1.73	1.24	0.77	77	111
Cuba	11,104	11,258	11,173	10,983	0.14	–0.08	–0.17	100	99
Dominica	70	68	68	69	–0.28	0.02	0.14	93	92
Dominican Republic	8,592	9,927	11,121	12,060	1.44	1.14	0.81	177	249
Ecuador	12,345	14,465	16,355	17,893	1.58	1.23	0.90	44	63
El Salvador	5,940	6,193	6,610	7,093	0.42	0.65	0.70	282	337
Falkland Islands (Malvinas)	3	3	3	3	0.46	0.22	0.00	0	0
French Guiana	165	231	295	365	3.37	2.45	2.13	2	4
Grenada	102	104	108	108	0.29	0.34	–0.05	295	313
Guadeloupe[20]	427	461	479	490	0.75	0.40	0.22	251	287
Guatemala	11,237	14,389	18,382	22,726	2.47	2.45	2.12	103	209
Guyana	733	754	773	795	0.29	0.24	0.28	3	4
Haiti	8,645	9,993	11,311	12,528	1.45	1.24	1.02	312	451
Honduras	6,218	7,601	9,179	10,657	2.01	1.89	1.49	55	95
Jamaica	2,582	2,741	2,828	2,842	0.60	0.31	0.05	235	259
Martinique	385	406	414	414	0.52	0.20	–0.01	350	375
Mexico	99,960	113,423	125,928	135,398	1.26	1.05	0.73	51	69
Montserrat	5	6	6	7	1.85	0.76	0.47	48	66
Netherlands Antilles[21]	180	201	212	213	1.10	0.54	0.05	225	266
Nicaragua	5,074	5,788	6,603	7,240	1.32	1.32	0.92	39	56
Panama	2,956	3,517	4,038	4,502	1.74	1.38	1.09	39	60
Paraguay	5,344	6,455	7,601	8,670	1.89	1.64	1.32	13	21
Peru	25,862	29,077	32,435	35,492	1.17	1.09	0.90	20	28
Puerto Rico	3,814	3,749	3,747	3,754	–0.17	0.00	0.02	430	423
Saint Kitts and Nevis	46	52	59	63	1.29	1.11	0.79	177	243
Saint Lucia	157	174	190	201	1.04	0.89	0.54	291	373
Saint Vincent and the Grenadines	108	109	110	111	0.13	0.03	0.10	278	286
Suriname	467	525	569	602	1.17	0.81	0.56	3	4
Trinidad and Tobago	1,292	1,341	1,373	1,354	0.38	0.23	–0.14	252	264

continued . . .

TABLE B.1

continued

	Estimates and projections ('000)				Rate of change (%)			Population density (people/km^2)	
	2000	2010	2020	2030	2000–2010	2010–2020	2020–2030	2000	2030
Turks and Caicos Islands	19	38	43	45	7.09	1.04	0.56	44	105
United States Virgin Islands	109	109	106	102	0.05	–0.28	–0.41	313	293
Uruguay	3,319	3,369	3,495	3,601	0.15	0.37	0.30	19	21
Venezuela (Bolivarian Republic of)	24,348	28,980	33,340	37,040	1.74	1.40	1.05	27	41
NORTHERN AMERICA									
Bermuda	63	65	66	67	0.33	0.18	0.07	1,186	1,256
Canada	30,667	34,017	37,163	39,850	1.04	0.88	0.70	3	4
Greenland	56	57	57	55	0.19	–0.06	–0.41	0	0
Saint-Pierre-et-Miquelon	6	6	6	6	–0.36	–0.01	–0.01	26	25
United States of America	282,496	310,384	337,102	361,680	0.94	0.83	0.70	29	38
OCEANIA									
American Samoa	58	68	81	95	1.72	1.64	1.66	290	478
Australia[22]	19,164	22,268	25,241	27,771	1.50	1.25	0.96	2	4
Cook Islands	18	20	21	22	1.29	0.51	0.38	76	94
Fiji	812	861	923	958	0.59	0.70	0.38	44	52
French Polynesia	238	271	298	318	1.30	0.97	0.63	59	79
Guam	155	180	202	222	1.48	1.15	0.93	283	404
Kiribati	84	100	116	132	1.70	1.51	1.32	116	182
Marshall Islands	52	54	62	67	0.36	1.40	0.80	288	372
Micronesia (Federated States of)	107	111	119	129	0.36	0.66	0.82	153	183
Nauru	10	10	11	11	0.21	0.51	0.22	478	525
New Caledonia	212	251	287	314	1.69	1.34	0.91	11	17
New Zealand	3,858	4,368	4,824	5,211	1.24	0.99	0.77	14	19
Niue	2	1	1	1	–2.58	–2.44	–0.71	7	4
Northern Mariana Islands	68	61	71	76	–1.16	1.48	0.69	147	163
Palau	19	20	22	25	0.66	0.92	0.97	42	54
Papua New Guinea	5,379	6,858	8,464	10,185	2.43	2.10	1.85	12	22
Pitcairn	...	...	...	...	...	...	...	...	...
Samoa	177	183	191	200	0.36	0.44	0.46	62	71
Solomon Islands	409	538	684	841	2.75	2.40	2.07	14	29
Tokelau	2	1	1	1	–3.13	0.48	0.89	129	109
Tonga	98	104	111	121	0.61	0.64	0.84	151	185
Tuvalu	9	10	10	11	0.42	0.35	0.75	362	422
Vanuatu	185	240	303	371	2.58	2.34	2.04	15	30
Wallis and Futuna Islands	14	14	13	13	–0.67	–0.41	0.06	72	66

Notes:
(1) Including Agalega, Rodrigues, and Saint Brandon.
(2) Including Ascension, and Tristan da Cunha.
(3) Including Zanzibar.
(4) Including Nagorno-Karabakh.
(5) For statistical purposes, the data for China do not include Hong Kong and Macao, Special Administrative Regions (SAR) of China.
(6) As of 1 July 1997, Hong Kong became a Special Administrative Region (SAR) of China.
(7) As of 20 December 1999, Macao became a Special Administrative Region (SAR) of China.
(8) Including Northern-Cyprus.
(9) Including Abkhazia and South Ossetia.
(10) Including Sabah and Sarawak.
(11) Including East Jerusalem.
(12) Refers to Guernsey, and Jersey.
(13) Including Åland Islands.
(14) Refers to the Vatican City State.
(15) Including Transnistria.
(16) Including Svalbard and Jan Mayen Islands.
(17) Including Kosovo.
(18) Including Canary Islands, Ceuta and Melilla.
(19) The former Yugoslav Republic of Macedonia.
(20) Including Saint-Barthélemy and Saint-Martin (French part).
(21) Refers to Curaçao, Sint Maarten (Dutch part), Bonaire, Saba and Sint Eustatius.
(22) Including Christmas Island, Cocos (Keeling) Islands, and Norfolk Island.

Sources: United Nations Department of Economic and Social Affairs, Population Division (2012) World Urbanization Prospects: The 2011 Revision, United Nations, New York, United Nations Department of Economic and Social Affairs, Population Division (2011) World Population Prospects: The 2010 Revision, United Nations, New York.

TABLE B.2

Urban and Rural Population Size and Rate of Change

	Urban population							Rural population						
	Estimates and projections ('000)				Rate of change (%)			Estimates and projections ('000)				Rate of change (%)		
	2000	2010	2020	2030	2000–2010	2010–2020	2020–2030	2000	2010	2020	2030	2000–2010	2010–2020	2020–2030
AFRICA														
Algeria	18,561	25,546	31,899	36,210	3.19	2.22	1.27	11,973	9,922	8,281	7,265	–1.88	–1.81	–1.31
Angola	6,822	11,140	16,207	21,625	4.90	3.75	2.88	7,104	7,942	8,573	9,176	1.11	0.76	0.68
Benin	2,498	3,917	5,836	8,265	4.50	3.99	3.48	4,019	4,933	5,686	6,365	2.05	1.42	1.13
Botswana	936	1,224	1,476	1,670	2.69	1.87	1.23	822	783	730	675	–0.49	–0.70	–0.79
Burkina Faso	2,194	4,227	7,532	12,086	6.56	5.78	4.73	10,100	12,242	14,618	17,026	1.92	1.77	1.53
Burundi	526	892	1,377	2,008	5.29	4.34	3.77	5,849	7,491	8,680	9,433	2.47	1.47	0.83
Cameroon	7,140	10,096	13,775	17,915	3.46	3.11	2.63	8,538	9,503	10,342	10,896	1.07	0.85	0.52
Cape Verde	234	307	374	432	2.72	1.99	1.44	204	189	170	156	–0.73	–1.06	–0.86
Central African Republic	1,393	1,710	2,236	2,979	2.05	2.68	2.87	2,308	2,691	3,107	3,386	1.53	1.44	0.86
Chad	1,771	2,441	3,344	4,890	3.21	3.15	3.80	6,452	8,787	11,125	13,547	3.09	2.36	1.97
Comoros	158	206	274	376	2.63	2.88	3.17	405	529	659	784	2.69	2.20	1.73
Congo	1,841	2,556	3,371	4,387	3.28	2.77	2.63	1,295	1,487	1,632	1,782	1.38	0.93	0.88
Côte d'Ivoire	7,220	9,979	14,085	18,829	3.24	3.45	2.90	9,362	9,759	10,419	10,993	0.42	0.65	0.54
Democratic Republic of the Congo	14,542	22,248	33,459	47,941	4.25	4.08	3.60	35,084	43,718	51,595	58,015	2.20	1.66	1.17
Djibouti	560	684	832	1,008	2.00	1.95	1.93	172	204	234	255	1.74	1.36	0.83
Egypt	28,951	35,186	43,145	52,864	1.95	2.04	2.03	38,697	45,935	51,665	53,634	1.71	1.18	0.37
Equatorial Guinea	202	276	376	498	3.11	3.10	2.83	318	425	529	603	2.88	2.20	1.31
Eritrea	646	1,098	1,766	2,643	5.30	4.75	4.03	3,021	4,156	5,082	5,752	3.19	2.01	1.24
Ethiopia	9,666	13,900	19,872	28,355	3.63	3.57	3.56	55,912	69,050	81,174	90,160	2.11	1.62	1.05
Gabon	990	1,292	1,607	1,932	2.67	2.18	1.84	246	213	211	214	–1.42	–0.08	0.11
Gambia	633	979	1,381	1,853	4.36	3.44	2.94	664	749	861	965	1.21	1.39	1.14
Ghana	8,424	12,492	17,428	22,937	3.94	3.33	2.75	10,741	11,899	12,897	13,600	1.02	0.80	0.53
Guinea	2,589	3,490	5,128	7,368	2.99	3.85	3.62	5,756	6,491	7,637	8,577	1.20	1.63	1.16
Guinea-Bissau	445	655	925	1,237	3.87	3.46	2.90	796	860	938	1,026	0.78	0.86	0.89
Kenya	6,217	9,549	14,675	21,868	4.29	4.30	3.99	25,037	30,963	37,889	44,060	2.12	2.02	1.51
Lesotho	392	583	817	1,051	3.96	3.37	2.53	1,572	1,588	1,578	1,515	0.11	–0.06	–0.41
Liberia	1,262	1,909	2,675	3,686	4.14	3.37	3.20	1,585	2,085	2,491	2,847	2.74	1.78	1.34
Libyan Arab Jamahiriya	3,993	4,929	5,626	6,340	2.11	1.32	1.20	1,238	1,426	1,457	1,443	1.41	0.22	–0.10
Madagascar	4,167	6,614	10,493	15,802	4.62	4.61	4.09	11,197	14,100	16,873	19,531	2.30	1.80	1.46
Malawi	1,641	2,316	3,600	5,874	3.45	4.41	4.90	9,588	12,585	17,078	22,300	2.72	3.05	2.67
Mali	3,172	5,268	8,372	12,618	5.07	4.63	4.10	8,124	10,102	12,165	14,166	2.18	1.86	1.52
Mauritania	1,057	1,426	1,915	2,587	3.00	2.95	3.01	1,586	2,033	2,383	2,613	2.48	1.59	0.92
Mauritius[1]	510	543	578	631	0.62	0.63	0.87	686	756	783	763	0.98	0.35	–0.26
Mayotte	71	102	138	184	3.64	3.00	2.87	78	102	133	159	2.71	2.64	1.78
Morocco	15,357	18,109	21,200	24,219	1.65	1.58	1.33	13,436	13,843	13,878	13,283	0.30	0.03	–0.44
Mozambique	5,296	7,241	9,898	13,844	3.13	3.13	3.35	12,905	16,149	19,279	22,063	2.24	1.77	1.35
Namibia	614	863	1,165	1,510	3.41	3.00	2.59	1,282	1,420	1,507	1,532	1.02	0.59	0.17
Niger	1,768	2,733	4,540	7,800	4.35	5.08	5.41	9,155	12,779	17,530	23,041	3.34	3.16	2.73
Nigeria	52,383	77,629	112,159	156,697	3.93	3.68	3.34	71,306	80,795	91,710	101,118	1.25	1.27	0.98
Réunion	664	795	895	969	1.80	1.18	0.80	75	51	40	37	–3.91	–2.24	–0.98
Rwanda	1,115	1,998	3,119	4,748	5.83	4.45	4.20	6,983	8,626	10,923	12,831	2.11	2.36	1.61
Saint Helena[2]	2	2	2	2	–2.27	–0.04	0.92	3	2	2	2	–1.92	–0.28	–0.14
São Tomé and Príncipe	75	103	136	169	3.08	2.81	2.16	66	63	64	66	–0.44	0.17	0.32
Senegal	3,835	5,253	7,318	10,144	3.15	3.31	3.27	5,671	7,180	8,679	9,819	2.36	1.90	1.23
Seychelles	40	46	51	56	1.50	1.08	0.93	39	40	39	36	0.36	–0.49	–0.65
Sierra Leone	1,484	2,281	3,084	4,115	4.30	3.02	2.88	2,659	3,586	4,094	4,417	2.99	1.32	0.76
Somalia	2,460	3,479	5,168	7,853	3.47	3.96	4.18	4,939	5,851	7,069	8,507	1.70	1.89	1.85
South Africa	25,464	30,855	34,627	38,199	1.92	1.15	0.98	19,296	19,278	17,946	16,513	–0.01	–0.72	–0.83
South Sudan	1,094	1,777	2,641	3,871	4.84	3.96	3.82	5,537	8,172	10,455	12,231	3.89	2.46	1.57
Sudan	8,954	11,117	14,681	19,919	2.16	2.78	3.05	18,602	22,486	27,142	30,835	1.90	1.88	1.28
Swaziland	241	253	287	340	0.49	1.27	1.71	823	933	1,054	1,121	1.26	1.22	0.62
Togo	1,577	2,262	3,122	4,163	3.61	3.22	2.88	3,216	3,765	4,220	4,521	1.58	1.14	0.69
Tunisia	5,998	6,928	7,879	8,699	1.44	1.29	0.99	3,458	3,553	3,639	3,514	0.27	0.24	–0.35
Uganda	2,925	5,067	8,882	14,762	5.49	5.61	5.08	21,288	28,358	36,542	45,084	2.87	2.54	2.10
United Republic of Tanzania[3]	7,594	11,784	19,030	30,281	4.39	4.79	4.64	26,445	33,057	42,051	51,571	2.23	2.41	2.04
Western Sahara	264	434	602	690	4.96	3.27	1.37	51	96	116	115	6.39	1.86	–0.11
Zambia	3,550	5,069	7,755	11,857	3.56	4.25	4.25	6,651	8,020	10,163	12,625	1.87	2.37	2.17
Zimbabwe	4,223	4,793	6,717	8,630	1.27	3.37	2.51	8,287	7,778	8,826	8,997	–0.63	1.26	0.19
ASIA														
Afghanistan	4,704	7,300	11,213	16,635	4.39	4.29	3.94	18,152	24,112	30,929	36,631	2.84	2.49	1.69
Armenia	1,989	1,981	2,044	2,094	–0.04	0.31	0.24	1,087	1,111	1,102	1,011	0.22	–0.08	–0.86
Azerbaijan[4]	4,168	4,906	5,740	6,469	1.63	1.57	1.19	3,943	4,281	4,490	4,338	0.82	0.48	–0.34
Bahrain	564	1,118	1,349	1,500	6.84	1.87	1.06	74	144	159	154	6.60	1.03	–0.30
Bangladesh	30,571	41,476	55,336	71,148	3.05	2.88	2.51	99,021	107,216	111,920	110,715	0.80	0.43	–0.11
Bhutan	145	253	350	434	5.54	3.27	2.15	426	473	479	465	1.05	0.11	–0.29

continued . . .

TABLE B.2

continued

	Urban population							Rural population						
	Estimates and projections ('000)				Rate of change (%)			Estimates and projections ('000)				Rate of change (%)		
	2000	2010	2020	2030	2000–2010	2010–2020	2020–2030	2000	2010	2020	2030	2000–2010	2010–2020	2020–2030
Brunei Darussalam	233	302	368	426	2.59	1.98	1.47	94	97	98	96	0.32	0.04	–0.16
Cambodia	2,313	2,801	3,509	4,522	1.91	2.25	2.54	10,134	11,337	12,384	12,841	1.12	0.88	0.36
China[5]	455,325	660,286	846,363	957,649	3.72	2.48	1.24	813,792	681,049	541,428	435,427	–1.78	–2.29	–2.18
China, Hong Kong SAR[6]	6,783	7,053	7,803	8,483	0.39	1.01	0.84	—	—	—	—	—	—	—
China, Macao SAR[7]	432	544	654	742	2.30	1.85	1.26	—	—	—	—	—	—	—
Cyprus[8]	648	776	882	976	1.81	1.28	1.01	296	328	336	325	1.03	0.25	–0.32
Democratic People's Republic of Korea	13,602	14,659	15,685	16,961	0.75	0.68	0.78	9,292	9,687	9,670	9,219	0.42	–0.02	–0.48
Georgia[9]	2,498	2,295	2,218	2,168	–0.85	–0.34	–0.23	2,248	2,057	1,862	1,592	–0.89	–0.99	–1.57
India	291,585	378,775	483,044	605,813	2.62	2.43	2.26	762,313	845,839	903,866	917,670	1.04	0.66	0.15
Indonesia	89,631	119,752	150,208	176,419	2.90	2.27	1.61	123,765	120,119	112,361	103,240	–0.30	–0.67	–0.85
Iran (Islamic Republic of)	41,846	50,996	57,184	61,517	1.98	1.15	0.73	23,496	22,978	23,861	22,922	–0.22	0.38	–0.40
Iraq	16,183	21,073	28,457	37,903	2.64	3.00	2.87	7,675	10,599	14,227	17,354	3.23	2.94	1.99
Israel	5,486	6,812	8,010	9,132	2.16	1.62	1.31	529	607	656	684	1.37	0.79	0.42
Japan	98,877	114,567	118,877	116,423	1.47	0.37	–0.21	26,843	11,969	5,927	3,795	–8.08	–7.03	–4.46
Jordan	3,852	5,103	6,240	7,275	2.81	2.01	1.53	975	1,084	1,125	1,140	1.07	0.37	0.13
Kazakhstan	8,335	8,611	9,451	10,545	0.33	0.93	1.10	6,622	7,415	8,229	8,328	1.13	1.04	0.12
Kuwait	1,904	2,689	3,339	3,951	3.45	2.17	1.68	37	48	55	61	2.72	1.40	0.91
Kyrgyzstan	1,749	1,883	2,207	2,694	0.74	1.59	1.99	3,206	3,451	3,805	3,972	0.74	0.98	0.43
Lao People's Democratic Republic	1,169	2,054	3,074	3,996	5.64	4.03	2.62	4,149	4,147	3,971	3,757	0.00	–0.44	–0.55
Lebanon	3,218	3,684	3,985	4,199	1.35	0.79	0.52	524	544	531	502	0.37	–0.24	–0.55
Malaysia[10]	14,512	20,450	25,694	30,209	3.43	2.28	1.62	8,903	7,951	7,291	7,057	–1.13	–0.87	–0.33
Maldives	76	126	179	217	5.12	3.49	1.94	198	190	177	166	–0.41	–0.69	–0.65
Mongolia	1,378	1,862	2,407	2,829	3.01	2.57	1.62	1,034	894	779	695	–1.45	–1.37	–1.15
Myanmar	12,235	15,388	19,583	23,939	2.29	2.41	2.01	32,722	32,575	32,104	30,392	–0.05	–0.15	–0.55
Nepal	3,277	4,990	7,127	9,917	4.20	3.56	3.30	21,123	24,969	28,037	30,026	1.67	1.16	0.69
Occupied Palestinian Territory[11]	2,302	2,994	4,059	5,311	2.63	3.04	2.69	897	1,045	1,258	1,444	1.53	1.86	1.38
Oman	1,620	2,036	2,490	2,815	2.28	2.01	1.22	644	746	800	788	1.47	0.69	–0.15
Pakistan	47,892	62,290	81,175	104,197	2.63	2.65	2.50	96,631	111,304	124,190	130,235	1.41	1.10	0.48
Philippines	37,101	45,370	56,623	71,145	2.01	2.22	2.28	40,209	47,891	53,119	55,176	1.75	1.04	0.38
Qatar	569	1,735	2,188	2,365	11.15	2.32	0.78	22	24	10	6	0.82	–8.17	–5.07
Republic of Korea	36,616	39,960	42,534	43,833	0.87	0.62	0.30	9,372	8,223	7,276	6,502	–1.31	–1.22	–1.12
Saudi Arabia	16,006	22,530	28,189	32,983	3.42	2.24	1.57	4,040	4,918	5,346	5,498	1.97	0.84	0.28
Singapore	3,919	5,086	5,597	5,978	2.61	0.96	0.66	—	—	—	—	—	—	—
Sri Lanka	2,945	3,138	3,674	4,652	0.63	1.58	2.36	15,800	17,722	18,670	18,443	1.15	0.52	–0.12
Syrian Arab Republic	8,306	11,363	14,377	17,832	3.13	2.35	2.15	7,683	9,047	9,702	10,027	1.63	0.70	0.33
Tajikistan	1,635	1,823	2,192	2,769	1.09	1.85	2.33	4,538	5,056	5,768	6,247	1.08	1.32	0.80
Thailand	19,669	23,315	27,375	32,039	1.70	1.61	1.57	43,486	45,807	44,716	41,282	0.52	–0.24	–0.80
Timor-Leste	201	314	481	713	4.45	4.25	3.94	629	810	1,029	1,277	2.53	2.39	2.16
Turkey	41,193	51,281	63,488	72,034	2.19	2.14	1.26	22,435	21,471	17,265	14,631	–0.44	–2.18	–1.66
Turkmenistan	2,067	2,441	2,952	3,498	1.66	1.90	1.70	2,435	2,601	2,723	2,668	0.66	0.46	–0.21
United Arab Emirates	2,434	6,313	7,950	9,261	9.53	2.31	1.53	600	1,199	1,224	1,228	6.93	0.21	0.03
Uzbekistan	9,273	9,936	11,492	13,803	0.69	1.45	1.83	15,502	17,509	19,283	19,571	1.22	0.97	0.15
Viet Nam	19,196	26,700	35,512	43,954	3.30	2.85	2.13	59,562	61,149	60,843	57,530	0.26	–0.05	–0.56
Yemen	4,655	7,635	12,138	18,120	4.95	4.64	4.01	13,068	16,418	20,094	23,222	2.28	2.02	1.45
EUROPE														
Albania	1,282	1,677	2,049	2,272	2.68	2.01	1.04	1,790	1,528	1,245	1,018	–1.58	–2.05	–2.01
Andorra	60	75	82	91	2.22	0.91	1.04	5	10	17	21	7.43	4.83	2.33
Austria	5,267	5,662	5,938	6,231	0.72	0.48	0.48	2,738	2,732	2,577	2,359	–0.02	–0.58	–0.88
Belarus	7,038	7,160	7,277	7,213	0.17	0.16	–0.09	3,020	2,436	2,004	1,670	–2.15	–1.95	–1.82
Belgium	9,882	10,440	10,752	11,010	0.55	0.29	0.24	293	273	250	232	–0.73	–0.88	–0.74
Bosnia and Herzegovina	1,589	1,795	1,941	2,039	1.22	0.78	0.49	2,105	1,965	1,706	1,434	–0.68	–1.41	–1.74
Bulgaria	5,516	5,435	5,434	5,231	–0.15	0.00	–0.38	2,490	2,059	1,566	1,224	–1.90	–2.73	–2.47
Channel Islands[12]	44	48	51	56	0.74	0.69	0.88	101	106	105	101	0.45	–0.07	–0.36
Croatia	2,504	2,534	2,617	2,712	0.12	0.32	0.35	2,001	1,870	1,694	1,474	–0.68	–0.99	–1.39
Czech Republic	7,579	7,709	7,902	8,091	0.17	0.25	0.24	2,664	2,784	2,839	2,707	0.44	0.19	–0.48
Denmark	4,544	4,817	5,053	5,252	0.58	0.48	0.39	796	733	682	633	–0.82	–0.72	–0.74
Estonia	951	932	935	939	–0.21	0.04	0.04	419	410	394	357	–0.24	–0.38	–1.00
Faroe Islands	17	20	22	25	1.82	1.01	1.18	29	29	29	28	–0.12	0.04	–0.14
Finland[13]	4,252	4,482	4,689	4,843	0.53	0.45	0.32	922	882	837	777	–0.44	–0.53	–0.74
France	45,405	53,513	58,999	62,593	1.64	0.98	0.59	13,643	9,275	6,875	5,873	–3.86	–2.99	–1.57
Germany	60,170	60,751	60,973	61,522	0.10	0.04	0.09	22,179	21,551	20,015	17,948	–0.29	–0.74	–1.09
Gibraltar	27	29	29	29	0.67	0.06	–0.08	—	—	—	—	—	—	—
Greece	6,563	6,954	7,399	7,861	0.58	0.62	0.61	4,424	4,405	4,170	3,760	–0.04	–0.55	–1.03
Holy See[14]	1	0	0	0	–5.41	–0.07	–0.16	—	—	—	—	—	—	—
Hungary	6,593	6,885	7,211	7,406	0.43	0.46	0.27	3,617	3,098	2,614	2,238	–1.55	–1.70	–1.55
Iceland	260	300	338	372	1.43	1.22	0.94	21	20	19	18	–0.46	–0.58	–0.68

continued . . .

TABLE B.2

continued

	Urban population							Rural population						
	Estimates and projections ('000)				Rate of change (%)			Estimates and projections ('000)				Rate of change (%)		
	2000	2010	2020	2030	2000–2010	2010–2020	2020–2030	2000	2010	2020	2030	2000–2010	2010–2020	2020–2030
Ireland	2,250	2,767	3,233	3,675	2.07	1.56	1.28	1,554	1,703	1,735	1,681	0.92	0.19	–0.32
Isle of Man	40	42	44	46	0.52	0.38	0.45	37	41	43	42	1.01	0.38	–0.19
Italy	38,307	41,308	43,072	44,524	0.75	0.42	0.33	18,679	19,243	18,218	16,326	0.30	–0.55	–1.10
Latvia	1,623	1,525	1,477	1,453	–0.63	–0.32	–0.17	762	727	692	621	–0.46	–0.50	–1.08
Liechtenstein	5	5	6	6	0.46	0.72	1.39	28	31	33	35	1.00	0.77	0.54
Lithuania	2,345	2,227	2,182	2,173	–0.51	–0.20	–0.04	1,156	1,097	1,008	895	–0.52	–0.85	–1.19
Luxembourg	365	432	504	568	1.70	1.53	1.20	71	75	73	70	0.61	–0.29	–0.44
Malta	367	394	411	416	0.72	0.40	0.14	30	22	17	14	–3.12	–2.59	–1.86
Moldova[15]	1,831	1,677	1,809	1,881	–0.88	0.76	0.39	2,276	1,896	1,548	1,266	–1.83	–2.03	–2.02
Monaco	35	35	35	36	0.08	0.02	0.03	—	—	—	—	—	—	—
Montenegro	370	398	415	430	0.73	0.40	0.36	262	233	221	203	–1.18	–0.52	–0.88
Netherlands	12,183	13,747	14,666	15,200	1.21	0.65	0.36	3,680	2,866	2,374	2,111	–2.50	–1.89	–1.17
Norway[16]	3,417	3,863	4,272	4,668	1.23	1.01	0.89	1,074	1,020	958	906	–0.51	–0.63	–0.56
Poland	23,639	23,328	23,387	23,807	–0.13	0.03	0.18	14,664	14,949	14,988	14,028	0.19	0.03	–0.66
Portugal	5,623	6,459	6,970	7,199	1.39	0.76	0.32	4,713	4,216	3,653	3,111	–1.11	–1.43	–1.61
Romania	11,763	11,343	11,226	11,391	–0.36	–0.10	0.15	10,429	10,143	9,744	8,900	–0.28	–0.40	–0.91
Russian Federation	107,647	105,292	106,410	105,804	–0.22	0.11	–0.06	39,111	37,666	34,611	30,626	–0.38	–0.85	–1.22
San Marino	25	30	31	32	1.63	0.52	0.28	2	2	2	2	0.52	–0.07	–0.80
Serbia[17]	5,369	5,523	5,794	6,035	0.28	0.48	0.41	4,765	4,333	3,924	3,444	–0.95	–0.99	–1.30
Slovakia	3,039	2,995	3,046	3,187	–0.15	0.17	0.45	2,366	2,467	2,500	2,360	0.42	0.13	–0.58
Slovenia	1,008	1,014	1,038	1,091	0.06	0.24	0.49	978	1,016	1,028	968	0.38	0.12	–0.59
Spain[18]	30,725	35,610	38,374	40,423	1.48	0.75	0.52	9,564	10,467	10,287	9,575	0.90	–0.17	–0.72
Sweden	7,445	7,978	8,585	9,113	0.69	0.73	0.60	1,415	1,402	1,339	1,267	–0.10	–0.46	–0.55
Switzerland	5,256	5,644	5,923	6,184	0.71	0.48	0.43	1,912	2,020	2,018	1,910	0.55	–0.01	–0.55
TFYR Macedonia[19]	1,193	1,220	1,263	1,317	0.22	0.35	0.42	816	841	810	726	0.29	–0.38	–1.09
Ukraine	32,828	31,216	30,478	29,735	–0.50	–0.24	–0.25	16,063	14,232	12,568	10,781	–1.21	–1.24	–1.53
United Kingdom	46,305	49,323	53,240	57,314	0.63	0.76	0.74	12,569	12,712	12,562	12,000	0.11	–0.12	–0.46
LATIN AMERICA AND THE CARIBBEAN														
Anguilla	11	15	17	18	3.28	1.30	0.45	—	—	—	—	—	—	—
Antigua and Barbuda	25	27	30	35	0.61	1.15	1.70	53	62	68	69	1.66	0.84	0.25
Argentina	33,284	37,320	41,056	44,088	1.14	0.95	0.71	3,647	3,092	2,800	2,673	–1.65	–0.99	–0.46
Aruba	42	50	53	56	1.76	0.55	0.57	48	57	58	55	1.73	0.06	–0.40
Bahamas	244	288	329	364	1.66	1.32	1.01	53	55	54	51	0.22	–0.16	–0.50
Barbados	103	120	136	149	1.57	1.27	0.92	165	153	143	131	–0.73	–0.72	–0.83
Belize	119	140	165	199	1.60	1.63	1.87	131	172	212	240	2.69	2.11	1.25
Bolivia	5,137	6,593	8,157	9,884	2.50	2.13	1.92	3,171	3,337	3,434	3,507	0.51	0.29	0.21
Brazil	141,619	164,409	182,648	195,116	1.49	1.05	0.66	32,806	30,537	27,785	25,376	–0.72	–0.94	–0.91
British Virgin Islands	8	9	11	13	1.51	1.51	1.51	12	14	14	14	1.09	0.43	–0.07
Cayman Islands	40	56	60	63	3.36	0.73	0.42	—	—	—	—	—	—	—
Chile	13,253	15,221	16,822	17,922	1.38	1.00	0.63	2,167	1,892	1,718	1,614	–1.35	–0.97	–0.63
Colombia	28,660	34,730	40,534	45,508	1.92	1.55	1.16	11,104	11,564	11,651	11,348	0.41	0.07	–0.26
Costa Rica	2,314	2,990	3,616	4,118	2.57	1.90	1.30	1,605	1,669	1,657	1,576	0.39	–0.07	–0.50
Cuba	8,395	8,468	8,417	8,435	0.09	–0.06	0.02	2,709	2,790	2,756	2,549	0.29	–0.13	–0.78
Dominica	47	45	47	49	–0.30	0.26	0.56	23	22	21	20	–0.24	–0.48	–0.85
Dominican Republic	5,305	6,857	8,255	9,362	2.57	1.86	1.26	3,287	3,070	2,866	2,698	–0.68	–0.69	–0.60
Ecuador	7,444	9,672	11,782	13,541	2.62	1.97	1.39	4,901	4,793	4,573	4,352	–0.22	–0.47	–0.50
El Salvador	3,500	3,981	4,554	5,155	1.29	1.35	1.24	2,441	2,212	2,056	1,937	–0.98	–0.73	–0.59
Falkland Islands (Malvinas)	2	2	2	3	1.31	0.80	0.39	1	1	1	1	–1.59	–1.60	–1.51
French Guiana	124	176	231	294	3.52	2.70	2.44	41	55	64	71	2.90	1.58	0.96
Grenada	37	41	46	50	1.03	1.22	0.87	65	64	62	58	–0.16	–0.26	–0.79
Guadeloupe[20]	420	453	472	483	0.75	0.41	0.23	7	7	7	7	0.70	–0.14	–0.89
Guatemala	5,071	7,098	9,922	13,403	3.36	3.35	3.01	6,166	7,291	8,460	9,323	1.68	1.49	0.97
Guyana	210	214	229	261	0.15	0.71	1.29	523	541	544	534	0.34	0.06	–0.18
Haiti	3,078	5,195	7,215	8,804	5.24	3.28	1.99	5,568	4,798	4,096	3,724	–1.49	–1.58	–0.95
Honduras	2,827	3,920	5,249	6,634	3.27	2.92	2.34	3,392	3,680	3,929	4,023	0.82	0.65	0.23
Jamaica	1,338	1,425	1,508	1,610	0.63	0.56	0.65	1,244	1,316	1,320	1,233	0.56	0.03	–0.69
Martinique	346	361	369	372	0.44	0.21	0.09	40	44	45	41	1.14	0.14	–0.89
Mexico	74,692	88,272	101,371	111,946	1.67	1.38	0.99	25,267	25,151	24,556	23,452	–0.05	–0.24	–0.46
Montserrat	1	1	1	1	4.32	1.85	1.84	4	5	5	6	1.50	0.57	0.19
Netherlands Antilles[21]	162	187	201	203	1.43	0.71	0.13	18	14	11	9	–2.57	–2.06	–1.59
Nicaragua	2,777	3,314	3,994	4,665	1.77	1.87	1.55	2,297	2,474	2,609	2,575	0.75	0.53	–0.13
Panama	1,945	2,624	3,218	3,712	3.00	2.04	1.43	1,011	893	820	790	–1.25	–0.85	–0.38
Paraguay	2,957	3,961	5,050	6,116	2.93	2.43	1.92	2,387	2,493	2,552	2,554	0.44	0.23	0.01
Peru	18,890	22,363	25,959	29,246	1.69	1.49	1.19	6,972	6,714	6,476	6,245	–0.38	–0.36	–0.36
Puerto Rico	3,610	3,703	3,726	3,736	0.25	0.06	0.03	204	46	21	17	–14.90	–7.76	–2.01
Saint Kitts and Nevis	15	17	20	23	1.03	1.54	1.77	31	36	39	40	1.41	0.90	0.26

continued . . .

TABLE B.2

continued

	Urban population							Rural population						
	Estimates and projections ('000)				Rate of change (%)			Estimates and projections ('000)				Rate of change (%)		
	2000	2010	2020	2030	2000–2010	2010–2020	2020–2030	2000	2010	2020	2030	2000–2010	2010–2020	2020–2030
Saint Lucia	44	32	25	24	–3.19	–2.62	–0.43	113	142	166	177	2.29	1.53	0.67
Saint Vincent and the Grenadines	49	53	58	63	0.93	0.80	0.85	59	56	52	48	–0.57	–0.78	–0.80
Suriname	303	364	416	459	1.83	1.34	0.98	164	161	153	143	–0.19	–0.51	–0.68
Trinidad and Tobago	140	180	221	255	2.54	2.04	1.40	1,152	1,161	1,152	1,100	0.08	–0.08	–0.46
Turks and Caicos Islands	16	36	41	44	8.07	1.38	0.66	3	3	2	1	–1.20	–5.41	–2.69
United States Virgin Islands	101	104	102	99	0.33	–0.16	–0.35	8	5	4	3	–4.41	–3.22	–2.09
Uruguay	3,031	3,115	3,261	3,382	0.27	0.46	0.37	288	254	234	219	–1.24	–0.82	–0.66
Venezuela (Bolivarian Republic of)	21,886	27,042	31,638	35,382	2.12	1.57	1.12	2,462	1,938	1,702	1,659	–2.39	–1.30	–0.26
NORTHERN AMERICA														
Bermuda	63	65	66	67	0.33	0.18	0.07	—	—	—	—	—	—	—
Canada	24,374	27,402	30,374	33,183	1.17	1.03	0.88	6,294	6,615	6,789	6,667	0.50	0.26	–0.18
Greenland	46	48	50	49	0.53	0.24	–0.19	10	9	7	6	–1.45	–1.86	–2.00
Saint–Pierre–et–Miquelon	6	5	6	6	–0.20	0.13	0.10	1	1	0	0	–1.81	–1.43	–1.39
United States of America	223,423	254,959	284,411	311,141	1.32	1.09	0.90	59,073	55,425	52,691	50,539	–0.64	–0.51	–0.42
OCEANIA														
American Samoa	51	64	76	91	2.18	1.84	1.74	6	5	4	4	–2.98	–1.43	–0.04
Australia[22]	16,705	19,829	22,813	25,361	1.71	1.40	1.06	2,460	2,439	2,428	2,411	–0.08	–0.05	–0.07
Cook Islands	12	15	16	17	2.46	0.85	0.71	6	5	5	5	–1.34	–0.50	–0.73
Fiji	389	446	515	572	1.37	1.43	1.06	423	414	408	386	–0.20	–0.16	–0.56
French Polynesia	124	139	155	174	1.12	1.10	1.12	113	132	143	144	1.50	0.84	0.07
Guam	144	168	189	209	1.49	1.20	1.00	11	12	13	13	1.38	0.53	–0.23
Kiribati	36	44	53	64	1.89	1.89	2.02	48	56	63	68	1.55	1.21	0.70
Marshall Islands	36	39	46	52	0.81	1.82	1.17	16	15	16	15	–0.70	0.28	–0.39
Micronesia (Federated States of)	24	25	28	34	0.45	1.23	1.90	83	86	90	95	0.34	0.49	0.46
Nauru	10	10	11	11	0.21	0.51	0.22	—	—	—	—	—	—	—
New Caledonia	131	155	175	198	1.70	1.22	1.20	81	96	112	117	1.65	1.55	0.43
New Zealand	3,305	3,765	4,185	4,568	1.30	1.06	0.88	553	603	639	643	0.87	0.58	0.06
Niue	1	1	0	0	–1.33	–1.30	0.27	1	1	1	1	–3.26	–3.19	–1.48
Northern Mariana Islands	62	56	65	71	–1.03	1.60	0.80	7	5	5	5	–2.45	0.15	–0.67
Palau	13	17	20	23	2.41	1.63	1.23	6	3	2	2	–5.26	–3.68	–1.50
Papua New Guinea	710	853	1,156	1,732	1.83	3.04	4.04	4,669	6,006	7,308	8,453	2.52	1.96	1.46
Pitcairn	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Samoa	39	37	36	38	–0.54	–0.30	0.72	138	146	156	162	0.60	0.62	0.40
Solomon Islands	65	108	168	242	5.10	4.44	3.67	344	430	516	599	2.24	1.82	1.49
Tokelau	—	—	—	—	—	—	—	2	1	1	1	–3.13	0.48	0.89
Tonga	23	24	27	33	0.76	1.17	1.83	75	80	84	88	0.56	0.47	0.49
Tuvalu	4	5	6	6	1.26	1.14	1.47	5	5	5	5	–0.35	–0.52	–0.18
Vanuatu	40	59	84	117	3.85	3.57	3.25	145	181	219	255	2.20	1.90	1.54
Wallis and Futuna Islands	—	—	—	—	—	—	—	14	14	13	13	–0.67	–0.41	0.06

Notes:
(1) Including Agalega, Rodrigues, and Saint Brandon.
(2) Including Ascension, and Tristan da Cunha.
(3) Including Zanzibar.
(4) Including Nagorno-Karabakh.
(5) For statistical purposes, the data for China do not include Hong Kong and Macao, Special Administrative Regions (SAR) of China.
(6) As of 1 July 1997, Hong Kong became a Special Administrative Region (SAR) of China.
(7) As of 20 December 1999, Macao became a Special Administrative Region (SAR) of China.
(8) Including Northern-Cyprus.
(9) Including Abkhazia and South Ossetia.
(10) Including Sabah and Sarawak.
(11) Including East Jerusalem.
(12) Refers to Guernsey, and Jersey.
(13) Including Åland Islands.
(14) Refers to the Vatican City State.
(15) Including Transnistria.
(16) Including Svalbard and Jan Mayen Islands.
(17) Including Kosovo.
(18) Including Canary Islands, Ceuta and Melilla.
(19) The former Yugoslav Republic of Macedonia.
(20) Including Saint-Barthélemy and Saint-Martin (French part).
(21) Refers to Curaçao, Sint Maarten (Dutch part), Bonaire, Saba and Sint Eustatius.
(22) Including Christmas Island, Cocos (Keeling) Islands, and Norfolk Island.

Sources: United Nations Department of Economic and Social Affairs, Population Division (2012) World Urbanization Prospects: The 2011 Revision, United Nations, New York.

TABLE B.3

Urbanization and Urban Slum Dwellers

	Level of urbanization							Urban slum dwellers Estimates (%)			
	Estimates and projections (%)				Rate of change (%)						
	2000	2010	2020	2030	2000–2010	2010–2020	2020–2030	2000	2005	2007	2009
AFRICA											
Algeria	60.8	72.0	79.4	83.3	1.70	0.97	0.48	...	...	...	...
Angola	49.0	58.4	65.4	70.2	1.75	1.14	0.71	...	86.5	76.2	65.8
Benin	38.3	44.3	50.6	56.5	1.44	1.35	1.09	74.3	71.8	70.8	69.8
Botswana	53.2	61.0	66.9	71.2	1.36	0.93	0.63	...	...	...	...
Burkina Faso	17.8	25.7	34.0	41.5	3.64	2.81	1.99	65.9	59.5	59.5	...
Burundi	8.2	10.6	13.7	17.5	2.55	2.52	2.48	...	64.3	64.3	...
Cameroon	45.5	51.5	57.1	62.2	1.23	1.03	0.85	48.4	47.4	46.6	46.1
Cape Verde	53.4	61.8	68.7	73.4	1.46	1.05	0.66	...	...	...	...
Central African Republic	37.6	38.8	41.9	46.8	0.32	0.74	1.12	91.9	94.1	95.0	95.9
Chad	21.5	21.7	23.1	26.5	0.09	0.61	1.38	93.9	91.3	90.3	89.3
Comoros	28.1	28.0	29.4	32.4	–0.04	0.49	1.00	65.4	68.9	68.9	...
Congo	58.7	63.2	67.4	71.1	0.74	0.64	0.54	...	53.4	51.7	49.9
Côte d'Ivoire	43.5	50.6	57.5	63.1	1.49	1.28	0.94	55.3	56.2	56.6	57.0
Democratic Republic of the Congo	29.3	33.7	39.3	45.2	1.41	1.54	1.40	...	76.4	69.1	61.
Djibouti	76.5	77.0	78.0	79.8	0.06	0.13	0.23	...	...	...	...
Egypt	42.8	43.4	45.5	49.6	0.13	0.48	0.87	28.1	17.1	17.1	17.1
Equatorial Guinea	38.8	39.3	41.5	45.2	0.14	0.54	0.86	...	66.3	...	...
Eritrea	17.6	20.9	25.8	31.5	1.70	2.10	1.99	...	...	...	...
Ethiopia	14.7	16.8	19.7	23.9	1.28	1.60	1.96	88.6	81.8	79.1	76.4
Gabon	80.1	85.8	88.4	90.0	0.69	0.29	0.19	...	38.7	...	...
Gambia	48.8	56.7	61.6	65.7	1.49	0.84	0.65	...	45.4	34.8	...
Ghana	44.0	51.2	57.5	62.8	1.53	1.15	0.88	52.1	45.4	42.8	40.1
Guinea	31.0	35.0	40.2	46.2	1.20	1.39	1.40	57.3	45.7	45.7	...
Guinea-Bissau	35.9	43.2	49.7	54.7	1.87	1.39	0.96	...	83.1	...	...
Kenya	19.9	23.6	27.9	33.2	1.70	1.69	1.72	54.8	54.8	54.8	54.7
Lesotho	20.0	26.8	34.1	41.0	2.96	2.39	1.83	...	35.1	44.4	53.7
Liberia	44.3	47.8	51.8	56.4	0.75	0.80	0.86	...	...	...	68.3
Libyan Arab Jamahiriya	76.3	77.6	79.4	81.5	0.16	0.24	0.25	...	...	...	...
Madagascar	27.1	31.9	38.3	44.7	1.63	1.83	1.54	84.1	80.6	78.0	76.2
Malawi	14.6	15.5	17.4	20.8	0.62	1.13	1.80	66.4	66.4	67.7	68.9
Mali	28.1	34.3	40.8	47.1	1.99	1.73	1.45	75.4	65.9	65.9	65.9
Mauritania	40.0	41.2	44.6	49.8	0.31	0.78	1.10	...	...	...	...
Mauritius[1]	42.7	41.8	42.5	45.3	–0.21	0.17	0.63	...	...	...	...
Mayotte	47.7	50.1	51.0	53.7	0.47	0.18	0.52	...	...	...	...
Morocco	53.3	56.7	60.4	64.6	0.61	0.64	0.66	24.2	13.1	13.1	13.1
Mozambique	29.1	31.0	33.9	38.6	0.62	0.92	1.28	78.2	79.5	80.0	80.5
Namibia	32.4	37.8	43.6	49.6	1.55	1.43	1.29	33.9	33.9	33.6	33.5
Niger	16.2	17.6	20.6	25.3	0.85	1.55	2.07	82.6	82.1	81.9	81.7
Nigeria	42.4	49.0	55.0	60.8	1.46	1.16	1.00	69.6	65.8	64.2	62.7
Réunion	89.9	94.0	95.7	96.4	0.45	0.17	0.07	...	...	...	...
Rwanda	13.8	18.8	22.2	27.0	3.12	1.66	1.96	79.7	71.6	68.3	65.1
Saint Helena[2]	40.4	39.5	40.1	42.6	–0.21	0.14	0.62	...	...	...	...
São Tomé and Príncipe	53.4	62.0	68.0	71.9	1.49	0.92	0.55	...	...	...	...
Senegal	40.3	42.3	45.7	50.8	0.46	0.79	1.05	48.9	43.3	41.1	38.8
Seychelles	50.4	53.2	57.1	60.9	0.55	0.70	0.65	...	...	...	...
Sierra Leone	35.8	38.9	43.0	48.2	0.82	1.00	1.16	...	97.0	...	...
Somalia	33.2	37.3	42.2	48.0	1.15	1.24	1.28	...	73.5	73.6	73.6
South Africa	56.9	61.5	65.9	69.8	0.79	0.68	0.58	33.2	28.7	23.0	23.0
South Sudan	16.5	17.9	20.2	24.0	0.79	1.21	1.76	...	...	...	...
Sudan	32.5	33.1	35.1	39.2	0.18	0.59	1.12	...	...	...	...
Swaziland	22.6	21.3	21.4	23.3	–0.60	0.04	0.85	...	...	...	...
Togo	32.9	37.5	42.5	47.9	1.32	1.25	1.20	...	62.1	...	...
Tunisia	63.4	66.1	68.4	71.2	0.41	0.34	0.40	...	...	...	...
Uganda	12.1	15.2	19.6	24.7	2.27	2.55	2.32	75.0	66.7	63.4	60.1
United Republic of Tanzania[3]	22.3	26.3	31.2	37.0	1.64	1.70	1.72	70.1	66.4	65.0	63.5
Western Sahara	83.9	81.8	83.8	85.7	–0.25	0.24	0.22	...	...	...	...
Zambia	34.8	38.7	43.3	48.4	1.07	1.11	1.12	57.2	57.2	57.3	57.3
Zimbabwe	33.8	38.1	43.2	49.0	1.22	1.25	1.25	3.3	17.9	21.0	24.1
ASIA											
Afghanistan	20.6	23.2	26.6	31.2	1.21	1.35	1.60	...	...	...	...
Armenia	64.7	64.1	65.0	67.4	–0.09	0.14	0.37	...	...	...	...
Azerbaijan[4]	51.4	53.4	56.1	59.9	0.38	0.49	0.65	...	...	...	...
Bahrain	88.4	88.6	89.4	90.7	0.03	0.09	0.14	...	...	...	...
Bangladesh	23.6	27.9	33.1	39.1	1.68	1.71	1.68	77.8	70.8	66.2	61.6
Bhutan	25.4	34.8	42.2	48.3	3.14	1.94	1.34	...	...	...	...

continued . . .

TABLE B.3

continued

	Level of urbanization							Urban slum dwellers			
	Estimates and projections (%)				Rate of change (%)			Estimates (%)			
	2000	2010	2020	2030	2000–2010	2010–2020	2020–2030	2000	2005	2007	2009
Brunei Darussalam	71.2	75.6	79.0	81.6	0.60	0.44	0.32	...	...	...	...
Cambodia	18.6	19.8	22.1	26.0	0.64	1.08	1.65	...	78.9	...	...
China[5]	35.9	49.2	61.0	68.7	3.16	2.14	1.20	37.3	32.9	31.0	29.1
China, Hong Kong SAR[6]	100.0	100.0	100.0	100.0	0.00	0.00	0.00	...	...	...	...
China, Macao SAR[7]	100.0	100.0	100.0	100.0	0.00	0.00	0.00	...	...	...	...
Cyprus[8]	68.6	70.3	72.4	75.0	0.24	0.30	0.35	...	...	...	...
Democratic People's Republic of Korea	59.4	60.2	61.9	64.8	0.13	0.27	0.46	...	...	...	...
Georgia[9]	52.6	52.7	54.4	57.7	0.02	0.30	0.59	...	...	...	...
India	27.7	30.9	34.8	39.8	1.11	1.19	1.33	41.5	34.8	32.1	29.4
Indonesia	42.0	49.9	57.2	63.1	1.73	1.36	0.98	34.4	26.3	23.0	23.0
Iran (Islamic Republic of)	64.0	68.9	70.6	72.9	0.74	0.23	0.32	...	...	...	...
Iraq	67.8	66.5	66.7	68.6	–0.19	0.02	0.28	16.9	52.8	52.8	52.8
Israel	91.2	91.8	92.4	93.0	0.07	0.07	0.06	...	...	...	...
Japan	78.6	90.5	95.3	96.8	1.41	0.51	0.17	...	...	...	...
Jordan	79.8	82.5	84.7	86.5	0.33	0.27	0.20	...	15.8	17.7	19.6
Kazakhstan	55.7	53.7	53.5	55.9	–0.36	–0.05	0.44	...	...	...	...
Kuwait	98.1	98.2	98.4	98.5	0.01	0.01	0.01	...	...	...	...
Kyrgyzstan	35.3	35.3	36.7	40.4	0.00	0.39	0.96	...	...	...	...
Lao People's Democratic Republic	22.0	33.1	43.6	51.5	4.10	2.76	1.66	...	79.3	...	...
Lebanon	86.0	87.1	88.2	89.3	0.13	0.13	0.12	...	53.1	...	...
Malaysia[10]	62.0	72.0	77.9	81.1	1.50	0.79	0.40	...	...	...	...
Maldives	27.7	40.0	50.3	56.7	3.67	2.29	1.20	...	...	...	...
Mongolia	57.1	67.6	75.5	80.3	1.68	1.12	0.61	64.9	57.9	57.9	...
Myanmar	27.2	32.1	37.9	44.1	1.65	1.66	1.51	...	45.6	...	...
Nepal	13.4	16.7	20.3	24.8	2.15	1.96	2.03	64.0	60.7	59.4	58.1
Occupied Palestinian Territory[11]	72.0	74.1	76.3	78.6	0.30	0.29	0.29	...	...	...	...
Oman	71.6	73.2	75.7	78.1	0.22	0.34	0.32	...	...	...	...
Pakistan	33.1	35.9	39.5	44.4	0.80	0.97	1.17	48.7	47.5	47.0	46.6
Philippines	48.0	48.6	51.6	56.3	0.14	0.59	0.88	47.2	43.7	42.3	40.9
Qatar	96.3	98.7	99.5	99.7	0.24	0.09	0.02	...	...	...	...
Republic of Korea	79.6	82.9	85.4	87.1	0.41	0.29	0.20	...	...	...	...
Saudi Arabia	79.8	82.1	84.1	85.7	0.28	0.24	0.19	...	18.0	...	...
Singapore	100.0	100.0	100.0	100.0	0.00	0.00	0.00	...	...	...	...
Sri Lanka	15.7	15.0	16.4	20.1	–0.43	0.89	2.03	...	...	...	...
Syrian Arab Republic	51.9	55.7	59.7	64.0	0.69	0.70	0.70	...	10.5	22.5	...
Tajikistan	26.5	26.5	27.5	30.7	0.01	0.39	1.09	...	...	...	...
Thailand	31.1	33.7	38.0	43.7	0.80	1.18	1.40	...	26.0	26.5	27.0
Timor-Leste	24.3	28.0	31.8	35.8	1.42	1.30	1.18	...	...	...	...
Turkey	64.7	70.5	78.6	83.1	0.85	1.09	0.56	17.9	15.5	14.1	13.0
Turkmenistan	45.9	48.4	52.0	56.7	0.53	0.72	0.87	...	...	...	...
United Arab Emirates	80.2	84.0	86.7	88.3	0.46	0.31	0.19	...	...	...	...
Uzbekistan	37.4	36.2	37.3	41.4	–0.33	0.31	1.02	...	...	...	...
Viet Nam	24.4	30.4	36.9	43.3	2.21	1.93	1.61	48.8	41.3	38.3	35.2
Yemen	26.3	31.7	37.7	43.8	1.89	1.71	1.52	...	67.2	76.8	...
EUROPE											
Albania	41.7	52.3	62.2	69.1	2.26	1.73	1.05	...	...	...	...
Andorra	92.4	87.8	83.0	81.1	–0.51	–0.57	–0.23	...	...	...	...
Austria	65.8	67.5	69.7	72.5	0.25	0.33	0.39	...	...	...	...
Belarus	70.0	74.6	78.4	81.2	0.64	0.50	0.35	...	...	...	...
Belgium	97.1	97.5	97.7	97.9	0.03	0.03	0.02	...	...	...	...
Bosnia and Herzegovina	43.0	47.7	53.2	58.7	1.04	1.09	0.98	...	...	...	...
Bulgaria	68.9	72.5	77.6	81.0	0.51	0.68	0.43	...	...	...	...
Channel Islands[12]	30.5	31.1	32.7	35.5	0.20	0.52	0.81	...	...	...	...
Croatia	55.6	57.5	60.7	64.8	0.34	0.54	0.65	...	...	...	...
Czech Republic	74.0	73.5	73.6	74.9	–0.07	0.01	0.18	...	...	...	...
Denmark	85.1	86.8	88.1	89.2	0.20	0.15	0.13	...	...	...	...
Estonia	69.4	69.5	70.3	72.5	0.01	0.13	0.30	...	...	...	...
Faroe Islands	36.3	40.9	43.3	46.5	1.19	0.56	0.73	...	...	...	...
Finland[13]	82.2	83.6	84.9	86.2	0.17	0.15	0.15	...	...	...	...
France	76.9	85.2	89.6	91.4	1.03	0.50	0.21	...	...	...	...
Germany	73.1	73.8	75.3	77.4	0.10	0.20	0.28	...	...	...	...
Gibraltar	100.0	100.0	100.0	100.0	0.00	0.00	0.00	...	...	...	...
Greece	59.7	61.2	64.0	67.6	0.25	0.44	0.56	...	...	...	...
Holy See[14]	100.0	100.0	100.0	100.0	0.00	0.00	0.00	...	...	...	...
Hungary	64.6	69.0	73.4	76.8	0.66	0.62	0.45	...	...	...	...
Iceland	92.4	93.6	94.6	95.4	0.13	0.11	0.08	...	...	...	...

continued . . .

TABLE B.3

continued

	Level of urbanization							Urban slum dwellers Estimates (%)			
	Estimates and projections (%)				Rate of change (%)						
	2000	2010	2020	2030	2000–2010	2010–2020	2020–2030	2000	2005	2007	2009
Ireland	59.1	61.9	65.1	68.6	0.45	0.50	0.53	…	…	…	…
Isle of Man	51.8	50.6	50.6	52.2	–0.24	0.00	0.31	…	…	…	…
Italy	67.2	68.2	70.3	73.2	0.15	0.30	0.40	…	…	…	…
Latvia	68.1	67.7	68.1	70.1	–0.05	0.06	0.28	…	…	…	…
Liechtenstein	15.1	14.4	14.4	15.5	–0.46	–0.04	0.72	…	…	…	…
Lithuania	67.0	67.0	68.4	70.8	0.00	0.21	0.35	…	…	…	…
Luxembourg	83.8	85.2	87.3	89.0	0.17	0.25	0.19	…	…	…	…
Malta	92.4	94.7	96.0	96.7	0.25	0.14	0.07	…	…	…	…
Moldova[15]	44.6	46.9	53.9	59.8	0.51	1.38	1.04	…	…	…	…
Monaco	100.0	100.0	100.0	100.0	0.00	0.00	0.00	…	…	…	…
Montenegro	58.5	63.1	65.2	68.0	0.75	0.33	0.42	…	…	…	…
Netherlands	76.8	82.7	86.1	87.8	0.75	0.39	0.20	…	…	…	…
Norway[16]	76.1	79.1	81.7	83.8	0.39	0.32	0.25	…	…	…	…
Poland	61.7	60.9	60.9	62.9	–0.13	0.00	0.32	…	…	…	…
Portugal	54.4	60.5	65.6	69.8	1.06	0.81	0.62	…	…	…	…
Romania	53.0	52.8	53.5	56.1	–0.04	0.14	0.47	…	…	…	…
Russian Federation	73.3	73.7	75.5	77.6	0.04	0.24	0.27	…	…	…	…
San Marino	93.4	94.1	94.4	95.0	0.07	0.03	0.06	…	…	…	…
Serbia[17]	53.0	56.0	59.6	63.7	0.56	0.62	0.66	…	…	…	…
Slovakia	56.2	54.8	54.9	57.5	–0.25	0.02	0.45	…	…	…	…
Slovenia	50.8	50.0	50.3	53.0	–0.16	0.06	0.52	…	…	…	…
Spain[18]	76.3	77.3	78.9	80.8	0.13	0.20	0.25	…	…	…	…
Sweden	84.0	85.1	86.5	87.8	0.12	0.17	0.15	…	…	…	…
Switzerland	73.3	73.6	74.6	76.4	0.04	0.13	0.24	…	…	…	…
TFYR Macedonia[19]	59.4	59.2	60.9	64.5	–0.03	0.29	0.56	…	…	…	…
Ukraine	67.1	68.7	70.8	73.4	0.23	0.30	0.36	…	…	…	…
United Kingdom	78.7	79.5	80.9	82.7	0.11	0.17	0.22	…	…	…	…
LATIN AMERICA AND THE CARIBBEAN											
Anguilla	100.0	100.0	100.0	100.0	0.00	0.00	0.00	…	…	…	…
Antigua and Barbuda	32.1	29.9	30.5	33.7	–0.72	0.21	0.99	…	…	…	…
Argentina	90.1	92.3	93.6	94.3	0.24	0.14	0.07	32.9	26.2	23.5	20.8
Aruba	46.7	46.8	48.0	50.4	0.02	0.26	0.49	…	…	…	…
Bahamas	82.0	84.1	85.9	87.7	0.24	0.22	0.20	…	…	…	…
Barbados	38.3	43.9	48.8	53.2	1.35	1.07	0.85	…	…	…	…
Belize	47.7	45.0	43.8	45.3	–0.58	–0.27	0.34	…	…	18.7	…
Bolivia	61.8	66.4	70.4	73.8	0.71	0.58	0.48	54.3	50.4	48.8	47.3
Brazil	81.2	84.3	86.8	88.5	0.38	0.29	0.19	31.5	29.0	28.0	26.9
British Virgin Islands	39.4	40.4	43.1	47.0	0.25	0.62	0.87	…	…	…	…
Cayman Islands	100.0	100.0	100.0	100.0	0.00	0.00	0.00	…	…	…	…
Chile	85.9	88.9	90.7	91.7	0.34	0.20	0.11	…	9.0	…	…
Colombia	72.1	75.0	77.7	80.0	0.40	0.35	0.30	22.3	17.9	16.1	14.3
Costa Rica	59.0	64.2	68.6	72.3	0.84	0.66	0.53	…	10.9	…	…
Cuba	75.6	75.2	75.3	76.8	–0.05	0.02	0.19	…	…	…	…
Dominica	67.2	67.1	68.7	71.6	–0.02	0.24	0.42	…	…	…	…
Dominican Republic	61.7	69.1	74.2	77.6	1.12	0.72	0.45	21.0	17.6	16.2	14.8
Ecuador	60.3	66.9	72.0	75.7	1.03	0.75	0.49	…	21.5	…	…
El Salvador	58.9	64.3	68.9	72.7	0.87	0.69	0.54	…	28.9	…	…
Falkland Islands (Malvinas)	67.6	73.6	78.0	81.1	0.85	0.58	0.39	…	…	…	…
French Guiana	75.1	76.2	78.2	80.6	0.15	0.25	0.30	…	10.5	…	…
Grenada	36.0	38.8	42.4	46.5	0.74	0.88	0.92	…	6.0	…	…
Guadeloupe[20]	98.4	98.4	98.5	98.7	0.00	0.01	0.02	…	5.4	…	…
Guatemala	45.1	49.3	54.0	59.0	0.89	0.90	0.89	48.1	42.9	40.8	38.7
Guyana	28.7	28.3	29.7	32.8	–0.13	0.46	1.01	…	33.7	33.5	33.2
Haiti	35.6	52.0	63.8	70.3	3.79	2.04	0.97	93.4	70.1	70.1	70.1
Honduras	45.5	51.6	57.2	62.3	1.26	1.03	0.85	…	34.9	…	…
Jamaica	51.8	52.0	53.3	56.6	0.03	0.25	0.60	…	60.5	…	…
Martinique	89.7	89.0	89.1	90.0	–0.07	0.01	0.10	…	…	…	…
Mexico	74.7	77.8	80.5	82.7	0.41	0.34	0.27	19.9	14.4	14.4	…
Montserrat	11.0	14.1	15.7	18.0	2.46	1.09	1.37	…	…	…	…
Netherlands Antilles[21]	90.2	93.2	94.8	95.5	0.33	0.17	0.08	…	…	…	…
Nicaragua	54.7	57.3	60.5	64.4	0.45	0.55	0.63	60.0	45.5	45.5	…
Panama	65.8	74.6	79.7	82.5	1.26	0.66	0.34	…	23.0	…	…
Paraguay	55.3	61.4	66.4	70.5	1.04	0.79	0.60	…	17.6	…	…
Peru	73.0	76.9	80.0	82.4	0.52	0.40	0.29	46.2	36.1	36.1	…
Puerto Rico	94.6	98.8	99.4	99.5	0.43	0.07	0.01	…	…	…	…
Saint Kitts and Nevis	32.8	31.9	33.4	36.8	–0.26	0.43	0.98	…	…	…	…

continued . . .

TABLE B.3

continued

	Level of urbanization							Urban slum dwellers			
	Estimates and projections (%)				Rate of change (%)			Estimates (%)			
	2000	2010	2020	2030	2000–2010	2010–2020	2020–2030	2000	2005	2007	2009
Saint Lucia	28.0	18.3	12.9	11.7	–4.22	–3.50	–0.97	...	11.9	...	...
Saint Vincent and the Grenadines	45.2	48.9	52.9	56.9	0.79	0.78	0.74		...	...	...
Suriname	64.9	69.3	73.1	76.3	0.67	0.53	0.42	...	3.9	...	...
Trinidad and Tobago	10.8	13.4	16.1	18.8	2.16	1.81	1.54	...	24.7	...	...
Turks and Caicos Islands	84.5	93.3	96.5	97.4	0.98	0.34	0.10	...	...	...	...
United States Virgin Islands	92.6	95.3	96.5	97.0	0.28	0.13	0.06	...	...	...	...
Uruguay	91.3	92.5	93.3	93.9	0.12	0.09	0.07	...	...	...	...
Venezuela (Bolivarian Republic of)	89.9	93.3	94.9	95.5	0.37	0.17	0.07	...	32.0	...	...
NORTHERN AMERICA											
Bermuda	100.0	100.0	100.0	100.0	0.00	0.00	0.00	...	...	...	...
Canada	79.5	80.6	81.7	83.3	0.13	0.15	0.19	...	...	...	...
Greenland	81.6	84.4	87.0	88.9	0.34	0.30	0.22	...	...	...	...
Saint-Pierre-et-Miquelon	89.1	90.6	91.8	92.9	0.16	0.14	0.11	...	...	...	...
United States of America	79.1	82.1	84.4	86.0	0.38	0.27	0.19	...	...	...	...
OCEANIA											
American Samoa	88.8	93.0	94.8	95.6	0.46	0.20	0.08	...	...	...	...
Australia[22]	87.2	89.0	90.4	91.3	0.21	0.15	0.10	...	...	...	...
Cook Islands	65.2	73.3	75.8	78.4	1.17	0.34	0.33	...	...	...	...
Fiji	47.9	51.8	55.8	59.7	0.79	0.74	0.68	...	...	...	...
French Polynesia	52.4	51.4	52.1	54.7	–0.19	0.12	0.49	...	...	...	...
Guam	93.1	93.2	93.6	94.3	0.01	0.04	0.07	...	...	...	...
Kiribati	43.0	43.8	45.5	48.8	0.20	0.38	0.70	...	...	...	...
Marshall Islands	68.4	71.5	74.6	77.4	0.45	0.41	0.38	...	...	...	...
Micronesia (Federated States of)	22.3	22.5	23.8	26.5	0.08	0.57	1.08	...	...	...	...
Nauru	100.0	100.0	100.0	100.0	0.00	0.00	0.00	...	...	...	...
New Caledonia	61.8	61.9	61.1	62.9	0.02	–0.13	0.29	...	...	...	...
New Zealand	85.7	86.2	86.7	87.7	0.06	0.06	0.10	...	...	...	...
Niue	33.1	37.5	42.0	46.3	1.25	1.14	0.98	...	...	...	...
Northern Mariana Islands	90.2	91.3	92.4	93.4	0.13	0.12	0.10	...	...	...	...
Palau	70.0	83.4	89.5	91.8	1.75	0.71	0.25	...	...	...	...
Papua New Guinea	13.2	12.4	13.7	17.0	–0.60	0.94	2.19	...	...	...	...
Pitcairn	...	...	...	...	...	...	...	...	...	...	...
Samoa	22.0	20.1	18.6	19.1	–0.90	–0.75	0.26	...	...	...	...
Solomon Islands	15.8	20.0	24.5	28.8	2.35	2.04	1.60	...	...	...	...
Tokelau	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	...	...	...
Tonga	23.0	23.4	24.7	27.2	0.15	0.54	1.00	...	...	...	...
Tuvalu	46.1	50.1	54.3	58.3	0.84	0.79	0.72	...	...	...	...
Vanuatu	21.7	24.6	27.8	31.4	1.26	1.23	1.21	...	...	...	...
Wallis and Futuna Islands	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	...	...	...

Notes:

(1) Including Agalega, Rodrigues, and Saint Brandon.
(2) Including Ascension, and Tristan da Cunha.
(3) Including Zanzibar.
(4) Including Nagorno-Karabakh.
(5) For statistical purposes, the data for China do not include Hong Kong and Macao, Special Administrative Regions (SAR) of China.
(6) As of 1 July 1997, Hong Kong became a Special Administrative Region (SAR) of China.
(7) As of 20 December 1999, Macao became a Special Administrative Region (SAR) of China.
(8) Including Northern-Cyprus.
(9) Including Abkhazia and South Ossetia.
(10) Including Sabah and Sarawak.
(11) Including East Jerusalem.
(12) Refers to Guernsey, and Jersey.
(13) Including Åland Islands.
(14) Refers to the Vatican City State.
(15) Including Transnistria.
(16) Including Svalbard and Jan Mayen Islands.
(17) Including Kosovo.
(18) Including Canary Islands, Ceuta and Melilla.
(19) The former Yugoslav Republic of Macedonia.
(20) Including Saint-Barthélemy and Saint-Martin (French part).
(21) Refers to Curaçao, Sint Maarten (Dutch part), Bonaire, Saba and Sint Eustatius.
(22) Including Christmas Island, Cocos (Keeling) Islands, and Norfolk Island.

Sources: United Nations Department of Economic and Social Affairs, Population Division (2012) World Urbanization Prospects: The 2011 Revision, United Nations, New York, United Nations Department of Economic and Social Affairs, Population Division (2011) World Population Prospects: The 2010 Revision, United Nations, New York, United Nations Human Settlements Programme (UN-Habitat), Global Urban Indicators Database 2012.

TABLE B.4

Number of Urban Households, Rate of Change and Mean Household Size

	Number of households								Mean household size			
	Estimates and projections ('000)				Rate of change (%)		Ten year increment ('000)		Estimates and projections			
	2000	2010	2020	2030	2000–2010	2000–2010	2010–2020	2020–2030	2000	2010	2020	2030
AFRICA												
Algeria	...	...	...	...	...	...	...	...	...	...	...	...
Angola	1,139	1,794	2,828	3,550	4.55	656	1,033	722	5.99	6.21	5.73	6.09
Benin	478	926	1,795	2,499	6.62	448	869	704	5.23	4.23	3.25	3.31
Botswana	297	462	718	895	4.41	165	256	177	3.15	2.65	2.06	1.86
Burkina Faso	386	819	1,736	2,527	7.51	432	917	791	5.68	5.16	4.34	4.78
Burundi	92	182	359	505	6.80	90	177	146	5.70	4.90	3.83	3.98
Cameroon	1,417	2,492	4,382	5,811	5.65	1,075	1,890	1,429	5.04	4.05	3.14	3.08
Cape Verde	61	70	85	98	1.25	8	15	13	3.80	4.40	4.40	4.40
Central African Republic	248	320	419	558	2.55	72	99	139	5.61	5.34	5.34	5.34
Chad	334	444	608	889	2.84	110	164	281	5.30	5.50	5.50	5.50
Comoros	26	38	54	65	3.58	11	16	11	5.98	5.44	5.08	5.83
Congo	354	581	953	1,221	4.95	227	373	268	5.20	4.40	3.54	3.59
Côte d'Ivoire	1,343	2,030	3,070	3,775	4.13	688	1,040	705	5.38	4.92	4.59	4.99
Democratic Republic of the Congo	2,187	4,058	7,529	10,256	6.18	1,871	3,472	2,727	6.65	5.48	4.44	4.67
Djibouti	90	110	135	149	2.00	20	24	14	6.20	6.20	6.17	6.77
Egypt	6,518	8,863	12,053	14,055	3.07	2,345	3,189	2,002	4.44	3.97	3.58	3.76
Equatorial Guinea	37	...	...	...	...	...	...	...	5.50	...	...	...
Eritrea	138	234	397	517	5.30	96	163	120	4.70	4.70	4.45	5.11
Ethiopia	2,301	3,310	4,759	5,707	3.63	1,008	1,450	948	4.20	4.20	4.18	4.97
Gabon	198	...	...	...	...	...	...	...	5.00	...	...	...
Gambia	117	163	227	268	3.31	46	64	41	5.40	6.00	6.08	6.91
Ghana	2,478	3,674	5,449	6,635	3.94	1,197	1,774	1,186	3.40	3.40	3.20	3.46
Guinea	384	607	962	1,211	4.60	224	355	249	6.75	5.75	5.33	6.09
Guinea-Bissau	54	96	173	232	5.86	43	77	59	8.30	6.80	5.35	5.33
Kenya	1,907	3,121	5,107	6,532	4.92	1,214	1,986	1,426	3.26	3.06	2.87	3.35
Lesotho	135	201	299	364	3.96	66	98	65	2.90	2.90	2.73	2.89
Liberia	...	347	...	...	...	...	...	...	...	5.50	...	...
Libyan Arab Jamahiriya	...	880	...	...	...	...	...	...	...	5.60	...	...
Madagascar	906	1,619	2,892	3,866	5.80	713	1,274	974	4.60	4.09	3.63	4.09
Malawi	374	584	908	1,481	4.47	210	324	574	4.39	3.96	3.96	3.96
Mali	559	959	1,645	2,155	5.40	400	687	510	5.68	5.49	5.09	5.85
Mauritania	176	223	299	404	2.35	47	76	105	6.00	6.40	6.40	6.40
Mauritius	134	...	...	...	...	...	...	...	3.80	...	...	...
Mayotte	...	...	...	...	...	...	...	...	...	...	...	...
Morocco	2,925	3,929	5,277	6,116	2.95	1,004	1,348	839	5.25	4.61	4.02	3.96
Mozambique	974	1,601	2,633	3,376	4.97	627	1,032	744	5.44	4.52	3.76	4.10
Namibia	143	234	384	491	4.93	91	149	107	4.29	3.69	3.04	3.08
Niger	281	429	712	1,223	4.23	148	284	511	6.29	6.38	6.38	6.38
Nigeria	11,348	18,150	29,030	36,713	4.70	6,802	10,879	7,683	4.62	4.28	3.86	4.27
Réunion	...	...	...	...	...	...	...	...	...	...	...	...
Rwanda	232	400	690	906	5.45	168	290	216	4.81	5.00	4.52	5.24
Saint Helena	1	1	1	1	–0.60	0	0	0	2.60	2.20	2.33	2.63
São Tomé and Príncipe	17	27	44	55	4.71	10	16	12	4.43	3.76	3.11	3.05
Senegal	490	675	941	1,304	3.21	185	265	363	7.83	7.78	7.78	7.78
Seychelles	10	13	17	19	2.65	3	4	2	3.95	3.52	3.01	2.89
Sierra Leone	241	400	662	853	5.05	159	263	190	6.16	5.71	4.66	4.82
Somalia	...	570	...	...	...	...	...	...	...	6.10	...	...
South Africa	7,014	12,909	14,487	15,982	6.10	5,896	1,578	1,494	3.63	2.39	2.39	2.39
South Sudan	168	279	462	595	5.05	111	183	133	6.50	6.37	5.72	6.51
Sudan	1,426	1,806	2,385	3,236	2.36	380	579	851	6.28	6.16	6.16	6.16
Swaziland	72	93	119	135	2.49	20	26	16	3.33	2.73	2.41	2.53
Togo	331	546	901	1,157	5.01	215	355	257	4.77	4.15	3.47	3.60
Tunisia	...	...	...	...	...	...	...	...	...	...	...	...
Uganda	713	1,308	2,292	3,810	6.06	594	985	1,517	4.10	3.88	3.88	3.88
United Republic of Tanzania	1,766	2,740	4,426	7,042	4.39	974	1,685	2,616	4.30	4.30	4.30	4.30
Western Sahara	...	...	...	...	...	...	...	...	...	...	...	...
Zambia	637	1,025	1,568	2,397	4.75	387	543	829	5.57	4.95	4.95	4.95
Zimbabwe	1,108	1,169	1,638	2,105	0.54	61	469	466	3.81	4.10	4.10	4.10
ASIA												
Afghanistan	...	1,000	...	...	...	...	...	...	...	7.30	...	...
Armenia	485	566	660	713	1.54	81	94	53	4.10	3.50	3.10	2.94
Azerbaijan	985	1,377	1,925	2,275	3.35	392	547	351	4.23	3.56	2.98	2.84
Bahrain	125	248	300	333	6.84	123	51	34	4.50	4.50	4.50	4.50
Bangladesh	6,006	9,132	13,884	17,119	4.19	3,126	4,752	3,235	5.09	4.54	3.99	4.16
Bhutan	...	...	...	...	...	...	...	...	...	...	...	...

continued . . .

TABLE B.4

continued

	Number of households								Mean household size			
	Estimates and projections ('000)				Rate of change (%)		Ten year increment ('000)		Estimates and projections			
	2000	2010	2020	2030	2000–2010	2000–2010	2010–2020	2020–2030	2000	2010	2020	2030
Brunei Darussalam	...	...	...	...	...	...	...	...	...	...	...	...
Cambodia	406	539	715	824	2.83	133	176	109	5.70	5.20	4.91	5.49
China	142,289	227,685	364,332	460,870	4.70	85,396	136,647	96,538	3.20	2.90	2.32	2.08
China, Hong Kong SAR	2,136	2,411	2,722	2,891	1.21	275	310	170	3.18	2.93	2.87	2.93
China, Macao SAR	138	196	278	332	3.52	58	82	53	3.14	2.78	2.35	2.24
Cyprus	206	274	365	422	2.87	68	91	56	3.15	2.83	2.42	2.32
Democratic People's Republic of Korea	...	...	...	...	...	...	...	...	...	...	...	...
Georgia	...	...	...	...	...	...	...	...	...	...	...	...
India	57,969	85,929	127,375	155,080	3.94	27,960	41,446	27,705	5.03	4.41	3.79	3.91
Indonesia	19,918	29,031	42,313	51,084	3.77	9,113	13,282	8,771	4.50	4.13	3.55	3.45
Iran (Islamic Republic of)	9,893	14,641	21,669	26,362	3.92	4,749	7,028	4,693	4.23	3.48	2.64	2.33
Iraq	2,345	3,902	6,493	8,376	5.09	1,557	2,591	1,883	6.90	5.40	4.38	4.53
Israel	1,597	2,038	2,600	2,937	2.44	441	562	337	3.44	3.34	3.08	3.11
Japan	36,621	47,342	61,200	69,584	2.57	10,720	13,859	8,384	2.70	2.42	1.94	1.67
Jordan	650	1,046	1,683	2,135	4.76	396	637	452	5.93	4.88	3.71	3.41
Kazakhstan	2,741	2,817	2,895	2,935	0.27	76	78	40	3.04	3.06	3.26	3.59
Kuwait	247	392	487	577	4.63	145	95	89	7.71	6.85	6.85	6.85
Kyrgyzstan	483	489	573	699	0.11	5	84	126	3.62	3.85	3.85	3.85
Lao People's Democratic Republic	205	437	654	850	7.57	232	217	196	5.70	4.70	4.70	4.70
Lebanon	777	1,051	1,421	1,653	3.02	274	371	232	4.14	3.51	2.80	2.54
Malaysia	3,480	5,589	8,976	11,376	4.74	2,109	3,387	2,399	4.17	3.66	2.86	2.66
Maldives	9	20	28	34	7.43	10	8	6	8.16	6.48	6.48	6.48
Mongolia	293	477	778	993	4.88	184	300	215	4.70	3.90	3.09	2.85
Myanmar	2,353	3,017	3,869	4,381	2.49	664	852	512	5.20	5.10	5.06	5.46
Nepal	662	1,202	2,184	2,943	5.97	540	981	759	4.95	4.15	3.26	3.37
Occupied Palestinian Territory	...	...	...	...	...	...	...	...	...	...	...	...
Oman	202	268	355	409	2.83	66	88	54	8.03	7.61	7.01	6.88
Pakistan	6,652	8,899	11,904	13,769	2.91	2,247	3,006	1,865	7.20	7.00	6.82	7.57
Philippines	7,438	9,947	13,303	15,384	2.91	2,509	3,356	2,081	4.99	4.56	4.26	4.62
Qatar	...	235	...	...	...	...	...	...	...	7.38	...	...
Republic of Korea	11,129	14,282	18,327	20,761	2.49	3,152	4,045	2,434	3.29	2.80	2.32	2.11
Saudi Arabia	2,610	3,930	5,918	7,262	4.09	1,320	1,988	1,344	6.13	5.73	4.76	4.54
Singapore	1,059	1,453	1,994	2,335	3.16	394	541	342	3.70	3.50	2.81	2.56
Sri Lanka	734	738	864	1,094	0.06	4	126	230	4.01	4.25	4.25	4.25
Syrian Arab Republic	1,603	2,112	2,782	3,193	2.76	509	670	411	5.18	5.38	5.17	5.58
Tajikistan	287	381	507	584	2.84	94	125	77	5.70	4.78	4.33	4.74
Thailand	5,287	7,482	10,589	12,596	3.47	2,195	3,106	2,008	3.72	3.12	2.59	2.54
Timor-Leste	...	53	...	...	...	...	...	...	...	5.90	...	...
Turkey	10,368	13,962	18,800	21,816	2.98	3,593	4,839	3,016	3.97	3.67	3.38	3.30
Turkmenistan	470	...	...	...	...	...	...	...	4.40	...	...	...
United Arab Emirates	...	1,540	...	...	...	...	...	...	...	4.10	...	...
Uzbekistan	2,016	2,114	2,445	2,937	0.48	98	331	492	4.60	4.70	4.70	4.70
Viet Nam	4,256	6,867	11,079	14,073	4.78	2,611	4,212	2,994	4.51	3.89	3.21	3.12
Yemen	644	1,082	1,819	2,359	5.19	438	737	540	7.23	7.06	6.67	7.68
EUROPE												
Albania	326	514	809	1,015	4.54	188	295	206	3.93	3.26	2.53	2.24
Andorra	...	...	...	...	...	...	...	...	...	...	...	...
Austria	2,634	2,831	3,043	3,155	0.72	197	212	112	2.00	2.00	1.95	1.98
Belarus	2,213	2,403	2,608	2,717	0.82	189	206	109	3.18	2.98	2.79	2.65
Belgium	3,801	4,350	4,978	5,325	1.35	549	628	347	2.60	2.40	2.16	2.07
Bosnia and Herzegovina	...	579	...	...	...	...	...	...	...	3.10	...	...
Bulgaria	2,048	2,223	2,413	2,513	0.82	175	190	101	2.69	2.45	2.25	2.08
Channel Islands	...	...	...	...	...	...	...	...	...	...	...	...
Croatia	852	...	...	...	...	...	...	...	2.94	...	...	...
Czech Republic	3,158	3,083	3,011	2,975	–0.24	–74	–73	–36	2.40	2.50	2.62	2.72
Denmark	2,249	2,153	2,061	2,016	–0.44	–96	–92	–45	2.02	2.24	2.45	2.61
Estonia	409	411	413	414	0.04	2	2	1	2.32	2.27	2.27	2.27
Faroe Islands	...	...	...	...	...	...	...	...	...	...	...	...
Finland	2,029	2,139	2,255	2,316	0.53	110	116	60	2.10	2.10	2.08	2.09
France	18,162	23,266	29,806	33,735	2.48	5,105	6,539	3,930	2.50	2.30	1.98	1.86
Germany	28,653	30,376	32,202	33,157	0.58	1,723	1,827	954	2.10	2.00	1.89	1.86
Gibraltar	...	...	...	...	...	...	...	...	...	...	...	...
Greece	2,408	2,662	2,944	3,096	1.01	255	282	152	2.73	2.61	2.51	2.54
Holy See	...	...	...	...	...	...	...	...	...	...	...	...
Hungary	...	2,750	...	...	...	...	...	...	...	2.50	...	...
Iceland	103	125	151	166	1.88	21	26	15	2.51	2.40	2.25	2.25

continued . . .

TABLE B.4

continued

	Number of households								Mean household size			
	Estimates and projections ('000)				Rate of change (%)		Ten year increment ('000)		Estimates and projections			
	2000	2010	2020	2030	2000–2010	2000–2010	2010–2020	2020–2030	2000	2010	2020	2030
Ireland	765	962	1,209	1,356	2.29	197	247	147	2.94	2.88	2.67	2.71
Isle of Man	17	18	19	20	0.69	1	1	1	2.37	2.33	2.26	2.28
Italy	14,643	17,422	20,728	22,609	1.74	2,779	3,306	1,881	2.62	2.37	2.08	1.97
Latvia	624	587	551	534	–0.63	–38	–36	–17	2.60	2.60	2.68	2.72
Liechtenstein	…	…	…	…	…	…	…	…	…	…	…	…
Lithuania	927	887	849	830	–0.44	–40	–38	–18	2.53	2.51	2.57	2.62
Luxembourg	…	180	…	…	…	…	…	…	…	2.40	…	…
Malta	128	138	148	153	0.72	10	10	5	2.86	2.86	2.77	2.71
Moldova	631	671	713	734	0.60	39	42	22	2.90	2.50	2.54	2.56
Monaco	…	…	…	…	…	…	…	…	…	…	…	…
Montenegro	…	…	…	…	…	…	…	…	…	…	…	…
Netherlands	5,644	7,107	8,950	10,043	2.31	1,463	1,842	1,093	2.16	1.93	1.64	1.51
Norway	1,501	1,743	2,024	2,181	1.50	242	281	157	2.28	2.22	2.11	2.14
Poland	8,736	9,309	9,919	10,240	0.64	573	611	320	2.71	2.51	2.36	2.33
Portugal	2,030	2,537	3,171	3,545	2.23	507	634	374	2.77	2.55	2.20	2.03
Romania	4,113	4,431	4,774	4,955	0.75	318	343	181	2.86	2.56	2.35	2.30
Russian Federation	39,869	38,997	38,144	37,725	–0.22	–872	–853	–419	2.70	2.70	2.79	2.80
San Marino	…	…	…	…	…	…	…	…	…	…	…	…
Serbia	1,627	1,841	2,083	2,216	1.24	214	242	133	3.30	3.00	2.78	2.72
Slovakia	1,206	1,188	1,171	1,162	–0.15	–18	–17	–9	2.52	2.52	2.60	2.74
Slovenia	368	371	373	374	0.06	2	2	1	2.74	2.74	2.78	2.91
Spain	10,410	13,127	16,554	18,589	2.32	2,717	3,427	2,035	2.95	2.71	2.32	2.17
Sweden	3,384	3,989	4,702	5,105	1.64	605	713	403	2.20	2.00	1.83	1.78
Switzerland	2,460	2,738	3,047	3,215	1.07	278	309	168	2.14	2.06	1.94	1.92
TFYR Macedonia	…	…	…	…	…	…	…	…	…	…	…	…
Ukraine	10,834	14,365	19,047	21,933	2.82	3,531	4,682	2,885	3.03	2.17	1.60	1.36
United Kingdom	19,439	21,078	22,856	23,800	0.81	1,640	1,778	944	2.38	2.34	2.33	2.41
LATIN AMERICA AND THE CARIBBEAN												
Anguilla	…	…	…	…	…	…	…	…	…	…	…	…
Antigua and Barbuda	8	9	9	9	0.61	1	1	0	3.10	3.10	3.27	3.76
Argentina	9,564	11,699	14,311	15,827	2.01	2,135	2,611	1,517	3.48	3.19	2.87	2.79
Aruba	…	…	…	…	…	…	…	…	…	…	…	…
Bahamas	72	96	129	149	2.91	24	32	20	3.40	3.00	2.56	2.45
Barbados	34	40	47	51	1.57	6	7	4	3.00	3.00	2.91	2.95
Belize	31	40	52	60	2.71	10	12	8	3.91	3.50	3.14	3.31
Bolivia	1,206	1,721	2,456	2,934	3.56	515	735	478	4.26	3.83	3.32	3.37
Brazil	35,672	49,431	68,497	80,632	3.26	13,759	19,066	12,135	3.97	3.33	2.67	2.42
British Virgin Islands	3	4	5	5	2.59	1	1	1	2.84	2.55	2.29	2.34
Cayman Islands	15	23	37	46	4.52	9	13	9	2.70	2.40	1.64	1.37
Chile	3,621	4,530	5,668	6,339	2.24	909	1,137	672	3.66	3.36	2.97	2.83
Colombia	6,923	9,336	12,591	14,622	2.99	2,413	3,255	2,031	4.14	3.72	3.22	3.11
Costa Rica	583	753	973	1,107	2.57	170	220	133	3.97	3.97	3.71	3.72
Cuba	…	2,566	…	…	…	…	…	…	…	3.30	…	…
Dominica	15	…	…	…	…	…	…	…	3.22	…	…	…
Dominican Republic	1,340	1,994	2,968	3,620	3.98	654	974	653	3.96	3.44	2.78	2.59
Ecuador	1,985	2,972	4,448	5,442	4.03	986	1,477	994	3.75	3.25	2.65	2.49
El Salvador	…	…	…	…	…	…	…	…	…	…	…	…
Falkland Islands (Malvinas)	…	…	…	…	…	…	…	…	…	…	…	…
French Guiana	…	…	…	…	…	…	…	…	…	…	…	…
Grenada	…	…	…	…	…	…	…	…	…	…	…	…
Guadeloupe	…	…	…	…	…	…	…	…	…	…	…	…
Guatemala	1,037	1,375	1,923	2,597	2.83	339	547	674	4.89	5.16	5.16	5.16
Guyana	53	51	55	62	–0.33	–2	4	7	4.00	4.20	4.20	4.20
Haiti	659	1,186	2,135	2,865	5.88	527	949	730	4.67	4.38	3.38	3.07
Honduras	…	…	…	…	…	…	…	…	…	…	…	…
Jamaica	418	445	474	490	0.63	27	29	15	3.20	3.20	3.18	3.29
Martinique	…	…	…	…	…	…	…	…	…	…	…	…
Mexico	17,322	23,703	32,436	37,943	3.14	6,382	8,733	5,507	4.31	3.72	3.13	2.95
Montserrat	…	…	…	…	…	…	…	…	…	…	…	…
Netherlands Antilles	75	97	124	141	2.53	22	28	17	2.16	1.93	1.61	1.44
Nicaragua	545	808	1,200	1,462	3.95	264	391	262	5.10	4.10	3.33	3.19
Panama	497	723	1,053	1,271	3.76	226	330	218	3.91	3.63	3.06	2.92
Paraguay	632	964	1,470	1,815	4.22	332	506	345	4.68	4.11	3.43	3.37
Peru	4,080	5,727	8,038	9,523	3.39	1,647	2,312	1,485	4.63	3.91	3.23	3.07
Puerto Rico	1,190	1,371	1,580	1,696	1.42	181	209	116	3.03	2.70	2.36	2.20
Saint Kitts and Nevis	…	…	…	…	…	…	…	…	…	…	…	…

continued . . .

TABLE B.4

continued

	Number of households								Mean household size			
	Estimates and projections ('000)				Rate of change (%)		Ten year increment ('000)		Estimates and projections			
	2000	2010	2020	2030	2000–2010	2000–2010	2010–2020	2020–2030	2000	2010	2020	2030
Saint Lucia	15	13	12	11	–1.11	–2	–1	–1	2.97	2.41	2.08	2.10
Saint Vincent and the Grenadines	...	...	...	...	...	...	...	...	...	...	...	...
Suriname	78	97	121	135	2.22	19	24	14	3.90	3.75	3.44	3.40
Trinidad and Tobago	43	60	84	99	3.31	17	24	15	3.23	2.99	2.63	2.57
Turks and Caicos Islands	...	...	...	...	...	...	...	...	...	...	...	...
United States Virgin Islands	...	...	...	...	...	...	...	...	...	...	...	...
Uruguay	966	1,107	1,268	1,357	1.36	141	161	89	3.14	2.81	2.57	2.49
Venezuela (Bolivarian Republic of)	5,015	6,761	9,113	10,581	2.99	1,745	2,353	1,468	4.36	4.00	3.47	3.34
NORTHERN AMERICA												
Bermuda	25	26	27	27	0.33	1	1	0	2.50	2.50	2.46	2.44
Canada	9,027	10,539	12,304	13,295	1.55	1,512	1,765	990	2.70	2.60	2.47	2.50
Greenland	19	20	21	22	0.53	1	1	1	2.40	2.40	2.33	2.23
Saint-Pierre-et-Miquelon	...	...	...	...	...	...	...	...	...	...	...	...
United States of America	86,264	100,774	117,726	127,243	1.55	14,511	16,952	9,517	2.59	2.53	2.42	2.45
OCEANIA												
American Samoa	...	...	...	...	...	...	...	...	...	...	...	...
Australia	6,425	7,627	9,053	9,864	1.71	1,202	1,427	810	2.60	2.60	2.52	2.57
Cook Islands	3	4	6	8	3.79	1	2	1	4.00	3.50	2.61	2.32
Fiji	80	99	122	136	2.09	19	23	13	4.83	4.50	4.22	4.22
French Polynesia	...	...	...	...	...	...	...	...	...	...	...	...
Guam	37	...	...	...	...	...	...	...	3.90	...	...	...
Kiribati	5	6	8	9	2.69	1	2	1	7.80	7.20	6.65	7.11
Marshall Islands	4	6	8	9	2.98	1	2	1	8.60	6.92	6.16	5.96
Micronesia (Federated States of)	4	5	6	6	1.23	1	1	0	5.44	5.03	5.03	5.72
Nauru	2	2	2	2	0.20	0	0	0	5.92	5.93	6.12	6.19
New Caledonia	...	...	...	...	...	...	...	...	...	...	...	...
New Zealand	1,226	1,499	1,834	2,029	2.02	274	335	195	2.70	2.51	2.28	2.25
Niue	...	...	...	...	...	...	...	...	...	...	...	...
Northern Mariana Islands	17	...	...	...	...	...	...	...	3.70	...	...	...
Palau	...	...	...	...	...	...	...	...	...	...	...	...
Papua New Guinea	96	116	157	235	1.83	19	41	78	7.37	7.37	7.37	7.37
Pitcairn	...	...	...	...	...	...	...	...	...	...	...	...
Samoa	...	...	...	...	...	...	...	...	...	...	...	...
Solomon Islands	9	17	30	40	5.84	7	13	10	7.00	6.50	5.65	6.09
Tokelau	...	...	...	...	...	...	...	...	...	...	...	...
Tonga	4	4	5	5	0.83	0	1	1	6.04	6.00	6.00	6.00
Tuvalu	1	1	1	1	1.26	0	0	0	6.20	6.20	6.12	6.66
Vanuatu	8	12	18	22	3.85	4	6	4	4.80	4.80	4.67	5.33
Wallis and Futuna Islands	...	...	...	...	...	...	...	...	...	...	...	...

Source: United Nations Human Settlements Programme (UN-Habitat), Global Urban Indicators Database 2012

TABLE B.5

Access to Drinking Water and Sanitation

	Improved drinking water coverage						Household connection to improved drinking water						Improved sanitation coverage					
	Total (%)		Urban (%)		Rural (%)		Total (%)		Urban (%)		Rural (%)		Total (%)		Urban (%)		Rural (%)	
	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010
AFRICA																		
Algeria	89	83	93	85	84	79	71	72	84	80	52	56	92	95	99	98	82	88
Angola	46	51	52	60	40	38	12	21	23	34	1	2	42	58	75	85	11	19
Benin	66	75	78	84	59	68	10	15	23	31	2	4	9	13	19	25	3	5
Botswana	95	96	99	99	90	92	45	66	63	85	25	36	52	62	69	75	32	41
Burkina Faso	60	79	85	95	55	73	3	6	17	23	0	0	11	17	46	50	4	6
Burundi	72	72	89	83	70	71	4	6	41	47	1	1	45	46	46	49	45	46
Cameroon	64	77	86	95	42	52	13	16	25	26	2	3	49	49	61	58	37	36
Cape Verde	83	88	84	90	81	85	26	51	42	58	8	40	44	61	61	73	25	43
Central African Republic	63	67	85	92	49	51	3	2	7	6	0	0	22	34	32	43	16	28
Chad	45	51	60	70	41	44	4	...	15	23	0	1	10	13	26	30	5	6
Comoros	92	95	93	91	92	97	25	30	45	53	17	21	28	36	42	50	23	30
Congo	70	71	95	95	36	32	28	23	46	36	4	2	20	18	21	20	18	15
Côte d'Ivoire	77	80	91	91	67	68	30	40	57	64	10	16	22	24	37	36	10	11
Democratic Republic of the Congo	44	45	85	79	27	27	12	9	38	21	1	2	16	24	23	24	13	24
Djibouti	82	88	88	99	63	54	58	60	73	79	11	1	60	50	69	63	30	10
Egypt	96	99	98	100	95	99	78	96	95	100	66	93	86	95	95	97	79	93
Equatorial Guinea	51	...	66	...	42	...	4	5	10	...	1	1	89	...	92	...	87	...
Eritrea	54	...	70	...	50	...	7	...	42	...	0	0	11	...	54	...	2	4
Ethiopia	29	44	87	97	19	34	4	8	26	46	0	1	9	21	24	29	6	19
Gabon	85	87	95	95	47	41	43	44	52	49	8	10	36	33	37	33	30	30
Gambia	83	89	90	92	77	85	21	32	40	51	3	5	63	68	67	70	60	65
Ghana	71	86	87	91	58	80	18	18	37	33	...	...	10	14	16	19	6	8
Guinea	63	74	88	90	52	65	8	11	25	29	0	1	14	18	26	32	9	11
Guinea-Bissau	50	64	68	91	43	53	4	3	13	11	0	0	14	20	36	44	5	9
Kenya	52	59	87	82	42	52	19	19	50	45	11	12	28	32	30	32	28	32
Lesotho	80	78	94	91	76	73	10	20	39	63	3	4	25	26	37	32	22	24
Liberia	61	73	74	88	50	60	2	4	4	8	1	1	12	18	23	29	3	7
Libyan Arab Jamahiriya	54	...	54	...	55	...	...	...	...	...	...	...	97	97	97	97	96	96
Madagascar	38	46	75	74	24	34	7	6	19	14	2	3	12	15	18	21	10	12
Malawi	62	83	93	95	57	80	...	...	35	28	2	2	46	51	49	49	45	51
Mali	46	64	70	87	36	51	8	13	26	35	1	1	18	22	34	35	12	14
Mauritania	40	50	45	52	37	48	15	23	26	35	8	14	21	26	38	51	9	9
Mauritius	99	99	100	100	99	99	99	99	100	100	99	99	89	89	91	91	88	88
Mayotte	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Morocco	78	83	96	98	58	61	49	60	82	89	12	19	64	70	82	83	43	52
Mozambique	42	47	75	77	27	29	7	8	21	19	1	1	14	18	37	38	4	5
Namibia	81	93	99	99	72	90	39	45	77	72	21	28	28	32	60	57	13	17
Niger	42	49	78	100	35	39	6	8	30	39	1	2	7	9	27	34	3	4
Nigeria	53	58	77	74	36	43	10	4	20	8	2	1	34	31	37	35	32	27
Réunion	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Rwanda	66	65	86	76	63	63	3	3	23	13	0	1	47	55	60	52	45	56
Saint Helena	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
São Tomé and Príncipe	79	89	86	89	70	88	23	27	31	32	14	18	21	26	27	30	15	19
Senegal	66	72	90	93	49	56	29	39	60	75	8	13	45	52	66	70	31	39
Seychelles	...	...	84	100	...	...	...	...	84	100	...	...	...	...	94	98	...	...
Sierra Leone	46	55	75	87	30	35	7	8	19	19	1	1	11	13	22	23	5	6
Somalia	22	29	35	66	15	7	4	20	12	53	0	0	22	23	45	52	10	6
South Africa	86	91	98	99	71	79	62	69	87	89	28	36	75	79	84	86	63	67
South Sudan	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sudan[1]	62	58	76	67	55	52	31	26	62	47	16	12	27	26	48	44	16	14
Swaziland	52	71	88	91	41	65	26	35	70	74	13	25	52	57	63	64	49	55
Togo	55	61	84	89	38	40	5	6	13	12	0	1	13	13	26	26	5	3
Tunisia	90	...	98	99	77	...	70	...	92	...	33	...	81	...	95	96	57	...
Uganda	58	72	86	95	54	68		4	14	20	1	1	30	34	33	34	30	34
United Republic of Tanzania	54	53	86	79	45	44	8	8	28	22	2	3	9	10	15	20	7	7
Western Sahara	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Zambia	54	61	88	87	36	46	15	13	42	36	1	1	47	48	59	57	40	43
Zimbabwe	80	80	99	98	70	69	34	34	89	82	6	4	40	40	53	52	34	32
ASIA																		
Afghanistan	22	50	36	78	18	42	2	4	10	16	0	0	32	37	46	60	28	30
Armenia	92	98	98	99	81	97	86	93	96	98	68	83	89	90	95	95	77	80
Azerbaijan	74	80	88	88	59	71	46	50	72	78	18	20	62	82	73	86	50	78
Bahrain	...	...	100	100	...	...	...	...	100	100	...	...	...	...	100	100	...	...
Bangladesh[2]	79	81	86	85	77	80	5	6	23	20	0	1	47	56	58	57	43	55
Bhutan	86	96	99	100	82	94	54	57	81	81	45	44	39	44	66	73	30	29
Brunei Darussalam	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

continued . . .

TABLE B.5

continued

	Improved drinking water coverage						Household connection to improved drinking water						Improved sanitation coverage					
	Total (%)		Urban (%)		Rural (%)		Total (%)		Urban (%)		Rural (%)		Total (%)		Urban (%)		Rural (%)	
	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010
Cambodia	44	64	63	87	40	58	7	17	33	63	2	5	17	31	50	73	10	20
China	80	91	98	98	70	85	51	68	93	95	28	45	44	64	61	74	35	56
China, Hong Kong SAR	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
China, Macao SAR	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cyprus	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Democratic People's Republic of Korea	100	98	100	99	99	97	77	88	81	93	72	80	61	80	65	86	55	71
Georgia	89	98	97	100	80	96	61	73	86	92	34	51	95	95	96	96	94	93
India	81	92	93	97	77	90	21	23	49	48	10	12	25	34	55	58	14	23
Indonesia	78	82	91	92	68	74	16	20	31	36	5	8	44	54	64	73	30	39
Iran (Islamic Republic of)	93	96	98	97	85	92	89	94	96	96	76	88	90	100	92	100	86	100
Iraq	80	79	95	91	49	56	74	76	92	89	37	50	69	73	76	76	54	67
Israel	100	100	100	100	100	100	100	100	100	100	98	98	100	100	100	100	100	100
Japan	100	100	100	100	100	100	96	98	98	99	91	95	100	100	100	100	100	100
Jordan	96	97	98	98	91	92	93	90	96	93	83	79	98	98	98	98	96	98
Kazakhstan	96	95	99	99	91	90	60	58	87	82	26	24	97	97	97	97	97	98
Kuwait	99	99	99	99	99	99	...	...	...	...	...	...	100	100	100	100	100	100
Kyrgyzstan	82	90	98	99	73	85	48	53	82	89	30	34	93	93	94	94	93	93
Lao People's Democratic Republic	45	67	75	77	37	62	12	20	37	55	5	3	26	63	64	89	15	50
Lebanon	100	100	100	100	100	100	98	...	100	100	85	...	98	...	100	100	87	...
Malaysia	97	100	99	100	93	99	89	...	95	99	80	...	92	96	94	96	90	95
Maldives	95	98	100	100	93	97	19	39	67	96	0	1	79	97	98	98	72	97
Mongolia	65	82	86	100	37	53	24	17	42	26	1	2	49	51	65	64	28	29
Myanmar	67	83	85	93	60	78	6	8	18	19	2	3	62	76	79	83	56	73
Nepal	83	89	94	93	81	88	13	18	48	53	8	10	20	31	42	48	17	27
Occupied Palestinian Territory	92	85	95	86	86	81	81	75	87	78	64	67	89	92	91	92	83	92
Oman	83	89	87	93	74	78	39	68	49	82	15	31	90	99	98	100	71	95
Pakistan	89	92	96	96	85	89	29	36	57	58	15	23	37	48	72	72	20	34
Philippines	89	92	93	93	85	92	33	43	50	61	17	25	65	74	74	79	57	69
Qatar	100	100	100	100	100	100	...	...	...	...	...	...	100	100	100	100	100	100
Republic of Korea	93	98	98	100	75	88	87	93	97	99	46	64	100	100	100	100	100	100
Saudi Arabia	...	...	97	97	...	...	...	...	97	97	...	...	...	...	100	100	...	...
Singapore	100	100	100	100	...	...	100	100	100	100	...	...	100	100	100	100	...	...
Sri Lanka	80	91	95	99	77	90	21	29	53	67	15	23	82	92	87	88	81	93
Syrian Arab Republic	87	90	95	93	79	86	77	85	93	92	60	77	88	95	95	96	81	93
Tajikistan	61	64	93	92	50	54	34	40	77	83	18	25	90	94	93	95	89	94
Thailand	92	96	97	97	90	95	39	48	77	80	22	31	94	96	95	95	93	96
Timor-Leste	54	69	69	91	49	60	14	21	24	45	11	12	39	47	56	73	33	37
Turkey	93	100	97	100	85	99	87	98	95	99	73	97	87	90	96	97	71	75
Turkmenistan	83	...	97	97	72	...	53	...	81	...	29	...	98	98	99	99	97	97
United Arab Emirates	100	100	100	100	100	100	78	...	80	...	70	...	97	98	98	98	95	95
Uzbekistan	89	87	98	98	83	81	52	47	86	85	32	26	91	100	97	100	87	100
Viet Nam	77	95	94	99	71	93	16	23	51	59	4	8	56	76	78	94	49	68
Yemen	60	55	83	72	52	47	35	40	77	71	20	26	39	53	82	93	24	34
EUROPE																		
Albania	98	95	100	96	96	94	68	79	96	91	48	67	84	94	95	95	76	93
Andorra	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Austria	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Belarus	100	100	100	100	99	99	71	89	89	95	30	72	93	93	91	91	96	97
Belgium	100	100	100	100	100	100	100	100	100	100	99	100	100	100	100	100	100	100
Bosnia and Herzegovina	97	99	99	100	96	98	85	82	96	94	77	71	95	95	98	99	93	92
Bulgaria	100	100	100	100	100	100	91	...	97	98	77	...	100	100	100	100	100	100
Channel Islands	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Croatia	99	99	100	100	97	97	88	...	96	96	77	...	99	99	99	99	98	98
Czech Republic	100	100	100	100	100	100	95	...	97	97	91	...	98	98	99	99	97	97
Denmark	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Estonia	98	98	99	99	97	97	86	...	95	97	65	...	95	95	96	96	94	94
Faroe Islands	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Finland	100	100	100	100	100	100	98	99	99	100	92	96	100	100	100	100	100	100
France	100	100	100	100	100	100	100	100	100	100	99	100	100	100	100	100	100	100
Germany	100	100	100	100	100	100	100	100	100	100	99	100	100	100	100	100	100	100
Gibraltar	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Greece	99	100	100	100	98	99	98	100	100	100	95	99	98	98	99	99	96	97
Holy See	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hungary	99	100	100	100	98	100	92	...	95	95	86	...	100	100	100	100	100	100
Iceland	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Ireland	100	100	100	100	100	100	100	100	100	100	99	99	99	99	100	100	98	98
Isle of Man	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

continued . . .

TABLE B.5

continued

	Improved drinking water coverage						Household connection to improved drinking water						Improved sanitation coverage					
	Total (%)		Urban (%)		Rural (%)		Total (%)		Urban (%)		Rural (%)		Total (%)		Urban (%)		Rural (%)	
	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010
Italy	100	100	100	100	100	100	100	100	100	100	100	100	...	...	...	...	...	...
Latvia	99	99	100	100	96	96	82	...	93	...	59	...	78	...	82	...	71	...
Liechtenstein	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Lithuania	92	...	98	98	81	...	81	...	93	95	57	...	86	...	95	95	69	...
Luxembourg	100	100	100	100	100	100	100	100	100	100	98	98	100	100	100	100	100	100
Malta	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Moldova	93	96	99	99	89	93	35	48	77	84	2	16	79	85	87	89	72	82
Monaco	100	100	100	100	...	...	100	100	100	100	...	...	100	100	100	100	...	...
Montenegro	98	98	99	99	96	96	86	87	98	98	70	70	90	90	92	92	87	87
Netherlands	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Norway	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Poland	...	...	100	100	...	...	95	98	99	99	89	96	90	...	96	96	80	...
Portugal	99	99	99	99	98	100	97	99	98	99	95	100	98	100	99	100	97	100
Romania	84	...	97	99	70	...	58	65	90	92	21	28	72	...	88	...	54	...
Russian Federation	95	97	98	99	86	92	78	81	90	91	46	55	72	70	77	74	59	59
San Marino	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Serbia	99	99	99	99	98	98	81	82	97	97	63	63	92	92	96	96	88	88
Slovakia	100	100	100	100	100	100	94	...	96	...	92	...	100	100	100	100	100	99
Slovenia	100	99	100	100	99	99	100	99	100	100	99	99	100	100	100	100	100	100
Spain	100	100	100	100	100	100	99	99	99	99	100	100	100	100	100	100	100	100
Sweden	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Switzerland	100	100	100	100	100	100	100	100	100	100	99	99	100	100	100	100	100	100
TFYR Macedonia[3]	100	100	100	100	99	99	91	91	96	96	84	84	88	88	92	92	82	82
Ukraine	97	98	99	98	92	98	78	66	92	86	50	22	95	94	97	96	91	89
United Kingdom	100	100	100	100	100	100	100	100	100	100	98	98	100	100	100	100	100	100
LATIN AMERICA AND THE CARIBBEAN																		
Anguilla	60	...	60	...	...	...	45	...	45	...	...	...	94	...	94	...	...	...
Antigua and Barbuda	91	...	95	95	89	...	79	...	73		82	...	95	...	98	98	94	...
Argentina	96	...	98	98	78	...	77	...	81	...	39	...	91	...	92	...	77	...
Aruba	100	100	100	100	100	100	100	100	100	100	100	100	...	...	...	...	...	...
Bahamas	96	...	98	98	86	...	71	...	69	...	80	...	100	100	100	100	100	100
Barbados	100	100	100	100	100	100	...	...	100	100	...	...	100	100	100	100	100	100
Belize	86	98	93	98	80	99	62	78	81	87	44	68	83	90	85	93	82	87
Bolivia	80	88	94	96	57	71	66	80	87	95	33	51	22	27	31	35	8	10
Brazil	94	98	98	100	77	85	86	92	94	96	53	65	74	79	82	85	38	44
British Virgin Islands	98	98	98	98	98	98	97	97	97	97	97	97	100	100	100	100	100	100
Cayman Islands	93	96	93	96	...	...	67	95	67	95	...	...	96	96	96	96	...	...
Chile	94	96	99	99	66	75	90	93	98	99	39	47	92	96	96	98	71	83
Colombia	91	92	99	99	71	72	85	84	95	92	58	58	73	77	81	82	52	63
Costa Rica	95	97	99	100	89	91	90	97	97	100	81	91	95	95	95	95	94	96
Cuba	90	94	95	96	73	89	71	75	80	82	44	54	86	91	90	94	73	81
Dominica	95	...	96	96	92	...	68	...	78	...	49	...	81	...	80	...	84	...
Dominican Republic	87	86	92	87	80	84	72	72	86	80	50	55	78	83	85	87	68	75
Ecuador	86	94	90	96	79	89	72	86	83	93	55	73	83	92	92	96	70	84
El Salvador	82	88	92	94	68	76	57	66	76	80	29	42	83	87	89	89	74	83
Falkland Islands (Malvinas)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
French Guiana	84	...	88	...	71	...	79	...	83	...	65	...	78	...	85	...	57	...
Grenada	94	...	97	97	93	...	81	...	93	...	75	...	97	97	96	96	97	97
Guadeloupe	98	...	98	98	93	...	98	...	98	98	75	...	...	...	94	95	...	...
Guatemala	87	92	95	98	81	87	67	82	83	96	54	69	71	78	85	87	60	70
Guyana	89	94	94	98	87	93	61	65	74	79	56	59	79	84	86	88	76	82
Haiti	62	69	84	85	50	51	9	10	21	15	3	4	22	17	34	24	15	10
Honduras	82	87	95	95	71	79	73	85	90	95	59	74	64	77	78	85	53	69
Jamaica	93	93	98	98	88	88	67	70	90	91	42	47	80	80	78	78	82	82
Martinique	...	...	100	100	...	...	...	...	99	99	...	...	...	...	94	95	...	...
Mexico	90	96	95	97	77	91	84	89	91	93	62	74	75	85	81	87	56	79
Montserrat	100	100	100	100	100	100	11	14	98	98	0	0	96	96	96	96	96	96
Netherlands Antilles	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Nicaragua	80	85	95	98	62	68	58	63	86	89	24	29	48	52	61	63	32	37
Panama	90	...	97	97	77	...	87	...	95	...	72	...	65	...	74	...	47	...
Paraguay	74	86	92	99	51	66	51	66	75	85	21	35	58	71	79	90	31	40
Peru	81	85	90	91	55	65	65	74	78	83	29	46	63	71	76	81	27	37
Puerto Rico	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Saint Kitts and Nevis	99	99	99	99	99	99	72	...	72	...	72	...	96	96	96	96	96	96
Saint Lucia	95	96	97	98	94	95	72	72	84	85	68	67	62	65	69	71	59	63
Saint Vincent and the Grenadines	...	...	...	...	93	...	...	...	...	...	73	...	...	...	...	...	96	96
Suriname	89	92	98	97	73	81	76	68	91	78	49	45	81	83	90	90	65	66

continued . . .

TABLE B.5

continued

	Improved drinking water coverage						Household connection to improved drinking water						Improved sanitation coverage					
	Total (%)		Urban (%)		Rural (%)		Total (%)		Urban (%)		Rural (%)		Total (%)		Urban (%)		Rural (%)	
	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010
Trinidad and Tobago	91	94	95	98	91	93	73	76	85	88	71	74	92	92	92	92	92	92
Turks and Caicos Islands	100	100	100	100	100	100	75	...	78	...	60	...	97	...	98	98	94	...
United States Virgin Islands	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Uruguay	98	100	99	100	88	100	94	98	96	98	73	...	96	100	97	100	90	99
Venezuela (Bolivarian Republic of)	92	...	94	...	74	...	85	...	89	...	50	...	89	...	93	...	54	...
NORTHERN AMERICA																		
Bermuda	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Canada	100	100	100	100	99	99	87	...	100	100	38	...	100	100	100	100	99	99
Greenland	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Saint-Pierre-et-Miquelon	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
United States of America	99	99	100	100	94	94	85	85	97	97	46	46	100	100	100	100	99	99
OCEANIA																		
American Samoa	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Australia	100	100	100	100	100	100	...	...	...	...	...	...	100	100	100	100	100	100
Cook Islands	95	...	99	98	87	...	...	...	...	...	...	...	100	100	100	100	99	100
Fiji	93	98	98	100	88	95	74	82	95	97	55	66	75	83	92	94	59	71
French Polynesia	100	100	100	100	100	100	98	98	99	99	96	96	98	98	99	99	97	97
Guam	100	100	100	100	100	100	...	...	...	...	...	...	99	99	99	99	98	98
Kiribati	62	...	77	...	50	...	33	...	48	...	21	...	33	...	47	...	22	...
Marshall Islands	95	94	93	92	98	99	1	1	1	1	0	0	70	75	80	83	48	53
Micronesia (Federated States of)	92	...	94	...	92	...	...	...	...	...	...	...	26	...	59	...	16	...
Nauru	98	88	98	88	...	...	...	...	...	...	...	...	66	65	66	65	...	...
New Caledonia	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
New Zealand	100	100	100	100	100	100	100	100	100	100	100	100	...	...	...	...	...	...
Niue	100	100	100	100	100	100	...	...	...	...	80	...	100	100	100	100	100	100
Northern Mariana Islands	98	98	98	98	97	97	...	...	...	...	...	...	92	...	92	...	93	96
Palau	83	85	78	83	96	96	40	43	40	43	40	40	84	100	91	100	68	100
Papua New Guinea	39	40	88	87	32	33	10	10	59	57			46	45	75	71	42	41
Pitcairn	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Samoa	92	96	96	96	91	96	78	81	85	84	76	80	98	98	99	98	98	98
Solomon Islands	70	...	94	...	65	...	13	...	76	...	1	1	31	...	98	98	18	...
Tokelau	93	97	...	...	93	97	...	...	...	...	...	...	63	93	...	...	63	93
Tonga	100	100	100	100	100	100	75	...	72	...	76	...	96	96	98	98	96	96
Tuvalu	94	98	95	98	93	97	94	97	95	97	93	97	83	85	87	88	79	81
Vanuatu	76	90	96	98	71	87	31	26	65	52	22	17	41	57	54	64	38	54
Wallis and Futuna Islands	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Notes:

(1) Data for Sudan includes South Sudan.

(2) The drinking water estimates for Bangladesh have been adjusted for arsenic contamination levels based on national surveys conducted and approved by the government.

(3) The former Yugoslav Republic of Macedonia.

Source: World Health Organization (WHO) and United Nations Children's Fund (UNICEF) Joint Monitoring Programme for Water Supply and Sanitation (JMP) (2012) Progress on Sanitation and Drinking-Water 2012 Update, WHO and UNICEF, Geneva.

TABLE B.6

Poverty and Inequality

	Gross national income PPP $/capita		Inequality: Income/consumption		Inequality: Land		National population below national poverty line				International poverty line: Population		
	2000	2011	Survey year[1]	Gini Index	Survey year	Gini Index	Survey year[2]	Rural %	Urban %	National %	Survey year[2,3]	below $1.25 a day	below $2 a day
AFRICA													
Algeria	5,130	8,310[4]	1995	0.35		...		...	...	...	1995	6.8	23.6
Angola	1,310	5,230	2000[5]	0.59		...	2000[7]	...	62.3	...	2000[11]	54.3	70.2
Benin	1,150	1,620	2003	0.39		...	2003[7]	46.0	29.0	39.0	2003	47.3	75.3
Botswana	7,930	14,550	1994	0.61		...	2003	44.8	19.4	30.6	1994	31.2	49.4
Burkina Faso	760	1,300	2009	0.40	1993	0.42	2009	52.6	27.9	46.7	2009	44.6	72.6
Burundi	450	610	2006	...		...	2006[7]	68.9	34.0	66.9	2006	81.3	93.5
Cameroon	1,540	2,330	2007	0.39		...	2007[7]	55.0	12.2	39.9	2007	9.6	30.4
Cape Verde	1,890	3,980	2002	0.51		...	2007[7]	44.3	13.2	26.6	2002	21.0	40.9
Central African Republic	660	810	2008	0.56		...	2008[7]	69.4	49.6	62.0	2008	62.8	80.1
Chad	660	1,360	2003	0.40		...	2003[7]	58.6	24.6	55.0	2003	61.9	83.3
Comoros	930	1,110	2004	0.64		...	2004[7]	48.7	34.5	44.8	2004	46.1	65.0
Congo	1,960	3,240	2005	0.47		...	2005	57.7	...	50.1	2005	54.1	74.4
Côte d'Ivoire	1,500	1,710	2008	0.42		...	2008[8]	54.2	29.4	42.7	2008	23.8	46.3
Democratic Republic of the Congo	210	340	2006	0.44		...	2006	75.7	61.5	71.3	2006	87.7	95.2
Djibouti	1,600	...	2002	0.40		...		...	...	...	2002	18.8	41.2
Egypt	3,710	6,120	2008	0.31	1990	0.65	2008	30.0	10.6	22.0	2008	<2	15.4
Equatorial Guinea	5,360	25,620		...		...		...	...	...		...	...
Eritrea	510	580		...		...		...	...	...		...	...
Ethiopia	460	1,110	2005	0.30	2001	0.47	2005	39.3	35.1	38.9	2005	39.0	77.6
Gabon	9,950	13,740	2005	0.42		...	2005	44.6	29.8	32.7	2005	4.8	19.6
Gambia	1,340	1,750	2003	0.47		...	2010[7,8]	73.9	32.7	48.4	2003	33.6	55.9
Ghana	920	1,810	2006	0.43		...	2006	39.2	10.8	28.5	2006	28.6	51.8
Guinea	780	1,020	2007	0.39		...	2007[7]	63.0	30.5	53.0	2007	43.3	69.6
Guinea-Bissau	960	1,240	2002	0.36	1988	0.62	2002	69.1	51.6	64.7	2002	48.9	78.0
Kenya	1,130	1,710	2005	0.48		...	2005[7]	49.1	33.7	45.9	2005	43.4	67.2
Lesotho	1,270	2,050	2003	0.53	1989–90	0.49	2003[8]	60.5	41.5	56.6	2003	43.4	62.3
Liberia	300	540	2007	0.38		...	2007[8]	67.7	55.1	63.8	2007	83.8	94.9
Libyan Arab Jamahiriya	...	...		...		...		...	...	...		...	...
Madagascar	790	950	2010	0.44		...	2005	73.5	52.0	68.7	2010	81.3	92.6
Malawi	580	870	2004	0.39	1993	0.52	2004	55.9	25.4	52.4	2004	73.9	90.5
Mali	660	1,040	2010	0.33		...	2010	50.6	18.8	43.6	2010	50.4	78.7
Mauritania	1,580	2,400	2008	0.41		...	2008	59.4	20.8	42.0	2008	23.4	47.7
Mauritius	8,070	14,330		...		...		...	...	...		...	...
Mayotte	...	...		...		...		...	...	...		...	...
Morocco	2,520	4,880	2007	0.41	1996	0.62	2007	14.5	4.8	9.0	2007	2.5	14.0
Mozambique	420	970	2008	0.46		...	2008	56.9	49.6	54.7	2008	59.6	81.8
Namibia	4,020	6,560	2004[6]	0.64	1997	0.36	2004	49.0	17.0	38.0	2004[12]	31.9	51.1
Niger	520	720	2008	0.35		...	2007[7]	63.9	36.7	59.5	2008	43.6	75.2
Nigeria	1,140	2,290	2010	0.49		...	2004[7]	63.8	43.1	54.7	2010	68.0	84.5
Réunion	...	...		...		...		...	...		...	...	...
Rwanda	570	1,270	2011	0.51		...	2011	48.7	22.1	44.9	2011	63.2	82.4
Saint Helena	...	...		...		...		...	...	...		...	...
São Tomé and Príncipe	...	2,080		...		...	2009[7]	...	...	66.2	2001	28.2	54.2
Senegal	1,330	1,940	2005	0.39	1998	0.50	2005[7,8]	61.9	35.1	50.8	2005	33.5	60.4
Seychelles	15,930	25,140	2007	0.66		...		...	...	...	2007	<2	<2
Sierra Leone	360	840	2003	0.43		...	2003[7]	78.5	47.0	66.4	2003	53.4	76.1
Somalia	...	...		...		...		...	...	...		...	...
South Africa	6,620	10,710	2009	0.63		...	2006	...	...	23.0	2009	13.8	31.3
South Sudan	...	...	2009	0.46			2009	55.4	24.2	50.6		...	...
Sudan	1,090	2,120	2009	0.35		...	2009	57.6	26.5	46.5	2009	19.8	44.1
Swaziland	4,030	5,930	2010	0.52		...	2001[7]	75.0	49.0	69.2	2010	40.6	60.4
Togo	790	1,040	2006	0.34		...	2006	74.3	36.8	61.7	2006	38.7	69.3
Tunisia	5,150	9,030	2005	0.41	1993	0.70		...	...	...	2005	<2	8.1
Uganda	670	1,310	2009	0.44	1991	0.59	2009	27.2	9.1	24.5	2009	38.0	64.7
United Republic of Tanzania	760	1,500	2007	0.38		...	2007	37.4	21.8	33.4	2007	67.9	87.9
Western Sahara	...	...		...		...		...	...	...		...	...
Zambia	870	1,490	2006	0.55		...	2006	76.8	26.7	59.3	2006	68.5	82.6
Zimbabwe	...	...	1995	0.50		...	2003[7]	...	...	72.0		...	...
ASIA													
Afghanistan	...	1,140[4]	2008	0.28		...	2008[7,8]	37.5	29.0	36.0		...	...
Armenia	2,090	6,100	2008	0.31		...	2010[8]	36.0	36.0	35.8	2008	<2	12.4
Azerbaijan	2,090	8,960	2008	0.34		...	2008[8]	18.5	14.8	15.8	2008	<2	2.8
Bahrain	20,460	...		...		...		...	...	...		...	...
Bangladesh	890	1,940	2010	0.32	1996	0.62	2010	35.2	21.3	31.5	2010	43.3	76.5
Bhutan	2,430	5,570	2007	0.38		...	2007[7]	30.9	1.7	23.2	2007	10.2	29.8
Brunei Darussalam	43,010	...		...		...		...	...	...		...	...

continued . . .

TABLE B.6

continued

	Gross national income PPP $/capita 2000	Gross national income PPP $/capita 2011	Inequality: Income/consumption Survey year[1]	Inequality: Income/consumption Gini Index	Inequality: Land Survey year	Inequality: Land Gini Index	National population below national poverty line Survey year[2]	Rural %	Urban %	National %	International poverty line: Population Survey year[2,3]	below $1.25 a day	below $2 a day
Cambodia	890	2,230	2008	0.38		...	2007[8]	34.5	11.8	30.1	2008	22.8	53.3
China	2,340	8,390	2005[6]	0.43		...	2005[9]	2.5	...	...	2008[13]	13.1	29.8
China, Hong Kong SAR	27,090	52,350	1996[6]	0.43		...		...	...	...		...	...
China, Macao SAR	21,520	...		...		...		...	...	...		...	...
Cyprus	18,170	...		...		...		...	...	...		...	...
Democratic People's Republic of Korea	...	...		...		...		...	...	...		...	...
Georgia	2,310	5,350	2008	0.41		...	2009[8]	30.7	18.4	24.7	2008	15.3	32.2
India	1,510	3,590	2005	0.33		...	2010	33.8	20.9	29.8	2010[13]	32.7	68.7
Indonesia	2,120	4,500	2005	0.34	1993	0.46	2011	15.7	9.2	12.5	2010[13]	18.1	46.1
Iran (Islamic Republic of)	6,660	...	2005	0.38		...		...	...	...	2005	<2	8.0
Iraq	...	3,750	2007	0.31		...	2007	39.3	16.1	22.9	2007	2.8	21.4
Israel	21,460	27,110	2001[6]	0.39		...		...	...	...		...	...
Japan	26,290	35,330	1993[6]	0.25	1995	0.59		...	...	...		...	...
Jordan	3,220	5,930	2010	0.35	1997	0.78	2006	19.0	12.0	13.0	2010	<2	<2
Kazakhstan	4,470	11,250	2009	0.29		...	2009[8]	...	...	8.2	2009	<2	<2
Kuwait	40,070	...		...		...		...	...	...		...	...
Kyrgyzstan	1,260	2,180	2009	0.36		...	2010[8]	...	...	33.7	2009	6.2	21.7
Lao People's Democratic Republic	1,150	2,580	2008	0.37	1999	0.39	2008[8]	31.7	17.4	27.6	2008	33.9	66.0
Lebanon	7,800	14,470		...		...		...	...	...		...	...
Malaysia	8,660	15,650	2009[6]	0.46		...	2009[8]	8.4	1.7	3.8	2009[12]	<2	2.3
Maldives	3,750	7,430		...		...		...	...	...		...	...
Mongolia	1,950	4,290	2008	0.37		...	2008[7]	46.6	26.9	35.2		...	...
Myanmar	...	...		...		...		...	...	...		...	...
Nepal	810	1,260	2010	0.33	1992	0.45	2010	27.4	15.5	25.2	2010	24.8	57.3
Occupied Palestinian Territory	3,300	...	2009	0.36		...	2009	...	...	21.9	2009	<2	<2
Oman	16,210	...		...		...		...	...	...		...	...
Pakistan	1,620	2,870	2008	0.30	1990	0.57	2006	27.0	13.1	22.3	2008	21.0	60.2
Philippines	2,390	4,140	2009	0.43	1991	0.55	2009	...	...	26.5	2009	18.4	41.5
Qatar	...	86,440	2007	0.41		...		...	...	...		...	...
Republic of Korea	17,110	30,370	1998[6]	0.32	1990	0.34		...	...	...		...	...
Saudi Arabia	18,070	24,700		...		...		...	...	...		...	...
Singapore	33,540	59,380	1998[6]	0.43		...		...	...	...		...	...
Sri Lanka	2,610	5,520	2007	0.40		...	2010	9.4	5.3	8.9	2007	7.0	29.1
Syrian Arab Republic	3,180	...	2004	0.36		...		...	...	...	2004	<2	16.9
Tajikistan	820	2,300	2009	0.31		...	2009[8]	...	...	46.7	2009	6.6	27.7
Thailand	4,800	8,360	2009	0.40	1993	0.47	2009	10.4	3.0	8.1	2009[14]	<2	4.6
Timor-Leste	1,060	...	2007	0.32		...	2007	...	...	49.9	2007	37.4	72.8
Turkey	9,120	16,940	2008	0.39	1991	0.61	2009	38.7	8.9	18.1	2008	<2	4.2
Turkmenistan	3,260	8,690	1998	0.41		...		...	...	...	1998	24.8	49.7
United Arab Emirates	...	47,890		...		...		...	...	...		...	...
Uzbekistan	1,430	3,420	2003	0.37		...		...	...	...		...	...
Viet Nam	1,400	3,250	2008	0.36	1994	0.53	2008	18.7	3.3	14.5	2008	16.9	43.4
Yemen	1,730	2,170	2005	0.38		...	2005	40.1	20.7	34.8	2005	17.5	46.6
EUROPE													
Albania	4,380	8,820	2008	0.35	1998	0.84	2008[8]	14.6	10.1	12.4	2008	<2	4.3
Andorra	...	...		...		...		...	...	...		...	...
Austria	28,420	42,050	2000[6]	0.29	1999–2000	0.59		...	...	...		...	...
Belarus	5,140	14,460	2008	0.27		...	2009	...	...	5.4	2008	<2	<2
Belgium	28,280	39,190	2000[6]	0.33	1999–2000	0.56		...	...	...		...	...
Bosnia and Herzegovina	5,010	9,190	2007	0.36		...	2007[8]	17.8	8.2	14.0	2007	<2	<2
Bulgaria	6,070	14,160	2007	0.28		...	2007[8]	...	...	10.6	2007	<2	<2
Channel Islands	...	...		...		...		...	...	...		...	...
Croatia	10,720	18,760	2008	0.34		...	2004[8]	...	...	11.1	2008	<2	<2
Czech Republic	15,280	24,370	1996[6]	0.26	2000	0.92		...	...	...	1996[12]	<2	<2
Denmark	28,210	41,900	1997[6]	0.25	1999–2000	0.51		...	...	...		...	...
Estonia	9,560	20,850	2004	0.36	2001	0.79		...	...	...	2004	<2	<2
Faroe Islands	...	...		...		...		...	...	...		...	...
Finland	25,470	37,670	2000[6]	0.27	1999–2000	0.27		...	...	...		...	...
France	25,530	35,910	1995[6]	0.33	1999–2000	0.58		...	...	...		...	...
Germany	25,480	40,230	2000[6]	0.28	1999–2000	0.63		...	...	...		...	...
Gibraltar	...	...		...		...		...	...	...		...	...
Greece	18,320	25,100	2000[6]	0.34	1999–2000	0.58		...	...	...		...	...
Holy See	...	...		...		...		...	...	...		...	...
Hungary	11,290	20,310	2007	0.31		...		...	...	...	2007	<2	<2
Iceland	28,040	31,020		...		...		...	...	...		...	...
Ireland	24,940	34,180	2000[6]	0.34		...		...	...	...		...	...
Isle of Man	...	...		...		...		...	...	...		...	...

continued . . .

TABLE B.6

continued

	Gross national income PPP $/capita		Inequality				National population below national poverty line				International poverty line		
			Income/consumption		Land						Population		
	2000	2011	Survey year[1]	Gini Index	Survey year	Gini Index	Survey year[2]	Rural %	Urban %	National %	Survey year[2,3]	below $1.25 a day	below $2 a day
Italy	25,560	32,400	2000[6]	0.36	1999–2000	0.73		...	...	...		...	...
Latvia	8,020	17,700	2008	0.37	2001	0.58	2004[8]	12.7	...	5.9	2008	<2	<2
Liechtenstein	...	...		...		...		...	...	...		...	...
Lithuania	8,470	19,640	2008	0.38		...		...	...	...	2008	<2	<2
Luxembourg	46,750	64,260		...	1999–2000	0.48		...	...	...		...	...
Malta	18,560	...		...		...		...	...	...		...	...
Moldova	1,490	3,640	2010	0.33		...	2010[8]	30.3	10.4	21.9	2010	<2	4.4
Monaco	...	...		...		...		...	...	...		...	...
Montenegro	6,620	13,700	2008	0.30		...	2010	11.3	4.0	6.6	2008	<2	<2
Netherlands	30,040	43,140	1999[6]	0.31	1999–2000	0.57		...	...	...		...	...
Norway	35,640	61,460	2000[6]	0.26	1999	0.18		...	...	...		...	...
Poland	10,480	20,430	2009	0.34	2002	0.69	2008[8]	...	...	10.6	2009	<2	<2
Portugal	17,430	24,440	1997[6]	0.39	1999–2000	0.74		...	...	...		...	...
Romania	5,620	15,120	2009	0.30		...	2006[8]	22.3	6.8	13.8	2009	<2	<2
Russian Federation	6,660	20,560	2009	0.40		...	2006	21.2	7.4	11.1	2009	<2	<2
San Marino	...	...		...		...		...	...	...		...	...
Serbia	5,770	11,540	2009	0.28		...	2010[8]	13.6	5.7	9.2	2009	<2	<2
Slovakia	10,950	22,130	2009[6]	0.26		...		...	...	...	2009[12]	<2	<2
Slovenia	17,570	26,510	2004	0.31	1991	0.62		...	...	...	2004	<2	<2
Spain	21,130	31,400	2000[6]	0.35	1999–2000	0.77		...	...	...		...	...
Sweden	27,720	42,200	2000[6]	0.25	1999–2000	0.32		...	...	...		...	...
Switzerland	34,850	52,570	2000[6]	0.34	1999	0.50		...	...	...		...	...
TFYR Macedonia	5,830	11,090	2009	0.43		...	2006[8]	21.3	17.7	19.0	2009	<2	5.9
Ukraine	3,180	7,040	2009	0.26		...	2008[8]	4.7	2.0	2.9	2009	<2	<2
United Kingdom	25,930	36,010	1999[6]	0.36	1999–2000	0.66		...	...	...		...	...
LATIN AMERICA AND THE CARIBBEAN													
Anguilla	...	...		...	...		...		...	...		...	...
Antigua and Barbuda	13,890	17,900[4]		...		...		...	...	...		...	...
Argentina	8,880	17,130	2010[5,6]	0.45	1988	0.83	2010[9]	...	9.9	...	2010[11,12]	<2	<2
Aruba	...	...		...		...		...	...	...		...	...
Bahamas	26,880	...[4]		...		...		...	...	...		...	...
Barbados	15,610	...[4]		...		...		...	...	...		...	...
Belize	4,650	6,090[4]	1999[6]	0.53		...		...	...	...	1999[15]	12.2	22.0
Bolivia	3,080	4,890	2007[6]	0.56		...	2007[9]	77.3	50.9	60.1	2008[12]	15.6	24.9
Brazil	6,820	11,420	2009[6]	0.55	1996	0.85	2009[9]	...	...	21.4	2009[15]	6.1	10.8
British Virgin Islands	...	...		...		...		...	...	...		...	...
Cayman Islands	...	...		...		...		...	...	...		...	...
Chile	9,380	16,330	2009[6]	0.52		...	2009[9]	12.9	15.5	15.1	2009[15]	<2	2.7
Colombia	5,740	9,560	2010[6]	0.56	2001	0.80	2010[9]	50.3	33.0	37.2	2010[15]	8.2	15.8
Costa Rica	6,650	11,860	2009[6]	0.51		...	2010[9]	...	...	24.2	2009[15]	3.1	6.0
Cuba	...	...		...		...		...	...	...		...	...
Dominica	6,540	13,000		...		...		...	...	...		...	...
Dominican Republic	4,910	9,420	2010[6]	0.47		...	2010[9]	...	...	34.4	2010[15]	2.2	9.9
Ecuador	4,350	8,510	2010[6]	0.49		...	2010[9]	53.0	22.5	32.8	2010[15]	4.6	10.6
El Salvador	4,500	6,640	2009[6]	0.48		...	2009[9,10]	46.5	33.3	37.8	2009[15]	9.0	16.9
Falkland Islands (Malvinas)	...	...		...		...		...	...	...		...	...
French Guiana	...	...		...		...		...	...	...		...	...
Grenada	6,770	10,350		...		...		...	...	...		...	...
Guadeloupe	...	...		...		...		...	...	...		...	...
Guatemala	3,470	4,760	2006[6]	0.56		...	2006	70.5	30.0	51.0	2006[15]	13.5	26.3
Guyana	2,050	...	1998[6]	0.45		...		...	...	...	1998[12]	8.7	18.0
Haiti	...	1,180	2001[6]	0.59		...	2001[9]	88.0	45.0	77.0	2001[12]	61.7	77.5
Honduras	2,510	3,820	2009[6]	0.57	1993	0.66	2010[9,10]	65.4	54.3	60.0	2009[15]	17.9	29.8
Jamaica	...	...	2004	0.46		...	2007[9]	...	...	9.9	2004	<2	5.4
Martinique	...	...		...		...		...	...	...		...	...
Mexico	8,780	15,390	2010[6]	0.48		...	2010[9]	60.8	45.5	51.3	2008	<2	5.2
Montserrat	...	...		...		...		...	...	...		...	...
Netherlands Antilles	...	...		...		...		...	...	...		...	...
Nicaragua	2,360	3,730	2005	0.41	2001	0.72	2005	67.9	29.1	46.2	2005[12]	11.9	31.7
Panama	6,830	14,510	2010[6]	0.52	2001	0.52	2008	59.8	17.7	32.7	2010[15]	6.6	13.8
Paraguay	3,440	5,390	2010[6]	0.52	1991	0.93	2010[9]	48.9	24.7	34.7	2010[15]	7.2	13.2
Peru	4,790	9,440	2010[6]	0.48	1994	0.86	2010	54.2	19.1	31.3	2010[15]	4.9	12.7
Puerto Rico	...	...		...		...		...	...	...		...	...
Saint Kitts and Nevis	11,840	16,470		...		...		...	...	...		...	...
Saint Lucia	7,660	11,220	1995[6]	0.43		...		...	...	...	1995[12]	20.9	40.6
Saint Vincent and the Grenadines	6,070	10,440		...		...		...	...	...		...	...
Suriname	4,400	...	1999[6]	0.53		...		...	...	...	1999[12]	15.5	27.2

continued . . .

TABLE B.6

continued

	Gross national income PPP $/capita		Inequality				National population below national poverty line				International poverty line		
			Income/consumption		Land						Population		
	2000	2011	Survey year[1]	Gini Index	Survey year	Gini Index	Survey year[2]	Rural %	Urban %	National %	Survey year[2,3]	below $1.25 a day	below $2 a day
Trinidad and Tobago	11,390	. . .	1992[6]	0.40		. . .		. . .	. . .	. . .	1992[12]	4.2	13.5
Turks and Caicos Islands	. . .	. . .		. . .		. . .		. . .	. . .	. . .		. . .	. . .
United States Virgin Islands	. . .	. . .		. . .		. . .		. . .	. . .	. . .		. . .	. . .
Uruguay	8,500	14,640	2010[6]	0.45	2000	0.79	2010[9]	6.2	18.7	18.6	2010[15]	<2	<2
Venezuela (Bolivarian Republic of)	8,380	12,430	2006[6]	0.45	1996–97	0.88	2009[9]	. . .	. . .	28.5	2006[15]	6.6	12.9
NORTHERN AMERICA													
Bermuda	. . .	. . .		. . .		. . .		. . .	. . .	. . .		. . .	. . .
Canada	27,670	39,660	2000[6]	0.33	1991	0.64		. . .	. . .	. . .		. . .	. . .
Greenland	. . .	. . .		. . .		. . .		. . .	. . .	. . .		. . .	. . .
Saint-Pierre-et- Miquelon	. . .	. . .		. . .		. . .		. . .	. . .	. . .		. . .	. . .
United States of America	35,690	48,820	2000[6]	0.41	1997	0.76		. . .	. . .	. . .		. . .	. . .
OCEANIA													
American Samoa	. . .	. . .		. . .		. . .		. . .	. . .	. . .		. . .	. . .
Australia	25,530	38,110	1994[6]	0.35		. . .		. . .	. . .	. . .		. . .	. . .
Cook Islands	. . .	. . .		. . .		. . .		. . .	. . .	. . .		. . .	. . .
Fiji	3,520	4,610	2009	0.43		. . .	2009	43.3	18.6	31.0	2009	5.9	22.9
French Polynesia	. . .	. . .		. . .		. . .		. . .	. . .	. . .		. . .	. . .
Guam	. . .	. . .		. . .		. . .		. . .	. . .	. . .		. . .	. . .
Kiribati	3,350	3,300		. . .		. . .		. . .	. . .	. . .		. . .	. . .
Marshall Islands	. . .	. . .		. . .		. . .		. . .	. . .	. . .		. . .	. . .
Micronesia (Federated States of)	2,760	3,580	2000[5]	0.61		. . .		. . .	. . .	. . .	2000	31.2	44.7
Nauru	. . .	. . .		. . .		. . .		. . .	. . .	. . .		. . .	. . .
New Caledonia	. . .	. . .		. . .		. . .		. . .	. . .	. . .		. . .	. . .
New Zealand	19,900	. . .	1997[6]	0.36		. . .		. . .	. . .	. . .		. . .	. . .
Niue	. . .	. . .		. . .		. . .		. . .	. . .	. . .		. . .	. . .
Northern Mariana Islands	. . .	. . .		. . .		. . .		. . .	. . .	. . .		. . .	. . .
Palau	11,650	11,080		. . .		. . .		. . .	. . .	. . .		. . .	. . .
Papua New Guinea	1,620	2,570	1996	0.51		. . .		. . .	. . .	. . .	1996	35.8	57.4
Pitcairn	. . .	. . .		. . .		. . .		. . .	. . .	. . .		. . .	. . .
Samoa	2,710	4,270		. . .		. . .		. . .	. . .	. . .		. . .	. . .
Solomon Islands	2,010	2,350		. . .		. . .		. . .	. . .	. . .		. . .	. . .
Tokelau	. . .	. . .		. . .		. . .		. . .	. . .	. . .		. . .	. . .
Tonga	3,450	5,000		. . .		. . .		. . .	. . .	. . .		. . .	. . .
Tuvalu	. . .	. . .		. . .		. . .		. . .	. . .	. . .		. . .	. . .
Vanuatu	3,210	4,330		. . .		. . .		. . .	. . .	. . .		. . .	. . .
Wallis and Futuna Islands	. . .	. . .		. . .		. . .		. . .	. . .	. . .		. . .	. . .

Notes:

(1) Data refers to expenditure shares by percentiles of population, ranked by per capita expenditure, unless otherwise specified.
(2) Refers to the year in which the underlying household survey data were collected or, when the data collection period bridged two calendar years, the year in which most of the data were collected
(3) Based on nominal per capita consumption averages and distributions estimated parametrically from grouped household survey data, unless otherwise noted.
(4) Estimate is based on regression.
(5) Covers urban areas only.
(6) Data refers to income shares by percentiles of population, ranked by per capita income.
(7) Estimates based on survey data from earlier years are available but are not comparable with the most recent year reported here; these are available at http://data.worldbank.org and http://povertydata.worldbank.org.
(8) World Bank estimates.
(9) Based on income per capita estimated from household survey data.
(10) Measured as share of households.
(11) Covers urban areas only.
(12) Based on per capita income averages and distributions estimated parametrically from grouped household survey data.
(13) Population-weighted average of urban and rural estimates.
(14) Estimated nonparametrically from nominal consumption per capita distributions based on unit-record household survey data.
(15) Estimated nonparametrically from nominal income per capita distributions based on unit-record household survey data.

Sources: World Bank (2012) World Development Indicators 2012, World Bank, Washington, DC, World Bank (2006) World Development Report 2006, World Bank, Washington, DC.

TABLE B.7

Transport Infrastructure

	Roads				Railways		
	Total (km) 2000–2009[1]	Paved (%) 2000–2009[1]	Passengers (m-p-km) 2000–2009[1]	Goods hauled (m-t-km) 2000–2009[1]	Route (km) 2000–2010[1]	Passengers (m-p-km) 2000–2010[1]	Goods hauled (m-t-km) 2000–2010[1]
AFRICA							
Algeria	112,039	74.0	...	...	3,512	1,045	1,281
Angola	51,429	10.4	166,045	4,709	...	...	...
Benin	19,000	9.5	...	...	758	...	36
Botswana	25,798	32.6	...	...	888	94	674
Burkina Faso	92,495	4.2	...	...	622	...	...
Burundi	12,322	10.4	...	...	...	...	...
Cameroon	28,857	17.0	...	...	977	377	978
Cape Verde	...	...	...	...	...	...	...
Central African Republic	24307	...	...	...	...	...	...
Chad	40,000	0.8	...	...	...	...	...
Comoros	...	...	...	...	...	...	...
Congo	17,000	7.1	...	...	795	211	234
Côte d'Ivoire	81,996	7.9	...	...	639	10	675
Democratic Republic of the Congo	153,497	1.8	...	...	3,641	37	193
Djibouti	...	...	...	...	...	...	...
Egypt	100,472	89.4	12,793	...	5,195	40,837	3,840
Equatorial Guinea	...	...	...	...	...	...	...
Eritrea	4,010	21.8	...	...	...	...	...
Ethiopia	44,359	13.7	219,113	2,456	...	...	...
Gabon	9,170	12.0	...	...	810	111	2,238
Gambia	3,742	19.3	16	...	...	...	...
Ghana	109,515	12.6	...	...	953	85	181
Guinea	44,348	9.8	...	...	...	...	...
Guinea-Bissau	3,455	27.9	...	...	...	...	...
Kenya	61,945	14.3	...	22	1,917	226	1,399
Lesotho	5,940	18.3	...	...	...	...	...
Liberia	...	...	...	...	...	...	...
Libyan Arab Jamahiriya	10,600	6.2	...	...	...	...	...
Madagascar	83,200	57.2	...	...	...	...	...
Malawi	49,827	11.6	...	...	854	10	12
Mali	15,451	45.0	...	...	797	44	33
Mauritania	22,474	24.6	...	...	733	196	189
Mauritius	11,066	26.8	...	...	728	47	7,566
Mayotte	2,066	98.0	...	...	...	...	...
Morocco	58,216	70.3	...	800	2,109	4,398	5,572
Mozambique	30,331	20.8	...	...	3,116	114	695
Namibia	42,100	14.7	47	591	...	...	...
Niger	18,948	20.7	...	...	...	...	...
Nigeria	193,200	15.0	...	...	3,528	174	77
Réunion	...	...	...	...	...	...	...
Rwanda	14,008	19.0	...	...	...	...	...
Saint Helena	...	...	...	...	...	...	...
São Tomé and Príncipe	...	...	...	...	...	...	...
Senegal	14,825	32.0	...	...	906	129	384
Seychelles	...	...	...	...	...	...	...
Sierra Leone	11,300	8.0	...	...	...	...	...
Somalia	22,100	11.8	...	...	...	...	...
South Africa	362,099	17.3	...	434	22,051	18,865	113,342
South Sudan	...	...	...	...	...	...	...
Sudan	11,900	36.3	...	...	4,508	34	766
Swaziland	3,594	30.0	...	...	300	0	776
Togo	11,652	21.0	...	...	...	...	...
Tunisia	19,371	75.2	...	16,611	1,119	1,493	2,073
Uganda	70,746	23.0	...	...	259	...	218
United Republic of Tanzania	103,706	6.7	8	7	2,600[2]	475[2]	728
Western Sahara	...	...	...	...	...	...	...
Zambia	66,781	22.0	...	...	1,273	183	...
Zimbabwe	97,267	19.0	...	...	2,583	...	1,580
ASIA							
Afghanistan	42,150	29.3	232	6,575	...	...	...
Armenia	7,705	93.6	2,356	182	826	50	346
Azerbaijan	52,942	50.6	15,291	10,634	2,079	917	8,250
Bahrain	4,083	82.1	...	...	...	...	...
Bangladesh	239,226	9.5	...	...	2,835	7,305	710
Bhutan	...	...	...	...	...	...	...
Brunei Darussalam	...	...	...	...	...	...	...

continued . . .

TABLE B.7

continued

	Roads				Railways		
	Total (km) 2000–2009[1]	Paved (%) 2000–2009[1]	Passengers (m-p-km) 2000–2009[1]	Goods hauled (m-t-km) 2000–2009[1]	Route (km) 2000–2010[1]	Passengers (m-p-km) 2000–2010[1]	Goods hauled (m-t-km) 2000–2010[1]
Cambodia	38,257	6.3	201	...	650	45	92
China	3,860,823	53.5	1,351,144	3,718,882	66,239	791,158	2,451,185
China, Hong Kong SAR	2,050	100.0	...	...	...	...	...
China, Macao SAR	...	...	...	...	...	...	...
Cyprus	12,380	64.9	...	944	...	...	...
Democratic People's Republic of Korea	25,554	2.8	...	...	...	...	...
Georgia	20,329	94.1	5,724	611	1,566	655	6,228
India	4,109,592	49.5	...	...	63,974	903,465	600,548
Indonesia	476,337	56.9	...	...	3,370	14,344	4,390
Iran (Islamic Republic of)	192,685	73.3	...	...	6,073	16,814	20,247
Iraq	40,988	84.3	...	...	2,025	54	121
Israel	18,318	100.0	...	...	1,034	1,986	1,062
Japan	1,207,867	80.1	905,907	334,667	20,035	244,235	20,432
Jordan	7,878	100.0	...	...	294	...	353
Kazakhstan	96,846	88.5	110,475	66,254	14,202	15,448	213,174
Kuwait	6,524	85.0	...	...	...	...	...
Kyrgyzstan	34,000	91.1	6,745	912	417	99	738
Lao People's Democratic Republic	39,568	13.7	2,113	287	...	...	...
Lebanon	6,970	...	...	...	...	...	...
Malaysia	98,722	81.3	...	...	1,665	1,527	1,384
Maldives	...	...	...	...	...	...	...
Mongolia	49,250	3.5	1,215	782	1,814	1,220	10,287
Myanmar	27,000	11.9	...	...	...	4,163	885
Nepal	19,875	53.9	...	...	...	...	...
Occupied Palestinian Territory	5,588	91.7	...	...	...	...	...
Oman	56,361	46.0	...	...	...	...	...
Pakistan	258,350	65.4	263,788	129,249	7,791	24,731	6,187
Philippines	200,037	9.9	...	...	479	83	1
Qatar	7,790	90.0	...	...	...	...	...
Republic of Korea	104,983	79.3	100,617	12,545	3,379	33,027	9,452
Saudi Arabia	221,372	21.5	...	...	1,020	337	1,748
Singapore	3,356	100.0	5,762	...	...	...	...
Sri Lanka	97,286	81.0	21,067	...	1,463	4,767	135
Syrian Arab Republic	68,157	90.3	589	...	2,139	1,120	2,370
Tajikistan	27,767	...	8,591	5,013	621	33	808
Thailand	180,053	98.5	...	...	4,429	8,037	3,161
Timor-Leste	...	...	...	...	...	...	...
Turkey	362,660	88.7	212,464	176,455	9,594	5,491	11,030
Turkmenistan	24,000	81.2	...	...	3,115	1,811	11,992
United Arab Emirates	4,080	100.0	...	...	...	...	...
Uzbekistan	81,600	87.3	56,674	21,038	4,227	2,905	22,282
Viet Nam	160,089	47.6	59,735	30,261	2,347	4,378	3,901
Yemen	71,300	8.7	...	...	...	...	...
EUROPE							
Albania	18,000	39.0	197	2,200	423	32	46
Andorra	...	...	...	...	...	...	...
Austria	106,840	100.0	69,000	16	5,066	10,306	23,104
Belarus	94,797	88.6	8,184	22,767	5,503	7,578	46,224
Belgium	153,872	78.2	131,470	36,174	3,578	10,493	5,439
Bosnia and Herzegovina	21,846	52.3	1,959	1,711	1,026	59	1,227
Bulgaria	40,231	98.4	13,839	17,742	4,098	2,100	3,061
Channel Islands	...	...	...	...	...	...	...
Croatia	29,343	90.5	3,438	9,429	2,722	1,742	2,618
Czech Republic	130,573	100.0	88,352	44,955	9,569	6,553	13,592
Denmark	73,330	100.0	68,907	10,003	2,131	7,405	2,030
Estonia	58,382	28.6	2,453	5,249	787	248	6,261
Faroe Islands	...	...	...	...	...	...	...
Finland	78,925	65.5	72,700	25,200	5,919	3,959	9,760
France	951,260	100.0	773,000	265,000	33,608	86,853	22,840
Germany	643,969	100.0	949,306	427,300	33,708	78,582	105,794
Gibraltar	...	...	...	...	...	...	...
Greece	116,929	91.8	...	28,585	2,552	1,413	538
Holy See	...	...	...	...	...	...	...
Hungary	197,519	38.0	20,449	35,373	7,893	5,398	1,000
Iceland	...	...	...	...	...	...	...
Ireland	96,424	100.0	...	12,787	1,919	1,678	92
Isle of Man	...	...	...	...	...	...	...
Italy	487,700	100.0	97,560	192,700	18,011	44,535	12,037

continued . . .

TABLE B.7

continued

	Roads				Railways		
	Total (km) 2000–2009[1]	Paved (%) 2000–2009[1]	Passengers (m-p-km) 2000–2009[1]	Goods hauled (m-t-km) 2000–2009[1]	Route (km) 2000–2010[1]	Passengers (m-p-km) 2000–2010[1]	Goods hauled (m-t-km) 2000–2010[1]
Latvia	69,148	20.9	14,625	8,115	1,897	79	17,164
Liechtenstein	...	...	...	...	...	...	...
Lithuania	81,331	29.4	20,376	17,757	1,767	373	13,431
Luxembourg	...	...	...	...	...	...	...
Malta	...	...	...	...	...	...	...
Moldova	12,779	85.8	2,268	2,714	1,157	399	927
Monaco	...	...	...	...	...	...	...
Montenegro	...	...	...	...	...	...	...
Netherlands	136,827	90.0	...	72,675	3,016	15,400	4,331
Norway	93,853	80.7	64,014	16,109	4,114	2,674	2,092
Poland	384,104	69.9	24,386	191,484	19,702	15,715	34,266
Portugal	82,900	86.0	...	35,808	2,843	3,718	1,932
Romania	198,817	30.2	12,805	20,878	13,620	5,248	9,134
Russian Federation	982,000	80.1	139,034	180,135	85,292	139,028	2,011,308
San Marino	...	...	...	...	...	...	...
Serbia	44,334	63.2	4,169	1,184	4,058	658	3,868
Slovakia	43,879	87.1	31,093	27,484	3,587	2,291	7,669
Slovenia	38,927	100.0	777	14,762	1,228	813	3,283
Spain	667,064	99.0	410,192	211,891	15,317	22,304	7,844
Sweden	582,950	24.4	109,100	35,000	9,957	6,774	11,500
Switzerland	71,371	100.0	95,090	16,734	3,543	17,609	8,725
TFYR Macedonia	...	...	...	...	...	...	...
Ukraine	169,495	97.8	54,631	33,193	21,705	50,240	218,091
United Kingdom	419,665	100.0	736,000	143,453	31,471	55,019	12,512
LATIN AMERICA AND THE CARIBBEAN							
Anguilla	...	...	...	...	...	...	...
Antigua and Barbuda	...	...	...	...	...	...	...
Argentina	231,374	30.0	...	...	25,023	6,979	12,025
Aruba	...	...	...	...	...	...	...
Bahamas	...	...	...	...	...	...	...
Barbados	...	...	...	...	...	...	...
Belize	...	...	...	...	...	...	...
Bolivia	80,294	7.9	...	...	2,866	313	1,060
Brazil	1,751,868	5.5	...	...	29,817	...	267,700
British Virgin Islands	...	...	...	...	...	...	...
Cayman Islands	...	...	...	...	...	...	...
Chile	78,425	22.5	...	...	5,352	840	4,032
Colombia	129,485	...	157	39,726	1,672	...	9,049
Costa Rica	39,039	26.0	27	1	...	...	...
Cuba	...	49.0	6,634	2,315	5,076	1,285	1,351
Dominica	...	...	...	...	...	...	...
Dominican Republic	12,600	49.4	...	...	...	...	...
Ecuador	43,670	14.8	11,819	1,193	...	...	...
El Salvador	10,029	19.8	...	...	...	...	...
Falkland Islands (Malvinas)	...	...	...	...	...	...	...
French Guiana	...	...	...	...	...	...	...
Grenada	...	...	...	...	...	...	...
Guadeloupe	...	...	...	...	...	...	...
Guatemala	14,095	34.5	...	...	...	...	...
Guyana	...	...	...	...	...	...	...
Haiti	4,160	24.3	...	...	...	...	...
Honduras	13,600	20.4	...	...	...	...	...
Jamaica	22,121	73.3	...	...	...	...	...
Martinique	...	...	...	...	...	...	...
Mexico	366,807	35.3	436,900	211,600	26,704	178	71,136
Montserrat	...	...	...	...	...	...	...
Netherlands Antilles	...	...	...	...	...	...	...
Nicaragua	21,975	11.6	133	...	...	...	...
Panama	13,974	42.0	...	...	...	...	...
Paraguay	31,531	50.8	...	...	...	...	...
Peru	126,500	13.9	...	...	2,020	76	900
Puerto Rico	26,677	95.0	...	10	...	...	...
Saint Kitts and Nevis	...	...	...	...	...	...	...
Saint Lucia	...	...	...	...	...	...	...
Saint Vincent and the Grenadines	...	...	...	...	...	...	...
Suriname	...	...	...	...	...	...	...
Trinidad and Tobago	8,320	51.1	...	...	...	...	...
Turks and Caicos Islands	...	...	...	...	...	...	...

continued . . .

TABLE B.7

continued

	Roads				Railways		
	Total (km) 2000–2009[1]	Paved (%) 2000–2009[1]	Passengers (m-p-km) 2000–2009[1]	Goods hauled (m-t-km) 2000–2009[1]	Route (km) 2000–2010[1]	Passengers (m-p-km) 2000–2010[1]	Goods hauled (m-t-km) 2000–2010[1]
United States Virgin Islands	…	…	…	…	…	…	…
Uruguay	77,732	10.0	2,588	…	2,993	15	284
Venezuela (Bolivarian Republic of)	96,155	33.6	…	…	336	…	81
NORTHERN AMERICA							
Bermuda	…	…	…	…	…	…	…
Canada	1,409,000	39.9	493,814	129,600	58,345	2,875	322,741
Greenland	…	…	…	…	…	…	…
Saint-Pierre-et-Miquelon	…	…	…	…	…	…	…
United States of America	6,545,839	67.4	7,874,329	1,889,923	228,513	9,518[3]	2,468,738
OCEANIA							
American Samoa	…	…	…	…	…	…	…
Australia	817,089	43.5	301,524	189,847	8,615	1,500	64,172
Cook Islands	…	…	…	…	…	…	…
Fiji	…	…	…	…	…	…	…
French Polynesia	…	…	…	…	…	…	…
Guam	…	…	…	…	…	…	…
Kiribati	…	…	…	…	…	…	…
Marshall Islands	…	…	…	…	…	…	…
Micronesia (Federated States of)	…	…	…	…	…	…	…
Nauru	…	…	…	…	…	…	…
New Caledonia	…	…	…	…	…	…	…
New Zealand	94,301	66.2	…	…	…	…	4,078
Niue	…	…	…	…	…	…	…
Northern Mariana Islands	…	…	…	…	…	…	…
Palau	…	…	…	…	…	…	…
Papua New Guinea	19,600	3.5	…	…	…	…	…
Pitcairn	…	…	…	…	…	…	…
Samoa	…	…	…	…	…	…	…
Solomon Islands	…	…	…	…	…	…	…
Tokelau	…	…	…	…	…	…	…
Tonga	…	…	…	…	…	…	…
Tuvalu	…	…	…	…	…	…	…
Vanuatu	…	…	…	…	…	…	…
Wallis and Futuna Islands	…	…	…	…	…	…	…

Notes:

(1) Data are for the latest year available in the period shown.

(2) Includes Tazara railway.

(3) Refers to class 1 railways only.

Sources: World Bank (2012) World Development Indicators 2012, World Bank, Washington, DC, World Bank (2004) World Development Indicators 2004, World Bank, Washington, DC.

TABLE B.8

Road Motor Vehicles and Fuel Prices

	Road motor vehicles						Pump price for fuels			
	Passenger cars		Other motor vehicles		Total		Diesel		Petrol	
	Number per 1000 population		Number per 1000 population		Number per 1000 population		US$ per litre		US$ per litre	
	1999–2001	2006–2010	1999–2001	2006–2010	1999–2001	2006–2010	2000	2010	2000	2010
AFRICA										
Algeria	...	76	...	38	...	114	0.15	0.19	0.27	0.32
Angola	...	...	...	...	...	38	0.15	0.43	0.30	0.65
Benin	...	18	...	4	...	22	0.39	1.21	0.48	1.04
Botswana	30	69	39	64	69	133	0.39	0.97	0.42	0.93
Burkina Faso	...	7	...	4	...	12	0.46	1.28	0.68	1.44
Burundi	...	2	...	4	...	6	0.71	1.42	1.01	1.43
Cameroon	...	10	...	4	...	14	0.47	1.10	0.56	1.20
Cape Verde	...	73	...	28	...	101	...	1.33	...	1.84
Central African Republic	0	1	1	...	1	0	0.65	1.69	0.81	1.71
Chad	...	2	...	4	...	6	0.60	1.31	0.68	1.32
Comoros	...	31	...	2	...	33	...	...	...	...
Congo	...	16	...	11	...	27	0.30	0.84	0.53	1.27
Côte d'Ivoire	...	16	...	4	...	20	0.51	1.30	0.76	1.68
Democratic Republic of the Congo	...	...	...	...	...	5	0.93	1.27	1.00	1.28
Djibouti	...	...	...	...	...	...	...	1.07	...	1.63
Egypt	...	33	...	12	...	45	0.10	0.32	0.26	0.48
Equatorial Guinea	...	...	...	...	...	...	...	...	...	...
Eritrea	...	6	...	5	...	11	0.33	1.07	0.56	2.54
Ethiopia	1	1	1	2	2	3	0.27	0.78	0.46	0.91
Gabon	...	...	...	...	...	...	0.37	...	0.53	...
Gambia	...	5	...	...	...	...	0.47	...	0.64	...
Ghana	...	18	...	12	...	30	0.19	0.83	0.20	0.82
Guinea	...	...	...	...	...	...	0.69	0.95	0.85	0.95
Guinea-Bissau	...	27	...	6	...	33	...	...	...	...
Kenya	8	14	3	10	11	24	0.60	1.27	0.71	1.33
Lesotho	...	...	...	...	...	...	0.47	1.07	0.50	0.97
Liberia	...	2	...	1	...	3	...	0.96	...	0.98
Libyan Arab Jamahiriya	...	225	...	65	...	290	0.16	0.13	0.25	0.17
Madagascar	...	7	...	19	...	26	0.45	1.26	0.76	1.52
Malawi	...	4	...	4	...	8	0.68	1.54	0.69	1.71
Mali	...	8	...	6	...	14	0.43	1.25	0.70	1.42
Mauritania	...	...	...	...	...	...	0.40	0.99	0.67	1.16
Mauritius	78	137	28	38	106	175	...	1.23	...	1.55
Mayotte	...	...	...	...	...	...	...	...	...	...
Morocco	41	53	10	17	51	70	0.53	0.88	0.82	1.23
Mozambique	...	9	...	3	...	12	0.54	0.86	0.56	1.11
Namibia	38	48	44	59	82	107	0.44	1.09	0.47	1.06
Niger	...	6	...	1	...	7	0.48	1.16	0.68	1.07
Nigeria	...	31	...	0	...	31	0.27	0.77	0.27	0.44
Réunion	...	...	...	...	...	...	...	...	...	...
Rwanda	...	2	...	3	...	5	0.84	1.62	0.89	1.63
Saint Helena	...	...	...	...	...	...	...	...	...	...
São Tomé and Príncipe	...	2	...	0	...	2	...	...	...	...
Senegal	11	16	3	6	14	22	0.52	1.34	0.73	1.57
Seychelles	...	140	...	37	...	176	...	...	...	...
Sierra Leone	0	5	0	1	0	6	0.00	0.94	0.00	0.94
Somalia	...	...	...	...	...	...	...	...	...	...
South Africa	...	112	...	53	...	165	0.50	1.14	0.50	1.19
South Sudan	...	...	...	...	...	...	...	...	...	...
Sudan	...	19	...	8	...	27	0.24	0.43	0.28	0.62
Swaziland	35	45	36	44	71	89	...	1.10	...	1.07
Togo	...	2	...	0	...	2	0.40	1.17	0.48	1.18
Tunisia	53	87	26	38	79	125	0.29	0.82	0.49	0.94
Uganda	...	3	...	5	...	8	0.75	1.11	0.86	1.42
United Republic of Tanzania	...	4	...	3	...	7	0.73	1.19	0.75	1.22
Western Sahara	...	...	...	...	...	...	...	...	...	...
Zambia	...	13	...	8	...	21	1.00	1.52	1.00	1.66
Zimbabwe	...	98	...	16	...	114	0.72	1.15	0.85	1.29
ASIA										
Afghanistan	...	20	...	8	...	28	...	1.00	...	1.15
Armenia	...	94	...	9	...	103	0.31	0.99	0.55	1.08
Azerbaijan	42	84	10	17	52	101	0.22	0.56	0.46	0.75
Bahrain	...	451	...	86	...	537	...	0.13	...	0.21
Bangladesh	0	2	1	1	1	3	0.29	0.63	0.46	1.09
Bhutan	...	46	...	11	...	57	...	0.82	...	1.08
Brunei Darussalam	...	485	...	25	...	510	...	0.24	...	0.39

continued . . .

TABLE B.8

continued

	Road motor vehicles						Pump price for fuels			
	Passenger cars		Other motor vehicles		Total		Diesel		Petrol	
	Number per 1000 population		Number per 1000 population		Number per 1000 population		US$ per litre		US$ per litre	
	1999–2001	2006–2010	1999–2001	2006–2010	1999–2001	2006–2010	2000	2010	2000	2010
Cambodia	...	...	...	...	6	...	0.44	0.98	0.61	1.15
China	7	44	5	14	12	58	0.45	1.04	0.40	1.11
China, Hong Kong SAR	57	59	20	18	77	77	0.80	1.32	1.46	1.92
China, Macao SAR	...	148	...	17	...	165	...	...	...	...
Cyprus	...	419	...	112	...	532	...	1.47	...	1.47
Democratic People's Republic of Korea	...	...	...	...	...	...	0.41	...	0.73	...
Georgia	55	130	15	25	70	155	0.25	1.13	0.46	1.13
India	6	12	4	7	10	18	0.39	0.82	0.60	1.15
Indonesia	...	32	...	28	25	60	0.06	0.51	0.17	0.79
Iran (Islamic Republic of)	...	113	...	15	...	128	0.02	0.02	0.05	0.10
Iraq	...	27	...	50	...	77	0.01	0.56	0.03	0.78
Israel	233	272	42	49	275	322	0.64	1.87	1.14	1.85
Japan	413	453	159	138	572	591	0.76	1.37	1.06	1.60
Jordan	...	123	...	42	...	165	0.15	0.73	0.45	1.04
Kazakhstan	67	189	19	30	86	219	0.29	0.51	0.36	0.71
Kuwait	...	439	...	88	...	528	0.18	0.21	0.21	0.23
Kyrgyzstan	38	44	...	15	...	59	0.33	0.79	0.44	0.85
Lao People's Democratic Republic	...	2	...	18	...	20	0.32	0.97	0.41	1.26
Lebanon	...	...	...	...	...	...	0.31	0.77	0.53	1.13
Malaysia	...	325	...	36	...	361	0.16	0.56	0.28	0.59
Maldives	...	11	...	17	...	28	...	0.83	...	0.84
Mongolia	18	48	13	24	31	72	0.38	1.04	0.38	1.11
Myanmar	...	5	...	2	...	7	...	0.80	...	0.80
Nepal	...	3	...	2	...	5	0.37	0.91	0.63	1.18
Occupied Palestinian Territory	...	33	...	9	...	42	0.00	1.54	0.01	1.71
Oman	...	166	...	49	...	215	0.29	0.38	0.31	0.31
Pakistan	5	13	4	4	9	18	0.27	0.92	0.53	0.86
Philippines	10	9	22	22	32	30	0.28	0.84	0.37	1.05
Qatar	...	...	...	...	...	532	...	0.19	...	0.19
Republic of Korea	171	276	84	87	255	363	0.66	1.35	0.92	1.52
Saudi Arabia	...	...	...	...	...	...	0.10	0.07	0.24	0.16
Singapore	122	117	46	31	168	149	0.38	1.04	0.84	1.42
Sri Lanka	12	20	25	29	37	48	0.27	0.66	0.66	1.19
Syrian Arab Republic	9	36	20	37	29	73	0.13	0.45	0.44	0.96
Tajikistan	...	29	...	9	...	38	0.55	0.91	0.45	1.02
Thailand	...	67	...	90	...	157	0.35	0.95	0.39	1.41
Timor-Leste	...	...	...	...	...	...	...	0.90	...	1.40
Turkey	63	104	22	51	85	155	0.66	2.03	0.88	2.52
Turkmenistan	...	80	...	26	...	106	0.02	0.20	0.02	0.22
United Arab Emirates	...	293	...	20	...	313	0.26	0.71	0.25	0.47
Uzbekistan	...	...	...	...	...	...	0.28	0.83	0.43	0.92
Viet Nam	...	13	...	0	...	13	0.27	0.77	0.38	0.88
Yemen	...	...	...	...	...	35	0.06	0.23	0.21	0.35
EUROPE										
Albania	43	92	23	32	66	124	0.30	1.40	0.57	1.46
Andorra	...	...	...	...	...	...	...	1.32	...	1.49
Austria	495	529	41	48	536	578	0.74	1.55	0.82	1.63
Belarus	145	274	...	88	112	362	0.13	0.86	0.34	1.08
Belgium	462	489	53	70	515	559	0.78	1.62	0.96	1.87
Bosnia and Herzegovina	...	119	...	...	...	214	0.57	1.42	0.68	1.42
Bulgaria	234	345	39	47	273	393	0.58	1.58	0.70	1.51
Channel Islands	...	...	...	...	...	...	...	...	...	...
Croatia	247	343	27	37	274	380	0.60	1.49	0.76	1.59
Czech Republic	335	427	29	58	364	485	0.68	1.69	0.77	1.75
Denmark	359	390	61	90	420	480	0.90	1.79	1.01	2.00
Estonia	339	412	65	64	404	476	0.55	1.57	0.60	1.54
Faroe Islands	...	410	...	146	...	556	...	...	...	...
Finland	403	538	58	74	461	612	0.84	1.60	1.06	1.94
France	477	481	98	99	575	580	0.82	1.72	0.99	1.98
Germany	516	517	...	55	...	572	0.78	1.68	0.91	1.90
Gibraltar	...	...	...	...	...	...	...	...	...	...
Greece	254	499	74	125	328	624	0.71	1.78	0.72	2.05
Holy See	...	...	...	...	...	...	...	...	...	...
Hungary	237	298	34	47	271	345	0.79	1.61	0.81	1.67
Iceland	...	644	...	102	...	745	...	1.71	...	1.71
Ireland	349	434	59	79	408	513	0.72	1.69	0.72	1.78
Isle of Man	...	...	...	...	...	...	...	...	...	...

continued . . .

TABLE B.8

continued

	Road motor vehicles						Pump price for fuels			
	Passenger cars		Other motor vehicles		Total		Diesel		Petrol	
	Number per 1000 population		Number per 1000 population		Number per 1000 population		US$ per litre		US$ per litre	
	1999–2001	2006–2010	1999–2001	2006–2010	1999–2001	2006–2010	2000	2010	2000	2010
Italy	542	602	64	77	606	679	0.83	1.69	0.97	1.87
Latvia	235	284	46	34	281	319	0.58	1.49	0.67	1.48
Liechtenstein	. . .	750	. . .	0	. . .	750	. . .	1.77	. . .	1.66
Lithuania	317	515	28	45	345	560	0.55	1.42	0.66	1.59
Luxembourg	. . .	665	. . .	74	. . .	739	. . .	1.36	. . .	1.55
Malta	. . .	579	. . .	114	. . .	693	. . .	1.66	. . .	1.63
Moldova	64	113	18	43	82	156	0.40	1.08	0.45	1.21
Monaco	. . .	732	. . .	131	. . .	863	. . .	1.69	. . .	1.92
Montenegro	. . .	262	. . .	0	. . .	262	. . .	1.49	. . .	1.62
Netherlands	384	466	44	61	428	527	0.78	1.71	1.03	2.13
Norway	411	472	100	112	511	584	1.15	2.01	1.19	2.12
Poland	259	451	48	86	307	537	0.65	1.50	0.76	1.57
Portugal	321	495	26	14	347	509	0.54	1.58	0.77	1.85
Romania	139	201	21	33	160	235	0.35	1.46	0.46	1.46
Russian Federation	132	233	44	38	176	271	0.29	0.72	0.33	0.84
San Marino	. . .	1139	. . .	124	. . .	1,263	. . .	. . .	. . .	. . .
Serbia	150	215	13	23	163	238	. . .	1.48	. . .	1.50
Slovakia	236	307	30	56	266	364	0.68	1.53	0.69	1.70
Slovenia	426	522	39	45	465	567	0.66	1.62	0.63	1.67
Spain	408	481	59	112	467	593	0.65	1.47	0.73	1.56
Sweden	450	462	44	57	494	520	0.80	1.82	0.94	1.87
Switzerland	493	521	41	45	534	566	0.84	1.77	0.78	1.66
TFYR Macedonia	. . .	138	. . .	17	170	155	0.56	1.27	0.76	1.52
Ukraine	104	148	. . .	25	. . .	173	0.30	0.92	0.37	1.01
United Kingdom	384	457	7	62	391	519	1.22	1.98	1.17	1.92
LATIN AMERICA AND THE CARIBBEAN										
Anguilla	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Antigua and Barbuda	. . .	153	. . .	77	. . .	230	. . .	0.96	. . .	0.99
Argentina	140	. . .	41	. . .	181	314	0.52	1.05	1.07	0.96
Aruba	. . .	468	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Bahamas	. . .	. . .	. . .	. . .	. . .	81	. . .	. . .	. . .	. . .
Barbados	. . .	407	. . .	62	. . .	469	. . .	1.14	. . .	1.25
Belize	. . .	. . .	. . .	. . .	. . .	174	. . .	0.98	. . .	1.13
Bolivia	. . .	18	. . .	50	53	68	0.50	0.54	0.80	0.70
Brazil	. . .	167	. . .	42	. . .	209	0.34	1.14	0.92	1.58
British Virgin Islands	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Cayman Islands	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Chile	87	127	46	57	133	184	0.47	1.02	0.64	1.38
Colombia	43	53	8	18	51	71	0.35	0.95	0.49	1.41
Costa Rica	. . .	135	. . .	42	. . .	177	0.44	0.97	0.65	1.14
Cuba	16	21	16	17	32	38	0.18	1.24	0.50	1.72
Dominica	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Dominican Republic	. . .	87	. . .	41	. . .	128	0.39	1.03	0.71	1.23
Ecuador	43	41	5	30	48	71	0.18	0.28	0.31	0.53
El Salvador	30	46	31	48	61	94	0.40	0.89	0.67	0.92
Falkland Islands (Malvinas)	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
French Guiana	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Grenada	. . .	. . .	. . .	. . .	. . .	. . .	. . .	1.02	. . .	1.02
Guadeloupe	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Guatemala	1	37	51	31	52	68	0.42	0.85	0.53	0.95
Guyana	. . .	59	. . .	36	. . .	95	. . .	0.85	. . .	0.93
Haiti	. . .	. . .	. . .	. . .	. . .	. . .	0.35	. . .	0.64	. . .
Honduras	51	29	9	66	60	95	0.46	0.92	0.62	1.04
Jamaica	. . .	144	. . .	44	. . .	188	0.49	0.98	0.62	0.98
Martinique	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Mexico	107	191	52	84	159	275	0.45	0.72	0.61	0.81
Montserrat	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Netherlands Antilles	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Nicaragua	12	17	18	40	30	57	0.54	0.99	0.62	1.09
Panama	. . .	102	. . .	30	. . .	132	0.41	0.77	0.53	0.85
Paraguay	. . .	28	. . .	26	. . .	54	0.34	1.01	0.72	1.28
Peru	27	44	16	30	43	73	0.54	1.10	0.80	1.41
Puerto Rico	. . .	621	. . .	14	. . .	635	0.32	. . .	0.34	. . .
Saint Kitts and Nevis	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Saint Lucia	. . .	203	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Saint Vincent and the Grenadines	. . .	85	. . .	119	. . .	204	. . .	. . .	. . .	. . .
Suriname	. . .	227	. . .	63	. . .	291	. . .	1.12	. . .	1.14

continued . . .

TABLE B.8

continued

	Road motor vehicles						Pump price for fuels			
	Passenger cars		Other motor vehicles		Total		Diesel		Petrol	
	Number per 1000 population		Number per 1000 population		Number per 1000 population		US$ per litre		US$ per litre	
	1999–2001	2006–2010	1999–2001	2006–2010	1999–2001	2006–2010	2000	2010	2000	2010
Trinidad and Tobago	...	...	...	...	...	353	0.20	...	0.39	...
Turks and Caicos Islands	...	...	...	...	...	...	...	...	...	...
United States Virgin Islands	...	...	...	...	...	...	...	...	...	...
Uruguay	...	179	...	21	...	200	0.53	1.44	1.19	1.49
Venezuela (Bolivarian Republic of)	...	107	...	40	...	147	0.08	0.01	0.12	0.02
NORTHERN AMERICA										
Bermuda	...	...	...	...	...	...	...	...	...	...
Canada	458	420	122	187	580	607	0.47	1.08	0.58	1.21
Greenland	...	...	...	...	...	...	...	...	...	...
Saint-Pierre-et-Miquelon	...	...	...	...	...	...	...	...	...	...
United States of America	481	627	298	171	779	797	0.48	0.84	0.47	0.76
OCEANIA										
American Samoa	...	...	...	...	...	...	...	...	...	...
Australia	...	556	...	139	...	695	0.57	1.23	0.57	1.27
Cook Islands	...	...	...	...	...	...	...	...	...	...
Fiji	...	118	...	61	...	179	...	...	...	...
French Polynesia	...	...	...	...	...	...	...	1.56	...	1.70
Guam	...	...	...	...	...	...	...	...	...	...
Kiribati	...	101	...	45	...	146	...	...	...	...
Marshall Islands	...	...	...	...	...	...	...	...	...	...
Micronesia (Federated States of)	...	16	...	21	...	37	...	...	...	...
Nauru	...	...	...	...	...	...	...	...	...	...
New Caledonia	...	...	...	...	...	...	...	...	...	...
New Zealand	578	599	118	113	696	712	0.34	0.97	0.48	1.47
Niue	...	...	...	...	...	...	...	...	...	...
Northern Mariana Islands	...	...	...	...	...	...	...	...	...	...
Palau	...	...	...	...	...	...	...	...	...	...
Papua New Guinea	...	6	...	3	...	9	0.34	...	0.53	...
Pitcairn	...	...	...	...	...	...	...	...	...	...
Samoa	...	40	...	37	...	77	...	1.06	...	1.03
Solomon Islands	...	...	...	...	...	...	...	...	...	...
Tokelau	...	...	...	...	...	...	...	...	...	...
Tonga	...	...	...	...	...	...	...	...	...	...
Tuvalu	...	...	...	...	...	...	...	...	...	...
Vanuatu	...	...	...	...	...	...	...	...	...	...
Wallis and Futuna Islands	...	...	...	...	...	...	...	...	...	...

Sources: World Bank (2012) World Development Indicators Online database, http://data.worldbank.org/indicator, World Bank (2004) World Development Indicators 2004, World Bank, Washington, DC, World Bank (2001) World Development Report 2001, World Bank, Washington, DC.

TABLE B.9

Road Traffic Accidents

	Road traffic deaths (estimates)				Road traffic deaths, by road user category				
	(Number)		Death rate (per 100,000 population)		Drivers/ passengers of 4-wheeled vehicles (%)	Drivers/ passengers of motorized 2- and 3-wheelers (%)	Cyclists (%)	Pedestrians (%)	Other or unspecified users (%)
	1999–2001	2007–2011	1999–2001	2007–2011	2007–2011	2007–2011	2007–2011	2007–2011	2007–2011
AFRICA									
Algeria	...	...	...	...	...	...	...	...	...
Angola	...	4,042	...	23	...	...	...	...	...
Benin	...	816	...	24	19	50	3	19	8
Botswana	...	385	...	21	55	2	1	30	13
Burkina Faso	...	966	...	28	...	...	...	...	...
Burundi	...	357	...	21	...	...	...	...	...
Cameroon	...	1,353	...	20	...	...	...	...	...
Cape Verde	...	63	...	22	...	...	...	...	...
Central African Republic	...	145	...	15	...	...	...	...	...
Chad	...	3,226	...	30	...	...	...	...	...
Comoros	...	14	...	22	27	27	...	46	...
Congo	...	269	...	17	...	...	...	...	...
Côte d'Ivoire	...	699	...	21	42	4	2	40	12
Democratic Republic of the Congo	...	332	...	21	71	15	...	5	9
Djibouti	...	...	...	...	...	...	...	...	...
Egypt	4,717[1]	9,608	8[1]	13	...	...	...	...	...
Equatorial Guinea	...	53	...	11	...	...	...	...	...
Eritrea	...	...	...	...	...	...	...	...	...
Ethiopia	...	2,506	...	18	...	...	...	...	...
Gabon	...	327	...	23	...	...	...	...	...
Gambia	...	94	...	19	...	...	...	...	...
Ghana	...	1,986	...	22	16	11	5	43	26
Guinea	...	503	...	20	...	...	...	...	...
Guinea-Bissau	...	134	...	31	...	...	...	...	...
Kenya	...	2,966	...	21	34	7	8	47	5
Lesotho	...	362	...	28	...	...	...	...	...
Liberia	...	78	...	19	34	...	...	66	...
Libyan Arab Jamahiriya	...	...	...	...	...	...	...	...	...
Madagascar	...	422	...	18	...	...	...	...	...
Malawi	...	976	...	20	29	3	15	35	18
Mali	...	739	...	23	...	...	...	...	...
Mauritania	...	163	...	28	...	...	...	...	...
Mauritius	181	158	15	12	19	37	6	36	1
Mayotte	...	...	...	...	...	...	...	...	...
Morocco	...	3,778	...	18	38	19	6	26	11
Mozambique	...	2,549	...	19	45	...	...	56	0
Namibia	...	292	...	25	53	1	...	31	16
Niger	...	703	...	24	...	...	...	...	...
Nigeria	...	5,279	...	34	...	...	...	...	...
Réunion	...	...	...	...	...	...	...	...	...
Rwanda	...	438	...	20	...	...	...	...	...
Saint Helena	...	...	...	...	...	...	...	...	...
São Tomé and Príncipe	...	33	...	21	...	...	...	...	...
Senegal	...	277	...	20	55	...	...	45	...
Seychelles	...	13	...	15	...	...	...	...	...
Sierra Leone	...	357	...	23	...	...	...	...	...
Somalia	...	...	...	...	...	...	...	...	...
South Africa	...	14,804	...	32	...	...	...	...	...
South Sudan	...	...	...	...	...	...	...	...	...
Sudan	...	3,582	...	25	...	...	...	33	67
Swaziland	...	216	...	23	30	...	3	43	24
Togo	...	742	...	17	...	...	...	...	...
Tunisia	...	1,208	...	19	43	17	4	28	9
Uganda	...	2,954	...	29	31	17	10	41	...
United Republic of Tanzania	...	3,582	...	23	...	18	13	33	36
Western Sahara	...	...	...	...	...	...	...	...	...
Zambia	...	1,348	...	24	38	3	13	46	...
Zimbabwe	...	1,777	...	15	...	...	...	...	...
ASIA									
Afghanistan	...	1,501	...	20	...	...	...	...	...
Armenia	232	285	6	18	54	...	...	44	2
Azerbaijan	523[1]	1,202	7[1]	13	63	...	1	36	1
Bahrain	60	73	10	11	44	1	11	39	5
Bangladesh	...	2,872	...	12	24	16	3	41	17

continued . . .

TABLE B.9

continued

	Road traffic deaths (estimates)				Road traffic deaths, by road user category				
	(Number)		Death rate (per 100,000 population)		Drivers/ passengers of 4-wheeled vehicles (%)	Drivers/ passengers of motorized 2- and 3-wheelers (%)	Cyclists (%)	Pedestrians (%)	Other or unspecified users (%)
	1999–2001	2007–2011	1999–2001	2007–2011	2007–2011	2007–2011	2007–2011	2007–2011	2007–2011
Bhutan	. . .	79	. . .	13	61	3	. . .	5	32
Brunei Darussalam	. . .	46	. . .	7	. . .	. . .	. . .	. . .	. . .
Cambodia	. . .	1,816	. . .	17	12	67	4	12	6
China	. . .	70,134	. . .	21	23	35	10	25	8
China, Hong Kong SAR	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
China, Macao SAR	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Cyprus	. . .	60	. . .	8	40	35	3	22	. . .
Democratic People's Republic of Korea	. . .	—	. . .	11	. . .	. . .	. . .	. . .	. . .
Georgia	344	685	6	16	. . .	. . .	0	25	75
India	. . .	130,037	. . .	19	16	32	5	9	39
Indonesia	. . .	31,234	. . .	18	6	36	2	21	35
Iran (Islamic Republic of)	. . .	23,249	. . .	34	48	23	. . .	29	1
Iraq	. . .	5,708	. . .	32	. . .	. . .	. . .	. . .	. . .
Israel	. . .	352	. . .	5	42	12	5	34	7
Japan	11,766	5,772	7	5	31	18	16	35	0
Jordan	. . .	670	. . .	23	64	. . .	. . .	33	3
Kazakhstan	. . .	3,379	. . .	22	68	2	0	24	4
Kuwait	363	374	24	17	. . .	. . .	. . .	. . .	. . .
Kyrgyzstan	558[1]	850	13[1]	19	22	1	0	18	60
Lao People's Democratic Republic	. . .	767	. . .	20	15	74	1	6	3
Lebanon	. . .	533	. . .	22	45	19	1	33	3
Malaysia	. . .	6,872	. . .	25	26	59	3	9	3
Maldives	. . .	6	. . .	2	50	33	. . .	17	. . .
Mongolia	. . .	477	. . .	18	40	19	0	25	16
Myanmar	. . .	2,464	. . .	15	26	23	9	27	16
Nepal	. . .	1,689	. . .	16	. . .	. . .	. . .	. . .	. . .
Occupied Palestinian Territory	. . .	131	. . .	3	45	2	. . .	53	1
Oman	. . .	820	. . .	30	72	3	2	23	0
Pakistan	. . .	5,192	. . .	17	16	39	. . .	41	4
Philippines	. . .	6,739	. . .	9	. . .	. . .	. . .	. . .	. . .
Qatar	. . .	228	. . .	14	64	3	1	33	. . .
Republic of Korea	10,496[1]	5,505	22[1]	14	25	20	5	38	12
Saudi Arabia	. . .	6,596	. . .	25	. . .	. . .	. . .	. . .	. . .
Singapore	201	193	5	5	9	46	8	29	8
Sri Lanka	. . .	2,483	. . .	14	68	. . .	. . .	33	. . .
Syrian Arab Republic	. . .	2,118	. . .	23	70	. . .	. . .	30	. . .
Tajikistan	246[1]	442	6[1]	18	53	. . .	5	42	0
Thailand	. . .	13,365	. . .	38	13	74	3	8	3
Timor-Leste	. . .	99	. . .	20	. . .	. . .	. . .	. . .	. . .
Turkey	. . .	5,253	. . .	12	59	9	2	16	14
Turkmenistan	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
United Arab Emirates	. . .	826	. . .	13	56	3	1	29	12
Uzbekistan	2,044[1]	2,731	10[1]	11	. . .	. . .	. . .	. . .	. . .
Viet Nam	. . .	11,859	. . .	25	. . .	. . .	. . .	. . .	. . .
Yemen	. . .	3,843	. . .	24	. . .	. . .	. . .	. . .	. . .
EUROPE									
Albania	319[1]	352	11[1]	13	44	15	4	36	1
Andorra	. . .	3	. . .	4	67	. . .	. . .	33	. . .
Austria	865	552	10	7	53	16	6	18	8
Belarus	1,514	1,190	14	14	42	7	9	41	1
Belgium	. . .	840	. . .	8	54	17	9	11	9
Bosnia and Herzegovina	. . .	336	. . .	16	61	12	7	16	5
Bulgaria	940	775	10	10	63	6	3	22	6
Channel Islands	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Croatia	535	426	11	10	48	16	7	25	4
Czech Republic	972	802	9	8	48	12	9	19	12
Denmark	495	255	10	5	59	13	10	17	1
Estonia	209	78	15	7	56	9	12	17	6
Faroe Islands	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Finland	. . .	272	. . .	5	62	9	10	13	7
France	7,953	3,992	12	6	57	24	4	12	4
Germany	7,153	3,648	9	5	50	19	10	13	7
Gibraltar	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Greece	2,227	1,451	19	12	46	31	1	14	8
Holy See	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .

continued . . .

TABLE B.9

continued

	Road traffic deaths (estimates)				Road traffic deaths, by road user category				
	(Number)		Death rate (per 100,000 population)		Drivers/ passengers of 4-wheeled vehicles (%)	Drivers/ passengers of motorized 2- and 3-wheelers (%)	Cyclists (%)	Pedestrians (%)	Other or unspecified users (%)
	1999–2001	2007–2011	1999–2001	2007–2011	2007–2011	2007–2011	2007–2011	2007–2011	2007–2011
Hungary	1,341	740	12	9	45	9	12	26	8
Iceland	...	8	...	3	63	13	...	25	...
Ireland	400	212	10	5	68	8	1	19	4
Isle of Man	...	...	...	...	...	...	...	...	...
Italy	7,776	4,237	12	7	42	30	7	16	5
Latvia	562	218	23	11	42	10	6	36	6
Liechtenstein	...	...	...	...	...	...	...	...	...
Lithuania	700	299	19	11	44	6	7	36	7
Luxembourg	74	32	18	6	84	3	3	3	6
Malta	19	15	4	4	53	27	...	20	...
Moldova	527	452	14	14	56	7	4	31	3
Monaco	...	...	...	...	...	...	...	...	...
Montenegro	...	95	...	15	59	11	1	24	5
Netherlands	1,095	640	7	4	42	16	25	11	6
Norway	349	208	8	4	65	13	2	12	8
Poland	5,607	3,907	13	12	47	9	7	32	5
Portugal	1,376	937	12	12	53	24	4	15	5
Romania	...	2,377	...	11	41	7	8	37	8
Russian Federation	...	26,567	...	19	53	7	2	33	5
San Marino	...	0	...	0	...	...	...	...	...
Serbia	...	660	...	8	43	10	10	26	11
Slovakia	745	515	13	9	35	6	8	44	8
Slovenia	285	138	13	7	49	17	12	19	4
Spain	6,128	2,478	14	5	53	20	3	19	6
Sweden	548	266	6	3	59	17	8	12	4
Switzerland	...	327	...	4	40	22	10	23	5
TFYR Macedonia	110	162	5	8	58	11	4	20	7
Ukraine	5,561	6,116	11	14	40	11	6	38	5
United Kingdom	3,479	1,905	6	4	47	22	6	22	3
LATIN AMERICA AND THE CARIBBEAN									
Anguilla	...	...	...	...	...	...	...	...	...
Antigua and Barbuda	...	...	...	...	...	...	...	...	...
Argentina	...	5,094	...	13	69	10	...	15	6
Aruba	...	...	...	...	...	...	...	...	...
Bahamas	...	43	...	14	64	16	2	18	...
Barbados	...	19	...	7	...	...	...	...	...
Belize	...	41	...	16	...	...	...	...	...
Bolivia	...	1,681	...	19	58	...	1	36	5
Brazil	...	36,499	...	23	23	25	4	23	25
British Virgin Islands	...	...	...	...	...	...	...	...	...
Cayman Islands	...	...	...	...	...	...	...	...	...
Chile	1,543	2,071	11	12	36	5	9	39	11
Colombia	...	5,502	...	16	10	39	6	31	14
Costa Rica	719[1]	700	20[1]	13	23	28	9	37	3
Cuba	1,656	809	14	8	18	13	13	35	22
Dominica	...	8	...	12	38	50	...	13	...
Dominican Republic	...	2,470	...	42	14	58	...	25	4
Ecuador	1,850[1]	3,222	17[1]	27	1	4	0	30	65
El Salvador	2,119[1]	1,017	42[1]	22	16	5	5	62	13
Falkland Islands (Malvinas)	...	...	...	...	...	...	...	...	...
French Guiana	...	...	...	...	...	...	...	...	...
Grenada	...	...	...	...	...	...	...	...	...
Guadeloupe	...	...	...	...	...	...	...	...	...
Guatemala	...	958	...	7	53	30	...	...	17
Guyana	...	112	...	28	13	20	16	35	17
Haiti	...	...	...	...	...	...	...	...	...
Honduras	...	1,217	...	19	39	11	6	45	...
Jamaica	...	319	...	12	36	14	8	36	6
Martinique	...	...	...	...	...	...	...	...	...
Mexico	10,525	17,301	12	15	23	4	1	29	43
Montserrat	...	...	...	...	...	...	...	...	...
Netherlands Antilles	...	...	...	...	...	...	...	...	...
Nicaragua	782	742	20	19	67	...	...	34	...
Panama	445[3]	422	16[1]	14	38	6	6	44	7
Paraguay	...	1,206	...	21	30	41	1	28	...

continued . . .

TABLE B.9

continued

	Road traffic deaths (estimates)				Road traffic deaths, by road user category				
	(Number)		Death rate (per 100,000 population)		Drivers/ passengers of 4-wheeled vehicles (%)	Drivers/ passengers of motorized 2- and 3-wheelers (%)	Cyclists (%)	Pedestrians (%)	Other or unspecified users (%)
	1999–2001	2007–2011	1999–2001	2007–2011	2007–2011	2007–2011	2007–2011	2007–2011	2007–2011
Peru	3,925[1]	2,514	18[1]	16	13	1	1	34	51
Puerto Rico	...	...	...	...	...	...	...	...	...
Saint Kitts and Nevis	...	9	...	17	67	11	...	11	11
Saint Lucia	...	14	...	15	57	...	...	43	...
Saint Vincent and the Grenadines	...	5	...	5	...	...	...	...	...
Suriname	...	87	...	20	45	37	8	10	...
Trinidad and Tobago	...	200	...	17	70	5	3	21	...
Turks and Caicos Islands	...	...	...	...	...	...	...	...	...
United States Virgin Islands	...	...	...	...	...	...	...	...	...
Uruguay	349	556	10	22	...	...	...	...	...
Venezuela (Bolivarian Republic of)	5,198[1]	7,714	23[1]	37	3	4	1	15	77
NORTHERN AMERICA									
Bermuda	...	...	...	...	...	...	...	...	...
Canada	2,938	2,227	9	7	69	9	2	14	7
Greenland	...	...	...	...	...	...	...	...	...
Saint-Pierre-et-Miquelon	...	...	...	...	...	...	...	...	...
United States of America	42,230	32,885	15	11	70	13	2	12	3
OCEANIA									
American Samoa	...	...	...	...	...	...	...	...	...
Australia	1,808	1,363	9	6	68	16	3	13	0
Cook Islands	...	2	...	10	...	100	...	...	...
Fiji	...	52	...	6	...	...	...	...	...
French Polynesia	...	...	...	...	...	...	...	...	...
Guam	...	...	...	...	...	...	...	...	...
Kiribati	...	6	...	6	17	33	...	50	...
Marshall Islands	...	4	...	7	25	...	...	75	...
Micronesia (Federated States of)	...	2	...	2	...	...	...	...	...
Nauru	...	...	...	...	...	...	...	...	...
New Caledonia	...	...	...	...	...	...	...	...	...
New Zealand	535	375	14	9	69	13	3	9	6
Niue	...	1	...	68	100	...	...	...	...
Northern Mariana Islands	...	...	...	...	...	...	...	...	...
Palau	...	3	...	15	100	...	...	...	...
Papua New Guinea	...	269	...	13	29	...	...	38	32
Pitcairn	...	...	...	...	...	...	...	...	...
Samoa	...	55	...	16	...	...	...	...	...
Solomon Islands	...	12	...	15	22	...	...	44	33
Tokelau	...	...	...	...	...	...	...	...	...
Tonga	...	6	...	6	50	17	...	33	...
Tuvalu	...	...	...	...	...	...	...	...	...
Vanuatu	...	4	...	16	33	0	...	67	...
Wallis and Futuna Islands	...	...	...	...	...	...	...	...	...

Notes:

(1) Estimated numbers to allow for completeness.

Sources: World Health Organization (WHO) (2013) Global Status Report on Road Safety 2013, WHO, Geneva, World Health Organization (WHO) (2004) World Report on Road Traffic Injury Prevention 2004, WHO, Geneva.

CITY LEVEL DATA

TABLE C.1

Urban Agglomerations with 750,000 Inhabitants or More: Population Size and Rate of Change

		Estimates and projections ('000)			Annual rate of change (%)		Share in national urban population (%)		
		2000	2010	2020	2000–2010	2010–2020	2000	2010	2020
AFRICA									
Algeria	El Djazaïr (Algiers)	2,278	2,851	3,608	2.25	2.35	12.3	11.2	11.3
Algeria	Wahran (Oran)	706	776	920	0.94	1.71	3.8	3.0	2.9
Angola	Huambo	578	1,039	1,666	5.87	4.72	8.5	9.3	10.3
Angola	Luanda	2,591	4,790	7,555	6.14	4.56	38.0	43.0	46.6
Benin	Cotonou	642	882	1,292	3.17	3.82	25.7	22.5	22.1
Burkina Faso	Ouagadougou	921	1,911	3,662	7.30	6.50	42.0	45.2	48.6
Cameroon	Douala	1,490	2,348	3,408	4.55	3.72	20.9	23.3	24.7
Cameroon	Yaoundé	1,351	2,320	3,420	5.41	3.88	18.9	23.0	24.8
Chad	N'Djaména	703	1,038	1,522	3.89	3.83	39.7	42.5	45.5
Congo	Brazzaville	1,022	1,557	2,074	4.21	2.86	55.5	60.9	61.5
Congo	Pointe-Noire	539	807	1,081	4.04	2.92	29.3	31.6	32.1
Côte d'Ivoire	Abidjan	3,028	4,151	5,896	3.16	3.51	41.9	41.6	41.9
Côte d'Ivoire	Yamoussoukro	348	885	1,633	9.34	6.12	4.8	8.9	11.6
Democratic Republic of the Congo	Kananga	533	846	1,293	4.63	4.24	3.7	3.8	3.9
Democratic Republic of the Congo	Kinshasa	5,414	8,415	12,322	4.41	3.81	37.2	37.8	36.8
Democratic Republic of the Congo	Kisangani	516	783	1,192	4.16	4.21	3.6	3.5	3.6
Democratic Republic of the Congo	Lubumbashi	960	1,486	2,242	4.36	4.12	6.6	6.7	6.7
Democratic Republic of the Congo	Mbuji-Mayi	891	1,433	2,172	4.75	4.16	6.1	6.4	6.5
Egypt	Al-Iskandariyah (Alexandria)	3,592	4,400	5,517	2.03	2.26	12.4	12.5	12.8
Egypt	Al-Qahirah (Cairo)	10,170	11,031	13,254	0.81	1.84	35.1	31.4	30.7
Ethiopia	Addis Ababa	2,377	2,919	3,881	2.05	2.85	24.6	21.0	19.5
Ghana	Accra	1,674	2,469	3,602	3.89	3.78	19.9	19.8	20.7
Ghana	Kumasi	1,187	1,935	2,841	4.89	3.84	14.1	15.5	16.3
Guinea	Conakry	1,221	1,715	2,632	3.40	4.28	47.2	49.1	51.3
Kenya	Mombasa	683	940	1,411	3.19	4.06	11.0	9.8	9.6
Kenya	Nairobi	2,214	3,237	4,939	3.80	4.23	35.6	33.9	33.7
Liberia	Monrovia	836	812	621	–0.29	–2.68	66.2	42.5	23.2
Libyan Arab Jamahiriya	Tarabulus (Tripoli)	1,022	1,111	1,324	0.84	1.75	25.6	22.5	23.5
Madagascar	Antananarivo	1,361	1,900	3,091	3.33	4.86	32.7	28.7	29.5
Malawi	Lilongwe	477	738	1,195	4.36	4.82	29.1	31.9	33.2
Mali	Bamako	1,142	1,932	2,998	5.26	4.39	36.0	36.7	35.8
Mauritania	Nouakchott	553	759	1,085	3.16	3.57	52.3	53.2	56.6
Morocco	Agadir	610	786	985	2.54	2.26	4.0	4.3	4.6
Morocco	Dar-el-Beida (Casablanca)	2,937	3,009	3,580	0.24	1.74	19.1	16.6	16.9
Morocco	Fès	868	1,065	1,319	2.04	2.15	5.7	5.9	6.2
Morocco	Marrakech	751	919	1,142	2.02	2.17	4.9	5.1	5.4
Morocco	Rabat	1,507	1,807	2,213	1.81	2.03	9.8	10.0	10.4
Morocco	Tanger	591	790	995	2.89	2.31	3.9	4.4	4.7
Mozambique	Maputo	1,019	1,132	1,507	1.05	2.86	19.2	15.6	15.2
Mozambique	Matola	498	759	1,120	4.20	3.89	9.4	10.5	11.3
Niger	Niamey	680	1,222	2,183	5.86	5.80	38.5	44.7	48.1
Nigeria	Aba	630	836	1,252	2.82	4.04	1.2	1.1	1.1
Nigeria	Abuja	833	2,010	3,306	8.82	4.97	1.6	2.6	2.9
Nigeria	Benin City	975	1,311	1,955	2.97	3.99	1.9	1.7	1.7
Nigeria	Enugu	547	776	1,178	3.50	4.17	1.0	1.0	1.1
Nigeria	Ibadan	2,236	2,855	4,165	2.44	3.78	4.3	3.7	3.7
Nigeria	Ilorin	633	788	1,169	2.20	3.94	1.2	1.0	1.0
Nigeria	Jos	604	748	1,108	2.14	3.94	1.2	1.0	1.0
Nigeria	Kaduna	1,184	1,476	2,167	2.21	3.84	2.3	1.9	1.9
Nigeria	Kano	2,602	3,271	4,748	2.29	3.73	5.0	4.2	4.2
Nigeria	Lagos	7,281	10,788	15,825	3.93	3.83	13.9	13.9	14.1
Nigeria	Maiduguri	700	827	1,213	1.66	3.83	1.3	1.1	1.1
Nigeria	Ogbomosho	798	1,039	1,545	2.64	3.97	1.5	1.3	1.4
Nigeria	Onitsha	533	867	1,346	4.86	4.40	1.0	1.1	1.2
Nigeria	Port Harcourt	1,091	1,807	2,782	5.05	4.32	2.1	2.3	2.5
Rwanda	Kigali	497	961	1,499	6.58	4.45	44.6	48.1	48.0
Senegal	Dakar	2,029	2,926	4,227	3.66	3.68	52.9	55.7	57.8
Sierra Leone	Freetown	688	910	1,294	2.79	3.53	46.4	39.9	42.0
Somalia	Muqdisho (Mogadishu)	1,201	1,426	2,693	1.72	6.36	48.8	41.0	52.1
South Africa	Cape Town	2,715	3,492	4,096	2.52	1.60	10.7	11.3	11.8
South Africa	Durban	2,370	2,954	3,471	2.20	1.61	9.3	9.6	10.0
South Africa	Ekurhuleni (East Rand)	2,326	3,284	3,872	3.45	1.65	9.1	10.6	11.2
South Africa	Johannesburg	2,732	3,763	4,421	3.20	1.61	10.7	12.2	12.8
South Africa	Port Elizabeth	958	1,097	1,309	1.36	1.76	3.8	3.6	3.8
South Africa	Pretoria	1,084	1,468	1,753	3.03	1.78	4.3	4.8	5.1
South Africa	Vereeniging	897	1,174	1,406	2.69	1.81	3.5	3.8	4.1
Sudan	Al-Khartum (Khartoum)	3,505	4,516	6,028	2.53	2.89	39.1	40.6	41.1
Togo	Lomé	904	1,453	2,151	4.75	3.92	57.3	64.2	68.9

continued . . .

TABLE C.1

continued

		Estimates and projections ('000)			Annual rate of change (%)		Share in national urban population (%)		
		2000	2010	2020	2000–2010	2010–2020	2000	2010	2020
Tunisia	Tunis	711	777	935	0.89	1.85	11.9	11.2	11.9
Uganda	Kampala	1,097	1,594	2,669	3.74	5.16	37.5	31.5	30.1
United Republic of Tanzania	Dar es Salaam	2,116	3,415	5,677	4.79	5.08	27.9	29.0	29.8
Zambia	Lusaka	1,073	1,719	2,764	4.71	4.75	30.2	33.9	35.6
Zimbabwe	Harare	1,379	1,526	1,990	1.01	2.66	32.7	31.8	29.6
ASIA									
Afghanistan	Kabul	1,963	3,052	4,136	4.41	3.04	41.7	41.8	36.9
Armenia	Yerevan	1,111	1,113	1,189	0.02	0.66	55.9	56.2	58.2
Azerbaijan	Baku	1,806	2,062	2,655	1.32	2.53	43.3	42.0	46.2
Bangladesh	Chittagong	3,308	5,069	6,963	4.27	3.17	10.8	12.2	12.6
Bangladesh	Dhaka	10,285	14,930	20,064	3.73	2.96	33.6	36.0	36.3
Bangladesh	Khulna	1,285	1,723	2,406	2.93	3.34	4.2	4.2	4.3
Bangladesh	Rajshahi	678	900	1,273	2.83	3.46	2.2	2.2	2.3
Cambodia	Phnum Pénh (Phnom Penh)	1,149	1,509	1,958	2.73	2.61	49.7	53.9	55.8
China	Anshan, Liaoning	1,384	1,662	2,086	1.83	2.27	0.3	0.3	0.2
China	Anyang	753	1,129	1,374	4.05	1.96	0.2	0.2	0.2
China	Baoding	884	1,148	1,499	2.62	2.67	0.2	0.2	0.2
China	Baoji	638	901	1,246	3.46	3.24	0.1	0.1	0.1
China	Baotou	1,406	1,931	2,319	3.17	1.83	0.3	0.3	0.3
China	Beijing	10,162	15,000	20,781	3.89	3.26	2.2	2.3	2.5
China	Bengbu	687	914	1,218	2.86	2.87	0.2	0.1	0.1
China	Benxi	857	968	1,176	1.22	1.95	0.2	0.1	0.1
China	Changchun	2,730	3,598	4,693	2.76	2.66	0.6	0.5	0.6
China	Changde	735	924	1,176	2.29	2.42	0.2	0.1	0.1
China	Changsha, Hunan	2,183	3,212	4,473	3.86	3.31	0.5	0.5	0.5
China	Changshu	541	742	991	3.16	2.89	0.1	0.1	0.1
China	Changzhou, Jiangsu	1,478	2,323	3,190	4.52	3.17	0.3	0.4	0.4
China	Chengdu	4,222	6,397	9,074	4.16	3.50	0.9	1.0	1.1
China	Chifeng	677	842	1,072	2.18	2.42	0.1	0.1	0.1
China	Chongqing	7,436	9,732	12,479	2.69	2.49	1.6	1.5	1.5
China	Cixi	650	781	966	1.83	2.12	0.1	0.1	0.1
China	Dalian	2,833	3,305	4,067	1.54	2.07	0.6	0.5	0.5
China	Dandong	679	795	986	1.58	2.16	0.1	0.1	0.1
China	Daqing	1,082	1,547	2,145	3.58	3.27	0.2	0.2	0.3
China	Datong, Shanxi	1,049	1,355	1,777	2.56	2.71	0.2	0.2	0.2
China	Dongguan, Guangdong	3,631	7,160	8,783	6.79	2.04	0.8	1.1	1.0
China	Dongying	628	949	1,363	4.13	3.61	0.1	0.1	0.2
China	Foshan	3,877	6,208	8,910	4.71	3.61	0.9	0.9	1.1
China	Fushun, Liaoning	1,358	1,377	1,567	0.14	1.29	0.3	0.2	0.2
China	Fuxin	667	821	1,053	2.08	2.48	0.1	0.1	0.1
China	Fuyang	695	874	1,092	2.30	2.22	0.2	0.1	0.1
China	Fuzhou, Fujian	1,978	2,799	3,830	3.47	3.13	0.4	0.4	0.5
China	Guangzhou, Guangdong	7,330	10,486	14,167	3.58	3.01	1.6	1.6	1.7
China	Guilin	757	968	1,261	2.46	2.65	0.2	0.1	0.1
China	Guiyang	1,860	2,458	3,226	2.78	2.72	0.4	0.4	0.4
China	Haerbin	3,888	5,496	7,471	3.46	3.07	0.9	0.8	0.9
China	Haicheng	588	738	950	2.27	2.52	0.1	0.1	0.1
China	Haikou	738	1,587	2,050	7.66	2.56	0.2	0.2	0.2
China	Handan	811	1,250	1,814	4.33	3.72	0.2	0.2	0.2
China	Hangzhou	3,160	5,189	7,674	4.96	3.91	0.7	0.8	0.9
China	Hefei	1,532	2,830	4,549	6.13	4.75	0.3	0.4	0.5
China	Hengyang	793	1,099	1,498	3.27	3.09	0.2	0.2	0.2
China	Hohhot	1,005	1,446	2,010	3.64	3.29	0.2	0.2	0.2
China	Huai'an	818	1,262	1,815	4.34	3.63	0.2	0.2	0.2
China	Huaibei	617	963	1,400	4.45	3.75	0.1	0.1	0.2
China	Huainan	1,049	1,396	1,855	2.85	2.84	0.2	0.2	0.2
China	Huangshi	647	761	945	1.61	2.17	0.1	0.1	0.1
China	Huizhou	1,003	1,760	2,688	5.63	4.23	0.2	0.3	0.3
China	Huludao	529	795	1,142	4.08	3.61	0.1	0.1	0.1
China	Huzhou	544	790	1,099	3.73	3.30	0.1	0.1	0.1
China	Jiamusi	619	817	1,088	2.78	2.86	0.1	0.1	0.1
China	Jiangmen	519	1,103	1,435	7.55	2.63	0.1	0.2	0.2
China	Jiangyin	530	747	1,012	3.44	3.03	0.1	0.1	0.1
China	Jiaozuo	631	783	1,000	2.15	2.45	0.1	0.1	0.1
China	Jiaxing	440	749	1,150	5.31	4.29	0.1	0.1	0.1
China	Jilin	1,435	1,889	2,492	2.75	2.77	0.3	0.3	0.3
China	Jinan, Shandong	2,592	3,581	4,821	3.23	2.97	0.6	0.5	0.6
China	Jingzhou	761	1,040	1,392	3.12	2.92	0.2	0.2	0.2
China	Jining, Shandong	856	1,207	1,643	3.43	3.09	0.2	0.2	0.2
China	Jinjiang	456	859	1,378	6.33	4.72	0.1	0.1	0.2

continued . . .

TABLE C.1

continued

		Estimates and projections ('000)			Annual rate of change (%)		Share in national urban population (%)		
		2000	2010	2020	2000–2010	2010–2020	2000	2010	2020
China	Jinzhou	770	856	1,029	1.07	1.84	0.2	0.1	0.1
China	Jiujiang	471	759	1,130	4.76	3.99	0.1	0.1	0.1
China	Jixi, Heilongjiang	823	1,043	1,352	2.36	2.60	0.2	0.2	0.2
China	Kaohsiung	1,488	1,514	1,723	0.17	1.29	0.3	0.2	0.2
China	Kunming	2,601	3,388	4,371	2.65	2.55	0.6	0.5	0.5
China	Lanzhou	1,890	2,487	3,267	2.75	2.73	0.4	0.4	0.4
China	Lianyungang	567	965	1,485	5.31	4.31	0.1	0.1	0.2
China	Liaocheng	464	727	1,064	4.50	3.80	0.1	0.1	0.1
China	Linyi, Shandong	1,130	1,426	1,797	2.33	2.31	0.2	0.2	0.2
China	Liuzhou	1,027	1,353	1,783	2.75	2.76	0.2	0.2	0.2
China	Lufeng	556	732	964	2.74	2.76	0.1	0.1	0.1
China	Luoyang	1,213	1,539	1,982	2.38	2.53	0.3	0.2	0.2
China	Luzhou	649	850	1,113	2.70	2.69	0.1	0.1	0.1
China	Maoming	617	1,004	1,482	4.87	3.89	0.1	0.2	0.2
China	Mianyang, Sichuan	758	1,006	1,323	2.83	2.74	0.2	0.2	0.2
China	Mudanjiang	665	783	973	1.63	2.17	0.1	0.1	0.1
China	Nanchang	1,648	2,331	3,185	3.47	3.12	0.4	0.4	0.4
China	Nanchong	606	808	1,071	2.88	2.82	0.1	0.1	0.1
China	Nanjing, Jiangsu	3,980	5,665	7,732	3.53	3.11	0.9	0.9	0.9
China	Nanning	1,445	2,096	2,632	3.72	2.28	0.3	0.3	0.3
China	Nantong	1,006	1,550	2,228	4.32	3.63	0.2	0.2	0.3
China	Nanyang, Henan	672	1,164	1,787	5.49	4.29	0.1	0.2	0.2
China	Neijiang	685	883	1,154	2.55	2.67	0.2	0.1	0.1
China	Ningbo	1,643	2,632	3,842	4.71	3.78	0.4	0.4	0.5
China	Panjin	593	813	1,103	3.16	3.05	0.1	0.1	0.1
China	Pingdingshan, Henan	852	1,024	1,276	1.84	2.20	0.2	0.2	0.2
China	Pingxiang, Jiangxi	542	732	989	3.01	3.01	0.1	0.1	0.1
China	Puning	603	912	1,268	4.13	3.30	0.1	0.1	0.2
China	Putian	613	1,030	1,567	5.19	4.20	0.1	0.2	0.2
China	Qingdao	2,659	3,680	4,935	3.25	2.93	0.6	0.6	0.6
China	Qinhuangdao	702	893	1,147	2.41	2.50	0.2	0.1	0.1
China	Qiqihaer	1,331	1,588	1,982	1.77	2.22	0.3	0.2	0.2
China	Quanzhou	728	1,062	1,448	3.77	3.10	0.2	0.2	0.2
China	Rizhao	613	816	1,079	2.87	2.79	0.1	0.1	0.1
China	Shanghai	13,959	19,554	26,121	3.37	2.90	3.1	3.0	3.1
China	Shantou	2,931	4,062	5,321	3.27	2.70	0.6	0.6	0.6
China	Shaoguan	670	840	1,067	2.26	2.39	0.1	0.1	0.1
China	Shaoxing	608	873	1,215	3.62	3.30	0.1	0.1	0.1
China	Shenyang	4,562	5,469	6,772	1.81	2.14	1.0	0.8	0.8
China	Shenzhen	6,550	10,222	14,221	4.45	3.30	1.4	1.5	1.7
China	Shijiazhuang	1,914	2,741	3,786	3.59	3.23	0.4	0.4	0.4
China	Shiyan	528	737	1,012	3.34	3.17	0.1	0.1	0.1
China	Suzhou, Jiangsu	1,698	3,248	5,266	6.48	4.83	0.4	0.5	0.6
China	Taian, Shandong	910	1,240	1,655	3.09	2.89	0.2	0.2	0.2
China	Taichung	978	1,140	1,404	1.53	2.09	0.2	0.2	0.2
China	Tainan	723	784	932	0.81	1.73	0.2	0.1	0.1
China	Taipei	2,630	2,654	3,001	0.09	1.23	0.6	0.4	0.4
China	Taiyuan, Shanxi	2,503	3,392	4,519	3.04	2.87	0.6	0.5	0.5
China	Taizhou, Jiangsu	1,190	1,338	1,622	1.17	1.93	0.3	0.2	0.2
China	Taizhou, Zhejiang	535	786	1,073	3.84	3.11	0.1	0.1	0.1
China	Tangshan, Hebei	1,390	1,871	2,500	2.97	2.90	0.3	0.3	0.3
China	Tianjin	6,670	8,535	10,916	2.47	2.46	1.5	1.3	1.3
China	Ürümqi (Wulumqi)	1,705	2,954	4,565	5.50	4.35	0.4	0.4	0.5
China	Weifang	1,235	1,699	2,286	3.19	2.97	0.3	0.3	0.3
China	Weihai	440	783	1,216	5.75	4.41	0.1	0.1	0.1
China	Wenzhou	1,565	2,635	3,651	5.21	3.26	0.3	0.4	0.4
China	Wuhan	6,638	8,904	11,641	2.94	2.68	1.5	1.3	1.4
China	Wuhu, Anhui	634	1,172	1,898	6.15	4.82	0.1	0.2	0.2
China	Wuxi, Jiangsu	1,835	3,222	4,651	5.63	3.67	0.4	0.5	0.5
China	Xiamen	1,416	2,702	4,388	6.46	4.85	0.3	0.4	0.5
China	Xi'an, Shaanxi	3,690	4,846	6,303	2.72	2.63	0.8	0.7	0.7
China	Xiangtan, Hunan	698	950	1,281	3.08	3.00	0.2	0.1	0.2
China	Xiangyang	1,202	1,531	1,964	2.42	2.49	0.3	0.2	0.2
China	Xianyang, Shaanxi	790	1,019	1,319	2.55	2.58	0.2	0.2	0.2
China	Xining	844	1,185	1,628	3.39	3.18	0.2	0.2	0.2
China	Xinxiang	762	1,016	1,351	2.87	2.85	0.2	0.2	0.2
China	Xuzhou	1,367	2,144	3,120	4.50	3.75	0.3	0.3	0.4
China	Yancheng, Jiangsu	671	1,290	1,739	6.53	2.99	0.1	0.2	0.2

continued . . .

TABLE C.1

continued

		Estimates and projections ('000)			Annual rate of change (%)		Share in national urban population (%)		
		2000	2010	2020	2000–2010	2010–2020	2000	2010	2020
China	Yangzhou	1,216	1,566	2,021	2.53	2.55	0.3	0.2	0.2
China	Yantai	1,218	1,526	1,929	2.26	2.34	0.3	0.2	0.2
China	Yichang	692	980	1,237	3.49	2.33	0.2	0.1	0.1
China	Yinchuan	571	1,052	1,700	6.11	4.80	0.1	0.2	0.2
China	Yingkou	624	849	1,149	3.08	3.03	0.1	0.1	0.1
China	Yiwu	532	735	981	3.23	2.88	0.1	0.1	0.1
China	Yiyang, Hunan	678	819	1,014	1.89	2.13	0.1	0.1	0.1
China	Yueyang	881	1,155	1,504	2.71	2.63	0.2	0.2	0.2
China	Zaozhuang	853	1,175	1,576	3.21	2.93	0.2	0.2	0.2
China	Zhangjiakou	797	1,043	1,377	2.69	2.77	0.2	0.2	0.2
China	Zhanjiang	818	1,014	1,333	2.15	2.73	0.2	0.2	0.2
China	Zhengzhou	2,438	3,796	5,453	4.43	3.62	0.5	0.6	0.6
China	Zhenjiang, Jiangsu	679	1,008	1,423	3.95	3.45	0.1	0.2	0.2
China	Zhongshan	1,376	2,695	4,276	6.72	4.62	0.3	0.4	0.5
China	Zhuhai	1,004	1,359	1,784	3.03	2.72	0.2	0.2	0.2
China	Zhuzhou	819	1,025	1,310	2.24	2.45	0.2	0.2	0.2
China	Zibo	1,874	2,456	3,187	2.71	2.61	0.4	0.4	0.4
China	Zigong	592	946	1,177	4.69	2.19	0.1	0.1	0.1
China	Zunyi	541	844	1,228	4.44	3.75	0.1	0.1	0.1
China, Hong Kong SAR	Hong Kong	6,783	7,053	7,803	0.39	1.01	100.0	100.0	100.0
Democratic People's Republic of Korea	P'yongyang	2,777	2,834	3,049	0.20	0.73	20.4	19.3	19.4
Georgia	Tbilisi	1,100	1,117	1,149	0.15	0.28	44.0	48.7	51.8
India	Agra	1,293	1,714	2,276	2.82	2.83	0.4	0.5	0.5
India	Ahmadabad	4,427	6,210	8,452	3.38	3.08	1.5	1.6	1.8
India	Aligarh	653	891	1,210	3.10	3.06	0.2	0.2	0.3
India	Allahabad	1,035	1,205	1,487	1.52	2.11	0.4	0.3	0.3
India	Amritsar	990	1,171	1,455	1.68	2.16	0.3	0.3	0.3
India	Asansol	1,065	1,232	1,507	1.46	2.01	0.4	0.3	0.3
India	Aurangabad	868	1,167	1,562	2.96	2.92	0.3	0.3	0.3
India	Bangalore	5,567	8,275	11,641	3.96	3.41	1.9	2.2	2.4
India	Bareilly	722	961	1,294	2.86	2.97	0.2	0.3	0.3
India	Bhopal	1,426	1,851	2,427	2.61	2.71	0.5	0.5	0.5
India	Bhubaneswar	637	865	1,165	3.05	2.98	0.2	0.2	0.2
India	Chandigarh	791	1,010	1,315	2.44	2.64	0.3	0.3	0.3
India	Chennai (Madras)	6,353	8,523	11,321	2.94	2.84	2.2	2.3	2.3
India	Coimbatore	1,420	2,095	2,973	3.89	3.50	0.5	0.6	0.6
India	Delhi	15,732	21,935	29,274	3.32	2.89	5.4	5.8	6.1
India	Dhanbad	1,046	1,186	1,438	1.26	1.93	0.4	0.3	0.3
India	Durg-Bhilainagar	905	1,054	1,298	1.52	2.08	0.3	0.3	0.3
India	Guwahati (Gauhati)	797	957	1,202	1.84	2.27	0.3	0.3	0.2
India	Gwalior	855	1,084	1,414	2.38	2.65	0.3	0.3	0.3
India	Hubli-Dharwad	776	932	1,177	1.84	2.33	0.3	0.2	0.2
India	Hyderabad	5,445	7,578	10,275	3.30	3.05	1.9	2.0	2.1
India	Indore	1,597	2,127	2,820	2.87	2.82	0.5	0.6	0.6
India	Jabalpur	1,100	1,257	1,532	1.33	1.98	0.4	0.3	0.3
India	Jaipur	2,259	3,017	3,988	2.89	2.79	0.8	0.8	0.8
India	Jalandhar	694	862	1,105	2.17	2.48	0.2	0.2	0.2
India	Jamshedpur	1,081	1,320	1,672	2.00	2.36	0.4	0.3	0.3
India	Jodhpur	842	1,116	1,492	2.82	2.90	0.3	0.3	0.3
India	Kanpur	2,641	2,904	3,427	0.95	1.66	0.9	0.8	0.7
India	Kochi (Cochin)	1,340	1,592	1,989	1.73	2.23	0.5	0.4	0.4
India	Kolkata (Calcutta)	13,058	14,283	16,648	0.90	1.53	4.5	3.8	3.4
India	Kota	692	978	1,360	3.46	3.30	0.2	0.3	0.3
India	Kozhikode (Calicut)	875	961	1,152	0.94	1.82	0.3	0.3	0.2
India	Lucknow	2,221	2,854	3,704	2.51	2.61	0.8	0.8	0.8
India	Ludhiana	1,368	1,598	1,966	1.55	2.07	0.5	0.4	0.4
India	Madurai	1,187	1,443	1,835	1.95	2.41	0.4	0.4	0.4
India	Meerut	1,143	1,406	1,786	2.07	2.39	0.4	0.4	0.4
India	Moradabad	626	871	1,195	3.30	3.17	0.2	0.2	0.2
India	Mumbai (Bombay)	16,367	19,422	23,661	1.71	1.97	5.6	5.1	4.9
India	Mysore	776	969	1,253	2.22	2.57	0.3	0.3	0.3
India	Nagpur	2,089	2,471	3,059	1.68	2.13	0.7	0.7	0.6
India	Nashik	1,117	1,531	2,066	3.15	2.99	0.4	0.4	0.4
India	Patna	1,658	2,022	2,534	1.98	2.26	0.6	0.5	0.5
India	Pune (Poona)	3,655	4,951	6,582	3.04	2.85	1.3	1.3	1.4
India	Raipur	680	1,088	1,621	4.69	3.99	0.2	0.3	0.3
India	Rajkot	974	1,361	1,862	3.34	3.13	0.3	0.4	0.4
India	Ranchi	844	1,107	1,465	2.72	2.80	0.3	0.3	0.3
India	Salem	736	907	1,160	2.09	2.46	0.3	0.2	0.2
India	Solapur	853	946	1,129	1.03	1.77	0.3	0.3	0.2

continued . . .

TABLE C.1

continued

		Estimates and projections ('000)			Annual rate of change (%)		Share in national urban population (%)		
		2000	2010	2020	2000–2010	2010–2020	2000	2010	2020
India	Srinagar	954	1,251	1,657	2.71	2.81	0.3	0.3	0.3
India	Surat	2,699	4,438	6,600	4.98	3.97	0.9	1.2	1.4
India	Thiruvananthapuram	885	952	1,129	0.73	1.70	0.3	0.3	0.2
India	Tiruchirappalli	837	1,009	1,276	1.86	2.35	0.3	0.3	0.3
India	Tiruppur	523	927	1,466	5.73	4.58	0.2	0.2	0.3
India	Vadodara	1,465	1,794	2,270	2.02	2.36	0.5	0.5	0.5
India	Varanasi (Benares)	1,199	1,419	1,771	1.69	2.22	0.4	0.4	0.4
India	Vijayawada	999	1,453	2,058	3.74	3.48	0.3	0.4	0.4
India	Visakhapatnam	1,309	1,700	2,238	2.61	2.75	0.4	0.4	0.5
India	Warangal	569	746	995	2.70	2.88	0.2	0.2	0.2
Indonesia	Bandar Lampung	743	884	1,114	1.74	2.31	0.8	0.7	0.7
Indonesia	Bandung	2,138	2,399	2,909	1.15	1.92	2.4	2.0	1.9
Indonesia	Batam	350	957	1,628	10.07	5.32	0.4	0.8	1.1
Indonesia	Bogor	751	954	1,239	2.39	2.61	0.8	0.8	0.8
Indonesia	Denpasar	409	797	1,271	6.68	4.66	0.5	0.7	0.8
Indonesia	Jakarta	8,390	9,630	11,638	1.38	1.89	9.4	8.0	7.7
Indonesia	Malang	757	822	1,015	0.82	2.11	0.8	0.7	0.7
Indonesia	Medan	1,912	2,100	2,497	0.94	1.73	2.1	1.8	1.7
Indonesia	Padang	716	836	1,043	1.54	2.22	0.8	0.7	0.7
Indonesia	Palembang	1,459	1,455	1,655	-0.02	1.29	1.6	1.2	1.1
Indonesia	Pekan Baru	588	906	1,362	4.32	4.08	0.7	0.8	0.9
Indonesia	Samarinda	523	732	998	3.35	3.11	0.6	0.6	0.7
Indonesia	Semarang	1,427	1,558	1,872	0.88	1.83	1.6	1.3	1.2
Indonesia	Surabaya	2,611	2,768	3,260	0.59	1.64	2.9	2.3	2.2
Indonesia	Ujung Pandang	1,031	1,345	1,796	2.66	2.89	1.2	1.1	1.2
Iran (Islamic Republic of)	Ahvaz	868	1,061	1,271	2.01	1.81	2.1	2.1	2.2
Iran (Islamic Republic of)	Esfahan	1,382	1,743	2,088	2.32	1.81	3.3	3.4	3.7
Iran (Islamic Republic of)	Karaj	1,087	1,584	1,968	3.77	2.17	2.6	3.1	3.4
Iran (Islamic Republic of)	Kermanshah	729	838	992	1.39	1.69	1.7	1.6	1.7
Iran (Islamic Republic of)	Mashhad	2,073	2,653	3,171	2.47	1.78	5.0	5.2	5.5
Iran (Islamic Republic of)	Qom	843	1,043	1,253	2.13	1.84	2.0	2.0	2.2
Iran (Islamic Republic of)	Shiraz	1,115	1,300	1,535	1.54	1.66	2.7	2.5	2.7
Iran (Islamic Republic of)	Tabriz	1,264	1,484	1,752	1.60	1.66	3.0	2.9	3.1
Iran (Islamic Republic of)	Tehran	6,880	7,243	8,138	0.51	1.17	16.4	14.2	14.2
Iraq	Al-Basrah (Basra)	759	923	1,222	1.96	2.80	4.7	4.4	4.3
Iraq	Al-Mawsil (Mosul)	1,056	1,447	2,020	3.15	3.34	6.5	6.9	7.1
Iraq	Baghdad	5,200	5,891	7,816	1.25	2.83	32.1	28.0	27.5
Iraq	Irbil (Erbil)	757	1,009	1,395	2.88	3.24	4.7	4.8	4.9
Iraq	Najaf	542	754	1,066	3.30	3.47	3.3	3.6	3.7
Iraq	Sulaimaniya	580	836	1,202	3.66	3.64	3.6	4.0	4.2
Israel	Hefa (Haifa)	905	1,044	1,208	1.42	1.46	16.5	15.3	15.1
Israel	Jerusalem	664	778	936	1.59	1.85	12.1	11.4	11.7
Israel	Tel Aviv-Yafo (Tel Aviv-Jaffa)	2,739	3,319	4,005	1.92	1.88	49.9	48.7	50.0
Japan	Fukuoka-Kitakyushu	2,716	2,845	3,067	0.46	0.75	2.7	2.5	2.6
Japan	Hiroshima	2,044	2,103	2,272	0.29	0.77	2.1	1.8	1.9
Japan	Kyoto	1,806	1,804	1,894	-0.01	0.49	1.8	1.6	1.6
Japan	Nagoya	3,122	3,300	3,556	0.55	0.75	3.2	2.9	3.0
Japan	Osaka-Kobe	11,165	11,430	12,004	0.23	0.49	11.3	10.0	10.1
Japan	Sapporo	2,508	2,714	2,947	0.79	0.82	2.5	2.4	2.5
Japan	Sendai	2,184	2,401	2,619	0.95	0.87	2.2	2.1	2.2
Japan	Tokyo	34,450	36,933	38,707	0.70	0.47	34.8	32.2	32.6
Jordan	Amman	1,017	1,150	1,476	1.23	2.50	26.4	22.5	23.7
Kazakhstan	Almaty	1,160	1,400	1,648	1.89	1.63	13.9	16.3	17.4
Kuwait	Al Kuwayt (Kuwait City)	1,333	2,318	2,991	5.53	2.55	70.0	86.2	89.6
Kyrgyzstan	Bishkek	766	831	982	0.81	1.67	43.8	44.1	44.5
Lao People's Democratic Republic	Vientiane	442	766	1,246	5.50	4.86	37.8	37.3	40.5
Lebanon	Bayrut (Beirut)	1,487	1,983	2,302	2.88	1.49	46.2	53.8	57.8
Malaysia	Johore Bahru	630	1,002	1,396	4.63	3.32	4.3	4.9	5.4
Malaysia	Klang	631	1,132	1,619	5.84	3.59	4.4	5.5	6.3
Malaysia	Kuala Lumpur	1,306	1,524	1,959	1.55	2.51	9.0	7.5	7.6
Mongolia	Ulaanbaatar	765	1,138	1,626	3.97	3.57	55.5	61.1	67.6
Myanmar	Mandalay	810	1,035	1,379	2.45	2.87	6.6	6.7	7.0
Myanmar	Nay Pyi Taw	—	1,026	1,394	. . .	3.07	—	6.7	7.1
Myanmar	Yangon	3,553	4,356	5,623	2.04	2.55	29.0	28.3	28.7
Nepal	Kathmandu	644	974	1,467	4.14	4.10	19.6	19.5	20.6
Pakistan	Faisalabad	2,142	2,947	3,986	3.19	3.02	4.5	4.7	4.9
Pakistan	Gujranwala	1,226	1,712	2,341	3.34	3.13	2.6	2.7	2.9
Pakistan	Hyderabad	1,223	1,648	2,254	2.98	3.13	2.6	2.6	2.8
Pakistan	Islamabad	595	889	1,231	4.01	3.26	1.2	1.4	1.5
Pakistan	Karachi	10,031	13,500	17,729	2.97	2.73	20.9	21.7	21.8

continued . . .

TABLE C.1

continued

		Estimates and projections ('000)			Annual rate of change (%)		Share in national urban population (%)		
		2000	2010	2020	2000–2010	2010–2020	2000	2010	2020
Pakistan	Lahore	5,455	7,352	9,769	2.98	2.84	11.4	11.8	12.0
Pakistan	Multan	1,265	1,720	2,350	3.07	3.12	2.6	2.8	2.9
Pakistan	Peshawar	1,067	1,475	2,022	3.24	3.15	2.2	2.4	2.5
Pakistan	Quetta	614	874	1,210	3.52	3.26	1.3	1.4	1.5
Pakistan	Rawalpindi	1,522	2,098	2,856	3.21	3.09	3.2	3.4	3.5
Philippines	Cebu	721	839	1,078	1.52	2.51	1.9	1.8	1.9
Philippines	Davao	1,152	1,523	2,000	2.79	2.73	3.1	3.4	3.5
Philippines	Manila	9,958	11,654	14,428	1.57	2.14	26.8	25.7	25.5
Philippines	Zamboanga	605	856	1,153	3.47	2.97	1.6	1.9	2.0
Republic of Korea	Ansan	592	769	876	2.61	1.31	1.6	1.9	2.1
Republic of Korea	Bucheon	763	915	1,027	1.82	1.15	2.1	2.3	2.4
Republic of Korea	Busan	3,673	3,398	3,296	-0.78	-0.31	10.0	8.5	7.8
Republic of Korea	Daegu	2,478	2,450	2,525	-0.12	0.30	6.8	6.1	5.9
Republic of Korea	Daejon	1,362	1,520	1,667	1.10	0.93	3.7	3.8	3.9
Republic of Korea	Goyang	744	968	1,096	2.63	1.24	2.0	2.4	2.6
Republic of Korea	Gwangju	1,346	1,486	1,627	0.99	0.91	3.7	3.7	3.8
Republic of Korea	Incheon	2,464	2,601	2,800	0.54	0.74	6.7	6.5	6.6
Republic of Korea	Seongnam	911	962	1,052	0.54	0.90	2.5	2.4	2.5
Republic of Korea	Seoul	9,917	9,751	9,849	-0.17	0.10	27.1	24.4	23.2
Republic of Korea	Suweon	932	1,140	1,275	2.01	1.12	2.5	2.9	3.0
Republic of Korea	Ulsan	1,011	1,089	1,193	0.74	0.92	2.8	2.7	2.8
Republic of Korea	Yongin	376	738	906	6.75	2.06	1.0	1.8	2.1
Saudi Arabia	Ad-Dammam	639	909	1,242	3.52	3.12	4.0	4.0	4.4
Saudi Arabia	Al-Madinah (Medina)	795	1,106	1,491	3.31	2.98	5.0	4.9	5.3
Saudi Arabia	Ar-Riyadh (Riyadh)	3,567	5,227	7,294	3.82	3.33	22.3	23.2	25.9
Saudi Arabia	Jiddah	2,509	3,452	4,690	3.19	3.06	15.7	15.3	16.6
Saudi Arabia	Makkah (Mecca)	1,168	1,543	2,055	2.79	2.87	7.3	6.8	7.3
Singapore	Singapore	3,919	5,086	5,597	2.61	0.96	100.0	100.0	100.0
Syrian Arab Republic	Dimashq (Damascus)	2,063	2,582	3,383	2.24	2.71	24.8	22.7	23.5
Syrian Arab Republic	Halab (Aleppo)	2,204	3,068	4,065	3.31	2.81	26.5	27.0	28.3
Syrian Arab Republic	Hamah	495	893	1,249	5.91	3.36	6.0	7.9	8.7
Syrian Arab Republic	Hims (Homs)	856	1,321	1,799	4.33	3.09	10.3	11.6	12.5
Thailand	Krung Thep (Bangkok)	6,360	8,213	10,265	2.56	2.23	32.3	35.2	37.5
Thailand	Samut Prakan	389	1,093	2,174	10.34	6.88	2.0	4.7	7.9
Turkey	Adana	1,123	1,423	1,863	2.37	2.69	2.7	2.8	2.9
Turkey	Ankara	3,179	4,074	5,229	2.48	2.50	7.7	7.9	8.2
Turkey	Antalya	595	877	1,164	3.89	2.83	1.4	1.7	1.8
Turkey	Bursa	1,180	1,659	2,172	3.41	2.69	2.9	3.2	3.4
Turkey	Gaziantep	844	1,160	1,527	3.17	2.75	2.1	2.3	2.4
Turkey	Istanbul	8,744	10,953	13,791	2.25	2.30	21.2	21.4	21.7
Turkey	Izmir	2,216	2,842	3,673	2.49	2.57	5.4	5.5	5.8
Turkey	Konya	734	1,023	1,351	3.31	2.78	1.8	2.0	2.1
United Arab Emirates	Abu Zaby (Abu Dhabi)	486	869	1,539	5.82	5.71	19.8	13.8	19.4
United Arab Emirates	Dubayy (Dubai)	906	1,835	3,134	7.06	5.35	36.9	29.1	39.4
United Arab Emirates	Sharjah	444	914	1,543	7.22	5.23	18.1	14.5	19.4
Uzbekistan	Tashkent	2,135	2,213	2,549	0.36	1.42	23.0	22.3	22.2
Viet Nam	Can Tho	284	902	1,753	11.57	6.64	1.5	3.4	4.9
Viet Nam	Da Nang	568	805	1,140	3.49	3.48	3.0	3.0	3.2
Viet Nam	Hà Noi	1,660	2,809	4,201	5.26	4.02	8.6	10.5	11.8
Viet Nam	Hai Phòng	599	889	1,280	3.95	3.65	3.1	3.3	3.6
Viet Nam	Thành Pho Ho Chí Minh (Ho Chi Minh City)	4,389	6,189	8,535	3.44	3.21	22.9	23.2	24.0
Yemen	Adan (Aden)	495	746	1,247	4.11	5.14	10.6	9.8	10.3
Yemen	Sana'a'	1,347	2,293	3,820	5.32	5.10	28.9	30.0	31.5
EUROPE									
Austria	Wien (Vienna)	1,549	1,708	1,852	0.97	0.81	29.4	30.2	31.2
Belarus	Minsk	1,700	1,847	1,982	0.83	0.71	24.2	25.8	27.2
Belgium	Antwerpen	922	956	1,018	0.36	0.63	9.3	9.2	9.5
Belgium	Bruxelles-Brussel	1,785	1,933	2,090	0.80	0.78	18.1	18.5	19.4
Bulgaria	Sofia	1,128	1,175	1,194	0.41	0.16	20.5	21.6	22.0
Czech Republic	Praha (Prague)	1,172	1,265	1,373	0.76	0.82	15.5	16.4	17.4
Denmark	København (Copenhagen)	1,077	1,192	1,330	1.02	1.09	23.7	24.8	26.3
Finland	Helsinki	1,019	1,122	1,244	0.96	1.03	24.0	25.0	26.5
France	Bordeaux	763	841	974	0.97	1.47	1.7	1.6	1.7
France	Lille	1,003	1,034	1,175	0.30	1.28	2.2	1.9	2.0
France	Lyon	1,362	1,471	1,682	0.77	1.34	3.0	2.7	2.9
France	Marseille-Aix-en-Provence	1,363	1,472	1,684	0.77	1.34	3.0	2.8	2.9
France	Nice-Cannes	899	980	1,130	0.86	1.42	2.0	1.8	1.9
France	Paris	9,739	10,516	11,681	0.77	1.05	21.5	19.7	19.8
France	Toulouse	778	917	1,078	1.65	1.62	1.7	1.7	1.8
Germany	Berlin	3,384	3,450	3,586	0.19	0.39	5.6	5.7	5.9

continued . . .

TABLE C.1

continued

		Estimates and projections ('000)			Annual rate of change (%)		Share in national urban population (%)		
		2000	2010	2020	2000–2010	2010–2020	2000	2010	2020
Germany	Hamburg	1,710	1,786	1,885	0.44	0.53	2.8	2.9	3.1
Germany	Köln (Cologne)	963	1,002	1,058	0.40	0.55	1.6	1.6	1.7
Germany	München (Munich)	1,202	1,350	1,463	1.16	0.81	2.0	2.2	2.4
Greece	Athínai (Athens)	3,179	3,382	3,728	0.62	0.97	48.4	48.6	50.4
Greece	Thessaloniki	797	872	987	0.90	1.24	12.1	12.5	13.3
Hungary	Budapest	1,787	1,731	1,838	-0.32	0.60	27.1	25.1	25.5
Ireland	Dublin	989	1,102	1,342	1.09	1.97	43.9	39.8	41.5
Italy	Bergamo	699	774	864	1.02	1.10	1.8	1.9	2.0
Italy	Milano (Milan)	2,985	2,916	3,018	-0.23	0.34	7.8	7.1	7.0
Italy	Napoli (Naples)	2,232	2,348	2,563	0.51	0.88	5.8	5.7	6.0
Italy	Palermo	855	904	1,005	0.56	1.06	2.2	2.2	2.3
Italy	Roma (Rome)	3,385	3,306	3,416	-0.24	0.33	8.8	8.0	7.9
Italy	Torino (Turin)	1,694	1,620	1,662	-0.45	0.26	4.4	3.9	3.9
Netherlands	Amsterdam	1,005	1,049	1,153	0.43	0.94	8.2	7.6	7.9
Netherlands	Rotterdam	991	1,010	1,097	0.19	0.83	8.1	7.3	7.5
Norway	Oslo	774	898	1,073	1.49	1.79	22.6	23.2	25.1
Poland	Kraków (Cracow)	756	756	773	0.01	0.21	3.2	3.2	3.3
Poland	Warszawa (Warsaw)	1,666	1,718	1,792	0.30	0.42	7.0	7.4	7.7
Portugal	Lisboa (Lisbon)	2,672	2,825	3,095	0.55	0.91	47.5	43.7	44.4
Portugal	Porto	1,254	1,355	1,511	0.78	1.09	22.3	21.0	21.7
Romania	Bucuresti (Bucharest)	1,949	1,935	1,991	-0.08	0.28	16.6	17.1	17.7
Russian Federation	Chelyabinsk	1,082	1,128	1,201	0.42	0.63	1.0	1.1	1.1
Russian Federation	Kazan	1,096	1,142	1,205	0.41	0.53	1.0	1.1	1.1
Russian Federation	Krasnodar	641	741	849	1.44	1.36	0.6	0.7	0.8
Russian Federation	Krasnoyarsk	911	972	1,050	0.64	0.77	0.8	0.9	1.0
Russian Federation	Moskva (Moscow)	10,005	11,472	12,478	1.37	0.84	9.3	10.9	11.7
Russian Federation	Nizhniy Novgorod	1,331	1,253	1,246	-0.60	-0.05	1.2	1.2	1.2
Russian Federation	Novosibirsk	1,426	1,472	1,548	0.31	0.50	1.3	1.4	1.5
Russian Federation	Omsk	1,136	1,153	1,202	0.15	0.41	1.1	1.1	1.1
Russian Federation	Perm	1,014	992	1,016	-0.22	0.24	0.9	0.9	1.0
Russian Federation	Rostov-na-Donu (Rostov-on-Don)	1,061	1,089	1,136	0.26	0.42	1.0	1.0	1.1
Russian Federation	Samara	1,173	1,165	1,203	-0.08	0.33	1.1	1.1	1.1
Russian Federation	Sankt Peterburg (Saint Petersburg)	4,719	4,842	5,065	0.26	0.45	4.4	4.6	4.8
Russian Federation	Saratov	878	839	841	-0.46	0.02	0.8	0.8	0.8
Russian Federation	Ufa	1,049	1,062	1,108	0.12	0.43	1.0	1.0	1.0
Russian Federation	Volgograd	1,010	1,021	1,058	0.10	0.36	0.9	1.0	1.0
Russian Federation	Voronezh	854	888	948	0.39	0.65	0.8	0.8	0.9
Russian Federation	Yekaterinburg	1,303	1,348	1,429	0.34	0.58	1.2	1.3	1.3
Serbia	Beograd (Belgrade)	1,122	1,133	1,185	0.10	0.45	20.9	20.5	20.5
Spain	Barcelona	4,731	5,488	6,230	1.48	1.27	15.4	15.4	16.2
Spain	Madrid	5,014	6,405	7,752	2.45	1.91	16.3	18.0	20.2
Spain	Valencia	795	799	837	0.05	0.47	2.6	2.2	2.2
Sweden	Stockholm	1,206	1,360	1,595	1.20	1.59	16.2	17.0	18.6
Switzerland	Zürich (Zurich)	1,078	1,183	1,305	0.93	0.98	20.5	21.0	22.0
Ukraine	Dnipropetrovsk	1,077	1,003	913	-0.71	-0.94	3.3	3.2	3.0
Ukraine	Donetsk	1,026	965	905	-0.61	-0.64	3.1	3.1	3.0
Ukraine	Kharkiv	1,484	1,453	1,431	-0.21	-0.15	4.5	4.7	4.7
Ukraine	Krivoi Rog	673	749	809	1.06	0.77	2.1	2.4	2.7
Ukraine	Kyiv (Kiev)	2,606	2,805	2,943	0.73	0.48	7.9	9.0	9.7
Ukraine	Odesa	1,037	1,009	1,034	-0.27	0.24	3.2	3.2	3.4
Ukraine	Zaporizhzhya	822	775	733	-0.59	-0.56	2.5	2.5	2.4
United Kingdom	Birmingham	2,285	2,273	2,453	-0.05	0.76	4.9	4.6	4.6
United Kingdom	Glasgow	1,171	1,140	1,220	-0.26	0.68	2.5	2.3	2.3
United Kingdom	Liverpool	818	797	856	-0.26	0.72	1.8	1.6	1.6
United Kingdom	London	8,225	8,923	9,796	0.81	0.93	17.8	18.1	18.4
United Kingdom	Manchester	2,248	2,216	2,384	-0.14	0.73	4.9	4.5	4.5
United Kingdom	Newcastle upon Tyne	880	875	955	-0.07	0.87	1.9	1.8	1.8
United Kingdom	West Yorkshire	1,495	1,605	1,820	0.71	1.25	3.2	3.3	3.4
LATIN AMERICA AND THE CARIBBEAN									
Argentina	Buenos Aires	11,847	13,370	14,876	1.21	1.07	35.6	35.8	36.2
Argentina	Córdoba	1,348	1,532	1,776	1.28	1.47	4.0	4.1	4.3
Argentina	La Plata	676	747	876	0.99	1.60	2.0	2.0	2.1
Argentina	Mendoza	838	942	1,101	1.17	1.56	2.5	2.5	2.7
Argentina	Rosario	1,152	1,264	1,468	0.93	1.49	3.5	3.4	3.6
Argentina	San Miguel de Tucumán	722	853	1,001	1.67	1.60	2.2	2.3	2.4
Bolivia	La Paz	1,390	1,678	2,143	1.88	2.45	27.1	25.4	26.3
Bolivia	Santa Cruz	1,054	1,653	2,248	4.50	3.07	20.5	25.1	27.6
Brazil	Aracaju	606	748	906	2.10	1.91	0.4	0.5	0.5
Brazil	Baixada Santista	1,468	1,659	1,897	1.22	1.34	1.0	1.0	1.0
Brazil	Belém	1,748	2,038	2,367	1.54	1.49	1.2	1.2	1.3

continued . . .

TABLE C.1

continued

		Estimates and projections ('000)			Annual rate of change (%)		Share in national urban population (%)		
		2000	2010	2020	2000–2010	2010–2020	2000	2010	2020
Brazil	Belo Horizonte	4,659	5,407	6,217	1.49	1.40	3.3	3.3	3.4
Brazil	Brasília	2,746	3,701	4,654	2.98	2.29	1.9	2.3	2.5
Brazil	Campinas	2,264	2,794	3,295	2.10	1.65	1.6	1.7	1.8
Brazil	Campo Grande	654	775	916	1.69	1.67	0.5	0.5	0.5
Brazil	Cuiabá	686	789	916	1.39	1.50	0.5	0.5	0.5
Brazil	Curitiba	2,494	3,118	3,761	2.24	1.87	1.8	1.9	2.1
Brazil	Florianópolis	734	1,010	1,300	3.19	2.52	0.5	0.6	0.7
Brazil	Fortaleza	2,875	3,520	4,190	2.02	1.74	2.0	2.1	2.3
Brazil	Goiânia	1,635	2,049	2,483	2.26	1.92	1.2	1.2	1.4
Brazil	Grande São Luís	1,066	1,304	1,562	2.01	1.81	0.8	0.8	0.9
Brazil	Grande Vitória	1,398	1,666	1,964	1.75	1.64	1.0	1.0	1.1
Brazil	João Pessoa	827	1,067	1,322	2.54	2.15	0.6	0.6	0.7
Brazil	Maceió	952	1,154	1,378	1.92	1.77	0.7	0.7	0.8
Brazil	Manaus	1,392	1,798	2,241	2.56	2.20	1.0	1.1	1.2
Brazil	Natal	910	1,252	1,610	3.20	2.51	0.6	0.8	0.9
Brazil	Norte/Nordeste Catarinense	923	1,114	1,327	1.88	1.75	0.7	0.7	0.7
Brazil	Pôrto Alegre	3,505	3,892	4,376	1.05	1.17	2.5	2.4	2.4
Brazil	Recife	3,230	3,684	4,210	1.32	1.33	2.3	2.2	2.3
Brazil	Rio de Janeiro	10,803	11,867	13,020	0.94	0.93	7.6	7.2	7.1
Brazil	Salvador	2,968	3,947	4,925	2.85	2.22	2.1	2.4	2.7
Brazil	São Paulo	17,099	19,649	22,243	1.39	1.24	12.1	12.0	12.2
Brazil	Sorocaba	578	776	987	2.95	2.40	0.4	0.5	0.5
Brazil	Teresina	789	902	1,045	1.33	1.48	0.6	0.5	0.6
Chile	Concepción	648	758	891	1.56	1.63	4.9	5.0	5.3
Chile	Santiago	5,275	5,959	6,748	1.22	1.24	39.8	39.1	40.1
Chile	Valparaíso	803	874	1,003	0.84	1.38	6.1	5.7	6.0
Colombia	Barranquilla	1,531	1,867	2,251	1.99	1.87	5.3	5.4	5.6
Colombia	Bogotá	6,356	8,502	10,579	2.91	2.19	22.2	24.5	26.1
Colombia	Bucaramanga	855	1,092	1,370	2.45	2.27	3.0	3.1	3.4
Colombia	Cali	1,950	2,402	2,936	2.08	2.01	6.8	6.9	7.2
Colombia	Cartagena	737	963	1,217	2.67	2.35	2.6	2.8	3.0
Colombia	Cúcuta	632	775	958	2.04	2.12	2.2	2.2	2.4
Colombia	Medellín	2,724	3,595	4,497	2.77	2.24	9.5	10.4	11.1
Costa Rica	San José	1,032	1,466	1,920	3.51	2.69	44.6	49.0	53.1
Cuba	La Habana (Havana)	2,187	2,128	2,017	-0.27	-0.54	26.0	25.1	24.0
Dominican Republic	Santo Domingo	1,813	2,154	2,613	1.72	1.93	34.2	31.4	31.7
Ecuador	Guayaquil	2,077	2,273	2,598	0.90	1.33	27.9	23.5	22.0
Ecuador	Quito	1,357	1,598	1,934	1.63	1.91	18.2	16.5	16.4
El Salvador	San Salvador	1,248	1,570	1,910	2.30	1.96	35.7	39.5	41.9
Guatemala	Ciudad de Guatemala (Guatemala City)	908	1,128	1,650	2.17	3.80	17.9	15.9	16.6
Haiti	Port-au-Prince	1,693	2,143	2,874	2.36	2.93	55.0	41.3	39.8
Honduras	Tegucigalpa	793	1,051	1,487	2.82	3.47	28.0	26.8	28.3
Mexico	Acapulco de Juárez	791	865	1,056	0.89	2.00	1.1	1.0	1.0
Mexico	Aguascalientes	734	934	1,162	2.41	2.18	1.0	1.1	1.1
Mexico	Chihuahua	683	854	1,060	2.24	2.16	0.9	1.0	1.0
Mexico	Ciudad de México (Mexico City)	18,022	20,142	23,239	1.11	1.43	24.1	22.8	22.9
Mexico	Ciudad Juárez	1,225	1,332	1,492	0.84	1.13	1.6	1.5	1.5
Mexico	Cuernavaca	667	878	1,111	2.76	2.36	0.9	1.0	1.1
Mexico	Culiacán	749	836	977	1.10	1.56	1.0	0.9	1.0
Mexico	Guadalajara	3,703	4,442	5,293	1.82	1.75	5.0	5.0	5.2
Mexico	Hermosillo	616	789	986	2.48	2.23	0.8	0.9	1.0
Mexico	León de los Aldamas	1,290	1,613	1,999	2.24	2.15	1.7	1.8	2.0
Mexico	Mérida	848	1,021	1,235	1.86	1.90	1.1	1.2	1.2
Mexico	Mexicali	770	938	1,142	1.97	1.96	1.0	1.1	1.1
Mexico	Monterrey	3,266	4,100	5,113	2.27	2.21	4.4	4.6	5.0
Mexico	Morelia	625	810	1,069	2.60	2.77	0.8	0.9	1.1
Mexico	Puebla	1,907	2,296	2,730	1.85	1.73	2.6	2.6	2.7
Mexico	Querétaro	795	1,101	1,466	3.25	2.86	1.1	1.2	1.4
Mexico	Reynosa	531	729	934	3.16	2.48	0.7	0.8	0.9
Mexico	Saltillo	643	825	1,044	2.50	2.35	0.9	0.9	1.0
Mexico	San Luis Potosí	858	1,042	1,257	1.95	1.87	1.1	1.2	1.2
Mexico	Tampico	659	763	908	1.46	1.74	0.9	0.9	0.9
Mexico	Tijuana	1,287	1,757	2,299	3.11	2.69	1.7	2.0	2.3
Mexico	Toluca de Lerdo	1,417	1,702	2,130	1.84	2.24	1.9	1.9	2.1
Mexico	Torreón	1,014	1,218	1,478	1.83	1.93	1.4	1.4	1.5
Nicaragua	Managua	887	954	1,192	0.73	2.24	31.9	28.8	29.9
Panama	Ciudad de Panamá (Panama City)	1,073	1,389	1,794	2.59	2.55	55.2	53.0	55.8
Paraguay	Asunción	1,507	2,073	2,777	3.19	2.92	51.0	52.3	55.0
Peru	Arequipa	678	791	960	1.54	1.95	3.6	3.5	3.7
Peru	Lima	7,294	8,950	10,695	2.05	1.78	38.6	40.0	41.2

continued . . .

TABLE C.1

continued

		Estimates and projections ('000)			Annual rate of change (%)		Share in national urban population (%)		
		2000	2010	2020	2000–2010	2010–2020	2000	2010	2020
Puerto Rico	San Juan	2,508	2,478	2,518	-0.12	0.16	69.5	66.9	67.6
Uruguay	Montevideo	1,605	1,659	1,816	0.33	0.90	53.0	53.3	55.7
Venezuela (Bolivarian Republic of)	Barquisimeto	946	1,215	1,510	2.50	2.18	4.3	4.5	4.8
Venezuela (Bolivarian Republic of)	Caracas	2,864	3,176	3,855	1.04	1.94	13.1	11.7	12.2
Venezuela (Bolivarian Republic of)	Ciudad Guayana	599	779	977	2.63	2.26	2.7	2.9	3.1
Venezuela (Bolivarian Republic of)	Maracaibo	1,724	2,255	2,773	2.69	2.07	7.9	8.3	8.8
Venezuela (Bolivarian Republic of)	Maracay	898	1,089	1,353	1.92	2.17	4.1	4.0	4.3
Venezuela (Bolivarian Republic of)	Valencia	1,392	1,821	2,249	2.69	2.11	6.4	6.7	7.1
NORTHERN AMERICA									
Canada	Calgary	953	1,191	1,420	2.23	1.76	3.9	4.3	4.7
Canada	Edmonton	924	1,121	1,325	1.93	1.68	3.8	4.1	4.4
Canada	Montréal	3,471	3,808	4,347	0.93	1.32	14.2	13.9	14.3
Canada	Ottawa-Gatineau	1,079	1,191	1,387	0.99	1.53	4.4	4.3	4.6
Canada	Québec	684	746	871	0.86	1.55	2.8	2.7	2.9
Canada	Toronto	4,607	5,485	6,298	1.74	1.38	18.9	20.0	20.7
Canada	Vancouver	1,959	2,235	2,583	1.32	1.45	8.0	8.2	8.5
United States of America	Allentown-Bethlehem	581	760	907	2.68	1.77	0.3	0.3	0.3
United States of America	Atlanta	3,542	4,875	5,620	3.19	1.42	1.6	1.9	2.0
United States of America	Austin	913	1,266	1,499	3.28	1.68	0.4	0.5	0.5
United States of America	Baltimore	2,083	2,415	2,814	1.48	1.53	0.9	0.9	1.0
United States of America	Birmingham	665	759	904	1.33	1.75	0.3	0.3	0.3
United States of America	Boston	4,049	4,772	5,491	1.64	1.40	1.8	1.9	1.9
United States of America	Bridgeport-Stamford	894	1,100	1,303	2.08	1.69	0.4	0.4	0.5
United States of America	Buffalo	977	1,090	1,289	1.09	1.67	0.4	0.4	0.5
United States of America	Charlotte	769	1,088	1,291	3.47	1.71	0.3	0.4	0.5
United States of America	Chicago	8,333	9,545	10,832	1.36	1.26	3.7	3.7	3.8
United States of America	Cincinnati	1,508	1,756	2,059	1.53	1.59	0.7	0.7	0.7
United States of America	Cleveland	1,789	2,022	2,364	1.22	1.56	0.8	0.8	0.8
United States of America	Columbus, Ohio	1,138	1,369	1,613	1.84	1.64	0.5	0.5	0.6
United States of America	Dallas-Fort Worth	4,172	5,143	5,913	2.09	1.40	1.9	2.0	2.1
United States of America	Dayton	706	835	993	1.67	1.74	0.3	0.3	0.3
United States of America	Denver-Aurora	1,998	2,492	2,905	2.21	1.54	0.9	1.0	1.0
United States of America	Detroit	3,909	4,364	5,025	1.10	1.41	1.7	1.7	1.8
United States of America	El Paso	678	813	968	1.82	1.74	0.3	0.3	0.3
United States of America	Hartford	853	982	1,164	1.41	1.70	0.4	0.4	0.4
United States of America	Honolulu	720	848	1,008	1.62	1.73	0.3	0.3	0.4
United States of America	Houston	3,849	4,785	5,509	2.18	1.41	1.7	1.9	1.9
United States of America	Indianapolis	1,228	1,552	1,827	2.35	1.63	0.5	0.6	0.6
United States of America	Jacksonville, Florida	886	1,066	1,263	1.85	1.69	0.4	0.4	0.4
United States of America	Kansas City	1,365	1,577	1,852	1.44	1.61	0.6	0.6	0.7
United States of America	Las Vegas	1,335	1,995	2,344	4.02	1.61	0.6	0.8	0.8
United States of America	Los Angeles-Long Beach-Santa Ana	11,814	13,223	14,907	1.13	1.20	5.3	5.2	5.2
United States of America	Louisville	866	1,021	1,210	1.64	1.70	0.4	0.4	0.4
United States of America	McAllen	532	824	984	4.37	1.78	0.2	0.3	0.3
United States of America	Memphis	976	1,165	1,378	1.77	1.67	0.4	0.5	0.5
United States of America	Miami	4,946	5,971	6,843	1.88	1.36	2.2	2.3	2.4
United States of America	Milwaukee	1,311	1,488	1,749	1.27	1.62	0.6	0.6	0.6
United States of America	Minneapolis-St. Paul	2,397	2,802	3,256	1.56	1.50	1.1	1.1	1.1
United States of America	Nashville-Davidson	755	951	1,129	2.31	1.72	0.3	0.4	0.4
United States of America	New Orleans	1,009	858	984	-1.62	1.38	0.4	0.4	0.4
United States of America	New York-Newark	17,846	20,104	22,487	1.19	1.12	8.0	7.9	7.9
United States of America	Oklahoma City	748	848	1,007	1.25	1.73	0.3	0.3	0.4
United States of America	Omaha	629	746	889	1.71	1.76	0.3	0.3	0.3
United States of America	Orlando	1,165	1,459	1,719	2.25	1.64	0.5	0.6	0.6
United States of America	Philadelphia	5,160	5,841	6,690	1.24	1.36	2.3	2.3	2.4
United States of America	Phoenix-Mesa	2,934	3,830	4,433	2.67	1.46	1.3	1.5	1.6
United States of America	Pittsburgh	1,755	1,965	2,298	1.13	1.56	0.8	0.8	0.8
United States of America	Portland	1,595	2,025	2,371	2.39	1.58	0.7	0.8	0.8
United States of America	Providence	1,178	1,373	1,617	1.53	1.64	0.5	0.5	0.6
United States of America	Raleigh	549	803	960	3.80	1.78	0.2	0.3	0.3
United States of America	Richmond	822	984	1,168	1.80	1.71	0.4	0.4	0.4
United States of America	Riverside-San Bernardino	1,516	1,882	2,206	2.16	1.59	0.7	0.7	0.8
United States of America	Rochester	696	814	969	1.56	1.74	0.3	0.3	0.3
United States of America	Sacramento	1,402	1,730	2,031	2.10	1.60	0.6	0.7	0.7
United States of America	Salt Lake City	890	1,040	1,232	1.56	1.69	0.4	0.4	0.4
United States of America	San Antonio	1,333	1,585	1,863	1.73	1.61	0.6	0.6	0.7
United States of America	San Diego	2,683	3,120	3,618	1.51	1.48	1.2	1.2	1.3
United States of America	San Francisco-Oakland	3,236	3,681	4,254	1.29	1.45	1.4	1.4	1.5
United States of America	San Jose	1,543	1,790	2,098	1.49	1.59	0.7	0.7	0.7
United States of America	Seattle	2,727	3,298	3,823	1.90	1.48	1.2	1.3	1.3

continued . . .

TABLE C.1

continued

		Estimates and projections ('000)			Annual rate of change (%)		Share in national urban population (%)		
		2000	2010	2020	2000–2010	2010–2020	2000	2010	2020
United States of America	St. Louis	2,081	2,351	2,740	1.22	1.53	0.9	0.9	1.0
United States of America	Tampa-St. Petersburg	2,072	2,484	2,895	1.82	1.53	0.9	1.0	1.0
United States of America	Tucson	724	891	1,059	2.07	1.73	0.3	0.3	0.4
United States of America	Virginia Beach	1,397	1,598	1,877	1.34	1.61	0.6	0.6	0.7
United States of America	Washington, D.C.	3,949	4,634	5,334	1.60	1.41	1.8	1.8	1.9
OCEANIA									
Australia	Adelaide	1,102	1,181	1,410	0.69	1.77	6.6	6.0	6.2
Australia	Brisbane	1,603	1,993	2,426	2.18	1.97	9.6	10.1	10.6
Australia	Melbourne	3,433	3,896	4,612	1.26	1.69	20.6	19.6	20.2
Australia	Perth	1,373	1,617	1,955	1.64	1.89	8.2	8.2	8.6
Australia	Sydney	4,078	4,479	5,254	0.94	1.60	24.4	22.6	23.0
New Zealand	Auckland	1,063	1,407	1,754	2.80	2.20	32.2	37.4	41.9

Source: United Nations Department of Economic and Social Affairs, Population Division (2012) World Urbanization Prospects: The 2011 Revision, United Nations, New York.

TABLE C.2

Population of Capital Cities (2011)

		City population ('000)	City population as a percentage of	
			Urban population (%)	Total population (%)
AFRICA				
Algeria	El Djazaïr (Algiers)	2,916	11.1	8.1
Angola	Luanda	5,068	43.6	25.8
Benin[1]	Cotonou	924	22.6	10.2
Benin[1]	Porto-Novo	314	7.7	3.5
Botswana	Gaborone	202	16.1	9.9
Burkina Faso	Ouagadougou	2,053	45.6	12.1
Burundi	Bujumbura	605	64.6	7.1
Cameroon	Yaoundé	2,432	23.3	12.1
Cape Verde	Praia	132	42.1	26.4
Central African Republic	Bangui	740	42.2	16.5
Chad	N'Djaména	1,079	42.9	9.4
Comoros	Moroni	54	25.5	7.1
Congo	Brazzaville	1,611	61.1	38.9
Côte d'Ivoire[2]	Abidjan	4,288	41.5	21.3
Côte d'Ivoire[2]	Yamoussoukro	966	9.3	4.8
Democratic Republic of the Congo	Kinshasa	8,798	37.9	13.0
Djibouti	Djibouti	496	71.0	54.8
Egypt	Al-Qahirah (Cairo)	11,169	31.1	13.5
Equatorial Guinea	Malabo	137	48.2	19.0
Eritrea	Asmara	712	61.6	13.1
Ethiopia	Addis Ababa	2,979	20.7	3.5
Gabon	Libreville	686	51.9	44.7
Gambia	Banjul	506	49.8	28.5
Ghana	Accra	2,573	19.9	10.3
Guinea	Conakry	1,786	49.3	17.5
Guinea-Bissau	Bissau	423	62.2	27.3
Kenya	Nairobi	3,363	33.7	8.1
Lesotho	Maseru	239	39.4	10.9
Liberia	Monrovia	750	37.7	18.2
Libya	Tarabulus (Tripoli)	1,127	22.6	17.5
Madagascar	Antananarivo	1,987	28.6	9.3
Malawi	Lilongwe	772	32.0	5.0
Mali	Bamako	2,037	36.8	12.9
Mauritania	Nouakchott	786	53.5	22.2
Mauritius	Port Louis	151	27.6	11.5
Mayotte	Mamoudzou	6	5.6	2.8
Morocco	Rabat	1,843	10.0	5.7
Mozambique	Maputo	1,150	15.4	4.8
Namibia	Windhoek	380	42.6	16.4
Niger	Niamey	1,297	45.3	8.1
Nigeria	Abuja	2,153	2.7	1.3
Réunion	Saint-Denis	145	17.9	16.9
Rwanda	Kigali	1,004	48.0	9.2
Saint Helena	Jamestown	1	42.1	16.6
Sao Tome and Principe	São Tomé	64	60.5	37.9
Senegal	Dakar	3,035	55.9	23.8
Seychelles	Victoria	27	57.1	30.6
Sierra Leone	Freetown	941	40.0	15.7
Somalia	Muqdisho (Mogadishu)	1,554	43.1	16.3
South Africa[3]	Bloemfontein	468	1.5	0.9
South Africa[3]	Cape Town	3,562	11.4	7.1
South Africa[3]	Pretoria	1,501	4.8	3.0
South Sudan	Juba	269	14.4	2.6
Sudan	Al-Khartum (Khartoum)	4,632	40.7	13.5
Swaziland[4]	Mbabane	66	25.6	5.4
Togo	Lomé	1,524	65.1	24.8
Tunisia	Tunis	790	11.2	7.5
Uganda	Kampala	1,659	30.9	4.8
United Republic of Tanzania	Dodoma	226	1.8	0.5
Western Sahara	El Aaiún	237	52.7	43.2
Zambia	Lusaka	1,802	34.2	13.4
Zimbabwe	Harare	1,542	31.3	12.1
ASIA				
Afghanistan	Kabul	3,097	40.7	9.6
Armenia	Yerevan	1,116	56.2	36.0
Azerbaijan	Baku	2,123	42.5	22.8
Bahrain	Al-Manamah (Manama)	262	22.3	19.8
Bangladesh	Dhaka	15,391	36.0	10.2
Bhutan	Thimphu	99	37.8	13.5

continued . . .

TABLE C.2

continued

		City population ('000)	City population as a percentage of	
			Urban population (%)	Total population (%)
Brunei Darussalam	Bandar Seri Begawan	16	5.3	4.0
Cambodia	Phnum Pénh (Phnom Penh)	1,550	54.2	10.8
China	Beijing	15,594	2.3	1.2
China, Hong Kong SAR[5]	Hong Kong	7,122	100.0	100.0
China, Macao SAR[6]	Macao	556	100.0	100.0
Cyprus	Lefkosia (Nicosia)	253	32.1	22.6
Democratic People's Republic of Korea	P'yongyang	2,843	19.3	11.6
Georgia	Tbilisi	1,121	49.0	25.9
India[7]	Delhi	22,654	5.8	1.8
Indonesia	Jakarta	9,769	7.9	4.0
Iran (Islamic Republic of)	Tehran	7,304	14.1	9.8
Iraq	Baghdad	6,036	27.8	18.5
Israel	Jerusalem	791	11.4	10.5
Japan	Tokyo	37,217	32.2	29.4
Jordan	Amman	1,179	22.5	18.6
Kazakhstan	Astana	664	7.6	4.1
Kuwait	Al Kuwayt (Kuwait City)	2,406	86.9	85.4
Kyrgyzstan	Bishkek	839	44.0	15.6
Lao People's Democratic Republic	Vientiane	810	37.6	12.9
Lebanon	Bayrut (Beirut)	2,022	54.4	47.5
Malaysia[8]	Kuala Lumpur	1,556	7.4	5.4
Maldives	Male	132	100.0	41.2
Mongolia	Ulaanbaatar	1,184	61.7	42.3
Myanmar	Nay Pyi Taw	1,060	6.7	2.2
Nepal	Kathmandu	1,015	19.6	3.3
Occupied Palestinian Territory	Ramallah	75	2.4	1.8
Oman	Masqat (Muscat)	743	35.5	26.1
Pakistan	Islamabad	919	1.4	0.5
Philippines	Manila	11,862	25.6	12.5
Qatar	Ad-Dawhah (Doha)	567	30.7	30.3
Republic of Korea	Seoul	9,736	24.2	20.1
Saudi Arabia	Ar-Riyadh (Riyadh)	5,451	23.6	19.4
Singapore	Singapore	5,188	100.0	100.0
Sri Lanka[9]	Colombo	693	21.8	3.3
Sri Lanka[9]	Sri Jayewardenepura Kotte	126	4.0	0.6
Syrian Arab Republic	Dimashq (Damascus)	2,650	22.8	12.8
Tajikistan	Dushanbe	739	39.9	10.6
Thailand	Krung Thep (Bangkok)	8,426	35.6	12.1
Timor-Leste	Dili	180	55.1	15.6
Turkey	Ankara	4,194	8.0	5.7
Turkmenistan	Ashgabat	683	27.5	13.4
United Arab Emirates	Abu Zaby (Abu Dhabi)	942	14.2	11.9
Uzbekistan	Tashkent	2,227	22.2	8.0
Viet Nam	Hà Noi	2,955	10.7	3.3
Yemen	Sana'a'	2,419	30.2	9.8
EUROPE				
Albania	Tiranë (Tirana)	419	24.4	13.0
Andorra	Andorra la Vella	23	31.3	27.3
Austria	Wien (Vienna)	1,720	30.2	20.4
Belarus	Minsk	1,861	25.9	19.5
Belgium[10]	Brussels	1,119	10.7	10.4
Bosnia and Herzegovina	Sarajevo	389	21.5	10.4
Bulgaria	Sofia	1,174	21.6	15.8
Channel Islands[11]	St. Helier	31	64.1	20.0
Croatia	Zagreb	686	27.0	15.6
Czech Republic	Praha (Prague)	1,276	16.5	12.1
Denmark	København (Copenhagen)	1,206	24.9	21.6
Estonia	Tallinn	400	43.0	29.9
Faroe Islands	Tórshavn	20	100.0	41.1
Finland	Helsinki	1,134	25.2	21.1
France	Paris	10,620	19.6	16.8
Germany	Berlin	3,462	5.7	4.2
Gibraltar	Gibraltar	29	100.0	100.0
Greece	Athínai (Athens)	3,414	48.8	30.0
Holy See	Vatican City	0	100.0	100.0
Hungary	Budapest	1,737	25.1	17.4
Iceland	Reykjavík	206	67.9	63.6
Ireland	Dublin	1,121	39.8	24.8
Isle of Man	Douglas	27	64.5	32.6
Italy	Roma (Rome)	3,298	7.9	5.4

continued . . .

TABLE C.2

continued

		City population ('000)	City population as a percentage of	
			Urban population (%)	Total population (%)
Latvia	Riga	701	46.2	31.3
Liechtenstein	Vaduz	5	100.0	14.4
Lithuania	Vilnius	546	24.6	16.5
Luxembourg	Luxembourg	94	21.4	18.3
Malta	Valletta	198	50.0	47.4
Monaco	Monaco	35	100.0	100.0
Montenegro	Podgorica	156	39.1	24.7
Netherlands[12]	Amsterdam	1,056	7.6	6.3
Netherlands[12]	s-Gravenhage (The Hague)	635	4.6	3.8
Norway	Oslo	915	23.4	18.6
Poland	Warszawa (Warsaw)	1,723	7.4	4.5
Portugal	Lisboa (Lisbon)	2,843	43.6	26.6
Republic of Moldova	Chişinău	677	40.0	19.1
Romania	Bucuresti (Bucharest)	1,937	17.1	9.0
Russian Federation	Moskva (Moscow)	11,621	11.0	8.1
San Marino	San Marino	4	14.3	13.5
Serbia	Beograd (Belgrade)	1,135	20.4	11.5
Slovakia	Bratislava	434	14.5	7.9
Slovenia	Ljubljana	273	26.9	13.4
Spain	Madrid	6,574	18.3	14.2
Sweden	Stockholm	1,385	17.2	14.7
Switzerland	Bern	353	6.2	4.6
TFYR Macedonia[13]	Skopje	499	40.8	24.2
Ukraine	Kyiv (Kiev)	2,829	9.1	6.3
United Kingdom	London	9,005	18.1	14.4
LATIN AMERICA AND THE CARIBBEAN				
Anguilla	The Valley	2	11.3	11.3
Antigua and Barbuda	St. John's	27	100.0	29.8
Argentina	Buenos Aires	13,528	35.9	33.2
Aruba	Oranjestad	37	72.7	34.1
Bahamas	Nassau	254	86.8	73.2
Barbados	Bridgetown	122	100.0	44.4
Belize	Belmopan	14	10.2	4.6
Bolivia[14]	La Paz	1,715	25.4	17.0
Bolivia[14]	Sucre	307	4.5	3.0
Brazil	Brasília	3,813	2.3	1.9
British Virgin Islands	Road Town	10	100.0	40.6
Cayman Islands	George Town	28	49.8	49.8
Chile	Santiago	6,034	39.2	34.9
Colombia	Bogotá	8,744	24.7	18.6
Costa Rica	San José	1,515	49.6	32.1
Cuba	La Habana (Havana)	2,116	25.0	18.8
Dominica	Roseau	14	29.8	20.0
Dominican Republic	Santo Domingo	2,191	31.3	21.8
Ecuador	Quito	1,622	16.4	11.1
El Salvador	San Salvador	1,605	39.8	25.8
Falkland Islands (Malvinas)	Stanley	2	100.0	74.1
French Guiana	Cayenne	67	36.9	28.2
Grenada	St.George's	41	100.0	39.1
Guadeloupe	Basse-Terre	13	2.9	2.9
Guatemala	Ciudad de Guatemala (Guatemala City)	1,168	15.9	7.9
Guyana	Georgetown	127	59.3	16.8
Haiti	Port-au-Prince	2,207	40.8	21.8
Honduras	Tegucigalpa	1,088	26.9	14.0
Jamaica	Kingston	571	39.9	20.8
Martinique	Fort-de-France	87	24.1	21.5
Mexico	Ciudad de México (Mexico City)	20,446	22.8	17.8
Montserrat[15]	Brades Estate	1	99.1	14.1
Montserrat[15]	Plymouth	0	0.1	0.0
Netherlands Antilles	Willemstad	115	60.6	56.6
Nicaragua	Managua	970	28.7	16.5
Panama	Ciudad de Panamá (Panama City)	1,426	53.1	39.9
Paraguay	Asunción	2,139	52.6	32.6
Peru	Lima	9,130	40.2	31.1
Puerto Rico	San Juan	2,475	66.8	66.1
Saint Kitts and Nevis	Basseterre	12	73.7	23.6
Saint Lucia	Castries	21	67.0	11.7
Saint Vincent and the Grenadines	Kingstown	31	57.2	28.2
Suriname	Paramaribo	278	75.2	52.5
Trinidad and Tobago	Port of Spain	66	35.7	4.9

continued . . .

TABLE C.2

continued

		City population ('000)	City population as a percentage of	
			Urban population (%)	Total population (%)
Turks and Caicos Islands[16]	Cockburn Town	7	18.5	17.3
United States Virgin Islands	Charlotte Amalie	60	57.3	54.7
Uruguay	Montevideo	1,672	53.4	49.5
Venezuela (Bolivarian Republic of)	Caracas	3,242	11.8	11.0
NORTHERN AMERICA				
Bermuda	Hamilton	11	17.0	17.0
Canada[17]	Ottawa-Gatineau	1,208	4.4	3.5
Greenland	Nuuk (Godthåb)	16	32.9	27.9
Saint Pierre and Miquelon	Saint-Pierre	5	100.0	90.7
United States of America	Washington, D.C.	4,705	1.8	1.5
OCEANIA				
American Samoa	Pago Pago	64	99.5	92.7
Australia	Canberra	399	2.0	1.8
Cook Islands[18]	Rarotonga	15	100.0	73.5
Fiji	Suva	177	39.1	20.4
French Polynesia	Papeete	137	97.4	50.0
Guam	Hagåtña	169	99.5	92.8
Kiribati[19]	Tarawa	44	100.0	43.9
Marshall Islands	Majuro	31	78.8	56.6
Micronesia (Fed. States of)	Palikir	7	26.6	6.0
Nauru	Nauru	10	100.0	100.0
New Caledonia	Nouméa	157	100.0	61.7
New Zealand	Wellington	410	10.8	9.3
Niue	Alofi	1	100.0	37.9
Northern Mariana Islands[20]	Saipan	56	100.0	91.5
Palau	Melekeok	1	3.7	3.1
Papua New Guinea	Port Moresby	343	39.2	4.9
Pitcairn	Adamstown	0	...	...
Samoa	Apia	37	100.0	19.9
Solomon Islands	Honiara	68	59.8	12.2
Tokelau[21]	...	...	...	
Tonga	Nuku'alofa	25	100.0	23.4
Tuvalu	Funafuti	5	100.0	50.6
Vanuatu	Port Vila	47	77.0	19.2
Wallis and Futuna Islands	Matu-Utu	1	—	8.1

Notes:

(1) Porto-Novo is the constitutional capital, Cotonou is the seat of government.
(2) Yamoussoukro is the capital, Abidjan is the seat of government.
(3) Pretoria is the administrative capital, Cape Town is the legislative capital and Bloemfontein is the judicial capital.
(4) Mbabane is the administrative capital, Lobamba is the legislative capital.
(5) As of 1 July 1997, Hong Kong became a Special Administrative Region (SAR) of China.
(6) As of 20 December 1999, Macao became a Special Administrative Region (SAR) of China.
(7) The capital is New Delhi, included in the urban agglomeration of Delhi. The population of New Delhi was estimated at 294,783 in the year 2001.
(8) Kuala Lumpur is the financial capital, Putrajaya is the administrative capital.
(9) Colombo is the commercial capital, Sri Jayewardenepura Kotte is the administrative and legislative capital.
(10) Data on city population is from Statistics Belgium.
(11) Refers to Guernsey and Jersey. St. Helier is the capital of the Bailiwick of Jersey and St. Peter Port is the capital of the Bailiwick of Guernsey.
(12) Amsterdam is the capital, 's-Gravenhage is the seat of government.
(13) The former Yugoslav Republic of Macedonia.
(14) La Paz is the capital and the seat of government, Sucre is the legal capital and the seat of the judiciary.
(15) Due to volcanic activity, Plymouth was abandoned in 1997. The government premises have been established at Brades Estate.
(16) Cockburn Town, the sole town of the Grand Turk Island, is the administrative and political capital, the estimated population refers to population of the Grand Turk Island.
(17) The capital is Ottawa.
(18) The capital is Avarua, located on the island of Rarotonga, the estimated population refers to the island of Rarotonga. Population estimates for Avarua have not been made available.
(19) The capital is Bairiki, located on the island of Tarawa, the estimated population refers to the island of South Tarawa. Population estimates for Bairiki have not been made available.
(20) The capital is Garapan, located on the island of Saipan, the estimated population refers to the island of Saipan. The population of Garapan was estimated at 3,588 in the year 2000.
(21) There is no capital in Tokelau. Each atoll (Atafu, Fakaofo and Nukunonu) has its own administrative centre.

Source: United Nations Department of Economic and Social Affairs, Population Division (2012) World Urbanization Prospects: The 2011 Revision, United Nations, New York.

TABLE C.3

Access to Services in Selected Cities

		Percentage of households with access to													
		1990–1999							2000–2009						
		Survey year	Improved water	Piped water	Improved sanitation	Telephone(s)	Mobile(s)	Connection to electricity	Survey year	Improved water	Piped water	Improved sanitation	Telephone(s)	Mobile(s)	Connection to electricity
AFRICA															
Angola	Luanda		...	...	...	...	...	...	2006	51.4	36.6	92.4	88.2	40.1	75.5
Benin	Cotonou	1996	99.0	98.1	71.2	...	...	56.6		...	...	...	...	...	...
Benin	Djougou	1996	84.3	65.4	45.1	...	...	23.5	2006	90.6	62.6	51.9	3.9	31.0	47.4
Benin	Porto-Novo	1996	57.7	40.3	50.8	...	...	29.4	2006	77.0	64.1	68.4	8.1	57.3	66.9
Burkina Faso	Ouagadougou	1999	88.5	27.1	51.5	13.7	...	41.3	2006	83.3	39.4	56.5	17.3	62.8	61.6
Cameroon	Douala	1998	77.2	32.2	80.8	7.6	...	93.8	2006	99.2	51.0	79.9	5.3	76.2	98.9
Cameroon	Yaoundé	1998	93.7	59.9	81.9	11.5	...	96.3	2006	99.5	53.8	79.9	7.3	82.8	98.9
Central African Republic	Bangui	1994	74.9	9.9	49.5	5.8	...	15.3	2006	97.3	7.4	81.5	6.1	40.4	43.3
Central African Republic	Berbérati		...	...	...	...	...	...	2006	94.7	3.5	79.7	2.7	13.1	4.1
Central African Republic	Boali		...	...	...	...	...	...	2006	79.1	5.7	71.7	1.7	23.1	16.5
Chad	N'Djaména	1997	30.6	21.0	69.9	2.8	...	17.2	2004	87.8	27.6	65.4	6.5	...	29.2
Comoros	Fomboni		...	...	...	...	...	...	2000	73.5	31.3	62.7	7.2	...	31.3
Comoros	Moroni	1996	95.7	22.2	67.6	13.0	...	55.1	2000	93.3	25.8	56.0	27.2	...	67.2
Comoros	Mutsamudu		...	...	...	...	...	...	2000	96.9	73.6	51.8	10.1	...	53.1
Congo	Brazzaville		...	...	...	...	...	...	2005	96.8	89.1	70.3	2.6	57.0	59.2
Côte d'Ivoire	Abidjan	1998	56.8	45.0	66.3	6.5	...	80.2	2005	98.6	83.3	79.3	49.5	0.0	95.0
Democratic Republic of the Congo	Kinshasa		...	...	...	...	...	...	2007	92.3	45.8	80.8	0.6	74.8	82.0
Democratic Republic of the Congo	Lubumbashi		...	...	...	...	...	...	2007	79.4	29.6	77.2	3.3	53.4	44.0
Democratic Republic of the Congo	Mbuji-Mayi		...	...	...	...	...	...	2007	95.8	10.2	84.6	1.1	34.0	3.7
Egypt	Al-Iskandariyah (Alexandria)	1995	99.7	94.2	79.4	...	...	99.8	2008	100.0	99.4	99.9	61.4	61.9	99.8
Egypt	Al-Qahirah (Cairo)	1995	98.6	94.8	76.2	...	...	99.0	2008	100.0	99.5	99.9	61.7	52.8	99.9
Egypt	Assiut	1995	94.7	91.7	61.8	...	...	96.1	2008	100.0	98.0	99.4	58.2	46.3	100.0
Egypt	Aswan	1995	95.5	88.6	56.8	...	...	98.2	2008	100.0	98.8	99.6	61.7	46.9	99.6
Egypt	Beni Suef	1995	88.9	83.8	57.6	...	...	96.0	2008	100.0	86.6	97.8	50.0	48.4	100.0
Egypt	Damanhur	1995	99.3	98.7	77.6	...	...	100.0	2008	100.0	100.0	100.0	58.5	48.1	100.0
Egypt	Damietta	1995	96.7	94.0	73.6	...	...	97.8	2008	100.0	100.0	100.0	61.0	35.0	100.0
Egypt	Fayoum	1995	92.7	88.3	50.4	...	...	97.8	2008	100.0	98.7	99.4	46.5	35.0	99.4
Egypt	Giza	1995	89.1	86.0	72.8	...	...	98.4	2008	100.0	99.1	99.8	69.6	81.3	99.8
Egypt	Ismailia	1995	94.2	91.8	85.1	...	...	99.1	2008	100.0	98.9	100.0	61.5	58.9	100.0
Egypt	Kafr El-Sheikh	1995	100.0	94.2	70.2	...	...	99.0	2008	100.0	100.0	100.0	68.7	35.5	100.0
Egypt	Kharijah	1995	93.5	92.7	69.9	...	...	99.2	2008	100.0	100.0	100.0	67.5	37.7	100.0
Egypt	Mansurah	1995	96.5	95.7	82.5	...	...	99.6	2008	100.0	97.2	100.0	63.8	51.1	100.0
Egypt	Port Said	1995	98.7	96.5	90.1	...	...	99.3	2008	98.4	98.2	100.0	69.3	49.7	100.0
Egypt	Qena	1995	89.9	81.4	68.2	...	...	96.1	2008	100.0	96.8	100.0	59.9	47.1	100.0
Egypt	Sawhaj	1995	89.8	87.0	65.4	...	...	96.0	2008	99.6	98.7	100.0	62.3	50.8	99.2
Egypt	Suez	1995	99.1	94.6	82.2	...	...	99.3	2008	99.8	99.8	100.0	64.4	42.5	100.0
Egypt	Tahta	1995	99.2	90.8	75.6	...	...	98.3	2008	99.7	88.7	100.0	59.9	49.8	100.0
Ethiopia	Addis Ababa		...	...	...	...	...	...	2010	99.8	68.3	71.3	37.4	86.2	98.6
Ethiopia	Nazret		...	...	...	...	...	...	2005	99.1	43.0	51.1	33.8	8.8	95.5
Gabon	Libreville		...	...	...	...	...	...	2000	99.7	58.2	83.4	20.4	...	95.5
Ghana	Accra	1998	97.7	64.4	69.5	12.3	...	92.0	2008	60.1	37.3	93.8	11.1	89.5	90.8
Guinea	Conakry	1999	82.7	39.2	84.8	7.2	...	71.4	2005	96.4	45.2	80.3	28.9	...	94.5
Kenya	Mombasa	1998	73.9	30.0	61.3	7.4	...	47.5	2008	74.0	36.4	78.8	6.9	80.6	57.9
Kenya	Nairobi	1998	92.1	77.6	84.3	11.2	...	60.1	2008	98.3	78.2	93.6	9.4	92.5	88.6
Lesotho	Maseru		...	...	...	...	...	...	2009	90.4	55.3	61.7	13.1	...	41.3
Liberia	Monrovia		...	...	...	...	...	...	2009	95.4	20.6	65.5	...	77.4	5.7
Madagascar	Antananarivo	1997	80.1	24.8	52.9	3.6	...	55.7	2003	85.7	22.0	56.4	21.4	...	67.8
Malawi	Blantyre		...	...	...	...	...	...	2006	97.0	30.6	42.6	6.7	35.1	32.7
Malawi	Lilongwe	1992	86.3	38.4	54.5	...	...	18.5	2006	92.2	20.2	42.1	2.0	26.5	18.0
Malawi	Mzaza		...	...	...	...	...	...	2006	96.7	41.9	42.1	5.5	32.5	35.6
Mali	Bamako	1996	70.5	17.3	51.6	3.7	...	33.7	2006	95.6	41.2	81.1	19.6	61.6	72.1
Mauritania	Nouakchott		...	...	...	...	...	...	2001	94.4	27.8	58.2	7.2	...	47.2
Morocco	Dar-el-Beida (Casablanca)	1992	99.1	74.1	92.9	...	...	78.7	2004	100.0	83.4	98.9	77.0	...	99.2
Morocco	Fès	1992	100.0	97.4	100.0	...	...	100.0	2004	99.6	93.8	99.6	57.9	...	97.7
Morocco	Marrakech	1992	100.0	84.0	94.7	...	...	90.4	2004	99.7	88.8	99.7	17.7	...	98.3
Morocco	Meknès	1992	99.2	89.4	99.2	...	...	84.1	2004	99.2	85.6	97.0	68.4	...	97.3
Morocco	Rabat	1992	96.5	86.0	92.5	...	...	83.9	2004	99.9	89.7	99.7	69.7	...	99.0
Mozambique	Maputo	1997	87.4	83.6	49.9	6.9	...	39.2	2009	99.7	61.5	49.2	6.8	86.4	80.0
Namibia	Windhoek	1992	98.0	93.9	92.7	...	...	70.0	2007	98.6	82.8	87.1	37.1	...	83.4
Niger	Niamey	1998	63.5	33.2	47.7	4.1	...	51.0	2006	94.7	42.3	65.7	6.5	47.7	61.1
Nigeria	Akure	1999	94.1	...	58.8	...	...	76.5	2008	93.1	1.8	74.0	0.5	97.7	97.7
Nigeria	Damaturu	1999	61.5	23.1	71.8	2.6	...	64.1	2008	83.3	3.1	86.3	1.3	60.8	60.8
Nigeria	Effon Alaiye	1999	32.8	4.4	48.9	2.2	...	93.3	2008	80.0	7.3	61.1	1.7	93.2	93.2
Nigeria	Ibadan	1999	93.3	...	13.3	...	...	33.3	2008	88.4	10.5	72.9	1.4	94.8	94.8
Nigeria	Kano	1999	54.8	27.3	58.8	4.5	...	82.2	2008	73.9	6.7	90.5	4.0	84.7	84.7
Nigeria	Lagos	1999	88.6	25.6	84.7	8.2	...	98.9	2008	94.0	5.4	91.6	7.4	98.0	98.0

continued . . .

TABLE C.3

continued

		Percentage of households with access to													
		1990–1999							2000–2009						
		Survey year	Improved water	Piped water	Improved sanitation	Telephone(s)	Mobile(s)	Connection to electricity	Survey year	Improved water	Piped water	Improved sanitation	Telephone(s)	Mobile(s)	Connection to electricity
Nigeria	Ogbomosho	1999	62.3	16.6	46.1	12.6	...	95.9		...	...	...	...	...	...
Nigeria	Owo	1999	34.4	7.4	68.8	9.9	...	95.3		...	...	...	...	...	...
Nigeria	Oyo	1999	35.0	11.0	65.8	3.6	...	92.1		...	...	...	...	...	...
Nigeria	Zaria	1999	74.4	54.6	55.8	4.6	...	94.2	2008	73.0	28.9	66.3	3.2	81.3	81.3
Rwanda	Kigali	1992	52.0	6.5	50.2	...	...	36.0	2011	93.1	34.1	94.8	2.2	87.3	65.6
Senegal	Dakar	1997	95.5	77.8	70.8	20.4	...	80.2	2010	98.2	85.6	91.5	26.2	96.7	95.0
Sierra Leone	Freetown		...	...	...	...	...	...	2008	95.7	36.0	83.9	3.7	75.2	51.8
Somalia			...	...	...	...	...	...	2006	52.9	38.6	83.0	19.8	26.2	30.5
South Africa	Cape Town	1998	95.8	79.7	83.4	49.6	...	88.0		...	...	...	...	...	...
South Africa	Durban	1998	98.4	87.7	90.1	46.3	...	84.3		...	...	...	...	...	...
South Africa	Port Elizabeth	1998	97.2	66.8	68.5	27.0	...	63.3		...	...	...	...	...	...
South Africa	Pretoria	1998	100.0	62.5	62.5	18.8	...	56.3		...	...	...	...	...	...
South Africa	West Rand	1998	99.4	84.2	84.8	47.6	...	75.0		...	...	...	...	...	...
Swaziland	Manzini		...	...	...	...	...	...	2006	92.8	68.6	79.9	17.7	76.6	60.5
Swaziland	Mbabane		...	...	...	...	...	...	2006	88.6	65.3	76.9	29.1	78.3	59.9
Togo	Lomé	1998	88.6	67.4	81.7	...	...	51.2	2006	92.9	14.3	82.5	10.9	56.1	71.6
United Republic of Tanzania	Arusha	1999	97.8	23.7	39.6	...	...	5.9	2010	93.5	59.6	37.4	1.5	...	34.7
United Republic of Tanzania	Dar es Salaam	1999	90.1	78.8	51.9	...	...	46.9	2010	86.2	48.3	42.3	4.6	...	66.5
Uganda	Kampala	1995	60.4	13.2	58.9	3.0	...	49.4	2009	94.3	26.3	93.7	9.3	88.2	68.3
Zambia	Chingola	1996	76.6	76.6	85.9	...	...	78.1	2007	90.4	80.1	86.7	9.6	71.7	76.5
Zambia	Lusaka	1996	93.9	49.8	70.3	...	...	50.7	2007	92.4	31.6	83.5	4.9	68.4	57.0
Zambia	Ndola	1996	92.3	59.4	85.1	...	...	52.0	2007	74.1	39.5	64.5	8.1	57.8	38.9
Zimbabwe	Harare	1999	99.6	93.5	97.2	19.9	...	84.7	2010	91.6	61.2	93.5	7.5	90.8	80.7
ASIA															
Armenia	Armavir		...	...	...	...	...	...	2010	74.7	73.7	91.6	78.3	87.8	100.0
Armenia	Artashat		...	...	...	...	...	...	2010	99.7	99.7	93.4	80.3	84.5	99.8
Armenia	Gavar		...	...	...	...	...	...	2010	99.6	88.9	100.0	88.5	87.5	99.7
Armenia	Gyumri		...	...	...	...	...	...	2010	100.0	97.4	93.1	72.6	86.5	99.5
Armenia	Hrazdan		...	...	...	...	...	...	2010	99.7	99.7	99.5	75.7	88.0	100.0
Armenia	Idjevan		...	...	...	...	...	...	2010	99.2	90.3	83.3	86.7	85.4	99.8
Armenia	Kapan		...	...	...	...	...	...	2010	100.0	100.0	98.8	97.7	83.9	100.0
Armenia	Vanadzor		...	...	...	...	...	...	2010	99.4	99.4	97.0	88.6	86.5	100.0
Armenia	Yerevan		...	...	...	...	...	...	2010	100.0	98.7	99.6	95.4	88.4	99.7
Azerbaijan	Baku		...	...	...	...	...	...	2006	92.7	89.6	98.8	85.8	75.4	99.6
Azerbaijan	Şirvan		...	...	...	...	...	...	2006	79.4	68.6	86.4	58.4	46.3	100.0
Bangladesh	Dhaka	1999	99.8	83.9	69.5	14.3	...	99.1	2007	100.0	63.2	55.1	9.7	64.0	96.9
Bangladesh	Rajshahi	1999	100.0	1.5	50.8	3.1	...	50.8	2007	100.0	0.8	53.4	1.1	31.9	60.1
Cambodia	Phnum Pénh (Phnom Penh)		...	...	...	...	...	...	2005	96.7	86.0	92.4	...	86.1	96.1
Cambodia	Siĕm Réab		...	...	...	...	...	...	2005	94.3	5.4	64.7	...	60.5	70.5
India	Agartala	1998	88.8	25.1	76.1	25.9	...	90.4	2006	95.1	35.1	86.3	25.5	18.0	91.8
India	Akola	1998	92.3	73.2	64.7	19.6	...	95.5	2006	99.2	69.8	61.4	21.3	24.6	93.1
India	Amritsar	1998	100.0	85.1	92.9	39.0	...	100.0	2006	100.0	79.0	98.7	26.6	40.3	97.0
India	Coimbatore	1998	94.1	36.0	90.0	19.1	...	89.6	2006	95.2	48.7	54.5	36.2	52.1	96.6
India	Hisar	1998	99.7	71.6	77.2	35.7	...	97.7	2006	99.2	65.3	77.4	25.5	38.1	97.9
India	Hyderabad	1998	98.4	87.5	70.3	29.7	...	96.1	2006	99.6	65.0	76.6	23.2	34.6	90.1
India	Jaipur	1998	98.5	83.7	91.5	28.5	...	98.0	2006	99.3	88.8	98.2	49.6	54.7	100.0
India	Jodhpur	1998	98.4	81.9	89.1	19.6	...	97.3	2006	97.9	84.7	69.2	34.7	38.4	94.7
India	Kanpur	1998	100.0	48.2	64.7	18.9	...	93.9	2006	98.6	37.4	81.3	19.1	39.1	92.6
India	Kharagpur	1998	90.9	40.4	87.1	15.0	...	82.6	2006	96.0	33.3	88.3	23.2	32.0	90.5
India	Kochi (Cochin)	1998	52.0	27.5	64.7	35.3	...	87.3		...	...	...	...	...	...
India	Kolkota	1998	98.5	35.1	94.3	25.6	...	93.8	2006	99.0	45.0	98.2	34.5	42.6	96.8
India	Krishnanagar	1998	89.7	32.7	78.6	18.9	...	81.5	2006	99.7	15.7	84.3	21.6	23.8	82.1
India	Mumbai (Bombay)	1998	99.4	76.7	98.0	31.6	...	99.0	2006	99.0	87.4	95.5	38.2	50.7	98.8
India	New Delhi	1998	99.2	80.8	94.0	45.4	...	97.6	2006	92.6	74.9	84.8	38.8	59.3	99.4
India	Pondichery	1998	93.7	35.9	52.5	13.0	...	87.0	2006	99.3	40.6	69.1	21.0	24.9	96.5
India	Pune (Poona)	1998	98.2	55.2	76.2	9.0	...	92.3	2006	99.1	74.0	78.7	23.3	35.5	97.0
India	Srinagar	1998	97.6	87.9	78.5	20.3	...	99.3	2006	98.8	83.5	64.1	41.6	55.2	99.4
India	Vijayawada	1998	96.9	39.2	68.1	13.2	...	96.8	2006	100.0	98.4	100.0	18.0	32.8	100.0
India	Yamunanagar	1998	99.7	59.7	77.7	27.0	...	98.3	2006	100.0	63.0	95.5	34.9	44.5	96.9
Indonesia	Bandung	1997	91.1	46.9	73.2	...	...	100.0	2007	80.2	14.3	93.4	58.4	...	98.6
Indonesia	Bitung	1997	84.4	52.4	80.6	...	...	96.3		...	...	...	...	...	...
Indonesia	Bogor	1997	95.1	42.0	89.6	...	...	99.3		...	...	...	...	...	...
Indonesia	Denpasar	1997	98.6	53.6	92.1	...	...	100.0		...	...	...	...	...	...
Indonesia	Dumai	1997	88.4	17.2	69.4	...	...	85.8		...	...	...	...	...	...
Indonesia	Jakarta	1997	99.2	35.6	70.7	...	...	99.9	2007	94.0	29.7	96.3	74.7	...	99.8
Indonesia	Jambi	1997	93.1	53.0	95.3	...	...	98.7		...	...	...	...	...	...
Indonesia	Jaya Pura	1997	88.3	61.1	76.0	...	...	88.0		...	...	...	...	...	...

continued . . .

TABLE C.3

continued

		Percentage of households with access to													
		1990–1999							2000–2009						
		Survey year	Improved water	Piped water	Improved sanitation	Telephone(s)	Mobile(s)	Connection to electricity	Survey year	Improved water	Piped water	Improved sanitation	Telephone(s)	Mobile(s)	Connection to electricity
Indonesia	Kediri	1997	94.1	17.9	48.0	. . .	. . .	98.6		. . .	. . .	. . .	. . .	. . .	. . .
Indonesia	Medan	1997	99.1	68.0	90.0	. . .	. . .	92.5	2007	83.5	48.6	93.2	67.0	. . .	99.6
Indonesia	Palembang	1997	98.0	81.2	90.8	. . .	. . .	100.0	2007	79.2	16.8	87.6	57.8	. . .	95.6
Indonesia	Palu	1997	99.4	39.7	68.7	. . .	. . .	92.1		. . .	. . .	. . .	. . .	. . .	. . .
Indonesia	Pekan Baru	1997	97.0	51.8	76.5	. . .	. . .	97.9		. . .	. . .	. . .	. . .	. . .	. . .
Indonesia	Purwokerto	1997	100.0	48.6	72.1	. . .	. . .	98.7		. . .	. . .	. . .	. . .	. . .	. . .
Indonesia	Surabaya	1997	100.0	71.0	70.5	. . .	. . .	100.0	2007	86.9	16.2	82.3	56.8	. . .	99.3
Indonesia	Surakarta	1997	100.0	0.0	46.0	. . .	. . .	100.0	2007	78.2	22.4	78.2	50.2	. . .	96.8
Indonesia	Ujung Pandang	1997	99.4	36.3	83.8	. . .	. . .	98.4	2007	81.8	44.6	92.4	64.5	. . .	99.0
Jordan	Ajlūn	1997	99.1	99.1	91.7	33.0	. . .	100.0	2009	97.6	62.2	100.0	15.5	96.6	99.6
Jordan	Al-Balqa	1997	98.6	98.1	97.7	35.8	. . .	99.1	2009	97.3	66.7	99.9	20.0	96.1	99.4
Jordan	Al-Karak	1997	97.1	96.6	92.6	33.7	. . .	98.9	2009	99.6	68.2	100.0	16.8	96.7	99.7
Jordan	Al-Mafraq	1997	97.7	96.9	99.2	44.5	. . .	98.4	2009	96.6	75.4	99.8	16.2	96.4	100.0
Jordan	Amman	1997	98.9	98.5	98.5	52.1	. . .	100.0	2009	99.3	54.2	100.0	34.3	97.9	99.8
Jordan	Aqaba	1997	100.0	100.0	98.9	45.5	. . .	100.0	2009	99.7	95.2	99.8	18.2	98.5	98.6
Jordan	Aṭ-Ṭafīlah	1997	98.8	98.8	97.6	51.5	. . .	96.4	2009	99.9	92.4	100.0	18.9	97.9	99.0
Jordan	Az-Zarqā'	1997	99.2	99.1	99.6	29.5	. . .	100.0	2009	99.0	66.4	100.0	17.1	96.9	99.7
Jordan	Irbid	1997	92.1	90.6	95.2	28.2	. . .	99.6	2009	97.0	48.0	100.0	20.5	96.6	99.3
Jordan	Jarash	1997	91.8	87.8	94.9	27.6	. . .	100.0	2009	98.2	63.3	100.0	11.4	96.4	99.7
Jordan	Ma'ān	1997	99.0	99.0	99.0	29.7	. . .	100.0	2009	98.8	66.5	99.8	16.3	97.4	99.2
Jordan	Ma'dabā	1997	100.0	100.0	100.0	42.9	. . .	100.0	2009	99.1	63.7	100.0	17.9	96.9	99.6
Kazakhstan	Almaty	1999	97.0	94.3	87.6	78.1	. . .	99.7	2006	100.0	98.7	98.7	89.7	62.2	100.0
Kazakhstan	Ôskemen		. . .	. . .	. . .	. . .	. . .	. . .	2006	99.4	81.2	100.0	62.3	33.4	99.8
Kazakhstan	Žezqazġan	1999	100.0	100.0	100.0	75.5	. . .	100.0		. . .	. . .	. . .	. . .	. . .	. . .
Kazakhstan	Qaragandy		. . .	. . .	. . .	. . .	. . .	. . .	2006	98.2	88.1	99.5	70.7	41.0	99.6
Kazakhstan	Šymkent	1999	100.0	100.0	100.0	73.7	. . .	100.0	2006	92.6	83.0	100.0	54.9	37.5	100.0
Kyrgyzstan	Bishkek	1997	99.2	95.3	84.0	63.7	. . .	100.0	2006	100.0	96.0	99.8	72.1	54.8	99.8
Nepal	Kathmandu		. . .	. . .	. . .	. . .	. . .	. . .		. . .	. . .	. . .			
Pakistan	Faisalabad	1990	98.1	78.1	87.6	. . .	. . .	98.7	2006	83.8	55.5	96.5	36.9	37.8	100.0
Pakistan	Islamabad	1990	94.1	80.3	71.0	. . .	. . .	97.8	2006	96.5	57.7	83.2	61.5	. . .	99.5
Pakistan	Karachi	1990	96.6	77.4	92.1	. . .	. . .	96.8	2006	92.4	66.7	85.3	64.5	. . .	97.5
Pakistan	Quetta		. . .	. . .	. . .	. . .	. . .	. . .	2006	97.6	79.3	76.5	62.7	. . .	98.8
Philippines	Bacolod	1998	92.7	31.1	75.0	12.8	. . .	78.7	2008	97.8	43.3	78.1	15.2	77.5	86.6
Philippines	Cagayan de Oro	1998	86.8	28.9	97.4	7.9	. . .	86.8	2008	100.0	16.1	98.9	14.9	78.5	93.3
Philippines	Cebu	1998	88.0	42.1	88.4	21.6	. . .	85.6	2008	99.0	21.9	84.4	22.4	80.6	93.4
Philippines	Manila	1998	91.0	65.9	96.9	45.7	. . .	98.7	2008	99.4	45.3	96.9	32.2	87.1	98.0
Turkey	Adana	1998	100.0	99.5	99.0	71.6	7.4	. . .	2004	99.5	92.2	99.6	76.8	39.0	. . .
Turkey	Aksaray	1998	47.6	42.9	64.3	69.0	7.1	. . .	2004	97.5	57.5	97.5	70.0	42.5	. . .
Turkey	Ankara	1998	97.4	86.6	99.5	90.3	23.6	. . .	2004	99.5	80.2	99.3	87.2	36.1	. . .
Turkey	Antalya	1998	91.7	89.1	90.1	83.3	20.3	. . .	2004	99.5	74.3	89.6	86.9	31.1	. . .
Turkey	Bursa	1998	92.0	87.7	98.8	82.7	14.8	. . .	2004	99.8	71.3	100.0	82.8	40.8	. . .
Turkey	Gaziantep	1998	96.2	94.9	90.4	73.1	7.7	. . .	2004	99.6	97.7	99.6	73.0	43.3	. . .
Turkey	Istanbul	1998	89.7	19.6	99.4	79.9	29.1	. . .	2004	99.3	39.7	99.1	83.3	35.6	. . .
Turkey	Izmir	1998	99.4	86.9	100.0	84.0	16.0	. . .	2004	98.3	56.1	100.0	84.5	39.5	. . .
Turkey	Karaman	1998	100.0	100.0	82.6	87.0	8.7	. . .		. . .	. . .	. . .	. . .	. . .	. . .
Turkey	Kırıkkale	1998	94.7	63.2	100.0	94.7	15.8	. . .	2004	100.0	23.9	100.0	87.0	50.0	. . .
Turkey	Malatya	1998	98.3	98.3	100.0	75.9	8.6	. . .	2004	100.0	100.0	99.2	86.5	37.6	. . .
Turkey	Van	1998	95.8	95.8	93.8	62.5	4.2	. . .	2004	98.9	93.6	77.7	78.7	33.0	. . .
Uzbekistan	Tashkent	1996	99.4	98.7	89.4	64.5	. . .	100.0		. . .	. . .	. . .	. . .	. . .	. . .
Viet Nam	Da Nang - CP		. . .	. . .	. . .	. . .	. . .	. . .	2002	88.8	88.8	100.0	80.0	. . .	100.0
Viet Nam	Hà Noi	1997	77.1	50.6	90.8	41.8	. . .	100.0	2002	77.2	74.1	97.3	72.9	. . .	100.0
Viet Nam	Hai Phòng	1997	97.9	75.1	72.1	6.4	. . .	100.0	2002	98.2	95.5	96.0	39.0	. . .	100.0
Viet Nam	Thành Pho Ho Chí Minh (Ho Chi Minh City)	1997	90.6	89.4	95.8	40.0	. . .	99.7	2002	89.3	88.8	98.4	74.5	. . .	99.8
Yemen	Aden	1991	97.0	97.0	91.4	28.7	. . .	95.6		. . .	. . .	. . .	. . .	. . .	. . .
Yemen	Sana'a'	1991	93.9	93.5	60.9	38.6	. . .	98.8	2006	56.8	22.5	88.7	. . .	. . .	. . .
Yemen	Taiz	1991	85.6	85.6	55.9	26.1	. . .	95.2		. . .	. . .	. . .	. . .	. . .	. . .
EUROPE															
Moldova	Chişinău		. . .	. . .	. . .	. . .	. . .	. . .	2005	99.5	89.1	97.8	93.6	60.6	99.7
Ukraine	Čerkasy		. . .	. . .	. . .	. . .	. . .	. . .	2007	99.4	81.5	99.7	64.4	79.8	99.7
Ukraine	Černihiv		. . .	. . .	. . .	. . .	. . .	. . .	2007	100.0	73.9	76.0	81.7	60.9	100.0
Ukraine	Černivcy		. . .	. . .	. . .	. . .	. . .	. . .	2007	100.0	94.9	97.0	87.2	61.8	100.0
Ukraine	Cherson		. . .	. . .	. . .	. . .	. . .	. . .	2007	99.7	78.0	100.0	54.4	71.3	100.0
Ukraine	Chmel'nyckyj		. . .	. . .	. . .	. . .	. . .	. . .	2007	98.1	81.5	98.4	84.5	64.2	99.4
Ukraine	Dnipropetrovs'k		. . .	. . .	. . .	. . .	. . .	. . .	2007	100.0	91.5	100.0	71.1	69.9	100.0
Ukraine	Donets'k		. . .	. . .	. . .	. . .	. . .	. . .	2007	100.0	76.4	99.8	50.3	79.3	99.9
Ukraine	Ivano-Frankivs'k		. . .	. . .	. . .	. . .	. . .	. . .	2007	100.0	72.6	100.0	85.6	77.5	100.0

continued . . .

TABLE C.3

continued

		Percentage of households with access to													
		1990–1999							2000–2009						
		Survey year	Improved water	Piped water	Improved sanitation	Telephone(s)	Mobile(s)	Connection to electricity	Survey year	Improved water	Piped water	Improved sanitation	Telephone(s)	Mobile(s)	Connection to electricity
Ukraine	Kharkiv		...	...	...	...	...	...	2007	100.0	79.0	99.7	68.8	70.9	100.0
Ukraine	Kirovhrad		...	...	...	...	...	...	2007	99.7	65.0	99.6	53.5	76.4	100.0
Ukraine	Krym		...	...	...	...	...	...	2007	99.6	91.3	99.3	58.2	68.9	99.8
Ukraine	Kyïv		...	...	...	...	...	...	2007	99.8	99.4	99.8	94.4	85.6	99.8
Ukraine	Luhans'k		...	...	...	...	...	...	2007	99.1	39.6	98.9	61.0	72.8	100.0
Ukraine	L'viv		...	...	...	...	...	...	2007	100.0	89.7	99.8	73.6	78.1	100.0
Ukraine	Mykolaïv		...	...	...	...	...	...	2007	93.2	91.0	100.0	47.2	56.2	99.6
Ukraine	Odesa		...	...	...	...	...	...	2007	99.8	85.8	99.3	72.5	61.7	99.9
Ukraine	Poltava		...	...	...	...	...	...	2007	98.3	71.7	100.0	70.9	71.1	100.0
Ukraine	Rivn		...	...	...	...	...	...	2007	100.0	95.0	98.0	72.6	72.4	99.3
Ukraine	Sėvastopol'		...	...	...	...	...	...	2007	100.0	95.4	100.0	85.9	65.5	100.0
Ukraine	Sumy		...	...	...	...	...	...	2007	99.6	78.9	100.0	70.6	70.2	100.0
Ukraine	Tėrnopil'		...	...	...	...	...	...	2007	97.7	84.2	100.0	82.5	73.5	100.0
Ukraine	Užhorod		...	...	...	...	...	...	2007	95.2	80.8	95.3	58.3	80.1	100.0
Ukraine	Vinnycja		...	...	...	...	...	...	2007	94.7	66.8	99.7	65.6	74.8	100.0
Ukraine	Volyn'		...	...	...	...	...	...	2007	100.0	84.3	100.0	85.3	71.0	100.0
Ukraine	Zaporizhzhya		...	...	...	...	...	...	2007	100.0	99.2	100.0	70.4	76.4	100.0
Ukraine	Žytomyr		...	...	...	...	...	...	2007	100.0	48.0	98.9	66.9	69.0	99.6
LATIN AMERICA AND THE CARIBBEAN															
Belize	Belize		...	...	...	...	...	...	2006	99.6	24.1	96.1	49.3	70.5	98.3
Bolivia	Cobija	1998	88.5	88.5	78.7	45.9	...	88.5	2008	86.7	85.2	79.7	23.4	85.0	96.2
Bolivia	Cochabamba	1998	83.5	83.5	65.0	47.5	7.6	98.2	2008	84.4	83.0	83.7	42.6	74.0	98.2
Bolivia	La Paz	1998	95.3	95.3	55.1	33.5	8.1	97.2	2008	97.5	95.0	83.6	29.7	77.0	98.3
Bolivia	Oruro	1998	93.9	93.9	42.3	29.5	4.8	95.8	2008	97.2	92.4	70.2	43.1	70.6	96.4
Bolivia	Potosí	1998	96.7	96.7	48.9	25.7	3.2	95.6	2008	98.1	95.1	82.8	23.7	74.9	97.8
Bolivia	Santa Cruz	1998	96.7	96.7	75.0	36.9	10.7	95.9	2008	98.9	98.1	78.3	25.8	84.5	97.7
Bolivia	Sucre	1998	96.5	96.5	71.9	36.1	8.4	95.7	2008	94.4	88.6	77.2	31.5	66.5	97.2
Bolivia	Tarija	1998	99.3	99.3	79.7	41.2	6.6	94.5	2008	99.3	94.5	86.4	31.7	81.8	94.9
Bolivia	Trinidad	1998	69.8	69.8	59.0	22.8	2.6	84.0	2008	65.0	60.7	65.4	14.9	65.8	91.5
Brazil	Belo Horizonte	1996	90.9	84.4	91.3	...	...	100.0		...	...	...	...	...	...
Brazil	Brasília	1996	90.2	89.8	81.7	...	...	99.6		...	...	...	...	...	...
Brazil	Curitiba	1996	90.0	84.2	88.7	...	...	100.0		...	...	...	...	...	...
Brazil	Fortaleza	1996	82.4	76.8	59.8	...	...	97.2		...	...	...	...	...	...
Brazil	Goiânia	1996	95.7	93.4	84.8	...	...	98.3		...	...	...	...	...	...
Brazil	Rio de Janeiro	1996	89.4	88.5	83.1	...	...	99.6		...	...	...	...	...	...
Brazil	São Paulo	1996	98.2	93.8	90.3	...	...	99.6		...	...	...	...	...	...
Brazil	Victoria	1996	94.6	90.4	90.8	...	...	99.2		...	...	...	...	...	...
Colombia	Armenia	1995	100.0	100.0	99.3	55.4	...	99.3	2010	100.0	97.0	99.6	37.9	...	98.6
Colombia	Barranquilla	1995	95.1	93.9	94.6	23.5	...	99.8	2010	98.6	94.5	97.0	36.1	...	99.6
Colombia	Bogotá	1995	100.0	100.0	99.8	80.6	...	99.9	2010	99.9	98.3	99.8	73.4	...	99.6
Colombia	Bucaramanga	1995	100.0	100.0	97.2	42.4	...	100.0	2010	99.1	97.1	99.0	49.1	...	99.4
Colombia	Cali	1995	99.9	99.7	97.3	43.1	...	99.9	2010	98.7	95.9	98.9	51.7	...	99.3
Colombia	Cartagena	1995	98.4	93.6	88.0	27.1	...	99.6	2010	93.2	81.8	92.3	25.6	...	99.2
Colombia	Cúcuta	1995	98.3	98.3	97.7	27.2	...	100.0	2010	97.9	93.4	98.4	33.4	...	99.4
Colombia	Ibagué	1995	99.1	99.1	97.0	32.5	...	97.7	2010	99.0	92.3	98.6	40.2	...	99.3
Colombia	Manizales	1995	99.6	99.6	99.6	52.3	...	98.8	2010	99.6	97.5	99.8	45.0	...	100.0
Colombia	Medellín	1995	99.4	99.4	96.5	52.3	...	98.8	2010	98.9	95.7	99.3	77.8	...	99.7
Colombia	Montería	1995	86.9	79.3	71.2	21.7	...	93.1	2010	93.6	70.5	94.3	23.4	...	99.1
Colombia	Neiva	1995	99.6	99.6	97.2	43.9	...	97.4	2010	100.0	96.7	99.3	39.4	...	99.4
Colombia	Pereira	1995	100.0	100.0	100.0	57.0	...	98.9	2010	99.5	93.4	100.0	56.6	...	99.4
Colombia	Popayán	1995	100.0	100.0	98.6	54.9	...	100.0	2010	98.2	89.7	99.1	29.1	...	99.5
Colombia	Quibdó	1995	94.3	64.0	8.2	35.1	...	79.6	2010	99.5	32.4	81.4	22.9	...	93.0
Colombia	Ríohacha	1995	100.0	100.0	92.9	16.8	...	94.6	2010	92.0	64.1	92.3	15.8	...	99.3
Colombia	Santa Marta	1995	80.0	74.2	79.6	18.4	...	100.0	2010	94.4	77.6	93.4	20.1	...	99.8
Colombia	Sincelejo	1995	100.0	100.0	86.6	19.5	...	98.5	2010	89.4	76.7	91.7	21.7	...	99.1
Colombia	Tunja	1995	100.0	100.0	99.3	22.1	...	98.7	2010	98.8	84.9	100.0	22.3	...	99.4
Colombia	Valledupar	1995	100.0	100.0	99.2	14.8	...	99.4	2010	99.5	94.2	96.3	23.2	...	98.3
Colombia	Villavicencio	1995	96.4	96.4	100.0	34.0	...	99.2	2010	96.8	57.8	99.5	26.4	...	99.4
Dominican Republic	Azua	1996	97.8	75.1	89.0	22.7	...	...	2007	92.1	49.1	92.5	15.3	46.5	99.1
Dominican Republic	Baní	1996	100.0	83.7	97.8	34.8	...	...	2007	78.4	22.6	93.6	29.4	64.6	98.7
Dominican Republic	Barahona	1996	92.2	89.3	79.7	14.8	...	...	2007	85.9	57.3	86.9	18.7	52.4	98.7
Dominican Republic	Bonao	1996	97.7	90.7	93.0	46.5	...	...	2007	94.6	34.3	98.3	31.4	75.2	99.2
Dominican Republic	Cotuí	1996	99.1	80.0	85.2	7.8	...	...	2007	93.7	6.5	93.5	29.4	69.7	100.0
Dominican Republic	Dajabón	1996	100.0	96.7	93.3	17.8	...	...	2007	82.2	38.3	94.7	18.5	62.5	96.9
Dominican Republic	Hato Mayor del Rey		...	...	...	...	...	...	2007	88.0	3.0	95.1	18.7	73.9	98.0
Dominican Republic	Higüey	1996	100.0	12.1	97.0	34.8	...	...	2007	94.3	0.1	97.8	21.7	79.2	98.0
Dominican Republic	La Romana	1996	100.0	29.3	92.9	34.2	...	...	2007	88.7	6.9	92.6	17.0	74.5	98.6

continued . . .

TABLE C.3

continued

		Percentage of households with access to													
		1990–1999							2000–2009						
		Survey year	Improved water	Piped water	Improved sanitation	Telephone(s)	Mobile(s)	Connection to electricity	Survey year	Improved water	Piped water	Improved sanitation	Telephone(s)	Mobile(s)	Connection to electricity
Dominican Republic	La Vega	1996	98.8	54.7	98.8	59.3	...	...	2007	91.5	27.6	96.7	26.0	73.1	98.6
Dominican Republic	Mao	1996	98.9	80.7	94.8	23.6	...	...	2007	96.4	36.6	95.1	24.0	72.9	96.1
Dominican Republic	Moca	1996	97.5	65.8	97.5	59.5	...	...	2007	97.9	37.9	97.1	23.6	73.6	98.2
Dominican Republic	Monte Cristi	1996	54.5	22.4	92.5	27.6	...	...	2007	93.8	20.2	94.3	28.2	67.6	95.3
Dominican Republic	Monte Plata	1996	98.4	63.2	89.3	14.2	...	...	2007	79.7	3.3	92.7	15.5	63.4	96.6
Dominican Republic	Nagua	1996	100.0	43.1	100.0	27.6	...	...	2007	89.2	4.6	93.5	21.3	76.9	98.9
Dominican Republic	Neiba	1996	96.6	92.7	82.0	12.4	...	...	2007	81.8	45.1	81.3	19.7	57.2	96.8
Dominican Republic	Puerto Plata	1996	97.4	46.2	98.7	32.1	...	...	2007	95.3	10.2	97.0	30.7	78.2	97.9
Dominican Republic	Sabaneta	1996	100.0	79.1	96.5	27.9	...	...	2007	89.6	21.2	93.3	27.3	73.7	98.7
Dominican Republic	Samaná	1996	96.6	82.8	51.7	3.4	...	...	2007	92.4	9.7	89.6	17.6	76.2	97.0
Dominican Republic	San Cristóbal	1996	88.2	56.6	91.5	36.8	...	...	2007	72.9	11.4	96.2	33.7	77.0	99.4
Dominican Republic	San Francisco de Macorís	1996	99.4	43.0	95.0	30.7	...	...	2007	90.2	10.7	95.0	31.5	73.5	98.7
Dominican Republic	San Juan	1996	97.8	87.8	92.8	21.0	...	...	2007	95.6	53.3	89.7	20.4	62.4	99.3
Dominican Republic	San Pedro de Macorís	1996	99.4	17.3	92.9	36.3	...	...	2007	76.8	4.4	92.7	19.5	70.3	98.3
Dominican Republic	Santiago	1996	99.7	77.8	96.3	46.0	...	...	2007	98.4	31.2	98.9	41.7	81.6	99.2
Dominican Republic	Santo Domingo	1999	97.7	31.1	87.2	54.3	...	...	2007	80.9	9.0	96.0	39.0	79.3	98.6
Guatemala	Ciudad de Guatemala (Guatemala City)	1998	91.1	53.2	83.6	31.9	...	91.7		...	...	...	...	...	...
Guatemala	Escuintla	1998	94.0	56.8	96.7	29.5	...	97.8		...	...	...	...	...	...
Guatemala	Quetzaltenango	1998	93.7	71.2	82.5	31.3	...	91.2		...	...	...	...	...	...
Guyana	Georgetown		...	...	...	...	...	...	2009	99.5	14.5	97.5	16.7	86.9	87.3
Haiti	Port-au-Prince	1994	48.5	31.9	93.4	...	...	92.3	2006	78.6	25.4	57.6	11.2	48.6	88.0
Honduras	Choluteca		...	...	...	...	...	...	2005	99.1	38.8	76.0	51.8	41.5	...
Honduras	Comayagua		...	...	...	...	...	...	2005	94.6	30.3	87.6	38.1	47.5	...
Honduras	Juticalpa		...	...	...	...	...	...	2005	96.9	35.2	78.2	46.2	43.3	...
Honduras	La Ceiba		...	...	...	...	...	...	2005	94.1	35.9	91.3	29.9	64.3	...
Honduras	San Pedro Sula		...	...	...	...	...	...	2005	98.9	30.2	93.3	40.1	57.6	...
Honduras	Santa Bárbara		...	...	...	...	...	...	2005	91.6	48.3	78.7	16.4	34.2	...
Honduras	Santa Rosa de Copán		...	...	...	...	...	...	2005	88.9	17.1	87.0	33.1	45.8	...
Honduras	Tegucigalpa		...	...	...	...	...	...	2005	89.4	32.7	86.0	54.9	53.0	...
Honduras	Trujillo		...	...	...	...	...	...	2005	91.8	24.8	92.7	45.7	51.8	...
Honduras	Yoro		...	...	...	...	...	...	2005	97.4	30.1	91.7	44.2	54.6	...
Honduras	Yuscarán		...	...	...	...	...	...	2005	92.6	42.4	83.4	35.1	37.2	...
Nicaragua	Chinandega	1998	82.1	78.6	62.2	8.2	...	84.0	2001	100.0	85.5	65.7	9.3	8.9	89.5
Nicaragua	Estelí	1998	95.3	94.5	66.7	12.5	...	84.9	2001	99.1	93.4	69.1	14.0	0.9	91.7
Nicaragua	Granada	1998	97.2	97.0	67.0	16.9	...	93.6	2001	99.8	97.4	71.6	23.9	12.3	95.0
Nicaragua	León	1998	92.4	92.0	68.8	12.6	...	92.5	2001	99.8	97.0	73.9	11.8	11.1	98.4
Nicaragua	Managua	1998	97.5	97.5	78.2	21.9	...	96.9	2001	99.8	97.1	81.7	29.1	21.9	99.6
Nicaragua	Masaya	1998	96.2	95.8	65.0	14.8	...	94.9	2001	100.0	98.9	69.4	18.4	10.4	97.9
Nicaragua	Matagalpa	1998	95.9	95.3	68.1	13.2	...	90.9	2001	98.1	87.5	72.0	16.5	1.2	92.2
Peru	Arequipa	1996	88.5	74.3	80.7	25.1	...	94.8	2004	93.6	93.2	89.5	36.1	...	98.1
Peru	Chiclayo	1996	89.1	74.8	72.1	20.6	...	88.7	2004	91.8	91.2	86.5	32.0	...	92.3
Peru	Chimbote	1996	76.4	72.0	79.6	24.0	...	91.4	2004	87.8	87.8	76.8	31.6	...	85.2
Peru	Lima	1996	83.1	73.7	85.1	35.7	...	97.4	2004	96.6	96.6	96.5	61.9	...	99.1
Peru	Piura	1996	88.9	84.8	78.9	18.9	...	83.4	2004	94.0	64.9	60.5	24.0	...	91.1
Peru	Tacna	1996	96.1	81.4	83.3	33.0	...	92.4	2004	100.0	100.0	98.6	27.9	...	99.0
Peru	Trujillo	1996	84.9	72.6	72.8	19.8	...	84.9	2004	93.5	93.5	98.3	50.7	...	98.1

Source: United Nations Human Settlements Programme (UN-Habitat), Global Urban Indicators Database 2012.

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PLANNING AND DESIGN FOR SUSTAINABLE URBAN MOBILITY

GLOBAL REPORT ON HUMAN SETTLEMENTS 2013

Urban transport systems worldwide are faced by a multitude of challenges. Among the most visible of these are the traffic gridlocks experienced on city roads and highways all over the world. The prescribed solution to transport problems in most cities has thus been to build more infrastructures for cars, with a limited number of cities improving public transport systems in a sustainable manner. However, a number of challenges faced by urban transport systems – such as greenhouse gas emissions, noise and air pollution and road traffic accidents – do not necessarily get solved by the construction of new infrastructure.

Planning and Design for Sustainable Urban Mobility argues that the development of sustainable urban transport systems requires a conceptual leap. The purpose of 'transportation' and 'mobility' is to gain access to destinations, activities, services and goods. Thus, access is the ultimate objective of transportation. As a result, urban planning and design should focus on how to bring people and places together, by creating cities that focus on accessibility, rather than simply increasing the length of urban transport infrastructure or increasing the movement of people or goods. Urban form and the functionality of the city are therefore a major focus of this report, which highlights the importance of integrated land-use and transport planning.

This new report of the United Nations Human Settlements Programme (UN-Habitat), the world's leading authority on urban issues, provides some thought-provoking insights and policy recommendations on how to plan and design sustainable urban mobility systems. *The Global Report on Human Settlements* is the most authoritative and up-to-date global assessment of human settlements conditions and trends. Preceding issues of the report have addressed such topics as *Cities in a Globalizing World, The Challenge of Slums, Financing Urban Shelter, Enhancing Urban Safety and Security, Planning Sustainable Cities and Cities and Climate Change*.

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