Changing Course in Urban Transport: An Illustrated Guide

This illustrated guide provides a rich collection of images of sustainable urban transport initiatives from around the world. It considers the transport problems evident in many cities in Asia, including high levels of energy consumption, carbon dioxide emissions, congestion, road casualties, urban sprawl, and social exclusion. The projections are that these worsening trends are set to continue. A change in course is recommended, with a much clearer focus on urban planning, traffic demand management, public transit, non-motorized transport, streetscape design, road planning, low-emission vehicles, and freight planning. This new paradigm for sustainable urban transport can support a much better quality of urban life in our cities in Asia.

About the Asian Development Bank

ADB's vision is an Asia and Pacific region free of poverty. Its mission is to help its developing member countries reduce poverty and improve the quality of life of their people. Despite the region's many successes, it remains home to two-thirds of the world's poor: 1.8 billion people who live on less than $2 a day, with 903 million struggling on less than $1.25 a day. ADB is committed to reducing poverty through inclusive economic growth, environmentally sustainable growth, and regional integration.

Based in Manila, ADB is owned by 67 members, including 48 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.

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ADB giz

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AN ILLUSTRATED GUIDE

Robin Hickman, Paul Fremer,
Manfred Breithaupt, Sharad Saxena

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6 ADB Avenue, Mandaluyong City
1550 Metro Manila, Philippines
Tel +63 2 632 4444
Fax +63 2 636 2444
www.adb.org

The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Dag-Hammarskjöld-Weg 1-5
65760 Eschborn
Germany

For orders, please contact:
Asian Development Bank
Department of External Relations
Fax +63 2 636 2648
adbpub@adb.org

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photos by Manfred Breithaupt, Shreya Gadepalli, and Carlos Pardo

Contents

0.2. JINAN (PEOPLE'S REPUBLIC OF CHINA [PRC])
Across Asia, urban areas are groaning under the strain of increased motorization, and projections suggest this will only get worse.

Foreword

Cities in Asia are growing rapidly. The traffic growth associated with this and increased aspirations toward motorization have meant worsening travel and environmental conditions for large numbers of people. The general quality of urban life is declining in many cities. Attempts to build our way out of the problem by providing more roads and parking space will simply lead to problems on a larger scale—more congestion, carbon emissions, pollution, social inequity, and economic decline.

There is another route—a change in course—where traffic is managed, mass transit systems developed, non-motorized modes encouraged, urban planning designed to support transport investment (and vice versa), slower travel speeds adopted, and low-emission vehicles used as the major share of the vehicle market. The benefits of such an integrated approach will be very large. Cities can regain their competitive edge, minimize their environmental impacts, become more attractive places to live and work, and develop strong senses of character and identity.

It is said that a picture is worth a thousand words—and this illustrated guide provides a rich collection of images of sustainable urban transport schemes and initiatives from around the world. It shows how we can upgrade the quality of urban transport to support wider sustainability goals. We hope that the initiatives and ideas that follow can be widely disseminated across Asia, and that we can all learn from the practical experience that results.

Ursula Schaefer-Preuss
Vice President
Knowledge Management and Sustainable Development
Asian Development Bank

Cornelia Richter
Director General Planning and Development Department
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

0.3. BEIJING (PRC)

“Solving traffic jams with more or bigger highways is like putting out a fire with gasoline.”

—Enrique Peñalosa, Colombian politician and former mayor of Bogotá

01. Introduction: An Urgent Need for Change

Urban transport in Asia is in crisis. Transport plays a major role in the life of anyone living in an Asian city. Yet, for many, the experience of travel is traumatic. The adverse impacts of the growth in motorization—in economic, environmental, and social terms—are ruining the quality of life in our cities and our global climate. There is an urgent need for a change in approach.

Great challenges face urban areas in the first half of the 21st century. Transport is a critical part of the future livability of cities: it is often viewed as the "maker and breaker of cities."[1] Societies depend on efficient transport, but this needs to be developed without unacceptable adverse impacts.

The dominant investment in transport has conventionally been in highway building. However, a revised approach is emerging that advocates managing the transport system in a way that supports sustainable urban living.

A better focus for policy and investment would be packaged strategies that include urban planning to support transport, traffic demand management, mass rapid transit, light rapid transit, bus rapid transit, informal non-motorized transit (like walking and bicycling), low-emission vehicles and alternative fuels, and freight planning.

This changed emphasis is particularly relevant in Asia and the Pacific, where mass motorization is reaching an ever-increasing number of areas, and is projected for enormous growth in future years. The potential implications for global transport and cross-sectoral greenhouse gas and carbon dioxide (CO_2) emissions are profound.

1.1. ALEPPO (SYRIA)
A rapidly growing proportion of the world's population lives in cities with intolerable and deteriorating transport systems.

1.2. BANGKOK (THAILAND)
It is impossible to build enough highways to remove the congestion across the city. The financial costs would be too high and the environmental, social, and quality of life impacts horrific.

1.3. VIENTIANE (LAO PEOPLE'S DEMOCRATIC REPUBLIC)
Public transport is usually poor, and many opt for private transport.

1.4. MANILA (PHILIPPINES)
The economic, environmental, and social costs of congested networks demand a new approach.

"Sustainable mobility requires clear and innovative thinking about city futures in terms of the reality (what is already there), desirability (what we would like to see), and the role that transport can (and should) play in achieving sustainable cities. This balances the requirements along the physical dimensions (urban structure and traffic) against the social dimensions (people and proximity)."

—D. Banister. 2008. The Sustainable Mobility Paradigm. *Transport Policy.* 15 (2). pp. 73–80.

1.5. BEIJING (PRC)
Designed for mass motorization, Beijing's complex arteries show that the conventional approach of 'predict and provide' is severely outdated. Highways soon fill up with traffic and congestion returns.

1.6. INDORE (INDIA)

1.7. AHMEDABAD (INDIA)

The projected growth in motorization in Asian cities is huge. In Delhi, for example, projections indicate a 500% increase in vehicles by 2030, compared to 1990 levels.[2]

1.8. DELHI (INDIA)

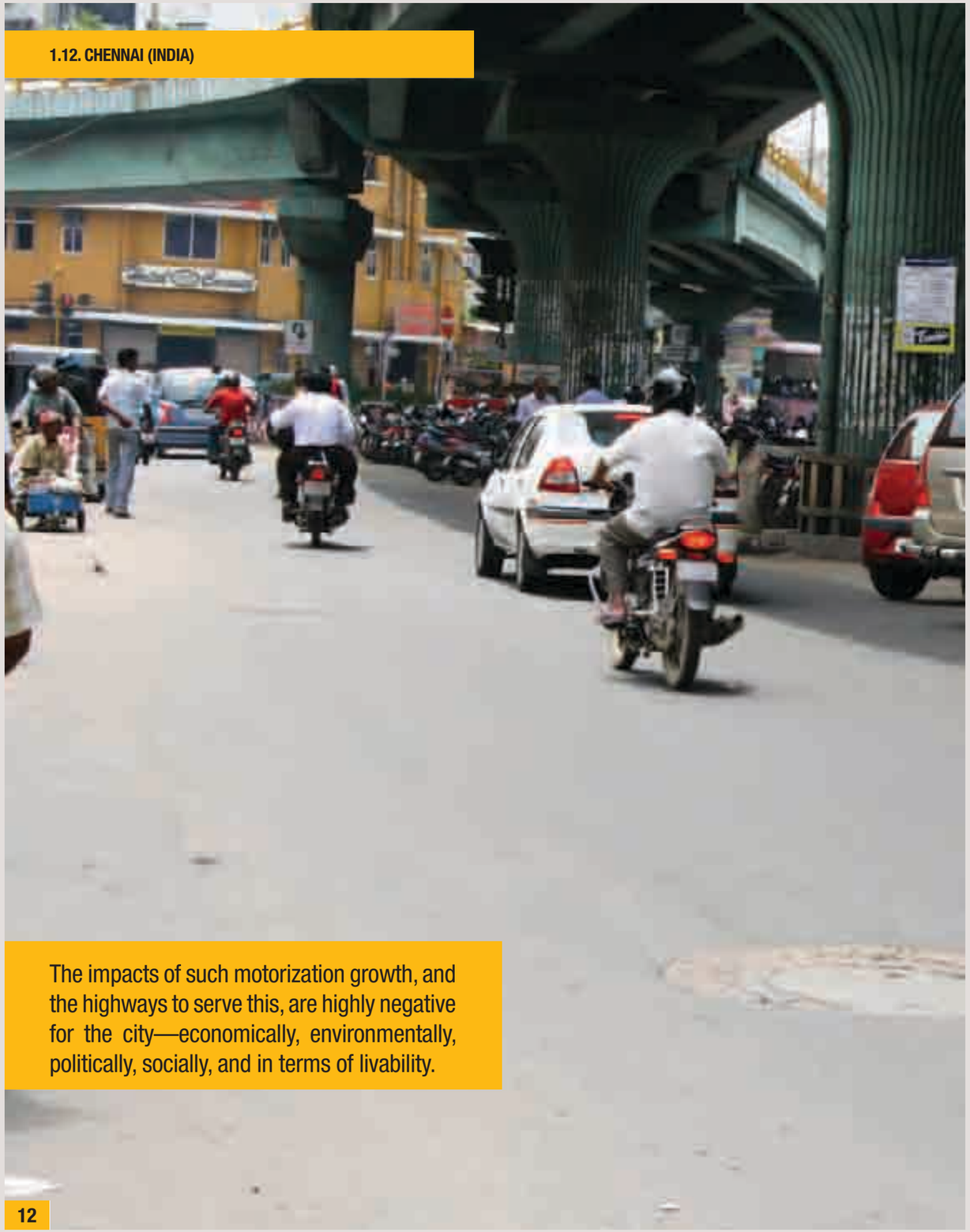
1.9. SAN DIEGO (US)
This type of residential development has been pervasive, and is the dominant type of suburbia across the world. It tends to be dispersed with many trip origins and destinations, making efficient public transit difficult to support.

1.10. TORONTO (CANADA)
Some streetcars are available in the city center, but suburban sprawl is very car-dependent.

1.11. NAPLES (US)
The North American model—low-density suburban sprawl, with very high motorization rates and car dependency—leads to high levels of energy consumption and emissions. It is not sustainable at the global scale.

The existing high levels of traffic in many industrialized cities are not sustainable globally.

1.12. CHENNAI (INDIA)



The impacts of such motorization growth, and the highways to serve this, are highly negative for the city—economically, environmentally, politically, socially, and in terms of livability.

1.13. MANILA (PHILIPPINES)

Even crossing a road can be dangerous in the current traffic-dominated environment. We, and our children, deserve a better place to live.

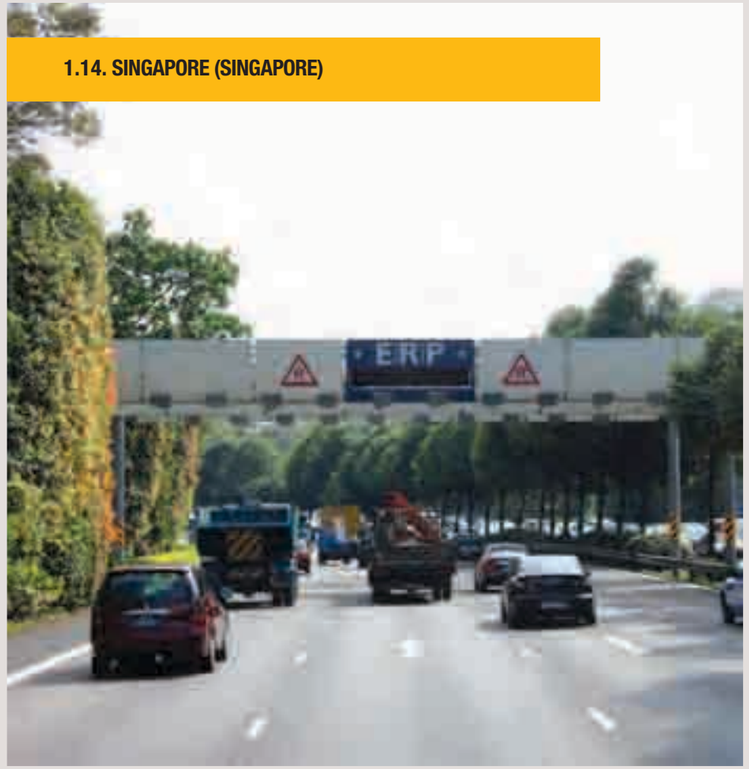
The aim of this illustrated guide is to show the traffic problems in cities in Asia and, more importantly, the remarkable and rapidly growing examples of good sustainable mobility available around the world. The guide is published by the Asian Development Bank (ADB) and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).

Schemes and initiatives cannot always be well conveyed through photographs, but this medium can introduce some very high quality transport projects, journeys, and travel behaviors. Dissemination of good practice and the transfer of knowledge can be very powerful tools in the effort to scale up the delivery of sustainable urban transport.

Managing traffic effectively can assist in achieving wider societal goals. Our implementation and investment programs can, and must, change dramatically relative to the past 50 years. There are, of course, many difficulties in the transferability of practice. Urban areas start from different baselines, and have different contexts, problems, and opportunities. Good practice is seldom widespread, even in the better-run cities. Strategies and implementation programs will need to be tailored specifically to the needs of each city.

Yet good practices in urban transport—in parts of Ahmedabad; Amsterdam; Bangalore; Barcelona; Bogotá; Copenhagen; Curitiba; Delhi; Freiburg; Ha Noi; Hong Kong, China; Jinan; Lanzhou; London; Lima; Lyon; Mexico City; Milan; Munich; Manchester; Oxford; Paris; Pune; San Sebastian; Seoul; Singapore; Stuttgart; Tokyo; Vancouver; Zürich; and many others—provide much inspiration about ways to deliver sustainable urban transport internationally.

1.14. SINGAPORE (SINGAPORE)



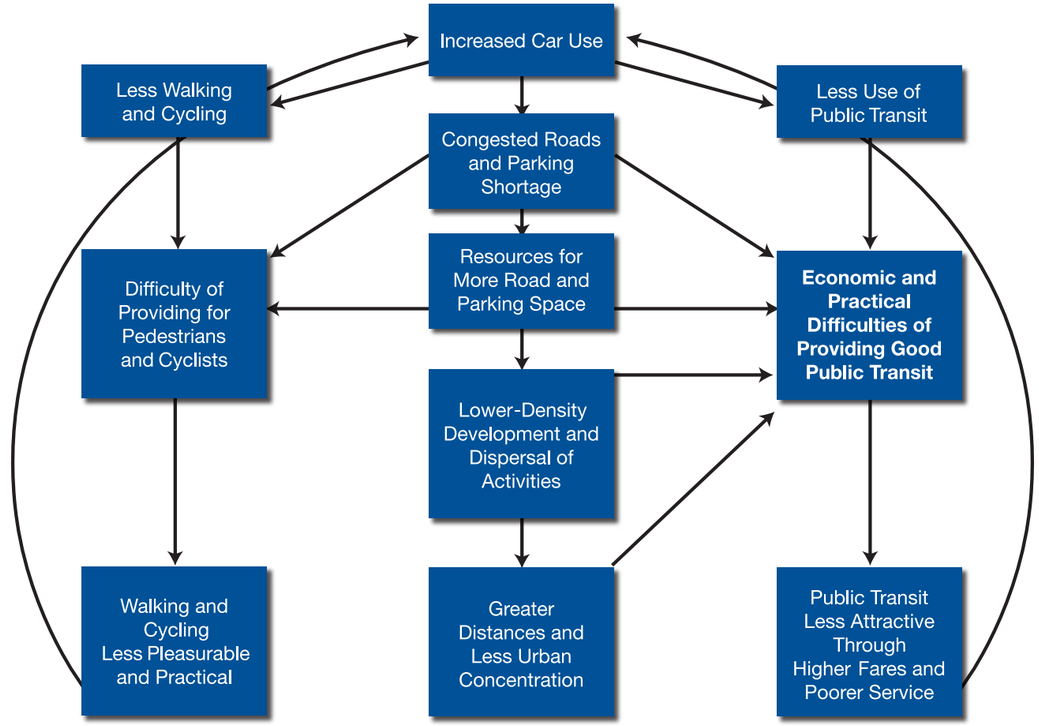
1.15. CURITIBA (BRAZIL)
A remarkable series of sustainable urban transport projects are being developed in cities across the world. These must now be delivered to more people.

02. The Urban Transport Dilemma

The amount of travel worldwide is rising considerably. There are very large projected motorization growth rates over the next few decades in most countries, and particularly in Asian cities. Conventionally, this rise in travel has been regarded positively—as a reflection of increasing personal mobility and economic growth. However, the side effects of traffic have increasingly been observed and understood, including increased congestion, air pollution, poor conditions for pedestrians and cyclists, high accident rates, degradation of the urban environment, and inefficient land consumption.

The problems of traffic growth and the vicious circle of transport decline have been acknowledged for over 50 years.[3] The universal similarity of these problems is striking, and provides this illustrated guide with its rationale—to understand how cities can better diagnose their problems and devise strategies and investment programs to develop more sustainable patterns of mobility.

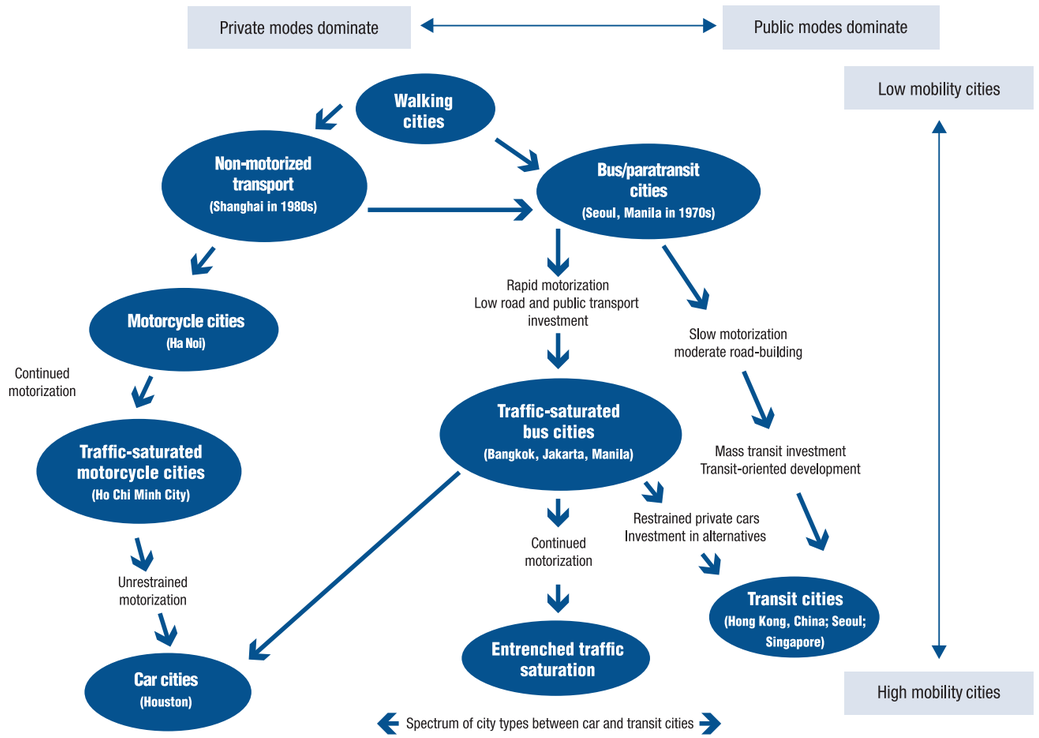
The Vicious Circle of Transport Decline



Source: T. Pharoah. 1992. *Less Traffic, Better Towns.* London: Friends of the Earth.

A typology of transport development paths in Asia is given below. There are differences in terms of low and high mobility, and also the dominance of private and public modes. Hong Kong, China; Seoul; and Singapore are viewed as transit cities, while Bangkok, Jakarta, and Manila are viewed as traffic-saturated bus cities, Ha Noi as a motorcycle city, and Ho Chi Minh as a traffic-saturated motorcycle city. Over time, achieving greater sustainability in transport means investing in accessibility and developing more effective transit cities.

Transport Development Paths for Developing Cities



Note: The model shows intended or potential transport development paths for developing cities.
Source: P. Barter. 2004. *A Broad Perspective on Policy Integration for Low Emissions Urban Transport in Developing Asian Cities*. Paper given at an international workshop, Institute for Global Environmental Strategies. Kanagawa, Japan.

"It is impossible to spend any time on the study of the future of traffic in towns without at once being appalled by the magnitude of the emergency that is coming upon us. We are nourishing at immense cost a monster of great potential destructiveness, and yet we love him dearly. To refuse to accept the challenge it presents would be an act of defeatism.

Given its head, the motor car would wreck our towns within a decade [...] The problems of traffic are crowding in upon us with desperate urgency. Unless steps are taken, the motor vehicle will defeat its own utility and bring about a disastrous degradation of the surroundings for living [...] Either the utility of vehicles in town will decline rapidly, or the pleasantness and safety of surroundings will deteriorate catastrophically—in all probability both will happen.

Some deliberate limitation of the volume of motor traffic is quite unavoidable. The need for it just can't be escaped."

—Sir Colin Buchanan and the UK Ministry of Transport. 1963. *Traffic in Towns [The Buchanan Report]*. Harmondsworth: HMSO and Penguin.

2.1. BANGKOK (THAILAND)

Recent years have witnessed many attempts to manage the transport systems in Asia (and internationally) in a more sustainable way. There is a rapidly expanding selection of very promising schemes and initiatives, yet good practice remains ad hoc, and many cities in Asia are deteriorating.

Transport in Asian cities is facing major difficulties in policy, planning, governance, and implementation. Transport strategies and master plans are often closer to wish lists than to feasible, budgeted, and prioritized strategies. Policies are often left unimplemented, or partially implemented—perhaps just the main roads in a city are built. When investment does occur, little is known about impacts relative to aspirations. Projects are very seldom evaluated to see if they have been successful, and lessons seldom learned from implementation. Projects are subject to overruns in time and cost, with little built-in resilience and adaptability to unpredictable futures. Political decisions sometimes ignore technical advice, and the levels of participation in decision making are usually very low. The transport sector is not being managed systematically or effectively. There is too little transferring of knowledge, benchmarking of practice, analyzing and managing of risk, and assessing of performance.[4]

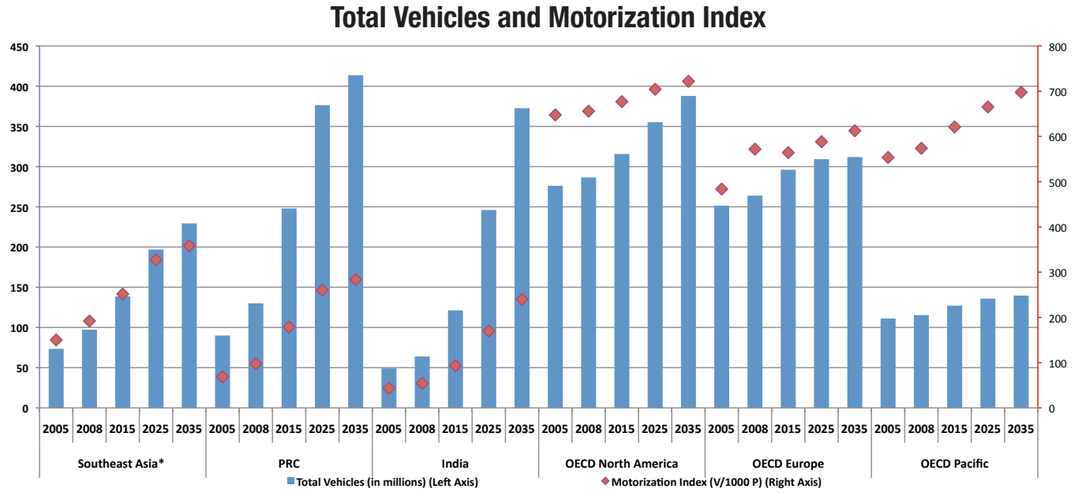
The end result is that sustainable travel behaviors are not being widely achieved—car dependency is very much a growing problem.[5] The imperative of climate change adds a greater impetus for action, with the window of opportunity closing more each year. Yet breaking the trend is, as yet, only an aspiration.

The Problems of Traffic Growth:

- **Increasing Motorization**
- **Increasing Car Use**
- **Growing Distances Traveled**
- **Congestion**
- **CO_2 Emissions**
- **Energy Consumption**
- **Local Air Pollution**
- **Social Exclusion**
- **Negative Health Impacts**
- **Negative Safety Impacts**
- **Land Consumption**

2.2. MANILA (PHILIPPINES)

GROWTH IN MOTORIZATION



PRC = People's Republic of China, OECD = Organisation for Economic Co-operation and Development, v/1000 P = vehicles per 1,000 persons
Sources: ADB. 2009. *Changing Course. A New Paradigm for Sustainable Urban Transport.* Manila.; with data from Clean Air Initiative for Asian Cities, Segment Y Automotive Intelligence Pvt. Ltd., and the International Energy Agency.

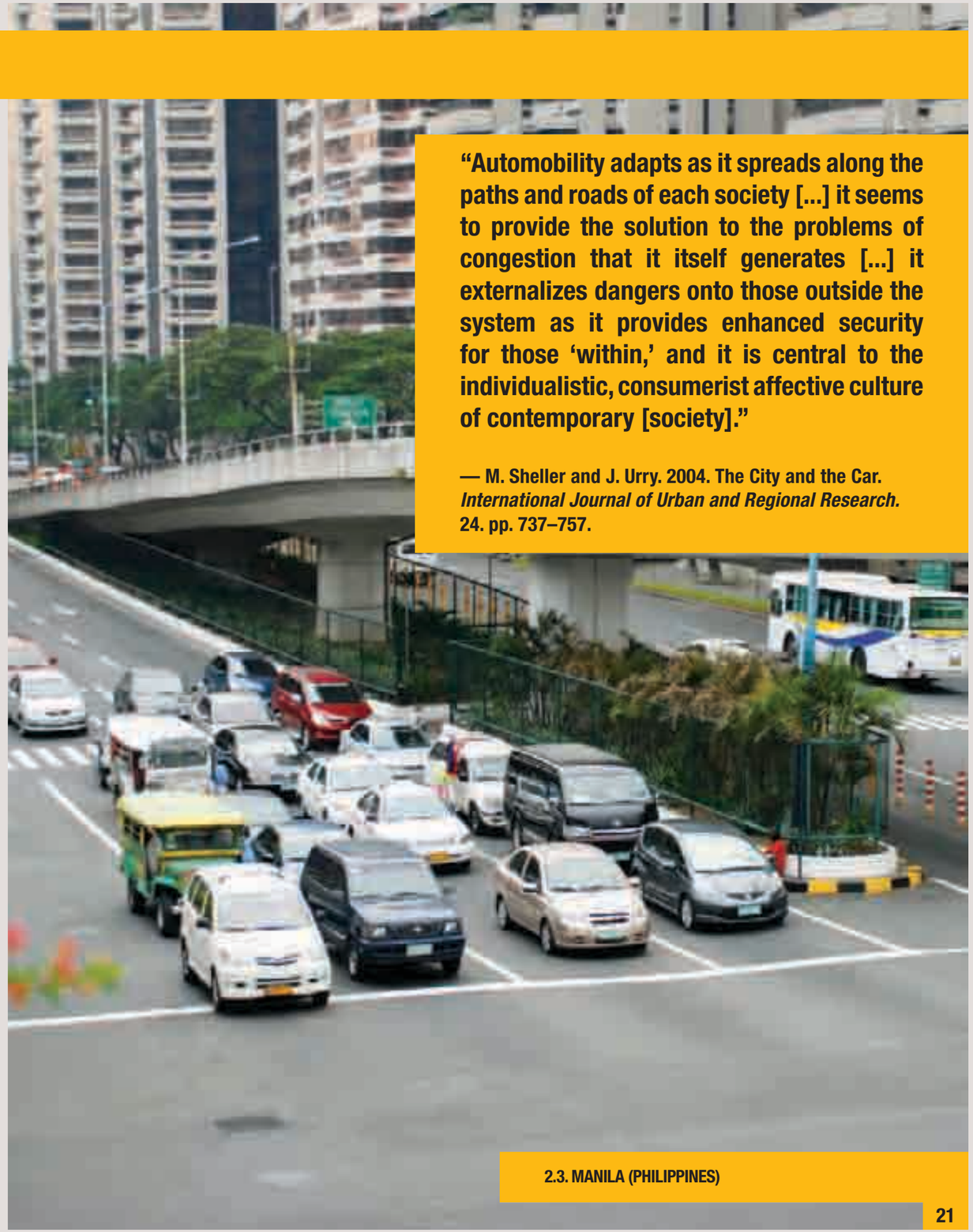
Motorization, in terms of the aggregate number of vehicles, is projected to reach nearly 250 million in the Association of Southeast Asian Nations (ASEAN), over 400 million in the PRC, over 350 million in India—reaching the numbers seen in North America and Europe. The difficulty is that the level of motorization is much lower in Asia, only reaching 200 vehicles per 1,000 persons. This suggests that growth in Asia may continue. If North American motorization rates—over 700 vehicles per 1,000 persons—are reached, then Asian cities are likely to be in serious trouble, and the environmental impacts will be dramatic across the world.

"I will build a car for the great multitude. It will be large enough for the family, but small enough for the individual to run and care for. It will be constructed of the best materials, by the best men to be hired, after the simplest designs that modern engineering can devise. But it will be so low in price that no man making a good salary will be unable to own one—and enjoy with his family the blessing of hours of pleasure in God's great open spaces."

—Henry Ford, founder of the Ford Motor Company, 1922

"Automobility adapts as it spreads along the paths and roads of each society [...] it seems to provide the solution to the problems of congestion that it itself generates [...] it externalizes dangers onto those outside the system as it provides enhanced security for those 'within,' and it is central to the individualistic, consumerist affective culture of contemporary [society]."

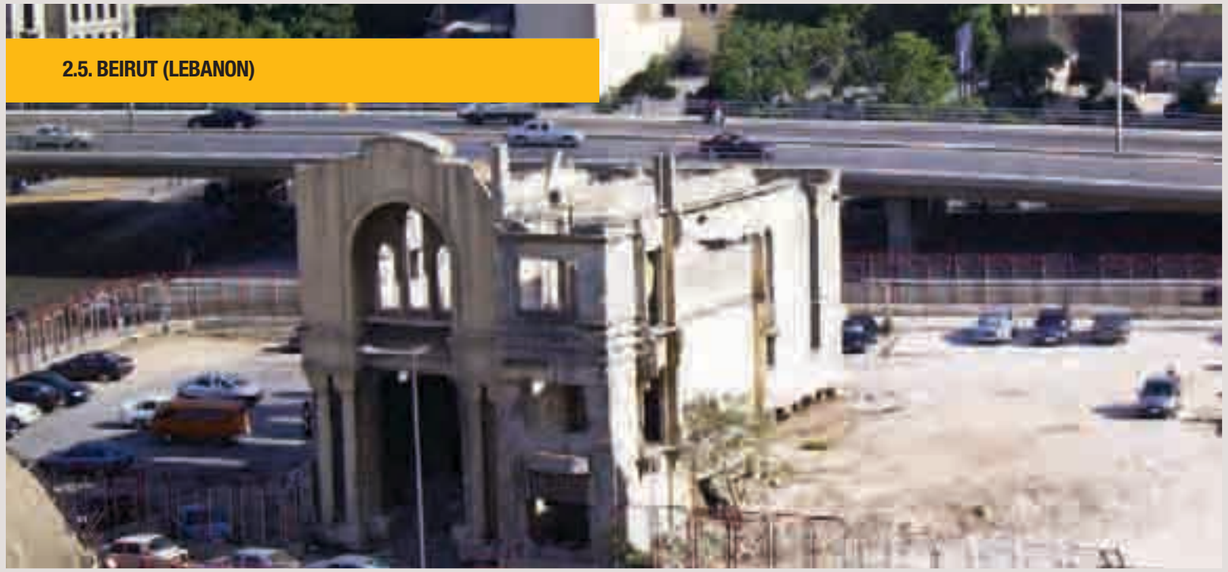
— M. Sheller and J. Urry. 2004. The City and the Car. *International Journal of Urban and Regional Research.* 24. pp. 737–757.



2.3. MANILA (PHILIPPINES)

02. The Urban Transport Dilemma

2.4. BANGKOK (THAILAND)
The global private motor car fleet is expected to jump from 1 billion in 2002 to 2 billion by 2022, largely a consequence of growth in motorization and a move toward car-centric cultures in Asia.[6]



2.5. BEIRUT (LEBANON)

2.6. BANGKOK (THAILAND)
The car and its associated infrastructure often dominate the urban fabric at the expense of other modes and the quality of the built environment.

“The ownership of cars in Beijing broke the 4 million mark in December. It took 31 months for the number to grow from 3 million to 4 million. It took Tokyo 12 years to do so.

The ownership of cars in Beijing is growing by half a million a year. Last week [first week of June 2010], 12,000 new cars hit the road, taking the total to 4.33 million. The number has been growing by more than 10,000 a week since April [2010].

For every million cars, the city needs 2.82 million kilometers (km) of roads, which equals the length of all the roads within the Third Ring Road. The parking area for 1 million cars is 30 km^2, equal to half of the land within the Second Ring Road.

The Committee recommends that the most effective, direct, and fundamental measures are to control the growth in traffic and car ownership, and to increase the cost of purchasing a car. [A strategy] may include emissions and environment fees, securing a parking spot prior to obtaining a car plate, raising parking fees and levying a congestion charge, developing bicycle and pedestrian lanes, and encouraging people to walk or ride a bike when their commuting time is less than 30 minutes.”

—The Standing Committee of the Beijing Committee of the Chinese People’s Political Consultative Conference (CPPCC). June 2010. *China Daily*. Beijing.

INCREASING DISTANCES TRAVELED

2.7. MANILA (PHILIPPINES)
The car is currently necessary for many journeys within the city, since transit investments do not often integrate with urban form. That is, public transit and non-motorized modes of travel are poor.

▲

2.8. LOS ANGELES (US)
Many Americans travel very long distances to work. This leads to a very inefficient use of energy, emissions, and time.[7]

In 1800, people in the US traveled, on average, 50 meters per day. They now travel 50 km per day. Today's world citizens travel 23 billion km; by 2050, it is forecast that this figure could have increased fourfold to 106 billion.[8]

2.9. MANILA (PHILIPPINES)
Even though the sports utility vehicle (SUV) is not as popular yet in Asia as it is in North America, there is much recent growth in market share.

◀

2.10. DELHI (INDIA)
The major growth areas in new vehicles in Asia are in the inexpensive, old technology, small cars; and larger, heavier vehicles. Both are relatively high polluters in terms of CO_2 emissions and local air quality.

An Average Commuting Experience in Bangkok

Morwand is a 36-year-old mother and bank officer.

She leaves home in Bang Talat at 6:45 a.m. and rides 25 minutes on the expressway to take her children to school.

The children eat breakfast in the backseat of the car.

Then Morwand begins her own journey to work by car. It takes her 90 minutes to reach her workplace in Pathum Wan.

With one mode and one stop, she travels an average of 115 minutes one way.

She also has to get home and pick up her children. She spends 3 hours and 50 minutes every day on the commute! This is not uncommon and is a huge waste of time in social terms.

2.11. BANGKOK (THAILAND)

02. The Urban Transport Dilemma

Transportation Timeline in Bangkok

1768
Bangkok was a small village with most transportation needs covered by waterways.

1783
The Klong Ong Ang Canal served as an important artery for water transport in Bangkok.

1870/80
Rickshaws were introduced from the People's Republic of China in the early 1870s. These were two-wheeled carts pulled by men, mostly Chinese. Bicycles were introduced in Bangkok. They also became very popular, initially among very high-ranking people, including the King.

1880
Buses were made possible by the construction of roads in Bangkok. Early buses were horse-drawn, four-wheeled carriages with a roof and with two long seats facing each other.

1887
Tram technology in Bangkok started simply, with carriages pulled by four horses. Bangkok was the second city in Asia to have trams, after Tokyo.

1896
The first railway was formally opened by King Rama V. The operating distance of the train was 71 kilometers (km) between the central station in Bangkok and Ayutthaya.

1900
The railway network was expanded toward the northeast, to Nakhon Ratchasima. The total length was 265 km.

1901
Trams in Bangkok were converted to electric power.

1904
Motorcars were introduced to the city after the construction of some roads. Initially, only the royal family, high-ranking government officials, and the wealthy had access to cars.

1906
Near the end of King Rama V's reign, only 251 cars existed in Bangkok.

1907
In Bangkok, three steam railway lines operated through the urban region to the north, south, and northeast. The stations in the urban area were 2 km–3 km apart.

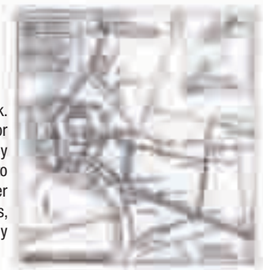
1913
Horse-drawn buses were replaced by motorized buses.

1926
Only 14 taxis existed in Bangkok.

1932
The political system changed from absolute monarchy to parliamentary democracy. Thailand was hit by a world depression and post-World War crisis. The focus of the Thai government shifted from railways to roads to support car usage.

The first road bridge across the Chao Phraya River was built to link Bangkok to Thon Buri.

1933
Tricycles were introduced in Bangkok. They were very convenient for traveling short distances, and they had the advantage of being able to travel along narrow lanes where other modes of transport, especially cars, could not venture. They were widely used at that time.



1946
The motorization period began in Bangkok, shifting the paradigm toward more road construction and promoting personal motorized transport.

1947
The private tram companies were taken over by the government via the Capital Electricity Authority. There were seven routes along the main roads, and the total length was 45 km with 200 trams. There were only about 3,000 cars in Bangkok before and during World War II and there were only about 700 motorcycles.

1960
The road length throughout Thailand was 8,000 km. In the same year, US consulting firms submitted the Bangkok Urban Plan, also known as The Greater Bangkok Plan 2533 (1990), to the Thai government. The basis of the plan was a pure North American paradigm, which focused on constructing roads and increasing dependence on automobiles.

1961
The government decided to abolish the tram system gradually.

1970
The number of vehicles in Bangkok increased to 275,000, with 197,700 cars and 41,600 pickup trucks (most were used as private cars).

1972
Transport users made 7,000 trips by trains, compared to 2.64 million trips by buses.

1980
Motor vehicles in Bangkok totaled 571,300, of which 299,100 were cars and 55,400 pickup trucks.

1993
Vehicle numbers reached 2.66 million, of which 1.09 million were cars and 0.27 million were pick-up trucks. During this time there were 0.11 million buses and 0.36 million taxis in Bangkok.

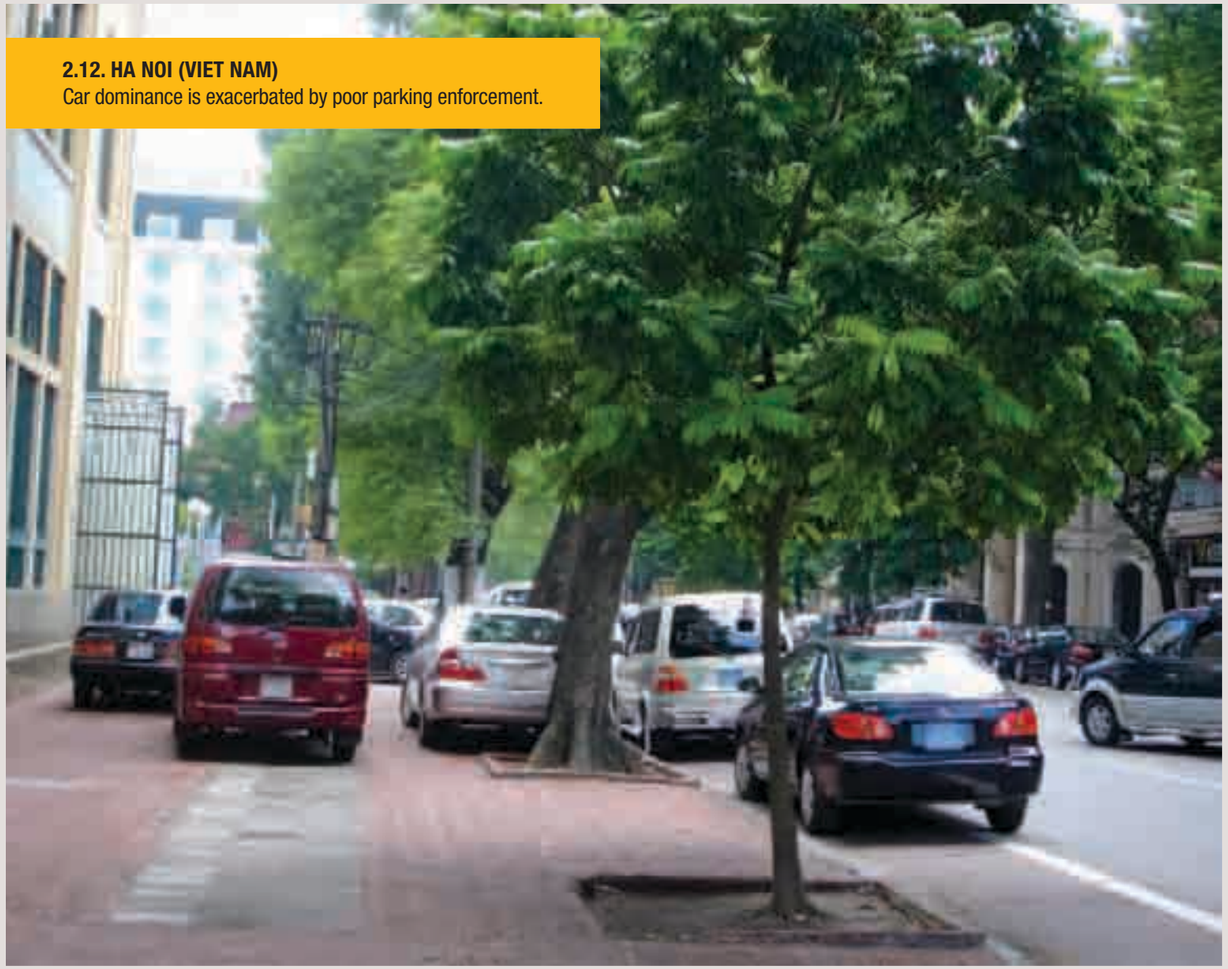
1999
The Bangkok Skytrain opened. The cost of construction was US$1.5 billion for 23 km for two lines.

2004
A mass rapid transit subway was opened in July 2004. The blue line was 21 km long.

2007
The Cabinet of Thailand approved construction of a 27 km bus rapid transit (BRT) line in Bangkok. The airport train link to Suvarnabhumi was also approved.

2009
The extension of the Bangkok Mass Transit System (BTS) SkyTrain across the Chao Phraya River was completed and was opened for operations.

2010
The BRT system in Bangkok was opened with a total length of 16.5 km The system was operated free for a month, then on a flat fare until December 2010, and then on a distance-based fare from 2011.



2.12. HA NOI (VIET NAM)
Car dominance is exacerbated by poor parking enforcement.

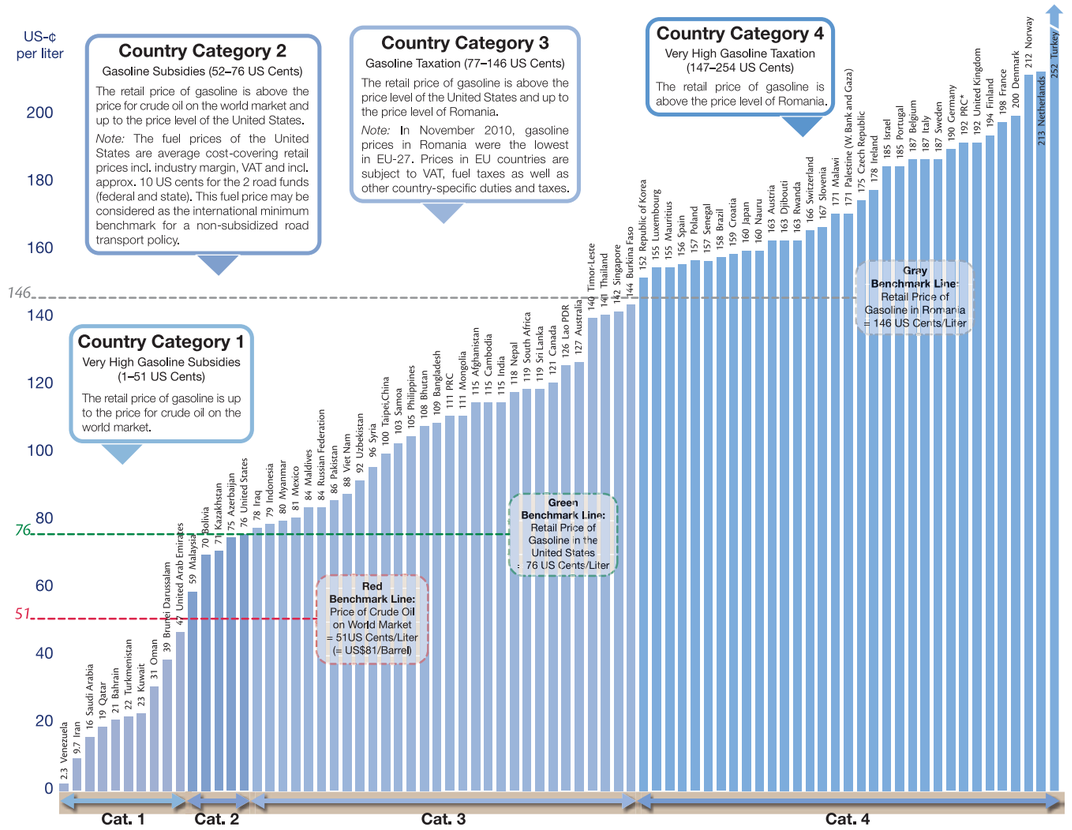
2.13. KUALA LUMPUR (MALAYSIA)

2.14. KUALA LUMPUR (MALAYSIA)

SUBSIDIZED CAR USE

Fuel prices differ markedly, by country, due to the varied levels of subsidy and taxation. The price of crude oil was US$83 a barrel (US$0.52/liter) in 2010. The retail price of gasoline is much below this level in some countries due to high subsidies (Kuwait, Qatar, and Saudi Arabia). Fuel prices gradually increase in countries with low subsidy (Malaysia, United Arab Emirates); low taxation (India, Mexico, the Philippines, and US); and medium-to-high taxation (Brazil, the Netherlands, Singapore, and the United Kingdom).

World Gasoline Prices

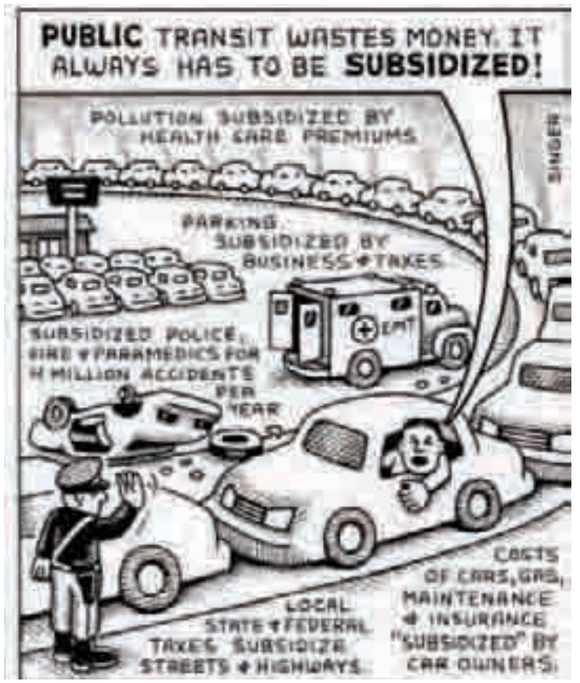


* = including Hong Kong, China; CAT = catagory; PRC = People's Republic of China; EU-27 = A group of 27 members of the European Union; Lao PDR = Lao People's Democratic Republic; VAT = value-added tax
Source: Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ). 2010. *International Fuel Prices.* Available at www.GTZ.de/fuelprices .

POOR QUALITY PUBLIC TRANSIT

◄▲

2.15 and 2.16. DELHI (INDIA)
Much of the public transit fleet involves old, contaminating vehicles. There is little coordination in services.



2.17. 'NO EXIT' ILLUSTRATION by ANDY SINGER

▲

2.18. PHNOM PENH (CAMBODIA)

◄

2.19. HA NOI (VIET NAM)

2.20 and 2.21. DELHI (INDIA) and KOTA (INDIA)
The old bus fleet does not provide an attractive means of travel.

2.22. MANILA (PHILIPPINES)
People wait for a bus. This is not much fun.

2.23. BANGKOK (THAILAND)
It is little wonder that children grow up wanting to use the car.

2.24. BOGOTÁ (COLOMBIA)

▲

2.25. MANILA (PHILIPPINES)
Even if the bus fleet is newer, there is often no priority in routing.

2.26. DELHI (INDIA)
In some cities, two- and three-wheelers dominate.

2.27. KUALA LUMPUR (MALAYSIA)
Two- and three-wheelers are spatially efficient relative to cars. Though they contribute to pollution, noise, safety, and aesthetic problems, their negative impacts can sometimes be overcome.

2.28. KOTA (INDIA)
The ubiquitous three-wheeler accounts for a high share of the vehicle fleet in some cities.

2.29. MANILA (PHILIPPINES)
Two- and three-wheelers and informal public transit jitneys can pollute or often mix in an unsafe way with other traffic. However, if clean, they are generally an important component of a transport system, since they use relatively little space per person.

2.30. DELHI (INDIA)
The vehicle mix sometimes leads to congestion.

2.31. DELHI (INDIA)
The use of two- and three-wheelers declines as the car becomes more popular, making congestion even more prevalent.

Note: 2007 data, unless otherwise noted
* 2006 data
** 2005 data
Lao PDR = Lao People's Democratic Republic, UAE = United Arab Emirates
Sources: GTZ. 2010. With data from International Road Federation (IRF), *World Road Statistics 2009.*

NEGLECTED WALKING AND CYCLING

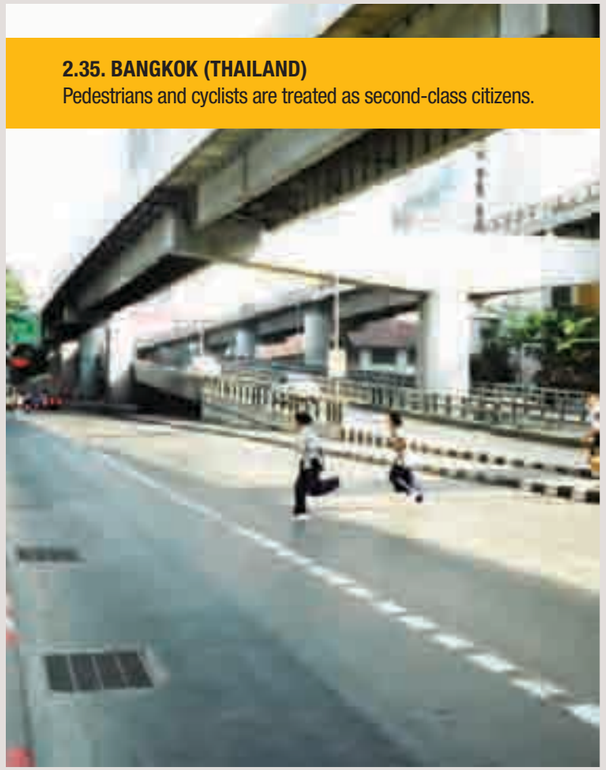
2.32. BEIJING (PRC)
A critical mass of cyclists makes cycling safer, though dedicated facilities are useful.

2.33. MANILA (PHILIPPINES)
The only means of transport for low-income citizens in many developing country cities are cycling and walking, yet the facilities are often nonexistent.

▲

2.34. BEIJING (PRC)
Provision is often poor, or even denied.

2.35. BANGKOK (THAILAND)
Pedestrians and cyclists are treated as second-class citizens.

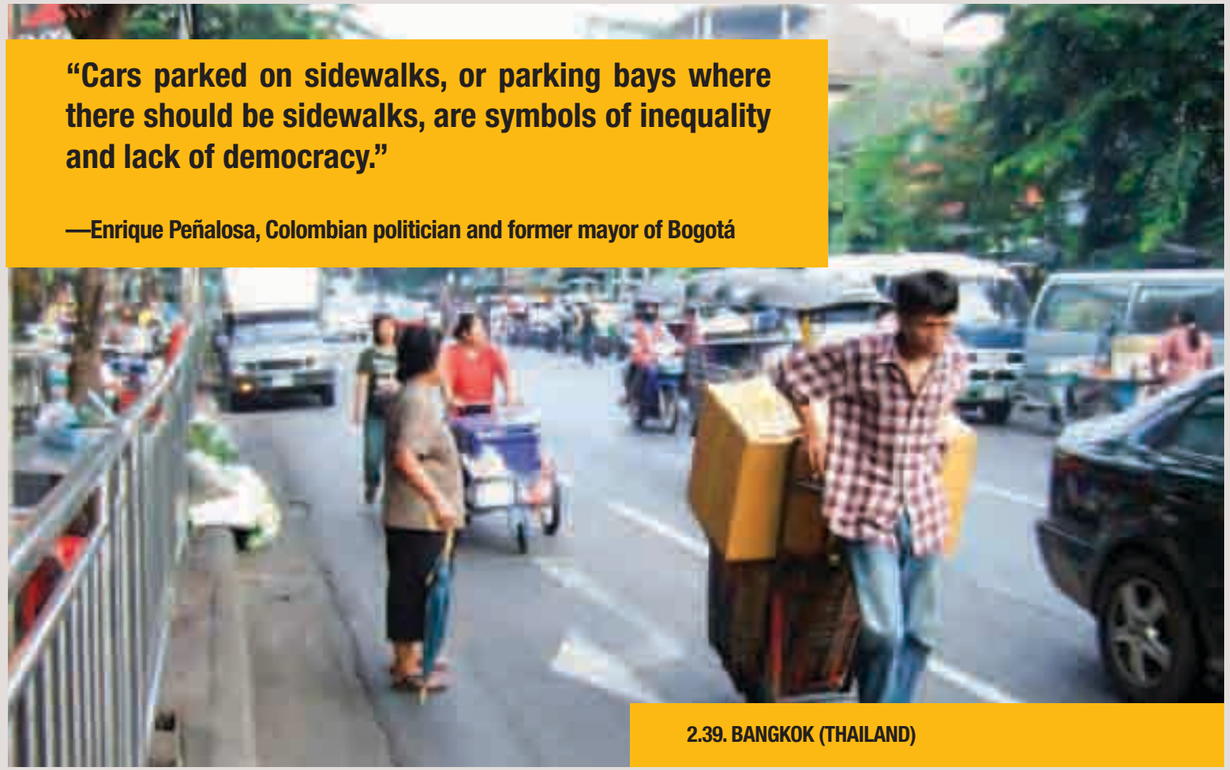


▲

2.37. MANILA (PHILIPPINES)
Facilities are often thoughtlessly designed: what happens at the end of the crossing?

"Cars parked on sidewalks, or parking bays where there should be sidewalks, are symbols of inequality and lack of democracy."

—Enrique Peñalosa, Colombian politician and former mayor of Bogotá



2.39. BANGKOK (THAILAND)

2.36. MUMBAI (INDIA)

2.38. MUMBAI (INDIA)

2.40. BANGKOK (THAILAND)

2.41. BHUBANESWAR (INDIA)

2.42. BANGKOK (THAILAND)

"In Dhaka´s strategic transport plan, out of the US$5 billion budget, only 0.22% is allocated for pedestrian facilities."

—ADB. 2009. *Sustainable Urban Transport in Asia 2009: A Year in Review.* By Clean Air Initiative for Asian Cities Center. Manila.

▲

2.43. VIENTIANE (LAO PEOPLE'S DEMOCRATIC REPUBLIC)

◀

2.44. DHAKA (BANGLADESH)

02. The Urban Transport Dilemma

2.45. MUMBAI (INDIA)

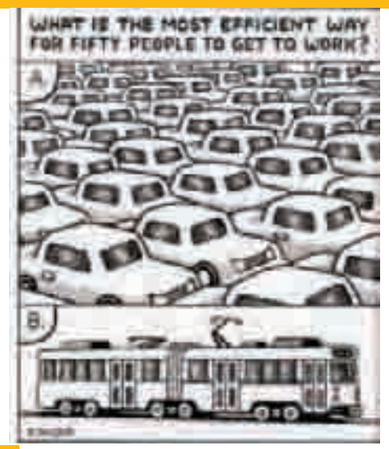
COSTS OF THE CURRENT APPROACH

CONGESTION

Congestion in many urban areas has been increasing in duration and intensity. Traffic speeds have been reducing each year in many cities, with the severity of congestion tending to increase with city size. Businesses and individuals waste much valuable time in traffic.

2.46. MANILA (PHILIPPINES)

2.47. 'PUBLIC TRANSIT' ILLUSTRATION by ANDY SINGER



In Thailand, with the longest commuting times in the world, a total of 37 million hours are spent traveling to work every day. The average working person living in Thailand spends about 2 hours every day traveling to and from work. Currently, the average travel speed in central Bangkok during peak hours is just 7 miles per hour.

2.48. BEIJING (PRC)

2.49. BEIJING (PRC)
The traffic problem is remarkably prevalent and similar in cities all around the world.

▲

2.50. DELHI (INDIA)
Major cities, including megacities of over 10 million people, grind to a halt.

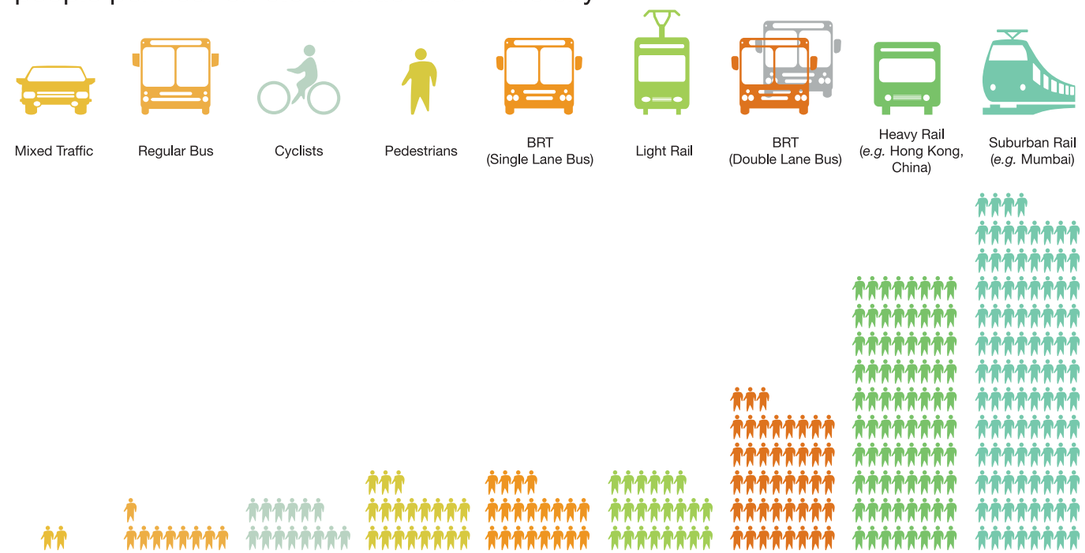
2.51. LOS ANGELES (US)
In car-dependent lifestyles, too much time is spent traveling from a nondescript residential zone in suburbia to a nondescript employment zone in suburbia. Where is the quality, character, and identity of urban life? Asia deserves better than this.

2.52. M62 MOTORWAY (UK)
It is not only in North America where the car is the dominant mode and congestion is increasing. Most industrialized western countries are very car-dependent outside the central urban area.

Depending on vehicle size, occupancy or loading, and speed, the use of space can vary greatly for different modes of travel. This means that the potential volumes of passengers vary greatly by mode along a corridor. Clearly, the car is the most spatially inefficient mode. Dense urban centers cannot effectively be served by the car, since not enough people can be delivered to the center.

Corridor Capacity

people per hour on 3.5 m wide lane in the city



BRT = bus rapid transit, m = meters
Sources: H. Botma and H. Papendrecht. 1991. Traffic Operation of Bicycle Traffic. In *Transportation Research Record 1320.* TRB. Washington, D. C.: National Research Council, and based on GTZ calculations (2009).

An Average Commuting Experience in Jakarta

Adhi is a 33-year-old communication officer for a nongovernment organization.

He leaves home in Cikupa, Tangerang, at 5:45 a.m. and rides 15 minutes on his motorbike to a paid parking space.

He then walks about 500 meters to the Citra Raya shuttle terminal.

He takes a bus directly to the Jl. Sudirman area, which takes between 90 and 120 minutes depending on traffic.

He uses three modes of transport and spends 125 minutes on an average one-way trip.

He also has to get home. He spends 4 hours and 15 minutes every day on the commute. This equals 2.5 working days per week!

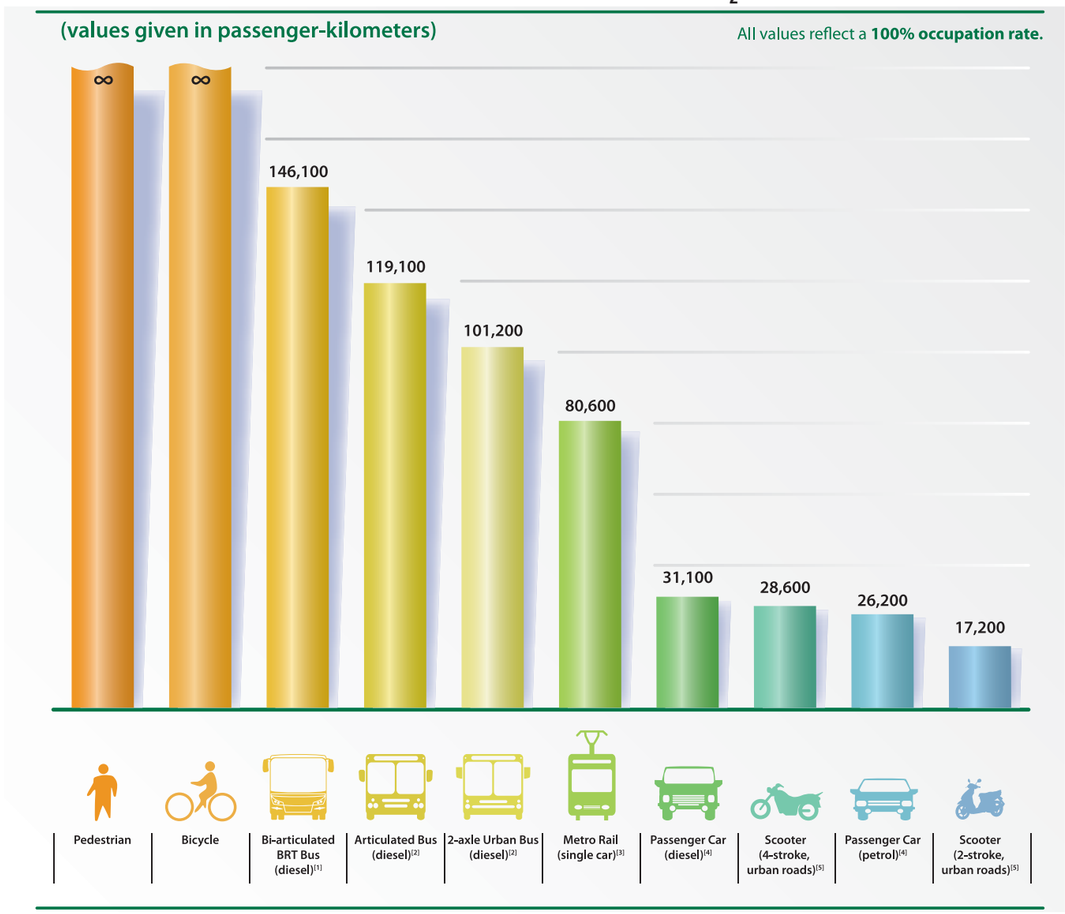
2.53. JAKARTA (INDONESIA)

02. The Urban Transport Dilemma

CARBON DIOXIDE EMISSIONS

Modes of travel have varying effects on emissions of CO_2 and other greenhouse gases that cause climate change. Passenger cars and scooters are the least efficient means of travel when considering CO_2 emissions. Walking and bicycling put negligible CO_2 into the atmosphere, meaning that one could travel immeasurably long distances on 1 ton of CO_2.

How Far Can I Travel on 1 Ton of CO_2?



Note: All values in passenger-kilometers (Pkm), reflecting a 100% occupation rate. All data given in this diagram should be considered as guideline values, as real values may differ considerably, depending on, for example, actual load factors, smoothness of traffic flow, and technical standards of vehicles and infrastructure. BRT = bus rapid transit

Sources: German International Cooperation (GIZ) Gmbh, 2011 [1] Volvo BRT http://www.volvobuses.com/bus/global/en-gb/volvogroup/Environment/going+greener/brt/pages/brt.aspx; [2] Calculations by Ian Barrett. 2010. Integrated Transport Planning Ltd. (ITP). ; [3] Institute for Energy and Environmental Research (IFEU). May 2008. *Wissenschaftlicher Grundlagenbericht zum UmweltMobilCheck (Basic Scientific Report, UmweltmobilCheck).* http://www.bahn.de/p/view/mdb/bahnintern/services/umwelt/MDB58033-umc_grundlagen_ifeu_080531.pdf; [4] Deutsches Institut für Wirtschaftsforschung (German Institute for Economic Research). 2008/2009. *Verkehr in Zahlen (Transport in Figures).* Sabine Radke, author. Berlin: DIW.; [5] W. Hook and L. Wright. 2002. *Reducing Greenhouse Gas Emissions by Shifting Passenger Trips to Less Polluting Modes, A Background Paper for the Brainstorming Session on Non-Technology Options for Engineering Modal Shift in City Transport Systems.* Institute for Transportation and Development Policy (ITDP), New York, United States.

02. The Urban Transport Dilemma

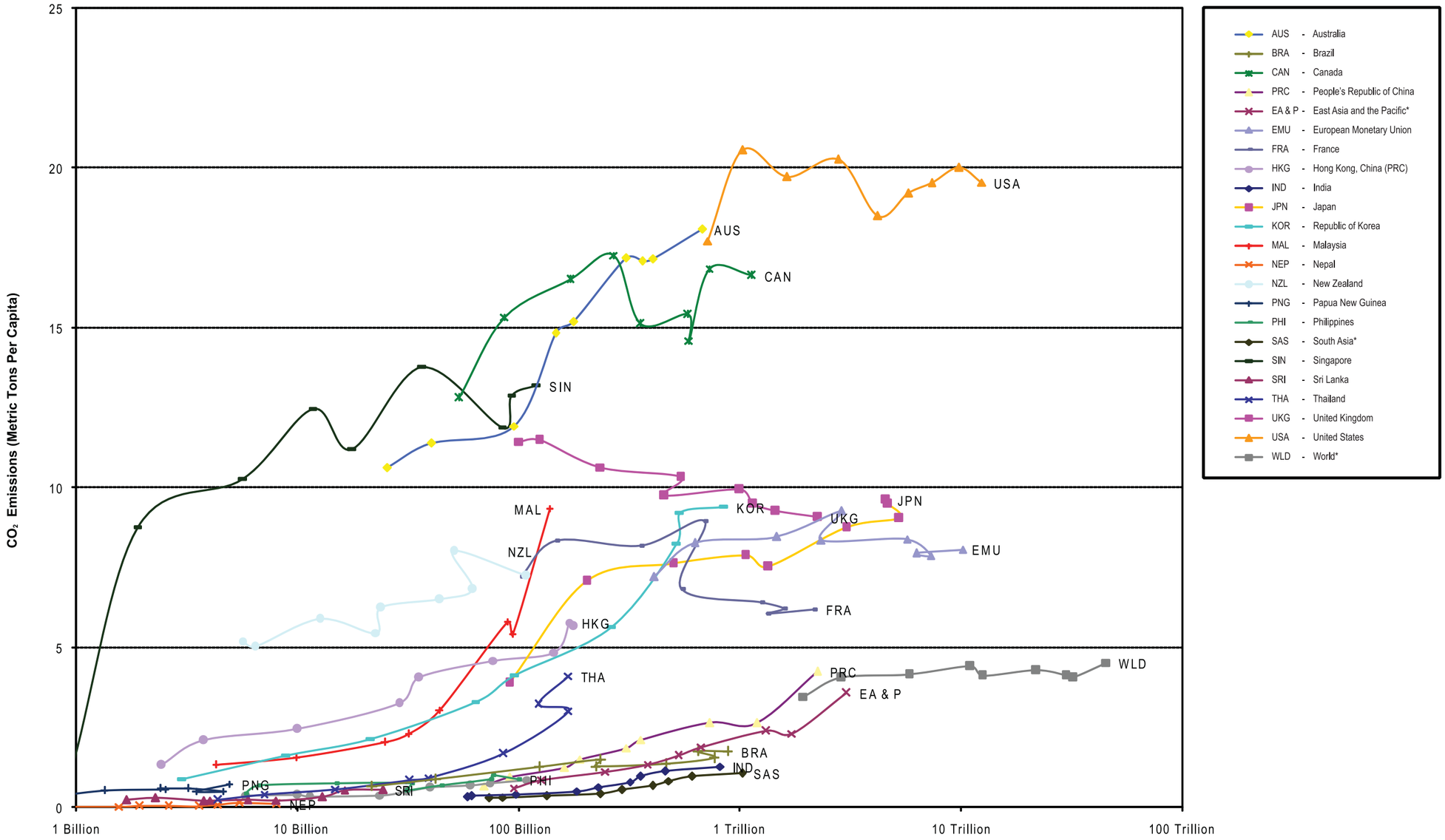
Carbon Dioxide Emissions Over Time (Cross Sectoral)

Internationally, globally, and within Asia, CO_2 emissions vary markedly. The only constant is the rise nationally over time. Cross-sectoral emissions, by country and region, are shown opposite. The PRC, Europe, India, the Russian Federation, and the US are the largest aggregate emitters, reflecting large populations.

Per capita emissions are highest in the countries with high car ownership and car-dependent lifestyles: in the US (19.5 metric tons per person [tpp]), Australia (18.1 tpp), Canada (16.6 tpp), Japan (9.6 tpp), the UK (9.1), and Europe (8.0 tpp).

Asia, on the whole, has low per capita emissions: the PRC emits about 4.3 tpp, and Thailand (4.1 tpp) and India (1.2 tpp) follow, though there are some notable exceptions, such as Singapore (13.2 tpp) and Malaysia (9.3 tpp).

The time series opposite shows rapid increases in CO_2 emissions over time from 1965 to 2005, particularly in countries such as Malaysia. Some countries in the Middle East have very high per capita emissions, such as Qatar (56.3 tpp), Kuwait (36.9 tpp), and United Arab Emirates (30.1 tpp). The world average is 4.5 tpp.



National GDP (US$) - Time Series (1965–2005)

PRC = People's Republic of China, CO_2 = carbon dioxide, GDP = gross domestic product
Notes: Country codes were changed to match those used by ADB, as applicable. Those marked with * use World Bank abbreviations. Time series data comparison 1965–2005. Each line represents one country or area with CO_2 per capita plotted against national gross domestic product (GDP) logged.
Source: World Bank. 2010. *World Development Indicators: Country Data.* Washington, D. C.

LOCAL AIR POLLUTION AND NOISE

Increasing local air pollution means that countries are exceeding air quality standards set by national governments and by the World Health Organization. Air pollution affects health, impairs visibility, and damages buildings and the local environment.

Noise from traffic affects residents and workers, indeed all city life. A large proportion of the population is exposed to high levels of noise from traffic. Disturbance can also be caused by vibration, particularly from heavy lorries, and from 24-hour deliveries.

▲

2.54. HA NOI (VIET NAM)

◀

2.55. CHANGCHUN (PRC)

▲

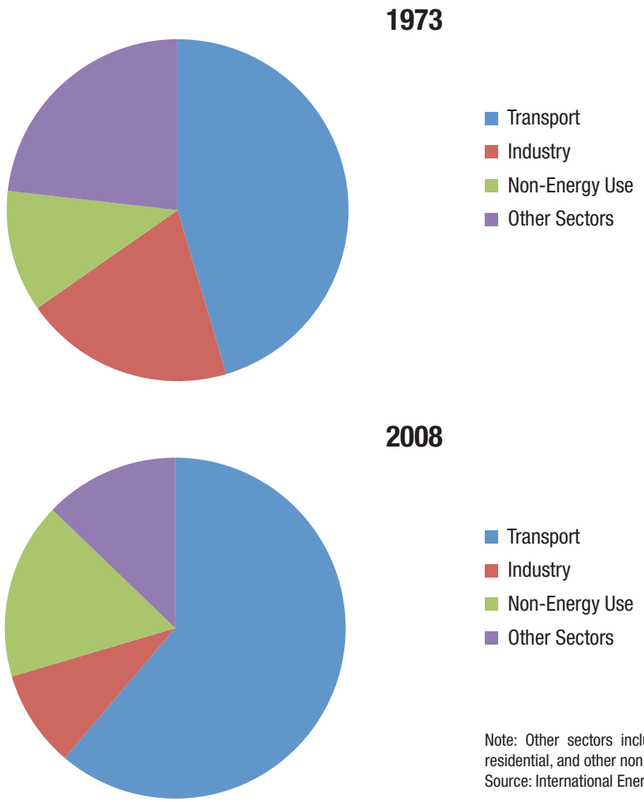
2.56. BANGKOK (THAILAND)

◀

2.57. DELHI (INDIA)

ENERGY CONSUMPTION

The transport sector is using a much greater share of finite oil resources over time, accounting for up to 62% of total oil consumption by 2008. This represents a huge increase, up from 1,020 million tons of oil equivalent (Mtoe) in 1973 to 2,150 Mtoe in 2008, an increase of 111%.



Note: Other sectors include agriculture, commercial and public services, residential, and other non-specified sectors.
Source: International Energy Agency. 2010. Key World Energy Statistics. Paris.

"The rapidly rising demand for energy and oil, fast-rising numbers of middle class inhabitants of Asian cities, and the rapidly changing lifestyles and consumption patterns of the fortunate pose major challenges for transport planners and city designers."

—H. T. Dimitriou. 2006. Towards a Generic Sustainable Urban Transport Strategy for Middle-Sized Cities in Asia: Lessons from Ningbo, Kanpur, and Solo. *Habitat International.* 30. 1082–1099.

HEALTH—ACTIVE TRAVEL

Inactive lifestyles, including from travel, are leading to higher levels of obesity and poor health. Sustainable transport strategies, including less use of motor vehicles and increases in the distances walked and cycled, could have very important health benefits. Levels of chronic disease, such as the prevalence of ischemic heart disease (reduced blood supply affecting the heart), cerebrovascular disease (changed blood pressure affecting the brain), depression, dementia, and diabetes, can all be lowered by active travel lifestyles.[9]

2.58. ASIA
Levels of obesity in Asia are beginning to follow the North American trend, raising concerns about implications for future health levels.

2.59. BEIJING (PRC)
Walking and cycling as part of everyday routines are the best ways to keep active. These modes improve health, while reducing CO_2 emissions—a very useful combination.

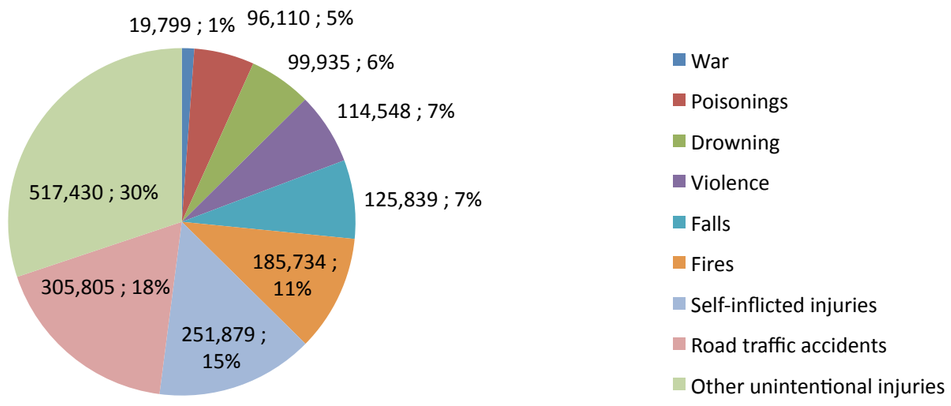
ROAD SAFETY

Road safety is a major concern in all cities. Worldwide, traffic accidents result in up to 1 million deaths each year and 50 million injuries each year.[10] This is a very high cost that is seemingly accepted by society. The majority of victims are pedestrians and cyclists. Accident rates are declining in some countries with high levels of motorization, but increasing in others with lower levels—such as most Asian countries. Personal security is also a growing social problem, with some transport implications.[11]

2.60. INDORE (INDIA)
Pedestrian facilities are often nonexistent. Pedestrians mix with vehicles and traffic.

2.61. HA NOI (VIET NAM)
Two-wheelers are frequently used without helmets, including when carrying large packages.

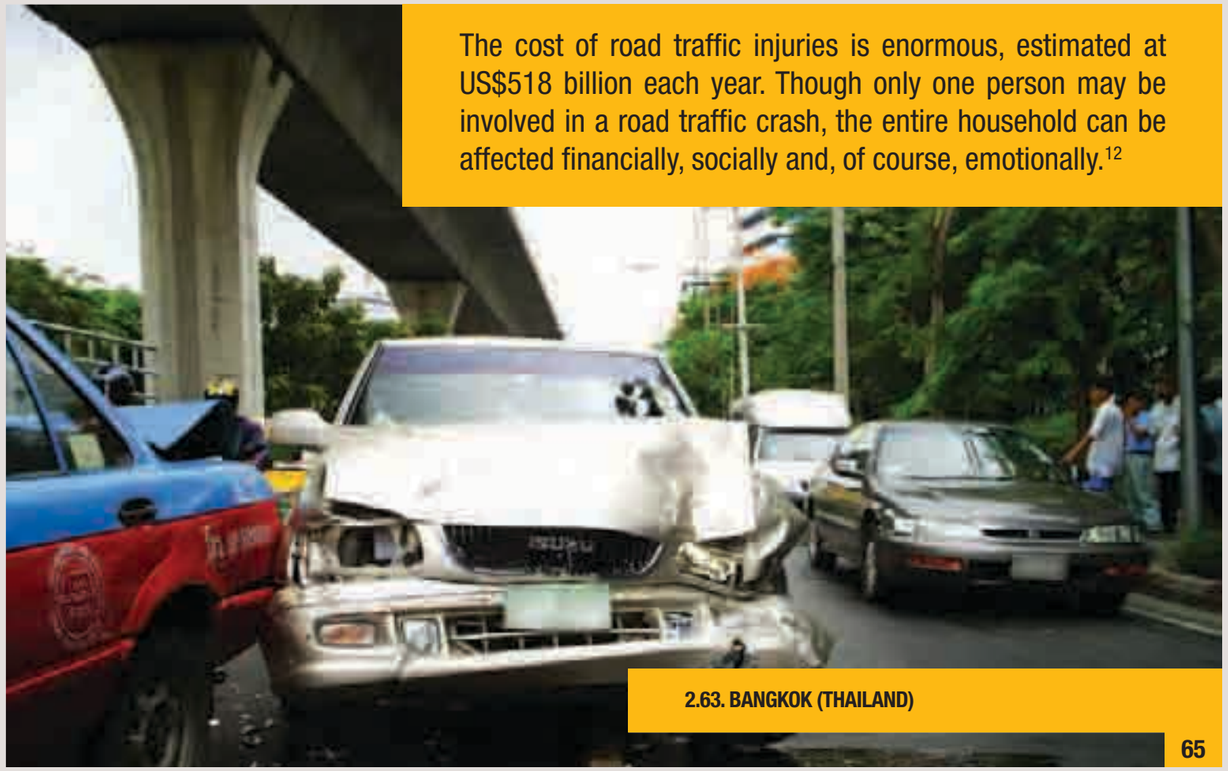
Injury-Related Mortality in the Southeast Asia Region, 2004



Source: World Health Organization. 2004. *Global Burden of Disease Study* (2004 update). Geneva.

2.62. DELHI (INDIA)
The two-wheeler is often used to carry the family, but only dad gets the helmet here.

The cost of road traffic injuries is enormous, estimated at US$518 billion each year. Though only one person may be involved in a road traffic crash, the entire household can be affected financially, socially and, of course, emotionally.[12]



2.63. BANGKOK (THAILAND)

2.64. KUNMING (PRC)

Almost three quarters of road traffic deaths in Southeast Asia are of vulnerable road users—motorcyclists, pedestrians, or cyclists.[13]

2.65. BANGKOK (THAILAND)
The lack of facilities for vulnerable road users means that their casualty rates are much higher than those of other groups, such as car users.

2.66. INDORE (INDIA)
The special contexts in some cities means the obstacles on the road can be uncertain.

Leading Causes of Death, by Age Group

Road traffic injuries are the leading cause of death among 15- to 29-year-olds. Among 5- to 14-year-olds, it is the second leading cause.

5–14 Years	15–29 Years
Lower respiratory infections	**Road traffic injuries**
Road traffic injuries	HIV/AIDS
Malaria	Tuberculosis
Drownings	Violence
Meningitis	Self-inflicted injuries
Diarrheal diseases	Lower respiratory infections
HIV/AIDS	Drownings
Tuberculosis	Fires
Protein–energy malnutrition	War and conflict
Fires	Maternal hemorrhage
Measles	Ischemic heart disease
Leukemia	Poisonings
Congenital anomalies	Abortion
Trypanosomiasis	Leukemia
Falls	Cerebrovascular disease
Epilepsy	Diarrheal diseases
Leishmaniasis	Falls
Violence	Meningitis
War and conflict	Nephritis and nephrosis
Poisonings	Malaria

Source: World Health Organization. 2009. *Global Status Report on Road Safety: Time for Action.* Geneva.

SOCIAL EXCLUSION

Investments in the private car and the growth in traffic facilitate the movement of the motorist, but can reduce the accessibility of others, since spaces given to the car (in the form of highways and car parks) often form obstacles for pedestrians, cyclists, and those with disabilities.

Transport interventions must serve deprived areas and target disadvantaged groups if they are to improve transport equity and opportunity. Transport provision, if designed to improve accessibility—rather than mobility—can be part of the social safety net providing access to employment and other facilities. Disadvantaged groups are most often thought of as low-income groups, but can also include people excluded by gender, age, and disability.

2.67. BEIJING (PRC)

2.68. NANDED (INDIA)

LAND CONSUMPTION AND URBAN SPRAWL

Cities in Asia are often sprawling, with the higher-income groups moving to areas with better living conditions and the lower-income groups becoming trapped and marginalized.

Globally, the use of space by traffic, in the form of highways and parking space, takes 10%–60% of land in the city (the latter in Los Angeles). The urban landscape can suffer from degradation when new roads and transport facilities are built, historic buildings demolished, and open space reduced. Highways can contribute to the decaying of the urban fabric and the neglect of central city areas.

The decentralization and suburbanization of urban areas has been facilitated by the car (and, in specific corridors, by public transit). This has resulted in the substantial growth of trip lengths, and travel patterns that are dispersed, reflecting 'many to many' origins and destinations.[14] Trips are rarely concentrated on the radial commute into the city center.

Under dispersal, development pressures occur in locations around key junctions on the road network, in areas that are poorly accessible for people without cars. Activities become spatially segregated. These trends make investing in efficient public transit more difficult, and increase car dependence.

2.69. MANILA (PHILIPPINES)
New residential enclaves—urban sprawl on the edge of the city—are built at very low densities and are usually very car dependent.

2.70. DELHI (INDIA)
A new metro system needs high densities around the major interchanges to increase patronage and encourage modal shifts.

2.71. SEOUL (REPUBLIC OF KOREA)
Larger cities and smaller urban areas provide opportunities to develop clusters of high-density development that can support public transit systems over car usage. However, this will require stronger urban planning regimes and strategic logic to urban form and layout. Density and transport policy must go hand in hand.

2.72. MANILA (PHILIPPINES)

2.73. MANILA (PHILIPPINES)
Even where there are clusters of high density, much valuable space is devoted, at ground level, to the parking of vehicles, which can sometimes result in wasted space. Urban centers are still served, in the most part, by the car, and that there is little coordination between urban form, layout, and public transit investment.

02. The Urban Transport Dilemma

Land Use and Transport Characteristics

Indicator	Metric	High-Income Asia	Middle-Income Asia	Low-Income Asia	MIO	LIO	US	Canada	AUS and NZ	Western Europe
Urban density	Persons/ha	134.4	164.3	205.6	53.7	122.1	14.9	26.2	15.0	54.9
Proportion of jobs in CBD	%	20.1%	13.1%	31.8%	16.8%	21.2%	9.2%	15.7%	15.1%	18.7%
Metropolitan GDP per capita	US$	$34,797	$9,776	$1,689	$6,625	$1,949	$31,386	$20,825	$19,775	$32,077
Passenger cars per 1,000 persons	-	217.3	198.3	38.0	265.1	71.2	587.1	529.6	575.4	413.7
Motorcycles per 1,000 persons	-	65.8	154.0	95.6	14.7	15.1	13.1	9.5	13.4	32.0
Passenger car km per capita	-	3,724	3,517	785	4,133	1,172	18,155	8,645	11,387	6,202
Motorcycle passenger km per capita	-	100	1,165	416	78	90	45	21	81	119
Length of expressway per person	m/pers	0.022	0.027	0.004	0.043	0.009	0.156	0.122	0.129	0.082
Private passenger vehicles per km of road	-	118.1	290.4	169.3	137.5	139.7	98.7	105.8	73.1	181.9
Average road network speed	km/h	31.3	20.9	20.5	35.9	30.4	49.3	44.5	44.2	32.9
Parking spaces per 1,000 CBD jobs	-	121	164	55	374	134	555	390	505	261
Public transport seat km of service per capita	-	5,535.2	2,734.4	2,057.4	3,282.8	3,322.2	1,556.8	2,289.7	3,627.9	4,212.7
Public transport boardings per capita	-	464.1	274.2	267.3	340.5	234.4	59.2	140.2	83.8	297.1
Public transport operating cost recovery	%	138.5%	98.8%	138.6%	82.9%	107.9%	35.5%	54.4%	52.7%	59.2%
Mode split: motorized private modes	%	38.6%	54.6%	21.6%	45.5%	30.9%	88.5%	80.5%	79.1%	49.7%
Mode split: motorized public modes	%	32.3%	25.6%	28.3%	26.6%	32.8%	3.4%	9.1%	5.1%	19.0%
Mode split: non-motorized modes	%	29.1%	19.8%	50.1%	27.9%	36.3%	8.1%	10.4%	15.8%	31.3%
Transport deaths per 100,000 people	-	5.9	20.7	10.4	18.3	13.2	12.7	6.5	8.6	7.1
Private passenger transport energy use per capita	MJ/person	9,556	10,555	2,376	10,569	4,052	60,034	32,519	29,610	15,675
Public transport energy use per capita	MJ/person	1,500	1,583	607	1,012	1,696	809	1,044	795	1,118
Total emissions per capita (CO_2, SO_2, VHC, NOX)	kg/person	31.3	97.2	69.1	157.5	81.8	264.6	178.9	188.9	98.3

AUS = Australia, CBD = central business district, PRC = People's Republic of China, CO_2 = carbon dioxide, GDP = gross domestic product, ha = hectare, kg = kilograms, km = kilometers, km/h = kilometers per hour, LIO = low-income other, MIO = middle-income other, m/pers = meters per person, MJ = megajoule, NOX = nitrogen oxides, NZ = New Zealand, SO_2 = sulfur dioxide, UK = United Kingdom, US = United States, VHC = volatile hydrocarbons

Sources: J. R. Kenworthy and F. Laube. 2001. *UITP Millennium Cities Database for Sustainable Transport*. Brussels: International Association of Public Transport.; P. Barter, J. R. Kenworthy, and F. Laube. 2003. Lessons from Asia on Sustainable Urban Transport. In N. P. Low and B. J. Gleeson, (eds.) *Making Urban Transport Sustainable*. Basingstoke: Palgrave Macmillan.

Comparative data from cities across the world show great differences in land use and wealth, private and public transport supply and usage, and energy usage and emissions.

HIGH-INCOME ASIA
Hong Kong, China
Osaka (Japan)
Sapporo (Japan)
Singapore
Tokyo (Japan)

MIDDLE-INCOME ASIA
Bangkok (Thailand)
Kuala Lumpur (Malaysia)
Seoul (Republic of Korea)
Taipei,China

LOW-INCOME ASIA
Beijing (PRC)
Chennai (India)
Guangzhou (PRC)
Ho Chi Minh City (Viet Nam)
Jakarta (Indonesia)
Manila (Philippines)
Mumbai (India)
Shanghai (PRC)

MIDDLE-INCOME OTHER
Budapest (Hungary)
Cape Town (South Africa)
Curitiba (Brazil)
Johannesburg (South Africa)
Krakow (Poland)
Prague (Czech Republic)
Riyadh (Saudi Arabia)
Sao Paulo (Brazil)
Tel Aviv (Israel)

LOW-INCOME OTHER
Bogotá (Colombia)
Tehran (Iran)
Tunis (Tunisia)
Cairo (Egypt)
Dakar (Senegal)
Harare (Zimbabwe)

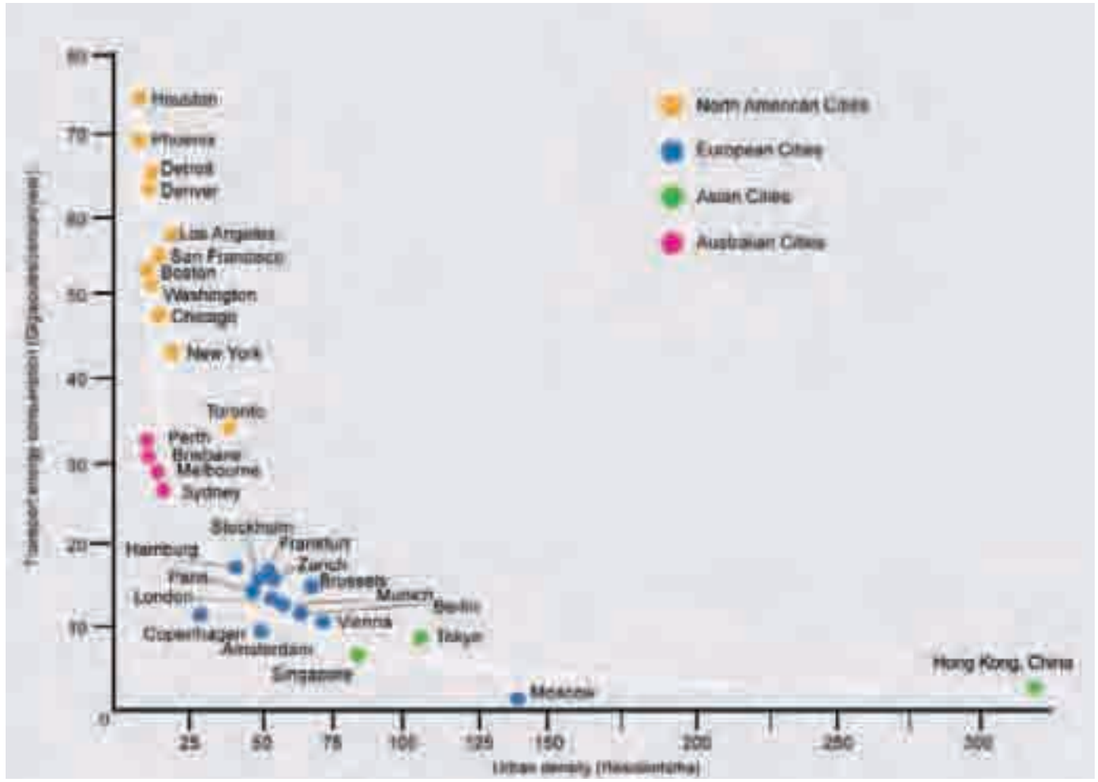
US
Atlanta
Chicago
Denver
Houston
Los Angeles
New York
Phoenix
San Diego
San Francisco
Washington, DC

CANADA
Calgary
Montreal
Ottawa
Toronto
Vancouver

AUSTRALIA and NEW ZEALAND
Brisbane (Australia)
Melbourne (Australia)
Perth (Australia)
Sydney (Australia)
Wellington (New Zealand)

WESTERN EUROPE
Amsterdam (the Netherlands)
Athens (Greece)
Barcelona (Spain)
Berlin (Germany)
Bern (Switzerland)
Bologna (Italy)
Brussels (Belgium)
Copenhagen (Denmark)
Dusseldorf (Germany)
Frankfurt (Germany)
Geneva (Switzerland)
Glasgow (UK)
Graz (Austria)
Hamburg (Germany)
Helsinki (Finland)
London (UK)
Lyon (France)
Madrid (Spain)
Manchester (UK)
Marseilles (France)
Milan (Italy)
Munich (Germany)
Nantes (France)
Newcastle (UK)
Oslo (Norway)
Paris (France)
Rome (Italy)
Ruhr (Germany)
Stockholm (Sweden)
Stuttgart (Germany)
Vienna (Austria)
Zurich (Switzerland)

Urban Density and Transport-Related Energy Consumption



Sources: P. Newman and J. R. Kenworthy. 1989. *Cities and Automobile Dependence: An International Sourcebook.* Aldershot: Gower.; P. Newman and J. R. Kenworthy. 1999. *Sustainability and Cities: Overcoming Automobile Dependence.* Washington, D. C.: Island Press.; Le Monde Diplomatique. 2007. *Atlas de l'Environnement:* Chantilly, France.

Urban density and transport energy consumption have been correlated, showing that high densities are associated with reduced energy consumption.[15] Although there are other important issues involved (fuel price and transport infrastructure, socioeconomic and population characteristics, integration of services, etc.), cities must find ways of strategically using urban structure to support sustainable travel. An important part of this will include raising densities in locations around interchanges.

MEGAPROJECTS, COST OVERRUNS, AND POOR PROJECT MANAGEMENT

Some projects are notorious for their poor management of cost and time. Megaprojects, in particular, have enormous opportunity costs and are risky by nature. Cost escalation can occur in construction and financing, and for different types and sizes of schemes—for example, roads, bridges, and railways. This occurs in public, private, and joint projects. Ambitious assumptions are often used in modeling forecasts.[16]

Not all megaprojects are beneficial. Major radial expressways can increase car usage and undermine sustainability aspirations. Metros frequently carry fewer passengers than forecast. Great care is required in defining, developing, and implementing all projects, particularly the larger ones.

2.74. BANGKOK (THAILAND)
Many major projects are subject to cost overruns and ambitious assumptions in forecasting.

2.75. BANGKOK (THAILAND)

“Many people just get into their cars in the morning almost without thinking, and then they find themselves stuck in another traffic jam. Experts have calculated that traffic jams cost the German economy several billion euro every year. And to my mind the answer is not simply to build more roads.

Stuck in traffic jams, people waste time, get irritated. Some people put themselves through it every day, even if a 5-minute walk would take them to the underground, which would get them to work quicker and more comfortably. Never mind the pleasure of being able to read the paper on the way!

It’s true that this is not possible in every town, nor in every suburb; but it is possible much more often than transport user figures would suggest. Are we actually aware how our quality of life suffers just because we don’t let go of old habits? Sometimes I wish people would think about this a little more.”

—Horst Köhler, former German Federal President, speaking to the German Motorists Association in Munich in early 2010.

02. The Urban Transport Dilemma

Transportation Timeline in Bogotá

1876
Horse-drawn carriages with 10-person capacity were used as public transport (operated by Compañía Franco–Inglesa de Carruajes de Alford y Gilede).

1882
The Bogotá City Railway Co. was hired to operate a mule-drawn tramway (Tranvía de Mulas) under a concession contract until 1912.

1884
Tranvía de Mulas started operating with eight vehicles with 10-passenger capacity each.

1900
Horse-drawn four-seater taxis were put into service. Tickets cost 40 cents per trip, or 1 peso per hour.

1903
The first car arrived in Bogotá.

1910
Bogota inaugurated electric service operation, which was boycotted for political reasons by public transport users. Twenty-five-horsepower electric tramways started operation—a 20-minute ride between Plaza de Bolivar and Chapinero.

1911
Municipal tramways transported 3.5 million passengers in 27 vehicles: 21 mule-drawn and 6 electric.

1921
Tramways moved 10.4 million passengers along 30.6 kilometers (km) of lines using 30 vehicles.

1928
Inter-city buses started operation, fully operated by private companies.

1941
In order to satisfy excessive demand, a consultant report suggested that tramways be complemented by bus-based systems.

1948
Twenty trolleybuses and 20 buses (bought by the city in 1947) started operation.

1951
The tramway service stopped operation due to high costs and increased motorization, and because they were seen as "premodern and archaic" by mayor Fernando Mazuera.

1964
The first report on integrated collective transport was presented to the municipality.

1968
The first large transport route and organization analysis was undertaken, as was the first official metro study and proposal.

The city had more than 3,000 privately owned and operated buses.

The national government created the Transit Code (Código de Tránsito), which, among other things, formalized public transport and created specific local authorities to regulate it.

1974
The city held its first Car-free Sunday (Ciclovia), 3.8 km in length.

1978
The city had 33 private transport companies providing service to 327 routes.

1988
Caracas Avenue was redesigned and rebuilt as a bus-only corridor. No management structure was developed. This was the first phase (southern portion).

1991
The local public transport authority, Empresa Distrital Transportes Urbanos (EDTU), was closed.

1996
Car-free Sunday encompassed 81 km of routes.

1998
354,481 automobiles were registered in the city.

2000
TransMilenio (a BRT system) was inaugurated along Avenida Caracas and Calle 80.

2003
TransMilenio built phase 2, including bicycle parking, at no cost to its users at terminal stations.

2004
The bikeway network measured over 330 km in length.

2006
Car-free Sunday encompassed 121 km of routes.

Automobile sales reached record numbers nationally: (200,000 compared to 60,000 in 1999).

The TransMilenio network comprised 84 km of trunk lines (phases 1 and 2 were completed).

2008
There were 895,293 automobiles registered in the city.

Mayor Samuel Moreno promised to have the first line of metro contracted by end of his mayoral term in December 2011. A study was undertaken.

Bicycle network expansion plans will add 20 km through December 2011.

2010
The national government gave numerous comments on the First Metro Line project, and this was postponed until a comprehensive review could be developed. Phase 3 of TransMilenio continued construction.

03. Options for Sustainable Mobility

There is widespread acknowledgement of the need to develop greater sustainability in travel patterns and a number of exciting projects are emerging internationally. There is also a general consensus on the likely components of sustainable mobility. Strategies to reduce traffic in Asian cities will need to include a wide range of measures, such as traffic management, improved access by non-motorized modes, urban planning, and the promotion of low-emission vehicles, where travel by private car is essential. Traffic reduction is not an end in itself, but is recognized as the best means of achieving wider sustainability and livability aspirations.

There is extensive literature that defines the difficulties, and examines the likely policy interventions available, in developing sustainable transport strategies. Useful further reading is given in the bibliography. Many publications have an Asian focus and, in addition, the *GIZ Sourcebook* (www.sutp.org) provides practical advice to policy makers in developing cities on many relevant topics for urban transport development.

3.1. HONG KONG, CHINA (PRC)

3.2. HONG KONG, CHINA (PRC)

3.3. HONG KONG, CHINA (PRC)

03. Options for Sustainable Mobility

3.4. MANILA (PHILIPPINES)

Transportation networks and facilities are designed to improve the quality of life in the city, with pedestrians and cyclists given priority.

METHODOLOGIES

There are a number of useful methodologies and approaches available to help decision makers formulate policies and investment programs. The range of interventions available have been classified into the 'AVOID–SHIFT–IMPROVE' typology:[17]

- AVOID: Reduce the need to travel.
- SHIFT: Change the transport modes that people choose.
- IMPROVE: Increase the energy efficiency of vehicles and fuels.

An example of scenario analysis and policy packaging is provided opposite. The rise in transport CO_2 emissions can be viewed as a projection of the business-as-usual policy, and an aspiration to change the trajectory can also be developed. A series of policy interventions, grouped into packages, can be used to help achieve this future scenario, including low-emission vehicle technologies, alternative fuels, public transit, walking and cycling, urban planning, and wider behavioral change initiatives.

The value of such work is to assess the likely contributions of, and trade-offs between, policy interventions. Many are likely to act across and between particular typologies.

The following equation simplifies the contribution of various factors:

$$G = A*S_i*I_i*F_{ij}$$

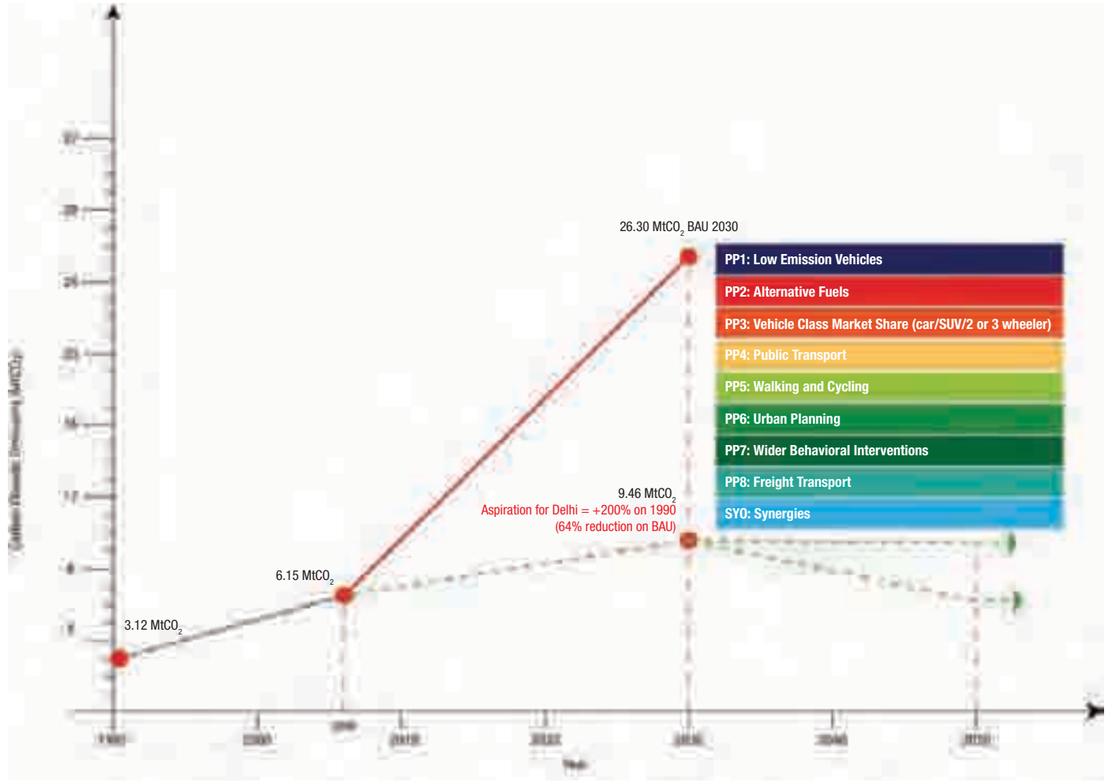
where

G is the total emissions summed over modes (i)
A is the total travel activity in passenger kilometers (or tons km) across all modes
S converts from passenger to vehicle travel
I is the energy intensity of each mode (including vehicle efficiency, occupancy or loading, vehicle weight, power, and driver behavior)
F is the fuel type (j) in mode (i)[18]

3.5. BOGOTÁ (COLOMBIA)

Packages of interventions that include a range of measures often make the greatest impact at the city level, as evidenced by this Delhi example.

Policy Solutions in Delhi



$MtCO_2$ = million tons carbon dioxide, BAU = business as usual, PP(1,2,3...etc.) = policy package (1,2,3...etc.), SUV = sport utility vehicle, SYO = synergetic effects
Source: R. Hickman and D. Banister. 2011. Transitions to Low Carbon Transport Futures. Strategic Conversations from London and Delhi. *Journal of Transport Geography*. Forthcoming.

Packaging the Components of a Strategy

AVOID: Reduce the need to travel.
- urban planning
- traffic demand management

SHIFT: Change the transport modes that people choose.
- public transit
  - mass and light rapid transit
  - bus rapid transit
  - ultralight and demand-responsive transit
- non-motorized transport
  - walking and cycling

IMPROVE: Increase the energy efficiency of vehicles and fuels.
- low-emission vehicles and alternative fuels

URBAN PLANNING

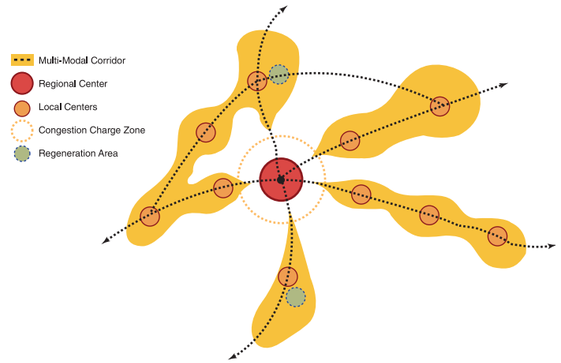
Planning regimes in Asian cities certainly need strengthening to more effectively guide and shape the location and form of development. Considerations within the urban planning field to help achieve sustainable travel behaviors include

- settlement size,
- strategic development location,
- density,
- jobs–housing balance,
- accessibility of key facilities,
- development site location,
- mix of uses, and
- neighborhood design and street layout.[19]

Alongside transport and infrastructure provision, traffic demand management measures, and wider efforts to change travel behavior norms and aspirations, urban planning can create the appropriate physical location of activities for sustainable travel patterns. Interventions can take place at the strategic level (the location of major areas of development) or at the local level (integration with transit schemes, density and mixed use standards, and street layout). Further guidance is given at www.plan4sustainabletravel.org.

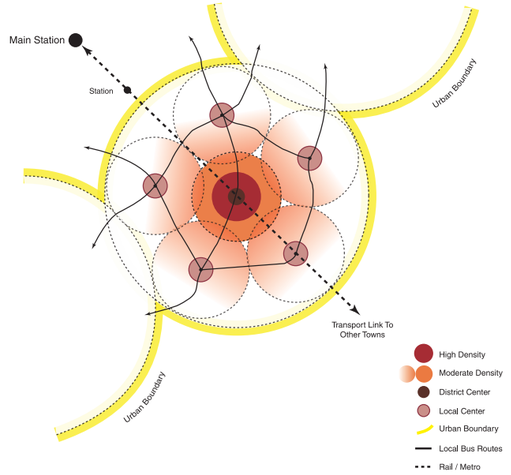
3.6. SINGAPORE

Focusing Development along the Major Transit Corridors, and near Interchanges



Source: R. Hickman, C. Seaborn, P. Headicar, and D. Banister. 2009. *Planning for Sustainable Travel. Summary Guide.* London: Halcrow and Commission for Integrated Transport.

Clustering Density around the Transit Network



Source: R. Rogers. 1997. *Cities for a Small Planet.* London: Faber.

Well-Linked and Permeable New Development

Source: R. Hickman, C. Seaborn, P. Headicar, and D. Banister. 2009. *Planning for Sustainable Travel. Summary Guide.* London: Halcrow and Commission for Integrated Transport.

3.7. HA NOI (VIET NAM)
The central area in Ha Noi has relatively high densities, creating vitality, and high levels of walking, cycling, and two-wheeler use—an example of a compact urban center in Asia.

3.8. HONG KONG, CHINA (PRC)
The ultrahigh densities in Hong Kong, China are associated with high public transport usage and low per capita energy consumption.

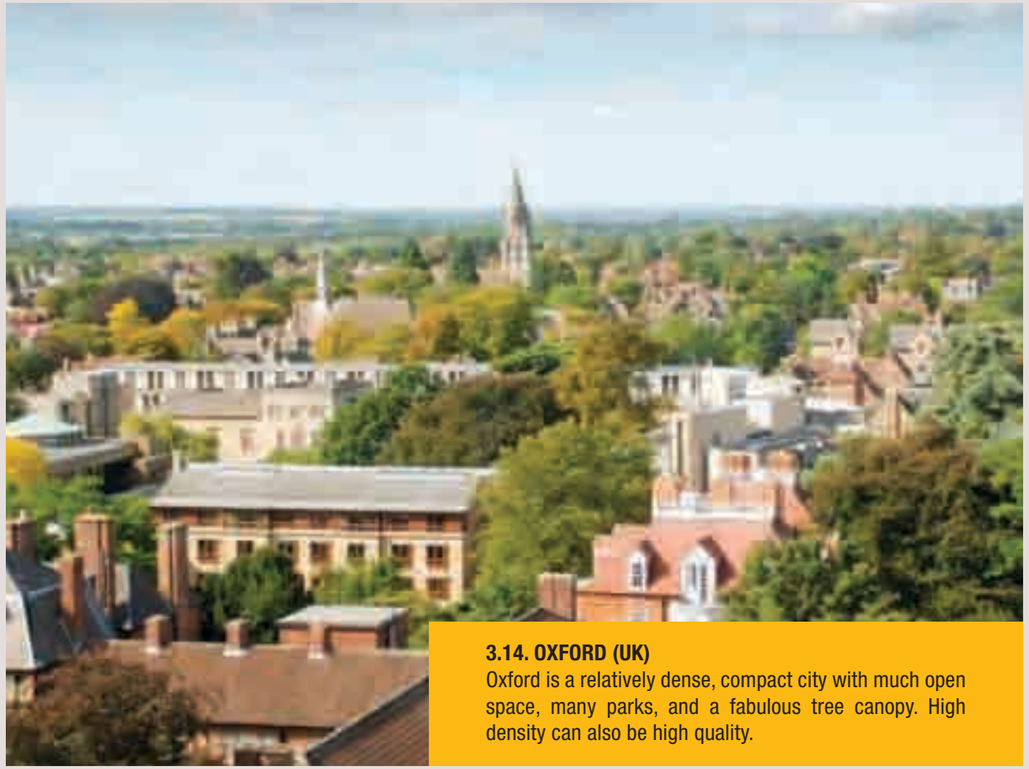
3.9. TORONTO (CANADA)
Toronto represents a classic use of development density clustered along the public transport route, in this case the Metro.

3.10. LONDON (UK)
Canary Wharf is a new financial district built at high densities, supported by a new Underground line (the Jubilee Line) and light rail (the Docklands Light Railway).

3.11. LONDON (UK)
A high-density and vibrant urban core—with employment, residential, and cultural facilities—is only possible if an effective public transport system delivers the people in numbers.

3.12. LONDON (UK)
Paddington Basin is one example of how major railway stations have been redeveloped as opportunity areas for higher densification and a wider mix of uses.

3.13. SEVILLE (SPAIN)
The city illustrates how sustainable modes can be supported by a compact urban structure. Many people live and work in the center, with excellent conditions for walking, cycling, and public transport.



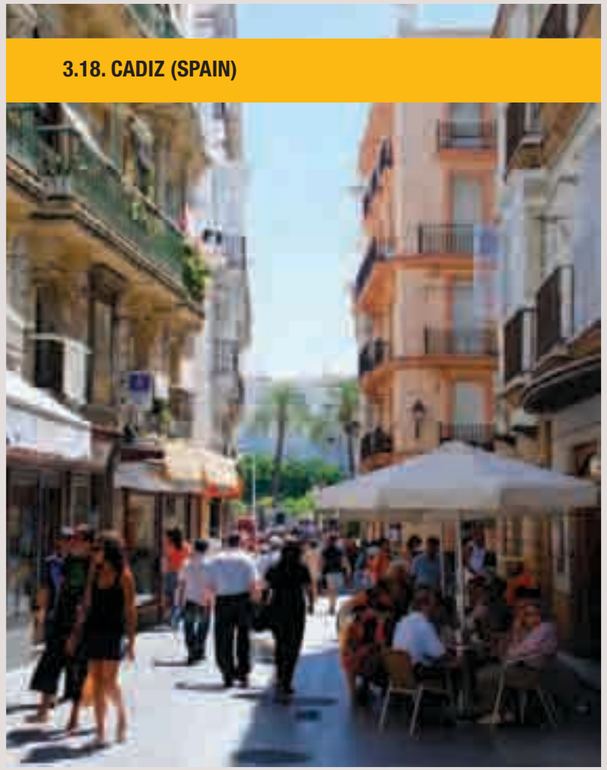
3.14. OXFORD (UK)
Oxford is a relatively dense, compact city with much open space, many parks, and a fabulous tree canopy. High density can also be high quality.

3.15. MANCHESTER (UK)
Manchester enjoys a much larger urban area, with higher buildings in the city center. The city has benefited from a very impressive urban renaissance over the last 20 years. Political intervention can turn cities around.

3.16. SYDNEY (AUSTRALIA)
A compact and vibrant center, with an incredible waterfront, supports a high quality urban life.

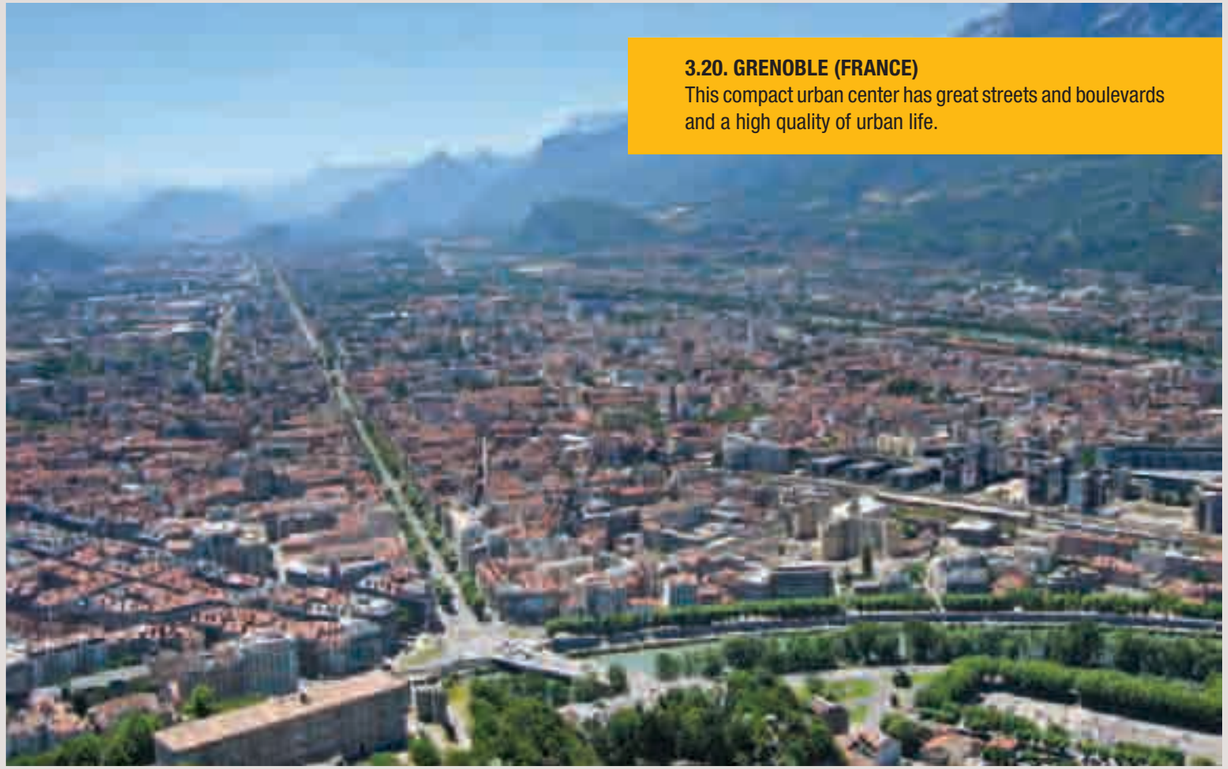
3.17. DELFT (THE NETHERLANDS)
Large numbers of people live in attractive urban centers in many European cities, leading to high vitality.

3.18. CADIZ (SPAIN)



3.19. LIVERPOOL (UK)
The new retail hub is a major redevelopment in the center of the city. It offers excellent permeability and linkages to neighboring areas and attractions.

3.20. GRENOBLE (FRANCE)
This compact urban center has great streets and boulevards and a high quality of urban life.

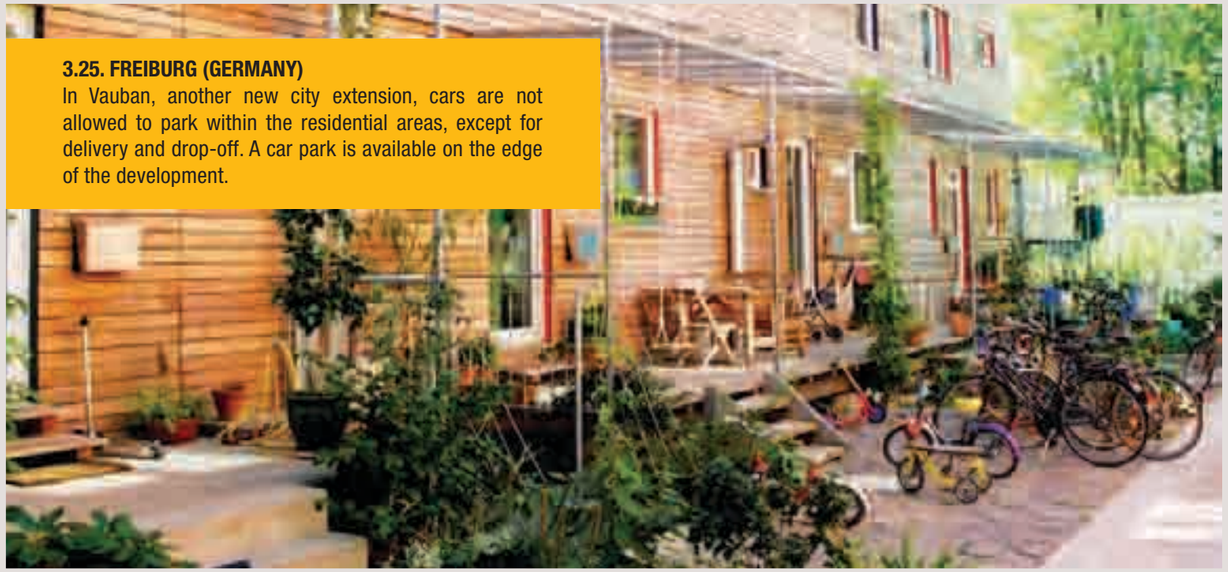


3.21. GRENOBLE (FRANCE)

3.22. AMSTERDAM (THE NETHERLANDS)
High-density areas can be of high quality—with employment, residential areas, and other facilities located in the city center.

3.23. SAN SEBASTIAN (SPAIN)
The Spanish seem to develop the very best in city center attractiveness and livability—a healthy aspiration for quality in street design.

3.24. FREIBURG (GERMANY)
A new city extension at Rieselfeld is built around the tram network and hides cars away in underground parking.



3.25. FREIBURG (GERMANY)
In Vauban, another new city extension, cars are not allowed to park within the residential areas, except for delivery and drop-off. A car park is available on the edge of the development.

▲

3.26. FREIBURG (GERMANY)
The quickest route to the city is purposively by tram or cycle, and pedestrian provisions are excellent.

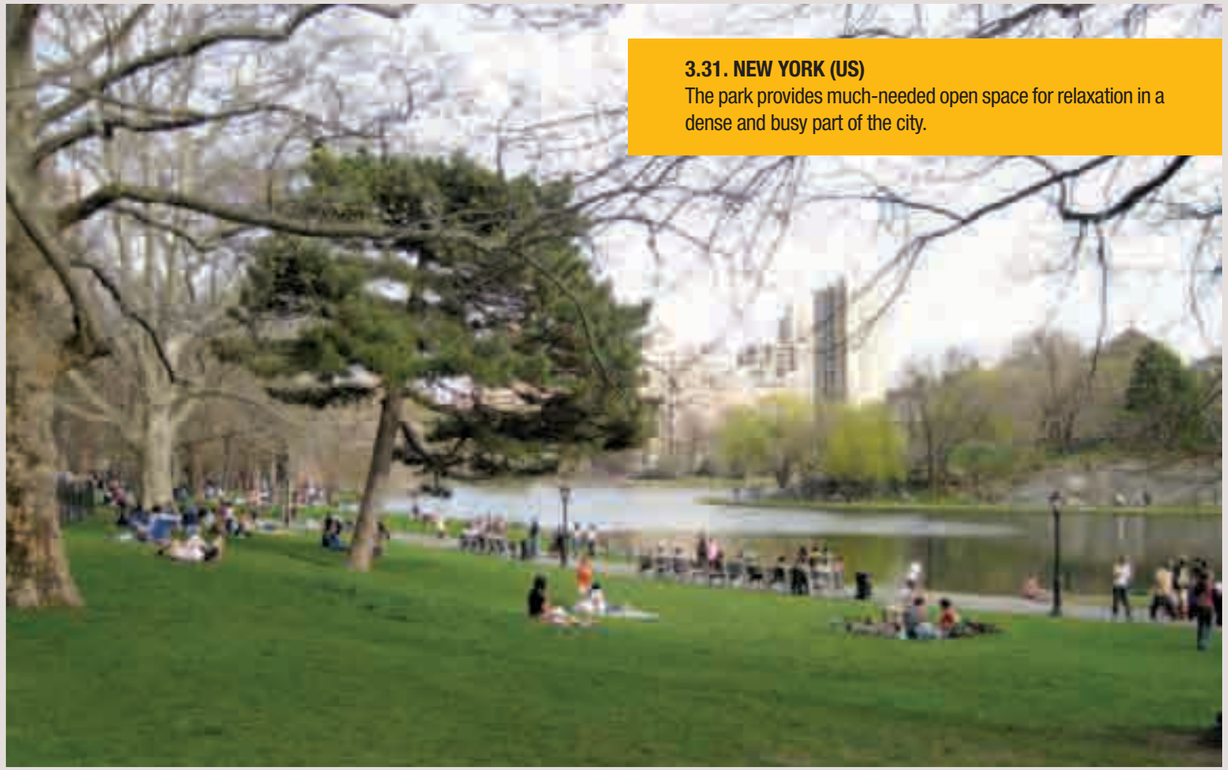
▶

3.27. FREIBURG (GERMANY)
The space not devoted to the car is available for gardens, play areas, and other community facilities.

◀▲

3.28 and 3.29. MIAMI (US)
Even very car-dependent cultures can develop attractive and popular pedestrian areas, and can repopulate and regenerate the central areas, allowing investment in public transit.

3.30. NAPLES (US)
Some of the new urbanist residential areas are popular, pedestrian friendly, and have active retail centers. However, many remain the enclaves of the wealthy.



3.31. NEW YORK (US)
The park provides much-needed open space for relaxation in a dense and busy part of the city.

3.32. PARIS (FRANCE)
Livability is greatly enhanced by beautiful parks and gardens, which help make city living attractive.

TRAFFIC DEMAND MANAGEMENT

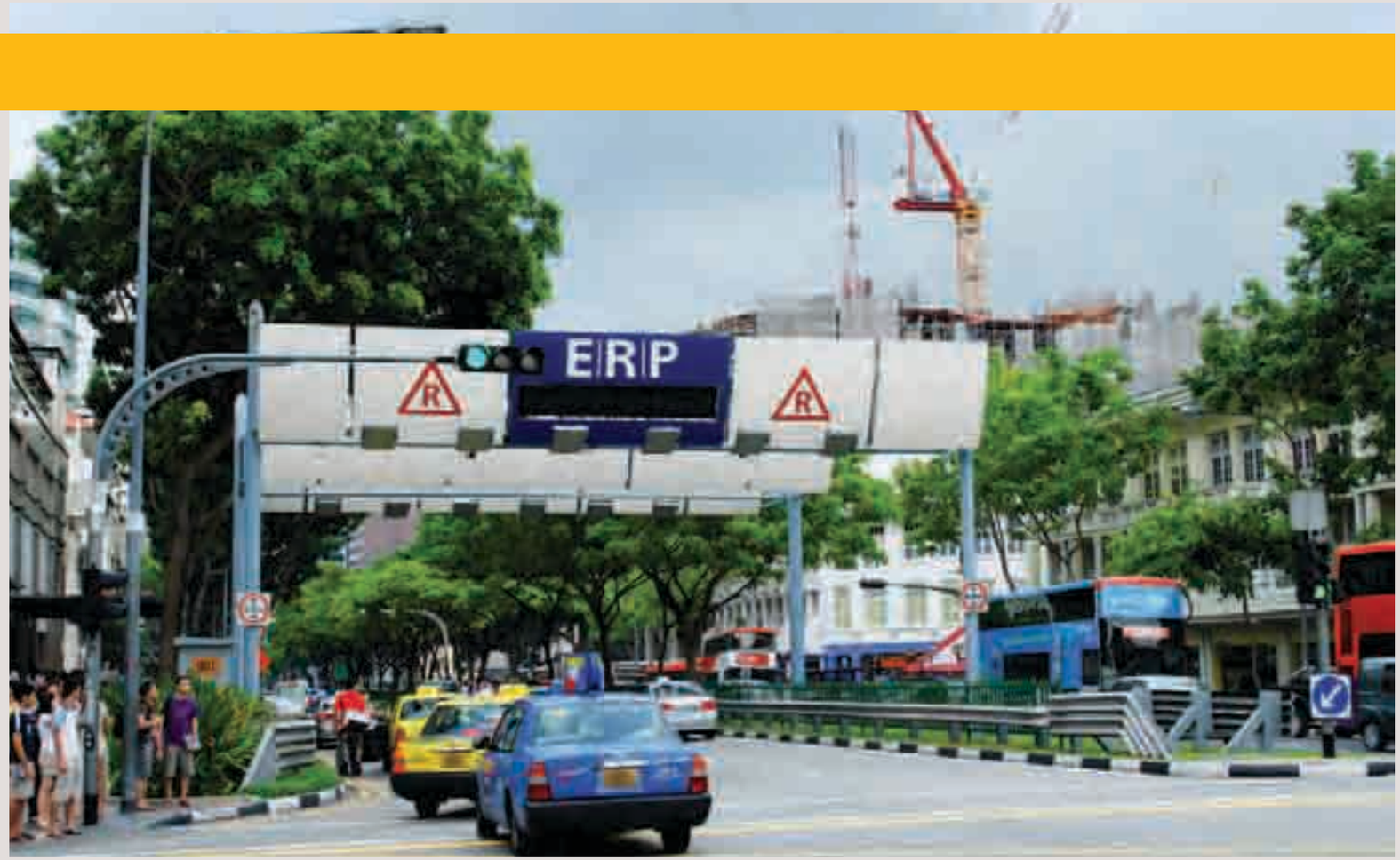
Traffic (or travel or transportation) demand management involves the application of strategies and measures to reduce travel demand. They are usually intended to apply to the reduction of single-occupancy private vehicles or to redistribute traffic in space or in time.

Traffic demand management can be a cost-effective alternative to increasing capacity, and has the potential to more effectively deliver environmental benefits, improve public health, strengthen communities, and make cities more economically prosperous and livable.

Traffic demand management measures can include road space reallocation away from the car (bus and cycle lanes, wider footways, pedestrian zones, and public realm improvements); high occupancy vehicle lanes; pricing (toll roads, congestion, or area-wide charging); parking supply charges and restrictions; traffic calming; and behavioral options (such as travel planning and flexible work). The Victoria Transport Policy Institute Traffic Demand Management Encyclopedia gives an overview of the various options available (www.vtpi.org/tdm).

"Years ago we believed it was possible to rebuild towns in such a way that they were appropriate to man and to vehicles. Now we must state precisely the incompatibility of what is right for car and man: even when car traffic is reduced, parked cars remain continually incompatible to playing children, cars parked on pavements restrict passers by and they restrict standing and sitting around. The number of cars must be [dramatically] reduced!"

—D. Garbrecht. 1981. *Walking: A Plea for Life in the Town.* Beltz Verlag: Weinheim.



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3.33. SINGAPORE
Singapore is the only location in Asia with a congestion charging scheme, providing inspiration for schemes developed in London and Stockholm.

◀

3.34. SINGAPORE
In Singapore's Electronic Road Pricing (ERP) system, sensors automatically deduct tolls from units inside vehicles.

3.35. XIAN (PRC)
Many central areas are now being developed as car-free areas, or at least car use is restricted.

3.36. XIAMEN (PRC)
Pedestrian and cycle space in central areas make cities more accessible and livable.

“A city that is good for children, the elderly, the handicapped, and the poor is good for everybody else.”

—Enrique Peñalosa, Colombian politician and former mayor of Bogotá

▲

3.37. NEW YORK (US)
Stacked parking or underground parking translates into more surface-level space available for other uses. Reduced parking supply effectively reduces car usage.

◀

3.38. NICE (FRANCE)
Road space can be dedicated to public transit. The left lane here is for bus transit.

▲▶▼

3.39, 3.40, and 3.41. LONDON (UK)
The congestion charging scheme in London has led to reduced traffic levels and emissions within the charging zone and has encouraged the use of non-motorized modes.

3.42. DELFT (THE NETHERLANDS)
Vehicle restrictions are well used in many urban areas across Europe, creating pedestrian- and cycle-friendly central environments.

'Smarter Choice' behavioral change measures, sometimes known as mobility management, are increasingly being used in Europe and North America to influence individuals' travel behaviors, and can be viewed as part of traffic demand management initiatives.

They include interventions that influence travel demand, and comprise travel plans (workplace, school, residential, personal); safe routes to school; car clubs and car-sharing schemes; home shopping; public transport information; marketing; cycle training; and travel awareness campaigns.[20]

3.43. DELFT (THE NETHERLANDS)
Safe routes to school reduce the use of cars by parents and help children get comfortable with non-car travel. This includes organized collection and drop-off for children, the use of active modes of travel and public transit, and skills development for modes, such as cycling.

PUBLIC TRANSIT

MASS RAPID TRANSIT

Mass rapid transit (MRT)—fully segregated urban rail systems also known as metros, subways, or underground networks—are often found at the core of large urban areas, alongside more conventional inter-urban rail services. There are over 140 systems in the world, including in Berlin, Buenos Aires, Chicago, London (the first underground network, which opened in 1863), Milan, Moscow, New York, Osaka, Paris, Tokyo (the most well-used with over 3 billion passenger rides per year), and more recently Bangkok; Beijing; Delhi; Dubai; Hong Kong, China; Kuala Lumpur; Manila; Nanjing; Rio de Janeiro; Shanghai (the most extensive in length at 420 km); Seoul; Singapore; and Vancouver. Many of these cities could not exist and deliver the high numbers of people to the dense urban centers without the metro systems.

For developing cities, it is sometimes asserted that these systems are unaffordable, unsuccessful on their own account with poor patronage and financial returns, and divert attention from other investments in non-motorized modes. Metros are most suited, given that they can be afforded, where high-capacity transit is necessary to support high-density central business districts; and they should be developed alongside other forms of public transit.

3.44. KUALA LUMPUR (MALAYSIA)
Depending on specifications, MRT systems can carry large volumes of people along radial corridors. They are particularly useful as part of a network into a central urban core.

3.45. SHANGHAI (PRC)
The magnetic levitation (MAGLEV) train carries passengers to and from Pudong Airport at speeds over 350 km/h. It serves alongside more conventional urban rail and MRT systems. It is, however, a very expensive system.

3.46. BEIJING (PRC)
The bullet train from Beijing to Tianjin opened in 2008, with a line distance of 117 km and trains running at a maximum speed of 350 km/h. It takes just 30 minutes, giving people more choice in where they live and work. However, improved services can also induce new long-distance travel, making energy consumption a problem.

3.47 and 3.48. MUMBAI (INDIA)
The iconic network of Indian railways stretches across the whole of the country and facilitates movement between cities.

▲▲▶

3.49, 3.50, and 3.51. BEIJING (PRC)
Larger cities need a varied range of public transit modes, including heavy rail, a metro, and lighter forms of transit and bus-based systems.

An Average Commuting Experience in Hong Kong, China

John is a 45-year-old engineer living in Tai Po.

He leaves home in Tai Po at 7:45 a.m. and walks 5 minutes to the MRT station.

He takes MRT for about 10 minutes.

He gets off, and walks out at the street level to a bus stop. This bus takes him to a stop just across the street from his office. It takes 5 minutes.

Using two modes of transport, he spends about 35 minutes, including wait time, on an average one-way trip.

He also has to get home. He spends a total of 1 hour and 10 minutes every day on the commute. This is a very time-saving way to go to work, and travel time can be spent reading.

3.52. HONG KONG, CHINA (PRC)

▲

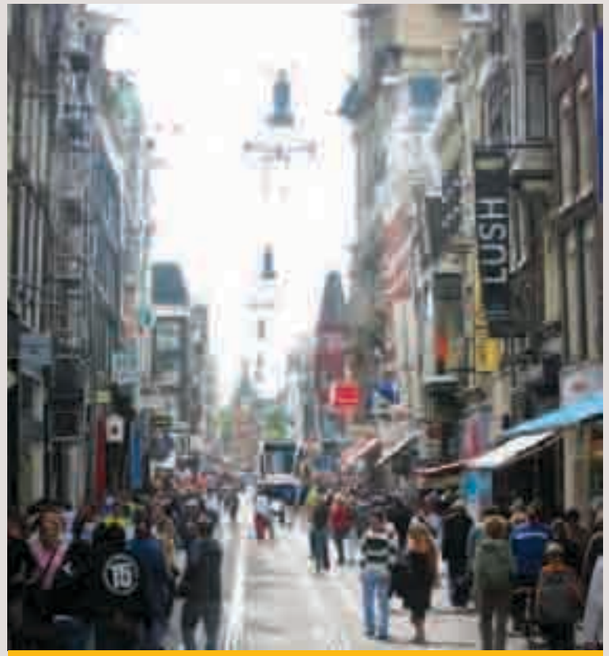
3.53. KUALA LUMPUR (MALAYSIA)

◀

3.54. BANGKOK (THAILAND)
The design of MRT systems needs very careful consideration, so as not to intrude on the urban fabric.

◀

3.55. VANCOUVER (CANADA)
In Vancouver, the Skytrain is used as a structuring element for urban form and layout. Development density clusters are found around the stations. It is an impressive example of urban structure that is shaped around the transit network.



3.56. AMSTERDAM (THE NETHERLANDS)
Urban vibrancy of this quality can be supported by long-term investments in a mix of transit systems.

3.57. LONDON (UK)
The earliest example of a rail network shaping its city, the District and Metropolitan Lines, laid in the 1880s, led to the development of high-quality suburbs with large public transit usage.

3.58. LONDON (UK)
Recent investments in high-speed trains in Europe are encouraging new rail-based travel patterns. Rail is now competing with short haul flights.

03. Options for Sustainable Mobility

Transportation Timeline in London

1863
The first line of the London Underground—the Metropolitan Line—was built. Within a few months, it was carrying over 26,000 passengers a day.

1877
The District Line opened to Richmond.

1900s
The first electric trams were introduced, replacing horse-drawn trams.

1913
Edward Johnston designed the London Transport's roundel—the famous circle and horizontal bar.

1920s and 1930s
Architect Charles Holden designed a number of iconic stations. The rapid growth of Outer London was facilitated by rail networks.

1920s
The northern Line to Edgware and Morden opened.

1933
The Piccadilly line to Cockfosters opened.

Harry Beck designed a new diagrammatic map of the Underground network—now considered a design classic.

1937
The Highway Development Survey reviewed London's road needs and recommended the construction of a program of new roads along the lines of American-style parkways—wide, landscaped roads with limited access and grade-separated junctions.

1939–1945
Many Underground stations were used as air-raid shelters.

1943 and 1944
Sir Patrick Abercrombie produced the County of London Plan and the Greater London Plan, including a series of urban 'ringways' or highways.

1948
London Transport was nationalized by the new Labour government.

720 million passengers rode the Underground network.

1949
Central Line extended to Epping.

1950s and 1960s
Car ownership boomed.

1969
The Victoria Line opened.

1970
The London Westway, an elevated dual carriageway, opened from Paddington to North Kensington.

1973
The London Ringway proposals were abandoned.

1986
M25, an outer orbital motorway around London, opened.

1987
A fire at King's Cross St. Pancras Underground station, the busiest station on the network, killed 31 people (which led to the abolition of wooden escalators).

1991
The first buildings were completed at Canary Wharf, providing a new financial district for London, supported by the Docklands Light Railway and a new Jubilee Line.

1994
Waterloo and City Line incorporated into the Underground network.

1999
The Jubilee line extension to Stratford was completed, including a refurbished station at Westminster.

2000s
London's first mayor was elected and Transport for London (TfL), a local government body responsible for most aspects of transport, was set up.

2003
The London congestion charging scheme was introduced.

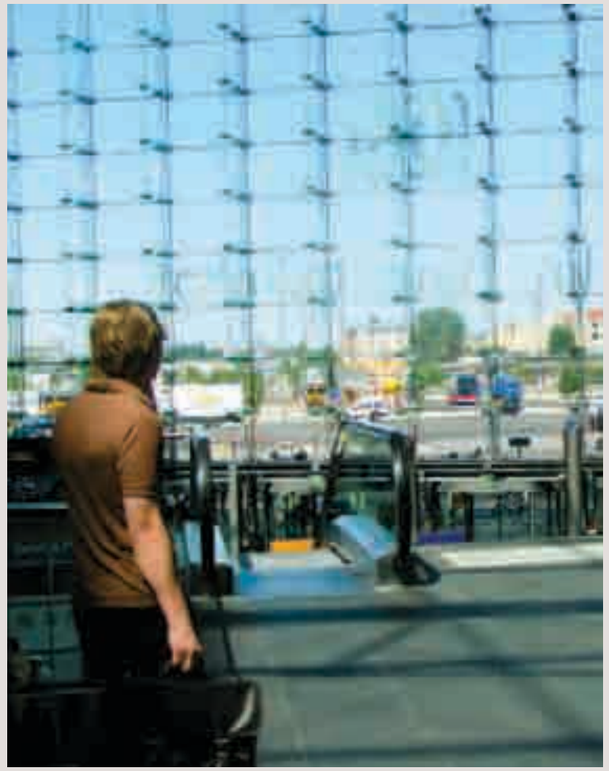
The Underground began operating as a public–private partnership (PPP), whereby the infrastructure and rolling stock were maintained by two private companies (Metronet and Tubelines), while London Underground Limited remained publicly owned and operated by TfL.

Oyster card introduced—electronic, integrated ticketing for Underground, bus, and rail. By 2010, over 34 million Oyster cards had been issued.

2007
Metronet went into administration, costing the Government of UK £2 billion. Two-thirds of the network reverted to TfL control.

2010
Over 7.5 million people lived within Greater London, which saw 10 million daily public transport journeys and 27 million total journeys in 2010.

3.59. LONDON (UK)
Even the branding and mapping of city transport can become iconic.



▲◀▲

3.60, 3.61, and 3.62. BERLIN (GERMANY)
Berlin's rail system benefits from very high quality investments in the mainline stations.

LIGHT RAPID TRANSIT

Light rail transit (LRT), sometimes known as light rapid transit, is a form of urban rail public transit that generally has lower capacity and speed than heavy rail and metro systems, but higher capacity and speed than conventional street-running tram or bus-based systems. Electric rail cars are usually used, operating in segregated lanes separate from other traffic. Sometimes in central urban areas, the vehicles mix with other traffic on street.

There are many examples in Europe (Barcelona, Croydon, Grenoble, Manchester, Milan, Montpellier, and Strasbourg); North America (Boston, Portland, and San Francisco); and Asia (Hong Kong, China; Manila; Shanghai; Singapore). The Manila light rail transit is one of the highest-capacity networks, serving up to 40,000 passengers per hour in each direction.

3.63. STRASBOURG (FRANCE)
The tram corridor is beautifully landscaped and becomes part of the special fabric of the city.

3.64. MANILA (PHILIPPINES)
Some travel by rail can be more informal. These children are on their way to school.

3.65 and 3.66. STRASBOURG (FRANCE)
The tram network is well supported by cycling and pedestrian facilities. Integration within and between transport modes is a critical element for success.

▲

3.67. BILBAO (SPAIN)

◀

3.68. GRENOBLE (FRANCE)
The city is urbane, vibrant, and an enjoyable place to be, with little congestion. The tram network allows many people to access and live in the central area.

3.69 and 3.70. BILBAO (SPAIN)
The tram corridor and wider public transport facilities are almost an extension of the art gallery.

BUS RAPID TRANSIT

In Latin America, busways have existed for more than 30 years. They have been very successful in moving large numbers of people, usually the urban poor. Bus rapid transit (BRT) is a variation of the conventional busway, physically segregated in the roadway with fares pre-paid, and fast boarding platforms.

There are nearly 200 systems worldwide. The best examples are in South America and Asia. These very exciting projects have become showcase examples for sustainable urban transport in recent years. The most well known include Bogotá's TransMilenio and Curitiba's Rede Integrada de Transporte; and there are other systems in Ahmedabad, Bangkok, Delhi, Jakarta, Nagoya, Pune; and many in the PRC, such as in Beijing, Chongqing, Guangzhou, Jinan, Xiamen, Xian, and Zhengzhou. There are similar systems in Africa, Asia, Australia, Europe, and North America.

Effective BRT is likely to satisfy the following criteria:
- availability of right-of-way
- compatibility with existing public transport systems
- effective implementation

In a few cities, BRT is the centerpiece of the sustainable transport strategy, and there is certainly much potential for their future development as relatively low-cost mass transit systems across Asia. Every city is different, however, and requires its own analysis of the most suitable transport options. Systems can rarely be templated from city to city.[21]

3.71. BANGKOK (THAILAND)

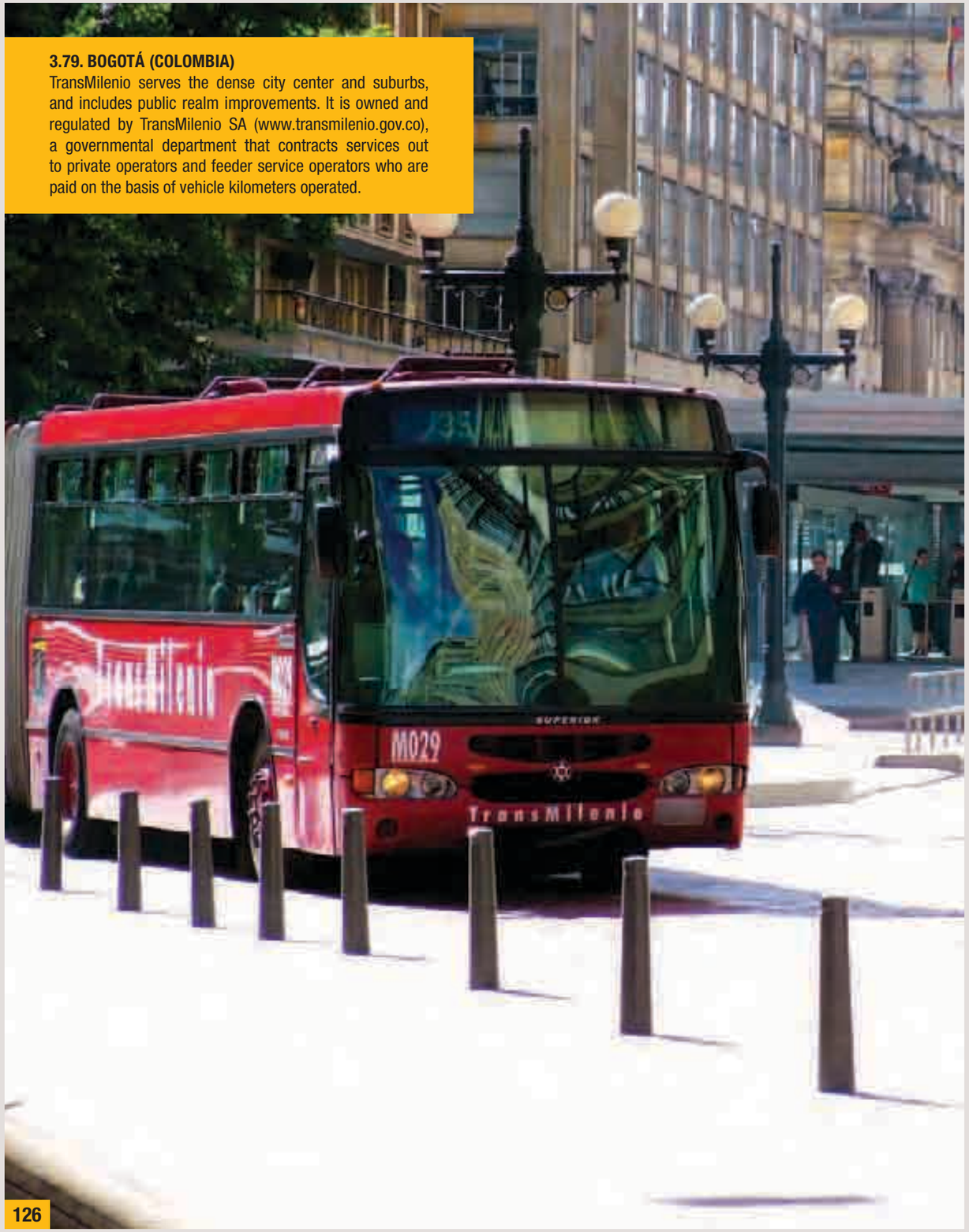
3.72. JAKARTA (INDONESIA)
TransJakarta BRT provides the quickest route around the rotary and other parts of the city.

3.73, 3.74, and 3.75. PUNE (INDIA)
Though ticketing is not electronic, BRT in Pune helped overcome previous levels of congestion. Paper tickets are fine for the local context.

3.76. KUNMING (PRC)
Workers prepare the BRT route.

3.77 and 3.78. JINAN (PRC)
The new BRT system, with modern vehicles and booking, has increased property prices, since living near a line is popular.

◀▼



3.79. BOGOTÁ (COLOMBIA)
TransMilenio serves the dense city center and suburbs, and includes public realm improvements. It is owned and regulated by TransMilenio SA (www.transmilenio.gov.co), a governmental department that contracts services out to private operators and feeder service operators who are paid on the basis of vehicle kilometers operated.

3.80. BOGOTÁ (COLOMBIA)
Operational from 1998, the well-known TransMilenio network has very high patronage levels, and 20% of users are also private car owners. TransMilenio's popularity has led to reduced traffic fatalities, air pollution, and travel times. After the current planned extension, the network will cover 388 km.

▲

3.82. BOGOTÁ (COLOMBIA)
The BRT is integrated with other non-motorized modes of transport, such as cycling.

3.81. BOGOTÁ (COLOMBIA)

▼

TransMilenio carries very high passenger volumes of up to 35,000 passengers per hour in each direction, and exceeds the capacity of light rail systems. This is due to a variety of system design features:

- high-capacity articulated vehicles (160 passengers) with multiple doors;
- high average bus occupancies (an average of 1,600 passengers per day);
- exclusive busways, unaffected by traffic congestion, with double lanes allowing express buses to overtake local buses;
- high-capacity station design, featuring level boarding and off-board fare payment using smart card technology;
- centralized control of bus operations, which coordinates local and express services, reduces bunching, and improves reliability; and
- high service frequency (280 buses per hour per direction on busy trunk sections, resulting in a combined headway of 13 seconds at busy stops).[22]

In Curitiba, Brazil, BRT was first introduced in 1974. Today, it serves a dense urban area. Raised interchanges allow fast docking, entrance, and egress. Routes are segregated, and design standards high: the shelters have become iconic for the city. The service approaches the speed, efficiency, and reliability of a subway system by

- integrated planning;
- exclusive bus lanes and feeder bus services;
- signal priority for buses (it is government policy to give priority to public transport);
- pre-boarding fare collection;
- free transfers between lines; and
- large capacity articulated and bi-articulated wide-door buses.

At present, the system carries over 500,000 passengers per day. Twenty-eight percent of riders previously used the car, in what was a car-dependent city. The network has been extended to five busways with coverage of approximately 65 km.[23]

3.84 and 3.85. CURITIBA (BRAZIL)

3.86. CURITIBA (BRAZIL)
The sign reads: “Vehicle monitored via satellite.”

▶ ▼

3.87 and 3.88. CURITIBA (BRAZIL)
The BRT service delivers high volumes of passengers to and from the high-density downtown, supporting a vibrant center and a number of cultural facilities.

3.83. CURITIBA (BRAZIL)
An extensive cycle network supports the BRT routes.

3.89. CURITIBA (BRAZIL)

▲◀▼

3.90, 3.91, and 3.92. MEXICO CITY (MEXICO)
Mexico City relies on the Metrobus BRT system to deliver people to workplaces and other activities.

▲

3.93. SHANGHAI (PRC)
The more conventional bus can also play an important role as part of a wider transport system.

◀

3.94. NANCY (FRANCE)
This variant in BRT technology is the 'tramway on tires,' a rubber-tired vehicle guided by a fixed rail in the ground.

ULTRALIGHT AND DEMAND-RESPONSIVE TRANSIT

There are also other variants of public transit, offering lower load capacities and greater flexibility in routing. Ultralight transit technologies are being tested and built, for example, in the UK and the Middle East.

Demand-responsive services also offer much potential for lower-density suburban and rural areas. Individuals can book a ride, via the Internet or phone, and the service is altered to pick up the passenger. Such dial-a-ride taxi–bus schemes are being developed in the UK, and services often exist for the elderly or other population groups.

3.95. MANILA (PHILIPPINES)
New electric tricycles in Manila's Fort Bonifacio shopping district offer energy-efficient, personal rapid transit for low volumes of people. There may be a wider role for these types of technologies alongside conventional public transit and other forms of demand-responsive transit, including para-transit such as minibuses and jeepneys.

NON-MOTORIZED TRANSPORT

WALKING

Walking is an extremely valuable means of travel, accounting for a large share of all journeys, and indeed is an integral part of all trips. The distance traveled is usually relatively short (below 1 km). The gains of walking for the individual can be important in terms of supporting an active and healthy lifestyle, and the cost to the community is minimal, unlike other modes. Despite this, the quality of the walking environment is often very poor. Improved networks and facilities can be designed to increase not only the proportion of journeys made on foot, but also the quality of the walking experience in the center and periphery of urban areas.

▲

3.96. BOGOTÁ (COLOMBIA)
Pedestrianized streets in central areas offer high quality walking environments, ideal for major retail hubs.

◀

3.97. DELHI (INDIA)
A new footway provides a segregated route away from traffic.

3.98. WUHAN (PRC)

▲◀▶

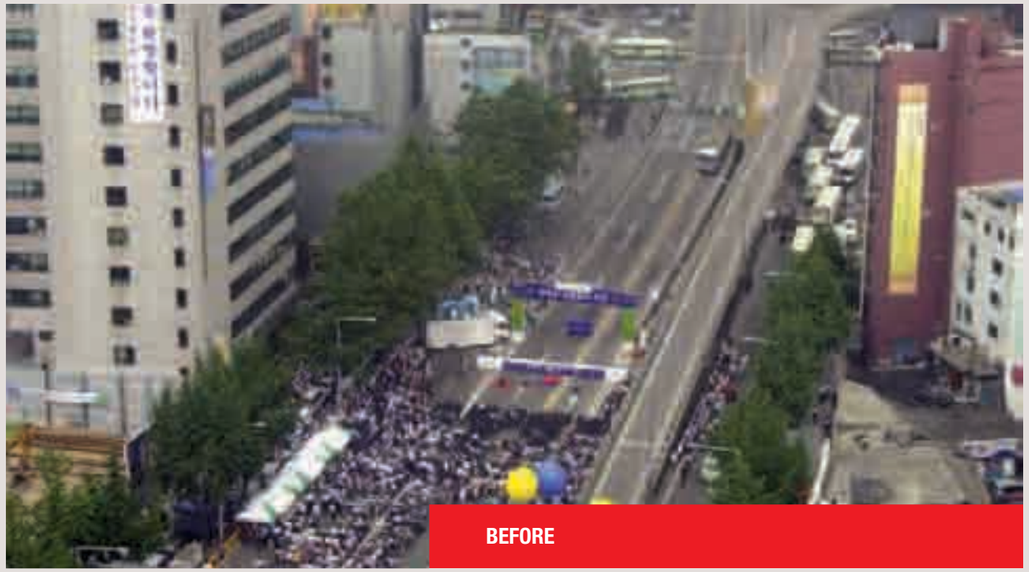
3.99, 3.100, and 3.101. MANILA (PHILIPPINES)
A few high quality pedestrian environments do exist in an otherwise car-dominated city.

A strategy to improve the quality and safety of walking could include

- new pedestrian links to create a network of convenient routes;
- better footways (paving, landscaping, lighting, street furniture);
- streets and public areas that create interest for pedestrians (building frontages, signs, and advertisements scaled for the pedestrian rather than the vehicle);
- priority for pedestrians on residential and local streets and central areas;
- better crossing facilities, including reduced speed and volume of traffic and increased crossing time for pedestrians; and
- developments that ensure facilities can be reached on foot easily.[24]

3.102. BOGOTÁ (COLOMBIA)
Investment in the public realm makes cities more livable.

3.103. MACAU, CHINA (PRC)
Life and vitality exist in the city center.



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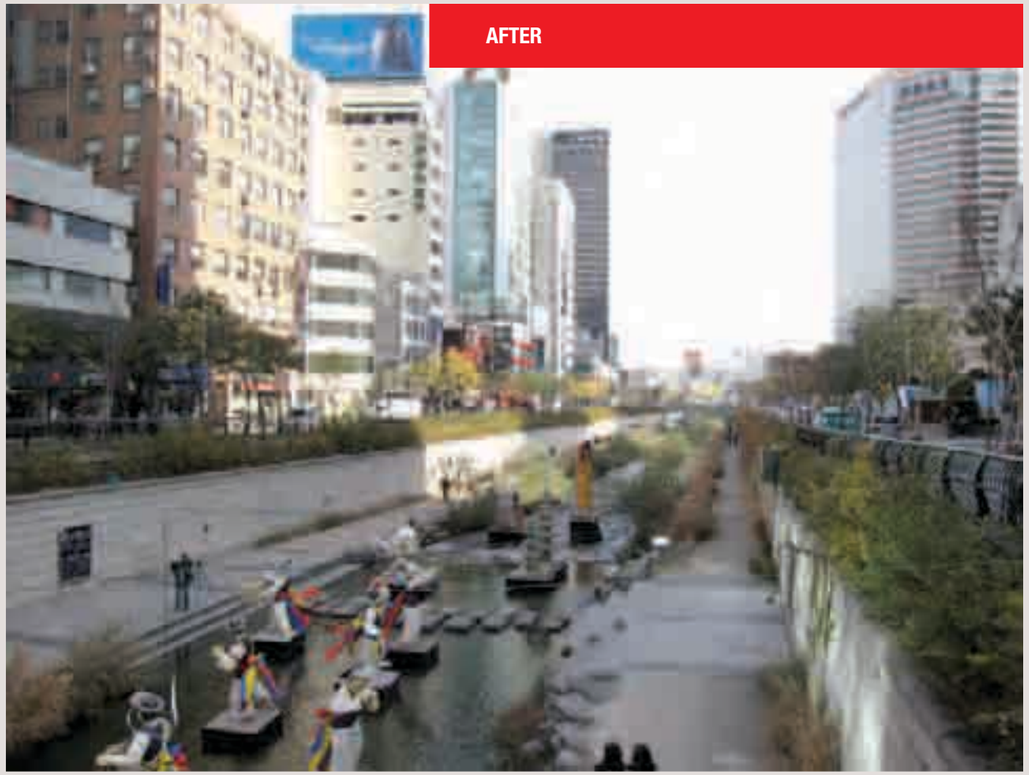


▲▲

3.104. and 3.105. SEOUL (REPUBLIC OF KOREA)
The dual carriageway through the city was taken down, the old river reinstated, and a pedestrian footway developed, in a classic example of sustainable, integrated transport.

▲

3.106. CHENNAI (INDIA)
Advertising for a marathon clearly conveys the value of active lifestyles, which bring health gains—particularly when the very inactive use walking and cycling as a means of travel and exercise.

"If a city is to be 'livable' it has to be 'walkable.' Reducing car travel will lead to a repopulation of footways and public spaces, making them safer and livelier places to be."

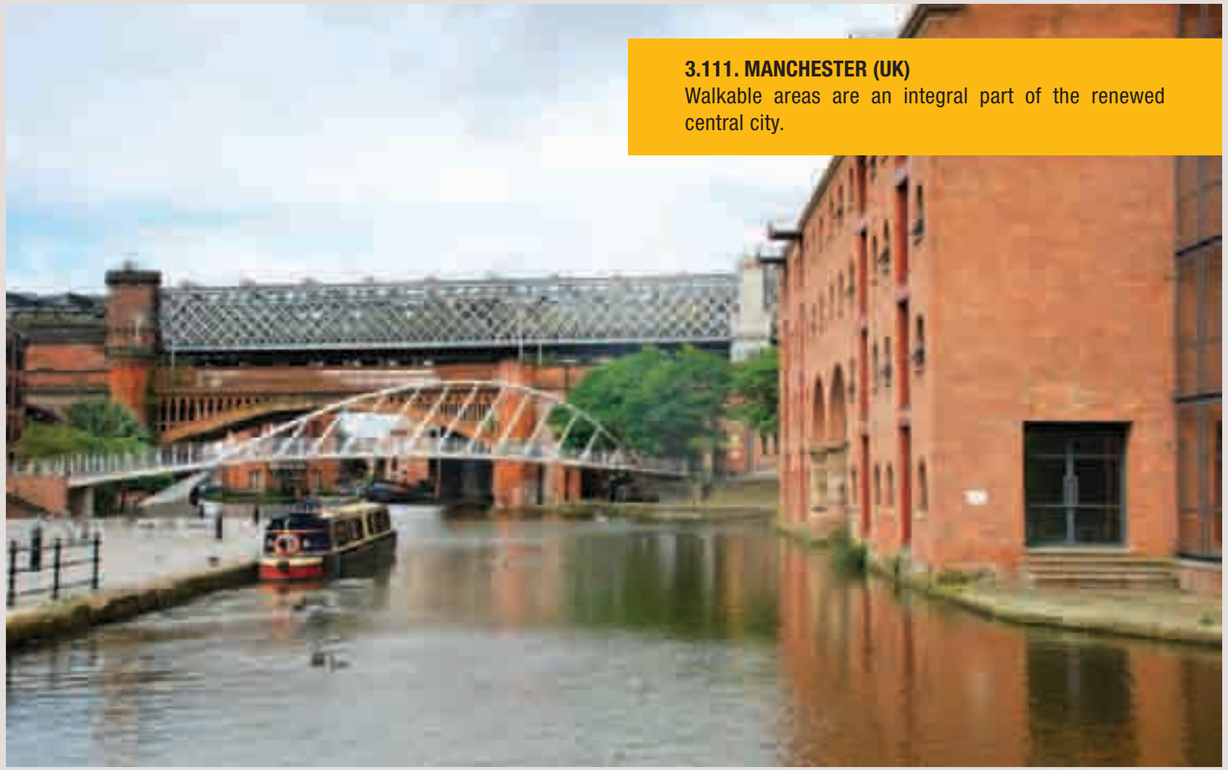
—T. Pharoah. 1992. *Less Traffic, Better Towns.* London: Friends of the Earth.

3.107. MACAU, CHINA (PRC)
Pedestrian crossing facilities with the width, and priority, to suit the volume.

3.108. COPENHAGEN (DENMARK)
Some of the pedestrian environments in Europe are of great quality.

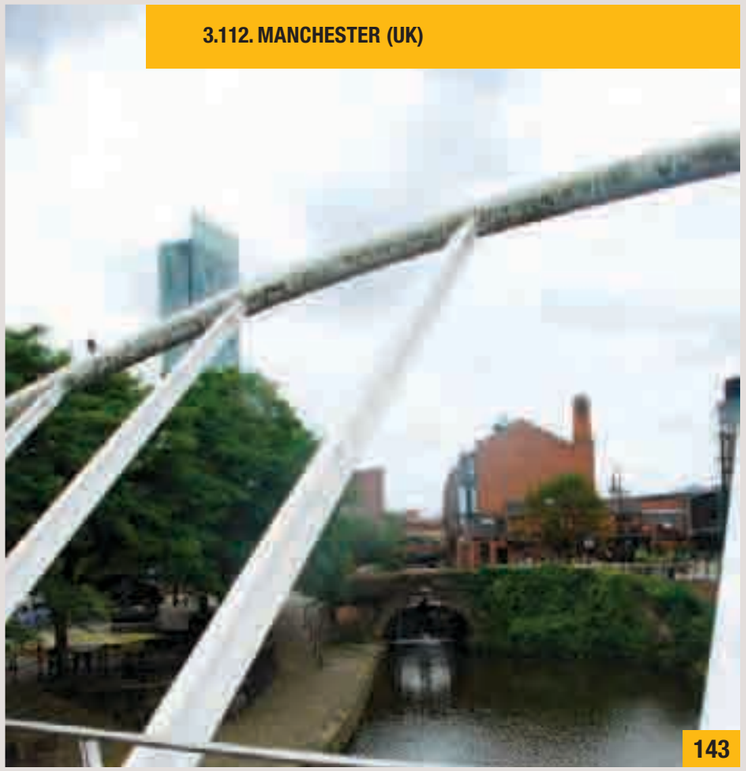
▲ ▶

3.109. PARIS (FRANCE) and 3.110. ANTIBES (FRANCE)
Residents in these cities enjoy fabulous boulevards and exemplary walkways.



3.111. MANCHESTER (UK)
Walkable areas are an integral part of the renewed central city.

3.112. MANCHESTER (UK)



The European Charter of Pedestrian Rights

Adopted by the European Parliament in 1988

I. The pedestrian has the right to live in a healthy environment and freely enjoy the amenities offered by public areas under conditions that adequately safeguard his/her physical and psychological well-being.

II. The pedestrian has the right to live in urban or village centers tailored to the needs of human beings and not to the needs of the motor car and to have amenities within walking or cycling distance.

III. Children, the elderly, and the disabled have the right to expect towns to be places of easy social contact and not places that aggravate their inherent weakness.

IV. The disabled have the right to specific measures to maximize their independent mobility, including adjustments in public areas, transport systems, and public transport (guidelines, warning signs, acoustic signals, accessible buses, trams and trains).

V. The pedestrian has the right to urban areas which are intended exclusively for his/her use, are as extensive as possible and are not mere pedestrian precincts but in harmony with the overall organization of the town, and also the exclusive right to connecting short, logical, and safe routes.[25]

▶

3.113. LONDON (UK)
The quality of pedestrian investment in some cities is remarkable, but needs to be much more widespread.

3.114. PRAGUE (CZECH REPUBLIC)
At times the public realm can be as beautiful as the architecture.

CYCLING

Cycling is also a very beneficial means of travel because it offers active lifestyle gains to the individual and minimal adverse impacts for the community. People are mainly deterred because cycling can be dangerous. Higher levels of use are achieved where safe and attractive facilities are provided.

A strategy to improve the quality and safety of cycling could include

- the provision of a fully segregated cycle network alongside facilities within the main road and footpath network;
- traffic calming so that speeds of vehicles are closer to those of cyclists; and
- parking and storage facilities that are secure and conveniently located.[26]

3.115. HA NOI (VIET NAM)
Though cycling is still popular in parts of Asia, facilities are usually poor. The aspiration is generally toward motorization, with cycling seen as an outdated means of travel.

3.116. BEIJING (PRC)

3.117. DELHI (INDIA)
Cycling in the city has a high modal share, but the networks and facilities are very poorly developed.

3.118. XIAN (PRC)
Only in limited places are special provisions made for cyclists.

3.119. TIANJIN (PRC)

3.120. ESFAHAN (IRAN)
Esfahan enjoys some excellent cycle provision, with segregated routes.

3.121. BEIJING (PRC)
Bicycle hire schemes are becoming very popular in Chinese cities.

3.122. BEIJING (PRC)

Two- and three-wheelers and rickshaws are available to almost all income levels and can be used to carry passengers and goods. They are found in many cities across Asia and are effectively zero carbon if manually operated. Again, though they suffer from lack of segregated lanes or at least dedicated space, they can be a very effective part of a sustainable transport system.

3.123. DELHI (INDIA)

3.125. HA NOI (VIET NAM)

3.124. LIMA (PERU)
Young people learn to ride with bicycle training.

3.126. BUDAPEST (HUNGARY)
Residents walk and cycle during a car-free day, which could surely become more frequent, if not permanent, in some locations.

“Twenty years ago in Bogotá there was not 1 meter of bikeway and ridership was insignificant. Today, more than 350,000 people ride to work daily.”

—Enrique Peñalosa, Colombian politician and former mayor of Bogotá

Bogotá’s original masterplan of the metro and elevated highways was rejected and replaced with bus rapid transit and 155 miles of dedicated cycleways, allowing safe cycling for as much as 5% of the population.

3.127. AMSTERDAM (THE NETHERLANDS)
Cycle parking at bus rapid transit stops increases ridership.

3.128–3.130. AMSTERDAM (THE NETHERLANDS)
The Dutch cycle, not because they are poor, but because it is healthy, fun, and the best way to travel. The quality of cycle provision here is among the best in the world, fueled by a strong cycling culture, where over 30% of people cycle for all trips.

"When I see an adult on a bicycle, I do not despair for the future of the human race."

—H.G. Wells, British author of science fiction, including *War of the Worlds* and *The Time Machine*

3.131. AMSTERDAM (THE NETHERLANDS)
This footbridge shows that well designed non-motorized transport routes can become iconic.

03. Options for Sustainable Mobility

Transportation Timeline in Amsterdam

1860s
Cycling became popular in the Netherlands with the first steel model of the *velocipede* (Latin for "fast foot"), used mainly by the wealthy. The earliest usable, wooden velocipede was created by the German Karl Drais in 1817 (known as the *laufmaschine* or "running machine").

1869
Mass market manufacturing of bicycles began, particularly through the Michaux company (in Paris).

1871
The first Dutch bicycle club was founded in Deventer.

1896
The slogan "Everybody on the bicycle" was coined to encourage middle- and lower-income people to use the bicycle.

1897
First municipal ferry services began.

1900
Amsterdam's municipal transport services were founded.

1908
Bus services began.

1916
Electrification of the Amsterdam tram network was completed.

1943
The municipal tram and ferry services were merged to form the municipal transport corporation Gemeentevervoerbedrijf (GVB).

1950
GVB delivered its 1,000th tram.

1955
Over 75% of journeys were taken by bicycle.

1960
Cycling's mode share declined with increased prosperity and the growth in car ownership.

1960s
The rapid increase in car traffic caused serious congestion in the city center, where narrow streets are very unsuitable for cars. Suburbanization of the city continued with development on the edge of the urban area.

1965
The municipal government made plans to replace the tram network with a mainly underground Metro network covering the whole built-up area of the city and its suburbs.

1969
GVB launched a night bus network with eight routes.

1970s
The use of the bicycle continued to decline, reaching a low point of 25% of all journeys being made on two wheels.

Local actors and neighborhood groups, including the counterculture movement 'Provo' and the Cyclists' Federation, lobbied for greater use of the bicycle.

Early 1970s
People became aware of the failures of transport policy and the need to reduce the growth in motorization.

1975
Traffic circulation plans were developed for cities in the Netherlands, paying equal attention to all transport modes and supporting the use of walking, cycling, and public transit.

Planners in the Netherlands pioneer the development of alternative approaches to streetscape design, e.g., *woonerfs* and home zones. These became very influential in Europe and are widely adopted in other countries. Transport planning and urban design became much more closely aligned.

1977
The first two Metro lines opened—Line 53 (Gaasperplas) and Line 54 (Holendrecht), with extensions to the Centraal Station in 1980. There was much local opposition due to the demolition of local residential areas.

1978
A new city council took office. It formally aimed to conserve the cultural and historic value of the city center and to encourage the use of the bicycle and public transport.

1980s
Strategies and policies were developed to integrate transport modes and redesign urban space.

1980
The *strippenkaart* national fares system of zones, strip tickets, and season tickets was introduced.

1991
Tram conductors began to be reintroduced.

1990
Line 51 opened to Amstelveen. (An extension to Westwijk was added in 2004.)

1994
Stadsmobiel, the transport service for the elderly and the disabled, was launched.

1997
Line 50 opened to Gein.

2001
The first of 155 new Combino-trams arrived.

2003
A trial of three Citaro fuel cell buses started.

2004
The shared space approaches to streetscape design were pioneered in Friesland by Hans Monderman. The conventional segregation of traffic is replaced in the centers of towns, with pedestrians, cyclists, and vehicles sharing space, and with vehicles traveling at lower speeds. Again the approaches became influential in other countries.

2005
Line 26 opened to IJburg, a newly built residential neighborhood on an artificial island in the IJmeer.

2006
The OV (*openbaar vervoer* or public transport)-chipcard was introduced on the Metro.

2010
A dense network of cycle routes had become available. There were over 400 km (250 miles) of dedicated cycle lanes in Amsterdam.

3.132. COPENHAGEN (DENMARK)
Cycling in the European city is a popular and fashionable means of travel.

03. Options for Sustainable Mobility

3.134. KRAKOW (POLAND)

3.135. PARIS (FRANCE)

3.133. BARCELONA (SPAIN)

▲

3.137. ZÜRICH (SWITZERLAND)
On a car-free day, this cyclist makes a statement about the space-saving value of cycles: “I am a car too.”

3.139. LISBON (PORTUGAL)
New developments offer the potential to design in non-motorized modes from the start.

▲

3.136. BUDAPEST (HUNGARY)
The idea for Critical Mass—a monthly bicycle ride to celebrate cycling and assert cyclists’ right to the road—started in San Francisco in September 1992 and spread to cities all over the world.

▶

3.138. OXFORD (UK)
Some cities generate a culture around cycling and become partly known by this popular means of travel.

▲

3.140. LISBON (PORTUGAL)
The Lisbon Expo site has state-of-the-art pedestrian, cycle, and Segway facilities, alongside the Metro station and retail and leisure environment.

▲

3.141. BILBAO (SPAIN)
The former dockyards have been redeveloped to provide a linear urban park alongside the river, allowing cyclists to ride to the major centers and attractions in the city.

3.142. SEVILLE (SPAIN)
Cycle hire schemes have become very popular in Europe. In addition to Seville, there are well-known schemes in Lyon, Paris, and a number of other cities.

3.143. NANTES (FRANCE)
Bicloo is the cycle-sharing scheme in Nantes. Across programs, the designs and specifications differ, but the premise remains the same—free cycle use, or very low charges, with cycle stands found around the central area.

bike + business

The Bike + Business initiative in Frankfurt seeks to encourage cycling by employees. The project has run since 2002, managed by the *Allgemeiner Deutscher Fahrrad-Club* (General German Bicycle Club) *Hesse and Planungsverband Ballungsraum Frankfurt Rhine/Main* (Frankfurt/Rhine-Main Conurbation Planning Association). The initiative includes

- initial consultation with employers and employees, establishing current travel behaviors and possibilities for mode shifts;
- assessment of site-specific cycle facilities, usage, and possible routes to work;
- development of an action plan, including improved routes, bicycle parking, changing facilities, and showers; and
- communication and development of a cycling culture, including advice, bike-to-work days, and wellness days.

3.144. FRANKFURT (GERMANY)
Secure bicycle parking sits adjacent to offices, making the cycle commute to work as smooth as possible.

3.145. FRANKFURT (GERMANY)
Business travel planning encourages use of the bicycle in the commute.

▲

3.146. POWYS (UK)
Sustrans, a sustainable transport charity in the UK, is developing a national network of off-road cycle routes in the UK. (www.sustrans.org.uk)

◀

3.147. GLASGOW (UK)
Already over 12,000 miles in length, Sustrans' routes are mainly used for leisure purposes. The paths also attract people back onto their cycles for other journeys, such as the commute.

3.148, 3.149, and 3.150. BRISTOL (UK)

3.151. BELFAST (UK)

3.152. CARDIFF (UK)

STREETSCAPE DESIGN

Emerging streetscape design practice in Europe offers much potential for practice in Asia. Street design has been developing as a discipline in Europe since the 1970s, first in the Netherlands with the concept of the *woonerf*, a street where pedestrians and cyclists have legal priority over motorists, and also in Germany with *Verkehrsberuhigung*, more widely known as traffic calming.[27] Traffic is made to travel at slower speeds by design interventions, such as road humps, pinch points, landscaping, and other physical features. The safety and livability results are marked. It is, or should be, an approach to the design of urban streets and places that makes them enjoyable for use by non-motorized travelers. Ideally, traffic volumes are reduced by physical design to give greater priority to walking and cycling.

More recently, concepts of shared space have developed in the Netherlands, where equal priority is given to pedestrians, cyclists, and the motor car. Projects have spread beyond residential areas to central and radial urban and rural streets, and throughout Europe. Although the Asian street is very different in context, there are lessons that can be learned in terms of providing priority for the pedestrian and cyclist, slowing traffic speeds through design initiative, and developing a streetscape that contributes to wider built environment design aspirations.

3.153. DELHI (INDIA)
Connaught Place provides some good streetscape design practice, and is an iconic center for Delhi.

3.154. AMSTERDAM (THE NETHERLANDS)
In the 1970s, the Dutch developed the *woonerf*—a residential street where the car was downgraded in importance. Pedestrians and cyclists could thrive and people could play and dwell. It was very influential in transport planning in Europe.

3.155. FRANKFURT (GERMANY)
Cyclists are intentionally given the most direct routes across the city, and are allowed to travel against the one-way traffic routes. This raises the attractiveness of cycling and reduces car speed.

3.156. NORRSKOPPING (SWEDEN)
In this shared space, equal priority is given to motorists and non-motorists.

3.157. HENNEF (GERMANY)
Here, less space has been provided for cars, and crossing areas have been provided for pedestrians.

3.158. POUNDBURY (UK)

▲

3.159. LONDON (UK)
High Street Kensington provides excellent pedestrian and cycle priority within a still busy thoroughfare. Cycle parking is provided in the center of the road to encourage people to cross the road informally and slow down the traffic.

◀

3.160. ASHFORD (UK)
The ring road, which restricted the growth of the town, has been downgraded from a dual carriageway to a single carriageway. It offers some shared space, giving much greater space and priority to pedestrians—a classic example of downgrading the racetrack around the town center.

ROAD PLANNING

A city's roads are an important part of its multi-modal infrastructure network. New roads can open up new areas for development, within and beyond the urban area. They can provide additional links and remove bottlenecks in the network. In many Asian cities, there will need to be continued investment in the road network. However, this should only be one part of the package of measures that ensures people can move around to access activities. The road network should be well maintained—road decay can lead to maintenance and safety problems.

Too often, road management results in capacity improvements to the detriment of other road users and the surrounding urban fabric. Traffic will expand to fill the road space available, certainly where there is much demand for travel by car. This phenomenon is known as induced traffic. The reverse is also true: if traffic capacity is not expanded, or capacity is removed, then the expected growth in traffic will not occur and potentially traffic volumes will reduce. Any new road space should be carefully justified.

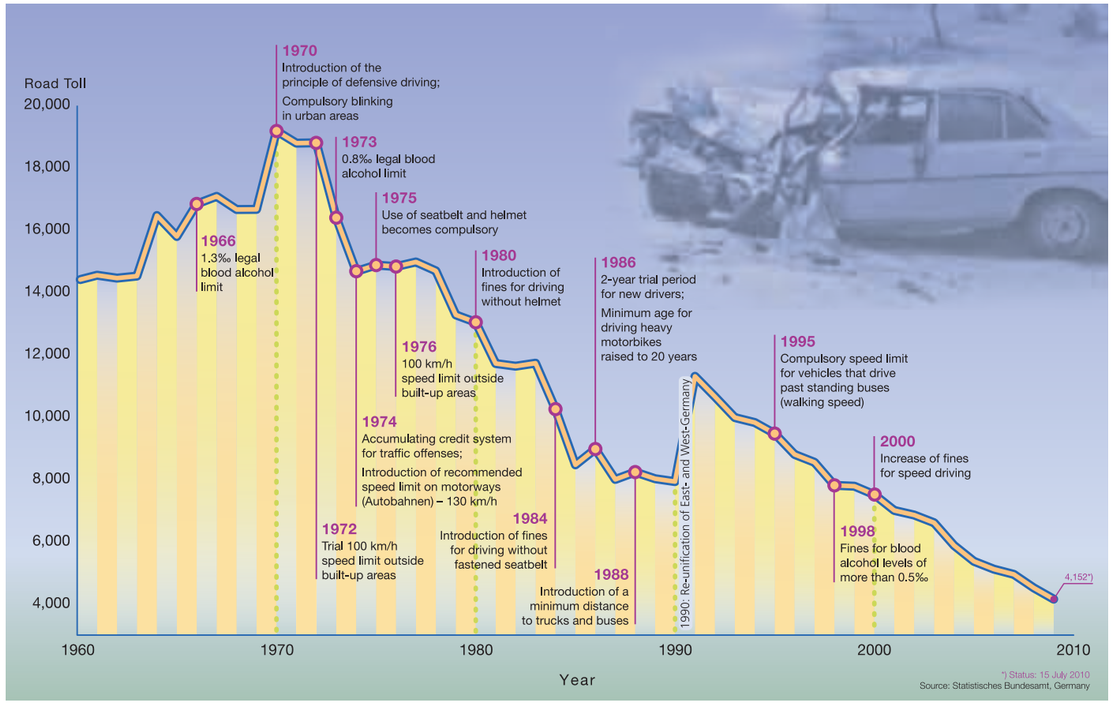
Traffic-free areas can be provided in central retail areas as a part of a pedestrianized area. In many European cities, such as Bologna, Cambridge, Delft, Groningen, and Lubeck, traffic has also been restricted over a wider central area to allow more attractive space for pedestrians and cyclists.

3.161. BANGKOK (THAILAND)
Road investment needs to be very carefully justified, with less focus on capacity enhancement and increased volume and a greater emphasis on improving access to activities.

ROAD SAFETY SOLUTIONS

The gradual decline in fatal accidents in Germany, outlined below, can be attributed to a number of road safety interventions. Reducing speeds, compulsory seatbelts (car) and helmets (motorbike), and lower blood alcohol limits have all had very positive impacts. Similar timelines can be seen in many European countries.

Road Safety Interventions in Germany 1960–2009



km/h = kilometers per hour
Note: In this context, road toll refers to the number of people killed in road accidents per year.
Source: *Statistisches Bundesamt* (Federal Statistical Office) Germany. 2010.; Data used in presentation by A. Rau, TU München, and D. Bongardt. GIZ. 2010. Eschborn, Germany.

Remarks by Michelle Yeoh, Asian Development Bank Transport Forum Manila, 2010

"As you probably know, I am an actress. Some of you may know me from my role in the James Bond series. Others may recognize me from the movie 'Crouching Tiger, Hidden Dragon.' Of all the roles I've played, nothing has been as important as the work I've done on behalf of the Make Roads Safe campaign to improve road safety. It is all too clear that transport policies are failing people. This failure is demonstrated in so many ways:

- in the Delhi trauma unit, where 70% of the beds are filled with road traffic victims;
- in the desperation etched on the faces of parents watching over their injured children in a Ha Noi hospital;
- in the smart new multi-lane highway which has far too few crossing points for the community it cuts in half;
- in the endless grief of a mother whose child's young life, so full of hope and promise, has been extinguished just because she wasn't wearing a helmet.

So we must change direction; for too long road safety has been an afterthought: just 1% or 2% of a project budget. We all know that the Asia Pacific region has huge road injury problems. But we also have the potential within Asia to solve this crisis. The global car manufacturing giants of the future will be Asian, and they must be encouraged to produce safe and green cars for the future. We have innovative Asian road safety solutions like the Global Helmet Vaccine Initiative, which builds on successful helmet campaigns in Viet Nam. We have the International Road Assessment Programme, which is working in many countries in this region—in Australia, Bangladesh, India, Malaysia, Viet Nam, and here in the Philippines. We do face a challenge, but I am optimistic about the future. I know that you will be heroes for road safety, and that together we can make the Decade of Action a reality."

▲

3.162. MANILA (PHILIPPINES)
Actress Michelle Yeoh is an international advocate for road safety.

3.163. LONDON (UK)

"No longer having to pay my increasing insurance premium and the running costs of my old car means that now I make substantial savings by being a member of a Car Club. It's easy! I am pleased that it helps to eliminate the number of vehicles on the road and for me it's very convenient. Car Clubs mean that I can have the use of a car without the worry, cost, and upkeep of my own vehicle."

—London Car Club member

Alternatives to conventional car ownership are becoming popular in urban areas, such as London. For example, members of the London Car Club book a car either via the Internet or by telephone, and use a smart card to get in. The cars are parked in a local parking bay, and returned when finished. Typically an annual fee is charged, ranging from £100 to £200, and a vehicle usage charge of about £4–£5 for the first hour and £2–£3 for subsequent hours. Mileage charges are low for a typical urban journey, about 15–20 pence a mile.

The benefits are great. Each car club vehicle can replace 20 private vehicles and the low-carbon vehicles used typically emit about 30% less CO_2 than the average UK car.[28]

LOW EMISSION VEHICLES AND ALTERNATIVE FUELS

Low-emission vehicles are those that achieve reduced fuel consumption through innovative engine design, including technologies such as hybrid petrol vehicles, diesel, and electric engines. All vehicles, including two- and three-wheelers and larger passenger and freight vehicles, can include more efficient engine technologies and use alternative fuels.

In terms of passenger vehicles, the current best generations worldwide of hybrid petrol vehicles have an emissions level of about 100 grams of carbon dioxide per kilometer (gCO_2/km). (The Toyota Prius, which is a hybrid gasoline vehicle, emits 89 gCO_2/km.) The small diesel vehicles are similar (the Volkswagen Polo Blue Motion emits 89 gCO_2/km). The intention with technological improvements is to push hard to reduce these levels even further. Perhaps most important is moving the very promising technologies into the mass market. In Asia, the key initial stage is to develop the range of technologies and fuels available for mass consumption. In India, for example, there are plans for hybrids to be made available, including the Honda hybrid Civic Sedan, and the Mahindra Industries hybrid SUV. TVS Motor Company and Bajaj Auto are developing a hybrid three-wheeler.

The size and mix of vehicles using the road network are very important in terms of energy usage, emissions, and road space. The smaller and lighter vehicles are much more efficient. This includes the small motorcar and two- and three-wheelers. The car market in India consists largely of small vehicles, but this is less so in the PRC, Malaysia, and elsewhere, where larger and heavier vehicles are preferred.

3.164. MENGCHENG COUNTY (PRC)
All vehicles—two-, three-, and four- or more wheelers—can be powered with alternative fuels, saving oil for other purposes.

Alternative fuels can also be used alongside emerging engine technologies. There are many possibilities, some of which are listed below.

- **Compressed natural gas (CNG):** A gaseous mixture of hydrocarbons with 80%–90% methane. CNG is colorless, odorless, non-toxic, highly flammable, and compressed to improve storage capability. Most CNG vehicles are retrofits, converted from gasoline and diesel vehicles. CNG contains less carbon than any other fossil fuel. The main drawback is the lack of refueling facilities.

- **Liquid petroleum gas (LPG):** A mixture of gases, liquefied by compression or refrigeration. The major drawback is limited supply—ruling out any mass conversion to LPG fuel.

- **Methanol:** An alcohol. Most of the world's methanol is produced by a process that uses natural gas as a feedstock. It is possible to produce methanol from feedstocks, such as coal or biomass, or urban waste and refuse.

- **Ethanol:** Alcohol-based, but considerably cleaner, less toxic, and less corrosive than methanol. Ethanol also has a high volumetric energy content. It can be produced by the fermentation of sugar cane or corn. Ethanol is more expensive to produce than methanol, and requires large harvests of crops and large amounts of energy for production. One-third of the 12 million cars in Brazil are ethanol powered.

- **Biodiesel:** Produced by reacting vegetable or animal fats with methanol or ethanol to produce a lower viscosity fuel that is similar in physical characteristics to diesel.

- **Hydrogen:** Potentially the cleanest fuel option. However, hydrogen suffers from two major problems: production and storage. The fuel is highly flammable and requires large storage capsules. Hydrogen is not a fossil fuel and is not found in significant quantities in nature. It therefore needs to be manufactured: the most common methods are electrolysis of water, reforming natural gas, or partial oxidation and steam reforming other fossil fuels. Significant investments are needed in infrastructure for delivery, storage, and dispensing of hydrogen if it is to be used as a vehicle fuel.

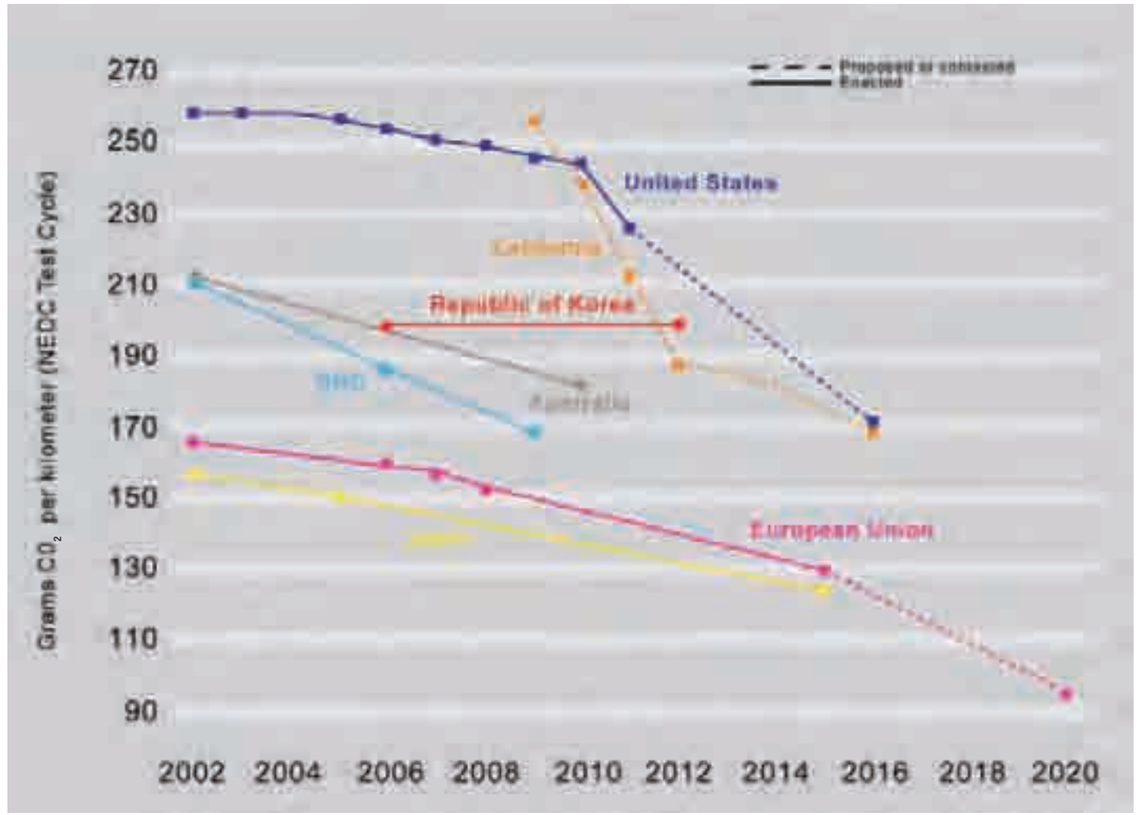
- **Electricity:** There is much potential for electricity-fueled vehicles as a niche part of the market. CO_2 emissions depend on the nature of the energy source used to produce the electricity.[29]

3.165. DELHI (INDIA)
This three-wheeled delivery van runs on compressed natural gas (CNG).

3.166. DELHI (INDIA)
CNG is also the fuel for this larger goods vehicle.

Vehicle emission standards for new vehicles have been adopted by a number of countries globally, and there is marked variation. The intention is to gradually make the new vehicle fleet more efficient in terms of CO_2 emissions. Motor manufacturers can operate within defined market boundaries, and wider societal goals can be achieved. For example, the PRC moved from a 2002 average of 210 gCO_2/km to below 170 gCO_2/km by 2009; the European Union from 168 gCO_2/km to 130 g/CO_2 km in 2015 and 95 gCO_2/km by 2020 (via the EU Voluntary Car Agreement, through which the European Automobile Manufacturers Association and the European Commission agreed to limit the amount of CO_2 emitted by European cars). Japan is slightly more progressive, targeting below 130 gCO_2/km by 2015. US standards are much less stringent, targeting just 170 gCO_2/km by 2020. There are no current agreements in India or Southeast Asia.

Actual and Projected Global New Passenger Vehicle Emission Standards (2002–2020)



PRC = People's Republic of China, CO_2 = carbon dioxide, NEDC = New European Driving Cycle
Source: Clean Air Initiative for Asian Cities (CAI-Asia) and International Council on Clean Transportation (ICCT). 2009. *Review of Fuel Efficiency Standards*. Manila: CAI-Asia.

3.167. DELHI (INDIA)
These three-wheelers are fueled by CNG.

3.168. DELHI (INDIA)
Small vehicles assist in keeping average fleet emissions low, and are often powered by alternative fuels.

3.169. JAKARTA (INDONESIA)
This bus is powered by liquefied natural gas.

3.170. DELHI (INDIA)
The conversion of vehicles to CNG has been successful, though there are some problems with refueling opportunities.

Low-emission vehicles available in the Asian market are few in number. The quality and range needs to be hugely improved, with subsidies and incentives for early take up and adoption. Asia, particularly the PRC and India, is likely to be the global leader in vehicle manufacture in this field, and will be able to sell its innovations to the West.

Because use of the car is so prevalent in society, the development of low-emission vehicles in the mass car (and public transit) market is critical to reducing CO_2 emissions and achieving sustainable mobility aspirations.

There is a greater range of low-emission vehicles in Europe, Japan, and North America, but their share of the market remains frustratingly small.

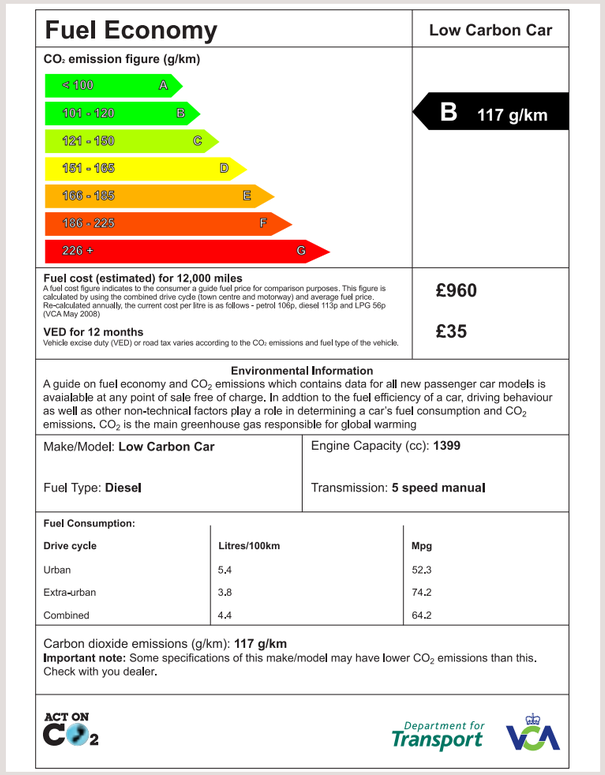
3.171. HANGZHOU (PRC)

3.172. TOYOTA PRIUS

3.173. DETROIT (US)

3.174. GREEN LOTUS SPORTS

3.175. FORD HYDROGEN FUEL CELL



Fuel Economy

	Low Carbon Car
CO_2 emission figure (g/km)	
< 100 A 101 - 120 B 121 - 150 C 151 - 165 D 166 - 185 E 186 - 225 F 226 + G	**B** 117 g/km
Fuel cost (estimated) for 12,000 miles A fuel cost figure indicates to the consumer a guide fuel price for comparison purposes. This figure is calculated by using the combined drive cycle (town centre and motorway) and average fuel price. Re-calculated annually, the current cost per litre is as follows - petrol 106p, diesel 113p and LPG 56p (VCA May 2008)	**£960**
VED for 12 months Vehicle excise duty (VED) or road tax varies according to the CO_2 emissions and fuel type of the vehicle.	**£35**

Environmental Information

A guide on fuel economy and CO_2 emissions which contains data for all new passenger car models is avaialable at any point of sale free of charge. In addtion to the fuel efficiency of a car, driving behaviour as well as other non-technical factors play a role in determining a car's fuel consumption and CO_2 emissions. CO_2 is the main greenhouse gas responsible for global warming

Make/Model: **Low Carbon Car**	Engine Capacity (cc): **1399**
Fuel Type: **Diesel**	Transmission: **5 speed manual**

Fuel Consumption:

Drive cycle	Litres/100km	Mpg
Urban	5.4	52.3
Extra-urban	3.8	74.2
Combined	4.4	64.2

Carbon dioxide emissions (g/km): **117 g/km**
Important note: Some specifications of this make/model may have lower CO_2 emissions than this. Check with you dealer.

ACT ON CO_2 — Department for Transport — VCA

3.176. CAR LABELING

Car labeling is starting to include fuel economy to help purchasers become more environmentally aware.

3.177, 3.178, and 3.179. COPENHAGEN (DENMARK)
A demonstration of models at the United Nations Climate Change Conference 2009 (COP15) highlighted innovations in engine technologies that will progress rapidly over the next 10 and 20 years. The major challenge is taking them to the mass market.

FREIGHT PLANNING

As well as passenger travel, freight transport is important to a city's transport system. The freight sector is often associated with high traffic volumes, safety issues, and CO_2 and other emissions. Load factors are particularly important to resulting emissions—with higher loads reducing vehicle efficiency, but improving the freight intensity of emissions. In Asia, many freight movements are informal. Data on freight movements is often nonexistent. The new module on urban freight from the GIZ Sourcebook (www.sutp.org) gives more details on potential initiatives.

3.180. DELHI (INDIA)
Freight deliveries in Asian cities are often of an informal nature.

3.181. M1 HIGHWAY (UK)
Freight traffic volumes can be significant along major highway corridors, and much greater effort is required in reducing their environmental impacts.

3.182. PHILADELPHIA (US)
Alternatively fueled freight vehicles can help reduce emissions significantly.

Freight vehicle routing strategies can usually assist in reducing the impact of vehicles through sensitive areas, though there are issues with compliance and enforcement.

There is a range of measures to help reduce emissions in the freight sector, including improving handling factors (number of links in the supply chain), reducing length of haul, improving mode share, empty running, fuel efficiency, and choice of fuel and/or power source.[30]

3.183. HO CHI MINH CITY (VIET NAM)
Freight in Asia needs to be carried by low-emission vehicles.

3.184. LILLE (FRANCE)
Electric delivery vans are being trialed in some cities.

04. Delivering Sustainable Mobility

A number of cities in Asia are demonstrating how sustainable mobility can be delivered. Many are already of high densities, and levels of motorization are relatively low. Growing levels of wealth can be used to move toward sustainable mobility behaviors and to avoid the outdated models of car dependency. However, the current trajectory for many cities is toward increased motorization, with the affluent middle classes aspiring and buying into car use. Space for more efficient modes is being removed to make room for the car. This needs to change.

Investment priorities can move from developing expressways and other provision for the car into providing for the sustainable modes—public transit, two- and three-wheelers (with clean fuels), walking, and cycling. Where private motorization is used, this should be of the clean variety, involving low-emission vehicles and alternative fuels.

Investing in sustainable modes is by far the most efficient when viewed in terms of space and the amount of city gross domestic product spent in moving people.[31] And, of course, quality in public transport provision and the public realm supports attractive and competitive cities.

4.1. DELHI (INDIA)
Megacities host the greatest transport difficulties, but problems of congestion are prevalent in most urban areas. Scaling up the delivery of sustainable transport options will take years.

4.2. HO CHI MINH CITY (VIET NAM)
Much can be gained from cleaning the fuel used in two- and three-wheelers.

4.3. BANGKOK (THAILAND)

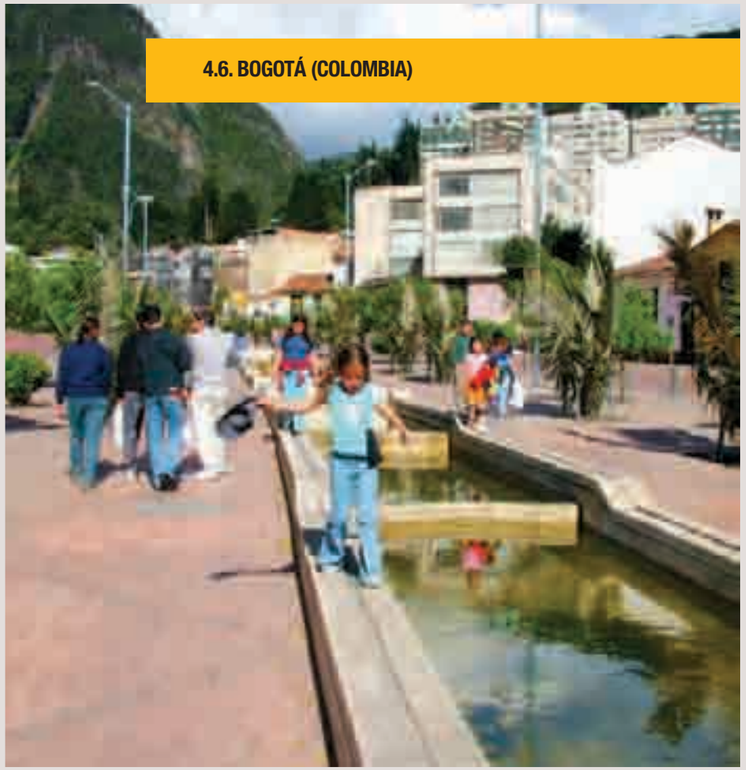
Which direction? Policy makers and the public involved in designing Asia's future cities have a critically important role to play. The challenges of climate change, economic competitiveness, health, and social equity mean that sustainable modes and active lifestyles need to be pursued with much renewed vigor. Organizations, such as ADB and GIZ, can help facilitate the move toward sustainable mobility.

The emerging signs are that carbon-intensive motorization can be avoided in Asia, with the transition to sustainable mobility involving urban planning and traffic demand management, high levels of walking and cycling, (carbon-efficient) two- and three-wheelers, mass transit, low-emission vehicles and alternative fuels, and a very selective role for the conventional petrol car.

4.4. KATHMANDU (NEPAL)

"It is frequent that images of high rises and highways are used to portray a city's advance. In fact, in urban terms, a city is more civilized not when it has highways, but when a child on a tricycle is able to move about everywhere with ease and safety."

—Enrique Peñalosa, Colombian politician and former mayor of Bogotá



4.6. BOGOTÁ (COLOMBIA)

4.5. MANILA (PHILIPPINES)

Achieving sustainable mobility is also aimed at improving city livability. This objective becomes paramount, and transport investment should be refocused on supporting quality in urban living. A real test for the success of interventions can be seen in how attractive a city is for children.

4.7. SURABAYA (INDONESIA)

The child's view of the city can be very revealing.

Low-carbon transport options can be portrayed as fun, cool, optimal ways to travel. The environmental and heath gains are positive side effects. The economic performance of attractive cities is also critical in an increasingly competitive world, and sustainable mobility cities tend to perform very well.

4.8. AMSTERDAM (THE NETHERLANDS)

4.9. AMSTERDAM (THE NETHERLANDS)
Particular types of journeys, e.g., the school run, are much better carried out by cycling and walking, instilling active lifestyles in the next generation. These require networks, facilities, and appropriate locations of activities.

4.10. LONDON (UK)
It is important to develop an appreciation of sustainable mobility at the earliest opportunity.

▲▲

4.11 and 4.12. ZURICH (SWITZERLAND)
Car-free days allow much activity and fun in the city center, and illustrate what can be done in car-free environments.

▶

4.13. MANILA (PHILIPPINES)

04. Delivering Sustainable Mobility

"What is happening in Asia is by far the most important development in the world today [...] not only for Asians, but also for the entire planet."

—John Naisbitt. 1996. *Megatrends Asia. The Eight Asian Megatrends that are Changing the World.* London: Nicholas Brealey

4.14. BEIJING (PRC)

The next 10 years are critical to the development of sustainable cities and sustainable transport in Asia. Some cities already have the basis for sustainable mobility.

Strong governance, an environmentally aware public, and effective use of scarce funding are crucial to success in policy implementation. The great challenge is to scale up the emerging good practices across cities.

ASIAN DEVELOPMENT BANK – SUSTAINABLE TRANSPORT INITIATIVE

The Asian Development Bank (ADB), through *Strategy 2020: The Long Term Strategic Framework of the Asian Development Bank, 2008–2020*, has established three strategic agendas to guide its work up to 2020—inclusive economic growth, environmentally sustainable growth, and regional integration. These aid ADB in its mission to help developing member countries in Asia and the Pacific reduce poverty and improve the quality of life of their people. [32]

Transport is a major part of infrastructure—one of ADB's five core areas of operational focus. It is also integral to the five drivers of change of Strategy 2020—private sector development and operations, good governance and capacity development, gender equity, knowledge solutions, and partnerships.

To align its transport operations with Strategy 2020, ADB has established the Sustainable Transport Initiative to support the development of accessible, safe, environment-friendly, and affordable transport systems. It adapts ADB's transport operations to the diverse and changing context of transport in the organization's developing member countries.

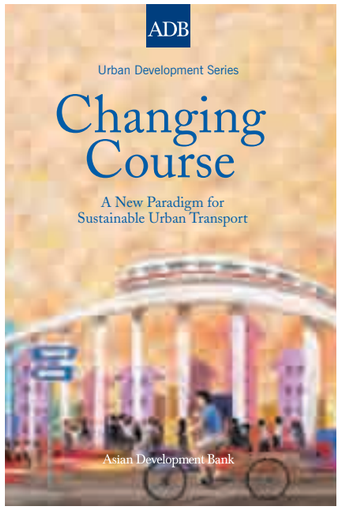
Through this initiative, ADB has identified four opportunities to introduce new and enhanced lending operations that will scale up its support for sustainable transport. ADB will

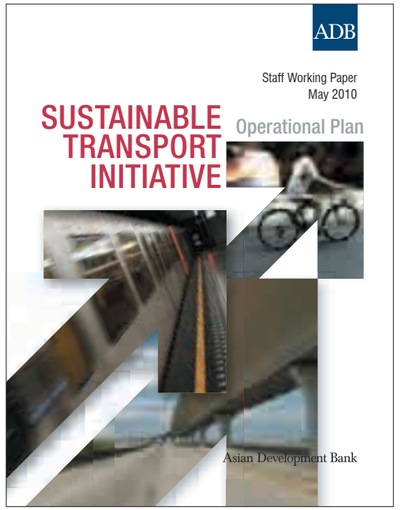
- expand operations and model projects that focus on urban transport;
- model projects that shift to transport modes with lower emissions and energy consumption, and improve transport efficiency in order to address climate change in transport;
- improve transport facilitation to enhance cross-border transport and logistics in support of regional economic integration; and
- increase operations, model projects, and best practices that improve and promote road safety and social sustainability.

The Sustainable Transport Initiative will also help ADB establish new types of sustainable transport operations by conducting research and pilot testing in the following areas: transport management tools, low-emission vehicle technologies, intelligent transport systems, and transport pricing systems, among others.

The initiative targets a significant expansion in ADB lending for urban transport and railways during the period 2010–2020. While roads remain an integral part of ADB transport operations, lending will be gradually adjusted to focus on aspects that are instrumental for improving sustainability, such as rural roads that promote inclusive economic growth.

Under the Sustainable Transport Initiative, ADB is also establishing a Sustainable Transport Partnership Facility to provide a mechanism by which partners can provide financing and expertise to support the initiative. It will also act as a catalyst to support the preparation and implementation of innovative forms of support for sustainable transport within ADB operations.





GIZ AND SUSTAINABLE URBAN TRANSPORT PROJECT

The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH was established on 1 January 2011. It brings together the long-standing expertise of the German Development Service (DED), the German Technical Cooperation (GTZ) and Capacity Building International, Germany (Inwent). As a federally owned enterprise, GIZ supports the Government of Germany in achieving its objectives in the field of international cooperation for sustainable development.

Most activities of the GIZ are commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ) and other German ministries, and public and private sector clients in Germany and abroad. The KfW Development Bank is Germany's leading development bank and an integral part of KfW Bank Group. By financing urban transport projects throughout the world, KfW supports the government to achieve the goals set for German development cooperation.

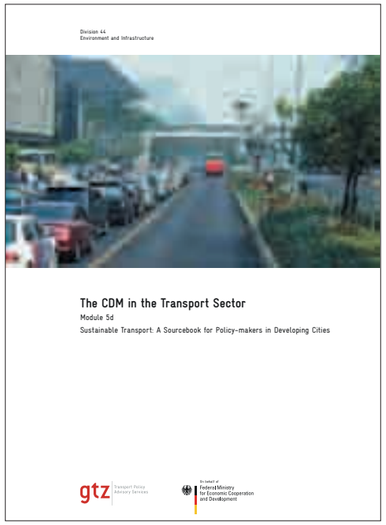
Beyond executing urban transport projects in various countries, GIZ is directing the Sustainable Urban Transport Project (SUTP), a cooperation of more than 30 institutions worldwide, including United Nations agencies, local governments, nonprofit organizations, and multilateral organizations. SUTP aims to help developing world cities achieve their sustainable transport goals through the dissemination of information about international experience, and through targeted work within cities.

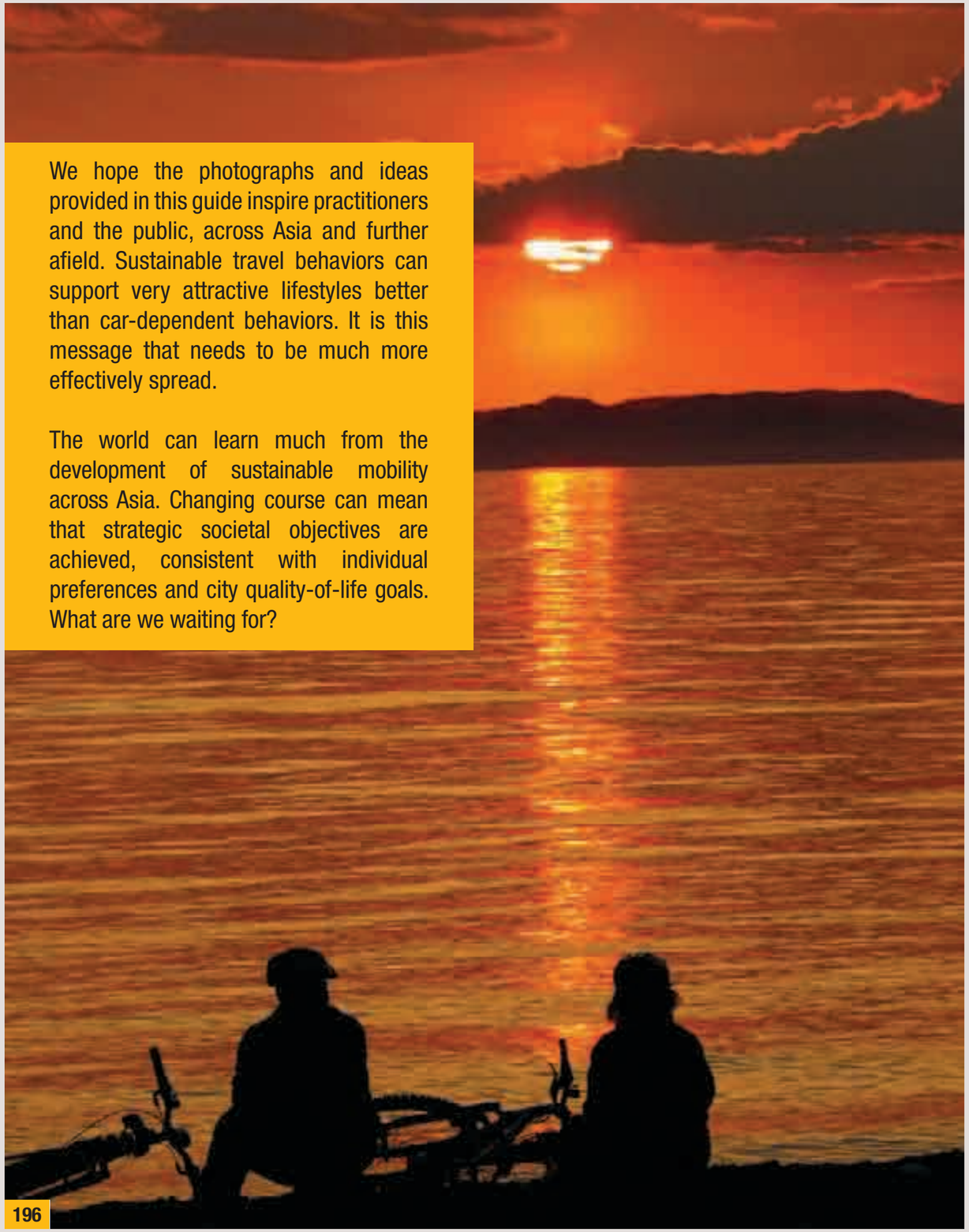
A major aspect of the project strategy is to work within existing networks and information dissemination channels to achieve the project objectives.

Main activities of the project include:
- developing documents and other written and graphic information material for diffusion;
- designing and conducting training courses; and
- conducting technical assessment on urban transport policies and projects in specific cities.

The SUTP website is considered among the leading references for transport planning guidance in developing cities worldwide.

For further information, please visit
www.sutp.org
www.gtz.de/transport
www.kfw.de





We hope the photographs and ideas provided in this guide inspire practitioners and the public, across Asia and further afield. Sustainable travel behaviors can support very attractive lifestyles better than car-dependent behaviors. It is this message that needs to be much more effectively spread.

The world can learn much from the development of sustainable mobility across Asia. Changing course can mean that strategic societal objectives are achieved, consistent with individual preferences and city quality-of-life goals. What are we waiting for?

ACKNOWLEDGEMENTS

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ABOUT THE AUTHORS

Robin Hickman was lead author on the guide, including developing text and sourcing images. He is an associate director and head of transport research at Halcrow, and a research fellow at the Transport Studies Unit, University of Oxford. www.tsu.ox.ac.uk/people/rhickman.php

Paul Fremer assisted in the development of the text and sourcing of images. He is a transport specialist with GIZ. www.GIZ.de/en

Manfred Breithaupt co-initiated, commented on, and helped edit the guide as it was developed, and sourced a number of the photos. He is coordinating the transport section with GIZ. www.GIZ.de/en

Sharad Saxena also co-initiated, commented on, and helped edit the guide and sourced a number of the photos. He is a transport and climate change specialist with ADB. www.adb.org/transport

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