Low Carbon Green Growth Roadmap for Asia and the Pacific

[Background Policy Paper]

Urban Transport:

Policy recommendations for the development of eco-efficient infrastructure

UNITED NATIONS ESCAP
Economic and Social Commission for Asia and the Pacific

KOICA
Korea International Cooperation Agency

Low Carbon Green Growth Roadmap for Asia and the Pacific

[Background Policy Paper]

Urban Transport:

Policy recommendations for the development of eco-efficient infrastructure

Prepared by

Holger Dalkmann and **Ko Sakamoto**
Transport Research Laboratory

This publication was prepared as a background policy paper for the East Asia Low Carbon Green Growth Roadmap project with funding from the Korea International Cooperation Agency (KOICA), under the East Asia Climate Partnership.

Table of Contents

Glossary of Terms and Abbreviations

ADB	Asian Development Bank
BOT	Build-Operate-Transfer
BRT	Bus Rapid Transit
CBD	Central Business District
CDM	Clean Development Mechanism
CIF	Climate Investment Funds
CNG	Clean Natural Gas
CTF	Clean Technology Fund
EC	European Commission
ERP	Electronic Road Pricing
EUR	Euro
GBP	British Pounds
GEF	Global Environment Facility
GIZ	Deutsche Gesellschaft fuer Internationale Zusammenarbeit GmbH
GTZ	Deutsche Gesellschaft fuer Technische Zusammenarbeit GmbH
HGV	Heavy Goods Vehicle
ICI	International Climate Initiative (Germany)
IMF	International Monetary Fund
ITDP	Institute for Transportation and Development Studies
JAMA	Japan Automobile Manufacturers Association
JPY	Japanese Yen
JNNURM	Jawahl Nehru National Urban Renewal Mission (India)
LTA	Land Transport Authority Singapore
MRT	Mass Rapid Transit
NAMA	Nationally Appropriate Mitigation Action
NUTP	National Urban Transport Policy (India)
NGO	Non Governmental Organisation
ODA	Official Development Aid
PBC	Performance Based Contract
PFI	Private Finance Initiative
pphpd	Passengers per hour per direction
PPIAF	Public-Private Infrastructure Advisory Facility
PPP	Public Private Partnerships
PoA	Programme of Activities
SGD	Singapore Dollar
SPV	Special Purpose Vehicle
TfL	Transport for London
THB	Thai Baht
TRL	Transport Research Laboratory (UK)
UK	United Kingdom
UMTA	Unified Metropolitan Transport Authority (India)
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNFCCC	United Nations Convention on Climate Change
US	United States

USD	**US Dollars**
VED	**Vehicle Excise Duty (UK)**
VQS	**Vehicle Quota System (Singapore)**
VTPI	**Victoria Transport Planning Institute**
WB	**World Bank**

Executive summary

The case for moving towards sustainable transport: No such thing as a freeway

The current trend of urban development, based on the private car, generates many economic, social and economic costs through chronic congestion, energy consumption, carbon emissions, air pollution, traffic accidents and severance of communities. These costs add up in some circumstances to more than 10% of a country's GDP. Nevertheless, many countries and cities across Asia and the Pacific continue to focus their investments on costly road infrastructure, such as urban highways, ring roads and flyovers. These are in most cases provided free of charge at the point of use to the general public, resulting in their overuse as witnessed in the chronically congested roads of the majority of cities across the region.

Sustainable transport reduces costs, creates jobs and improves economic performance

Leapfrogging towards more sustainable forms of transport, such as public transport, also requires a significant amount of upfront investments. However, such a shift would enable the reduction of congestion, accident and other costs, help increase employment and generate more value to the economy. For example:

- In the US, 36,000 jobs are created for each billion USD spent on public transport; a figure higher than the job creation impact of road maintenance/construction (see EDRG, 2009 in STPP, 2004).
- In some parts of Europe, every dollar spent in public transport yields 2 to 2.5 dollars of value to the regional economy (see Weisbrod and Reno, 2009).
- In Japan, the extensive development of urban and intercity transport has saved time, energy, carbon emissions and traffic accidents. Cities along the Shinkansen lines have received a large boost to the economy. In Kakegawa for example, there was a rise in employment by 8%, commercial production by 38%, and industrial sales by 39% within four years of the city being connected to the Shinkansen line.

Moving towards sustainable transport: Push away from cars, and pull towards sustainable transport

Governments can reap the large benefits of sustainable transport by pursuing two core aims, namely:

- Pushing demand away from private motorised transport, and
- Pulling demand towards public and other forms of sustainable transport.

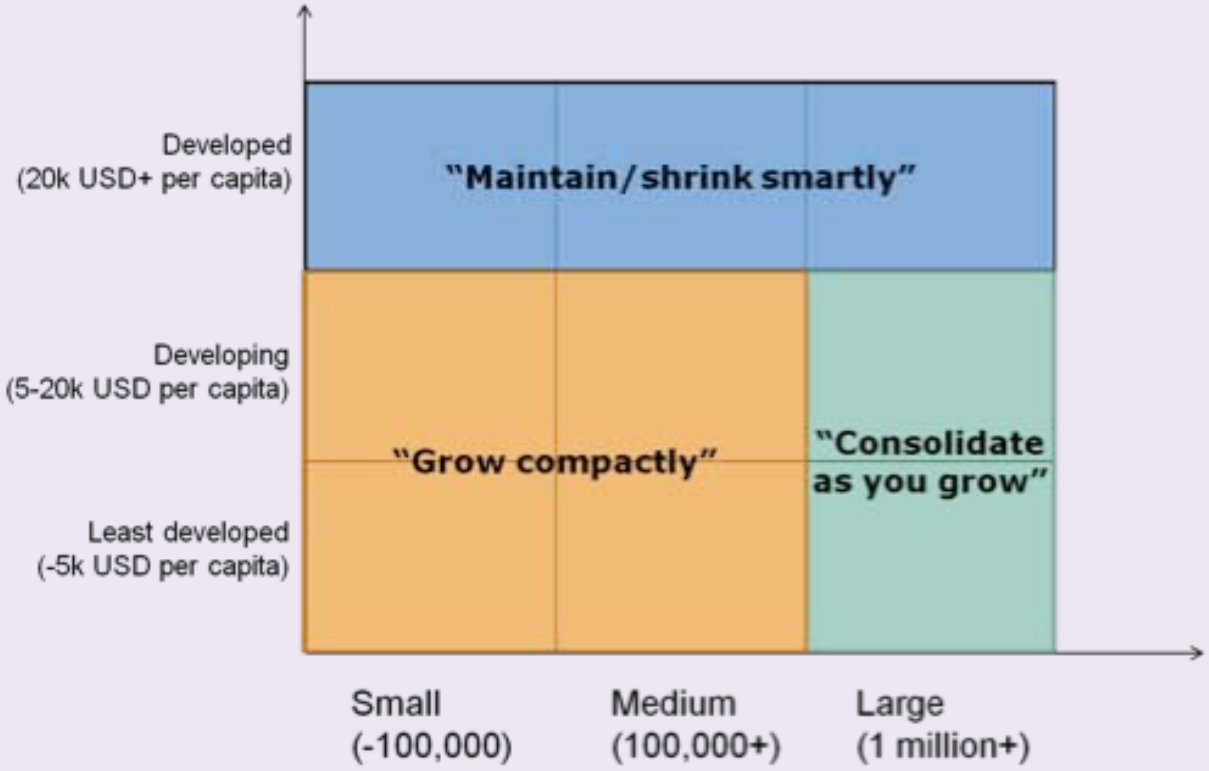
These two aims can be realised by the so-called "Avoid-Shift-Improve" strategy which contains a wide range of policy options that collectively:

- **Avoids** or reduce the number of journeys/length of trips taken
- **Shift** to (or preventing the shift away from) more environmentally efficient forms of transport
- **Improve** vehicle and fuel technology to improve environmental efficiency

Box 1: Develop sustainable transport for efficient, liveable cities

Strategies and policies must be applied differently to cities in the Asia and Pacific region, based on an understanding of their characteristics, especially with regards to population size and level of economic development (see figure below).

Figure 1: Typified overarching strategy/vision for various city types



- Small and medium size cities in least developed and developing countries could be encouraged to "grow compactly", which would be made possible through careful land use planning integrated with transport network planning. The additional (housing) developments expected could take place along public transport corridors to promote transit oriented development, involving private operators of railways who may also be allowed to develop the land around the corridors and use the revenues to cover the cost of developing rail infrastructure.

- The largest cities in least developed and developing countries could "consolidate as you grow", implying a revision of current land use regulations to encourage dense and mixed land use, and the development of high-quality public transport corridors to facilitate movement within and into the central business districts. In these cities, there is still a large scope for land use to change before people and businesses are locked in to a permanent situation. To leverage private resources, firms may be invited to bid for the right to build and operate the key transport corridors. A key consideration is how to regenerate and improve the quality of life in those often living in the slums in the outskirts of the city.

- Cities in developed countries which face a decreasing and ageing population could "maintain/shrink smartly". City centres (which face hollowing-out) would need to be revitalised through improving the pedestrian/cycling environment, and providing high, quality and demand responsive public transport systems that can cater for the needs of all citizens, especially senior citizens. Private companies could be encouraged to offer tailored services (such as home delivery of groceries) to further address their needs.

Within each of these contexts, individual policy measures under the Avoid, Shift and Improve strategy can be applied.

Pushing away from motorised private transport

As a precondition for the development of sustainable urban transport, policy measures to control the growth in private car usage are required. These policies are generally implemented at the local (municipal) level, including:

- **Integration of land use and transport planning:** How people travel and how goods are transported are heavily influenced by what kind of urban structure is in place. Integrating decisions on land use with those for transport is of vital importance, to ensure the move towards more sustainable cities. New neighbour hoods should ideally be built around a public transport corridor, to minimise reliance on the car.
- **Congestion charging/road pricing:** Congestion charging/road user charging is one way to confront road users with these costs which otherwise would go unpaid. The charge should reflect the extra costs the road user causes.
- **Parking management:** Every car journey begins and ends at a parking space. The availability and cost of parking space therefore has a direct impact on whether cars are used for a specific journey. By restricting the supply of, or increasing the cost of parking in the city centre, journeys made by private cars can be significantly reduced.
- **Promoting car-free city areas and low emission zones:** Cities built before the advent of the car were built for pedestrians. Cities which have kept or revitalised their car-free nature are now often the most liveable. Developing cities can mirror this approach by ensuring that city centres are made for people, not for cars.
- **Restriction and auctioning of number of license plates for cars:** The number of cars in developing cities is increasing exponentially, leaving cities increasingly congested, polluted and noisy. To curb the demand for car ownership, many cities are now implementing restrictions or auctioning of license plates, to directly control how many cars come onto the road in a given year/month.

In addition, several other policies implemented at national level are important in setting the correct market signals to rationalise private car use. These include:

- **Setting vehicle and fuel taxes, and removing car-oriented subsidies:** The price of purchasing and running a car defines its level of demand. Historically, vehicles and fuels have been favoured in financial terms, through subsidies and tax breaks, thereby reducing incentives to move towards sustainable transport patterns. It is imperative that such financial preferences be removed, and that vehicles and fuels are priced in ways that reflect their costs to society and the environment.

Furthermore, innovative private-sector led policy measures can also be utilised, such as:

- **Promoting distance-based car insurance schemes:** Traditional forms of car insurance ask for a flat fee for a certain amount of insured period, e.g. one year. The fee normally does not reflect the amount of driving. Linking the insurance premium to the volume of vehicle use (kilometres driven) can serve as a financial incentive for drivers to use their cars less.

Pulling towards more sustainable transport

In parallel with measures to control the growth in private cars, aggressive measures are necessary to improve the competiveness of non-motorised and public transport, in terms of affordability (price), comfort, convenience, speed and safety, including the following:

- **Reserving road space and giving priority to sustainable modes:** A certain amount of road space should be (re-)allocated specifically for public transport and non-motorised transport, e.g. in the form of bus or cycle lanes. This allows for increased frequency, faster speeds and fewer delays. Safety is also improved, as interaction with the general traffic is reduced. Signalling and junction design should allow public trans - port to gain priority over private cars.

- **Formalisation of services and integration of modes to improve connectivity and convenience (also with non-motorised transport):** Public transport in developing countries is often provided by informal providers. Such services should ideally be formalised, and brought under the control of an urban transport authority

- **Integration of modes:** The urban transport authority should be responsible for integrating the various modes of public transport, so that they form part of a single system/network.

- **Quality infrastructure:** Infrastructure for non-motorised and public transport, such as bus/train/metro stations should enable easy access to all users, including those with mobility impairments. Ensuring good design standards from the outset also reduces further expenditures in future, as retrofitting/redesigning old infrastructure is often more costly and technically difficult.

- **Maintenance of infrastructure and vehicles:** Both infrastructure and vehicles need to be appropriately maintained, so that cleanliness, comfort and safety are maintained.

- **Provision of information to the public:** The benefits of using public transport, including financial savings to households, improved health and lower burden to the environment need to be communicated to the public, e.g. through targeted campaigns.

- **Affordable fares:** Public transport fares should be set at rates which allow all members of society their use. Conversely, the price of using private cars should be higher than that of using public transport, e.g. through congestion charging and parking fees.

The combination of the "push" and "pull" measures create a positive spiral, whereby ridership of public transport increases, and financial viability also improves.

Box 2: Public Transport: Four priorities for Asia and the Pacific

In placing non-motorised and public transport within the Roadmap for Asia and the Pacific, the following priorities can be suggested:

1. Improve environment for non-motorised transport: For all cities in the region, a fundamental priority should be to improve the environment for non-motorised transport, i.e. walking and cycling. Irrespective of what other forms of public transport is existent, walking will always constitute the first and last leg of the journey, and therefore the improvement of the pedestrian environment should be a key consideration for cities of all sizes and level of income.

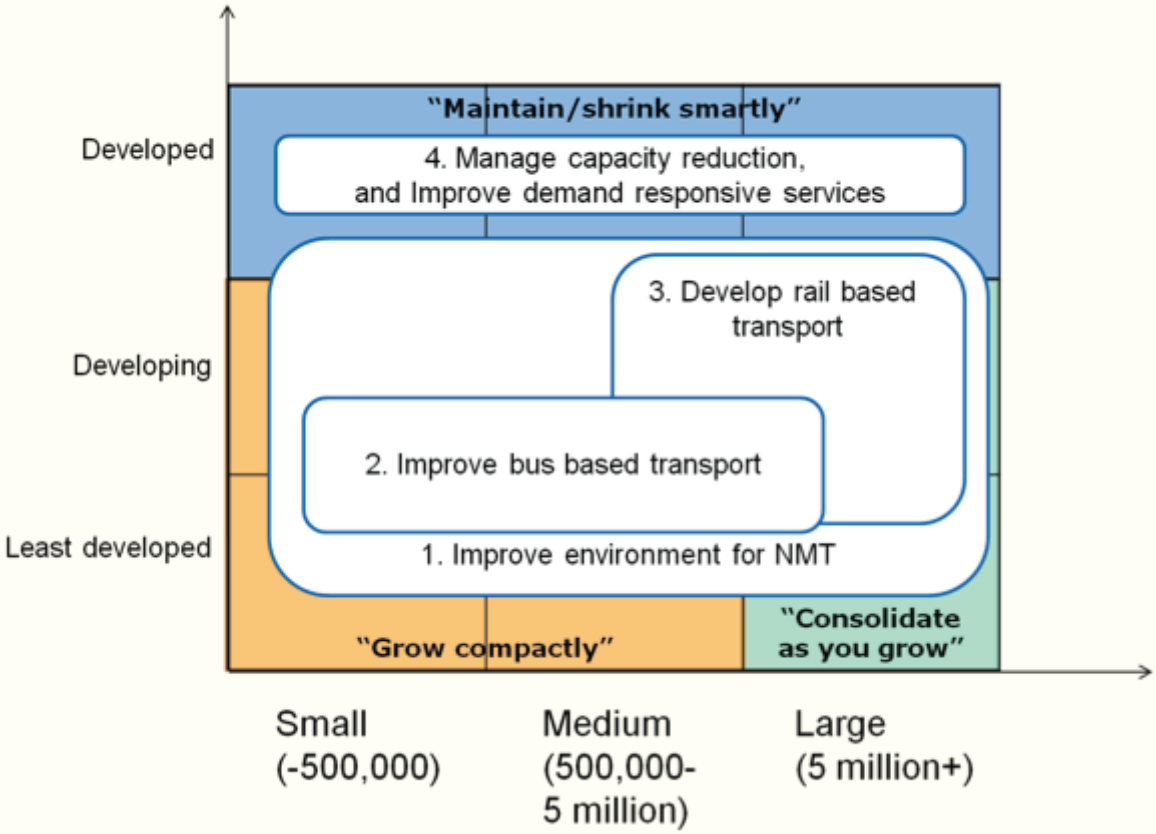
2. Improve bus based transport: Cities of all sizes and income levels should focus on the improvement of bus based transport systems. Buses are typically responsible for the vast majority of passengers carried on public transport, and their role in providing affordable mobility is unrivalled. Buses are flexible in their routing, and can cater for low (minibus) to very high levels (BRT) of demand.

3. Develop rail based transport: Medium to large size cities with more financial means may wish to invest in rail-based mass transit options such as MRT and subways. Such systems have the benefit of allowing for very large levels of demand to be met. Land use policy could be synchronised with their development, so as to enable transit-oriented development around railway corridors.

4. Manage capacity reduction and improve demand responsive services: For cities which face a shrinking population, the reduction in capacity needs to be managed carefully, so that public transport services can maintain their financial feasibility despite the reduced demand. A key concept would be to move towards demand-responsive services, which provide door-to-door access from the home to essential facilities including hospitals and shopping areas. Furthermore, home delivery services could be provided to offset shopping journeys.

Box 2: Public Transport: Four priorities for Asia and the Pacific - Continued

Figure 2: Priorities for Asia and the Pacific



Removing barriers to implementation: Governments must take centre stage

To remove the key barriers towards the implementation of sustainable urban transport policies, a number of building blocks and key strategies are identified, as follows:

- **Political leadership:** Foster political champions for sustainable urban transport policies
- **Institutions:** Establish integrated urban transport agencies, which would be tasked with overseeing the development of key policies to manage transport demand, control expenditures, develop an integrated plan for public and non-motorised transport, and the enforcement of traffic regulations. This should be done in the pretext of a sustainable urban development plan/strategy which should cut across various government departments.
- **Financing:** Set up an urban transport fund. The fund could draw resources from various sources, including those on car users, collected as congestion charges or parking charges. National level taxes such as fuel and vehicle taxes could also be channelled through to the local level via such a fund.
- **Technology:** Combine local technologies with those from other regions. This could include south-south transfer of key technologies, as shown in the case of BRT which was first developed in Latin America and rolled into Asia and other parts of the world since.

Box 3: Governments' role in properly involving the private sector

The role of the private sector in sustainable urban transport can be manifold, including the provision of infrastructure through Public Private Partnership arrangements, operation of public transport through franchising arrangements etc..

However, their contribution to wider society can only be maximised with the active role of governments in setting the right market framework and regulatory regimes. Governments can learn from the past mistakes of premature privatisations, uncontrolled market competition and misalignment with social/environmental goals by:

- Ensuring that the planning, fare setting and coordination of public transport is conducted by the public sector so that socially-desired routes/services are provided for.
- Setting up clauses in contracts, so that private companies are required to follow certain social and environmental standards, e.g. on vehicle emissions, safety procedures etc.
- Incentivising property developers to accommodate aspects of sustainable land use and transport practices, e.g. via controlling planning permissions, mandating transport impact assessments and providing public financial support for public transport and non-motorised transport infrastructure.

Key Recommendations

A number of key actions can be suggested for policy makers in Asia and the Pacific, at local, national and international level, to ensure the development of sustainable urban transport in the region.

Local Governments have a central role to play in the development and implementation of sustainable urban transport. Recommendations are contained in the table below.

Objective	Recommendation
Set the institutional framework for the development of sustainable and integrated urban transport policies	• Set up integrated urban transport authorities within their cities, covering all modes of transport (including freight transport) and considering issues beyond transport, such as housing and land use.
Promote long-term urban planning	• Develop integrated transport and land use master plans, coupled with local and district development plans.
Duplicate political leadership	• Utilise forums such as the C40 or ICLEI to exchange good practice. New forums focusing specifically at cities within Asia and the Pacific could also be considered, for example a "CIVITAS Initiative for Asian Cities", replicating the forum developed in Europe.
Set a favourable environment for the development of sustainable transport	• Implement a basic package of policies to push car users away from private cars, including congestion charging, parking management, restriction/auction of licence plates, and promoting car-free areas.
Ensure that adequate financial resources are available and outlays are properly managed	• Set up an urban transport fund that oversees investments in sustainable transport, especially public transport and non-motorised transport.

National governments have a key role to play in catalysing actions at the local level. Recommendations for policy makers at the national level are shown in the table below.

Objective	Recommendation
Help foster local-level leadership	• Provide prizes (e.g. "sustainable transport awards") to recognise the actions and commitments of local governments. • Make budgetary support provided from the national government to cities conditional upon good governance that supports and delivers sustainable transport policies. For example, national grants and loans can be provided to cities that have created the aforementioned urban transport authority, and those which also have in place a master plan for sustainable urban transport development.
Set the right conditions for sustainable urban transport modes to be developed	• Design and implement fiscal measures such as fuel and vehicle taxes, and phase out environmentally harmful subsidies (e.g. on fossil fuels and traditional forms of vehicle manufacturing). • Implement regulatory measures such as vehicle efficiency standards and fuel standards. • Promote private investments in more environmentally efficient vehicle and fuel technologies through e.g. tax cuts/rebates, and subsidies/grants for research and development. • Provide guidance to cities on good practice in e.g. traffic demand management and public transport management/ operations, as well as how to set up urban transport institutions.
Provide budgetary support for local actions	• Transfer revenues from national taxes (e.g. fuel and vehicle taxes) to the local level (potentially an earmarked proportion of tax revenues). • Provide national grants and loans with favourable conditions (e.g. lower interest) for sustainable urban transport. • Facilitate the matching of international sources (e.g. ODA and climate finance) to local level actions[1].

International bodies (including UNESCAP and regional financing bodies such as the Asian Development Bank) can further support developing countries in the region by providing external assistance in technical and financial terms. Recommendations are shown in the table below.

Objective	Recommendation
Help foster local leadership	• Provide scholarships for future leaders to receive education in sustainable transport policy. • Provide prizes (e.g. "sustainable transport awards") to recognise their actions and commitments.
Help enhance institutional and human capacity	• Provide technical assistance in setting up the aforementioned integrated urban transport authority at city level. • Provide training courses in sustainable transport policy (including for example public transport management and operations etc.
Help set the conditions for reforming transport policies	• Provide technical assistance projects on e.g. master planning, transport demand management, tax reform, regulatory reform etc.
Provide financial resources for the implementation of sustainable transport projects	• Earmark a certain percentage of Official Development Assistance to sustainable transport. • Revise rules on climate finance in the context of the development of the framework around Nationally Appropriate Mitigation Actions (NAMAs) to make them more inductive to actions in the transport sector.

[1] As in the case with UNFCCC negotiations, national governments are generally given the mandate to negotiate terms and conditions on ODA, climate finance and other types of international monetary flows. As such, national level stakeholders must ensure that the support provided through such support feed into local-level actions.

1 Why move towards sustainable transport?

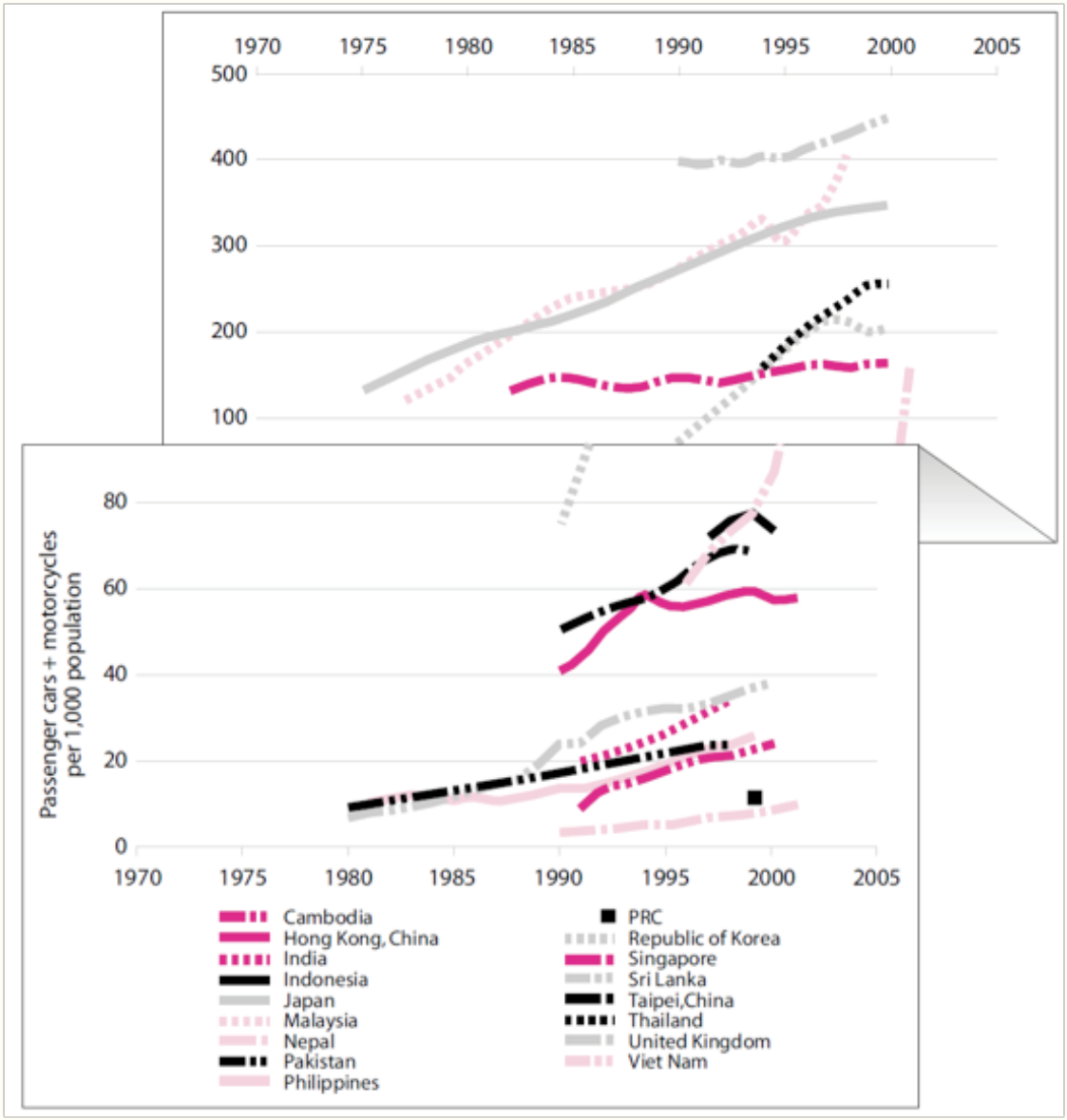
1.1 The costs of car-oriented transport in the Asia and the Pacific Region[2]

The transport networks of Asian countries, as throughout the developing world, are showing signs of emulating the same pattern of development as those in the developed world. As noted in Dalkmann (2010);

- Transport in urban areas is shifting away from non-motorized to motorized forms of transport, including two, three and four wheelers. Whilst public transport patronage is increasing in absolute terms, its overall modal share is decreasing.

- Car ownership is aspired to. Vehicle fleets are growing rapidly, especially in middle-income countries of Asia and the Pacific, such as Indonesia, Philippines, Thailand and Malaysia (see figure below). In China alone, the level of car ownership grew from 15 to 22 vehicles per 1000 population between 2005 and 2007 (International Road Federation, 2010).

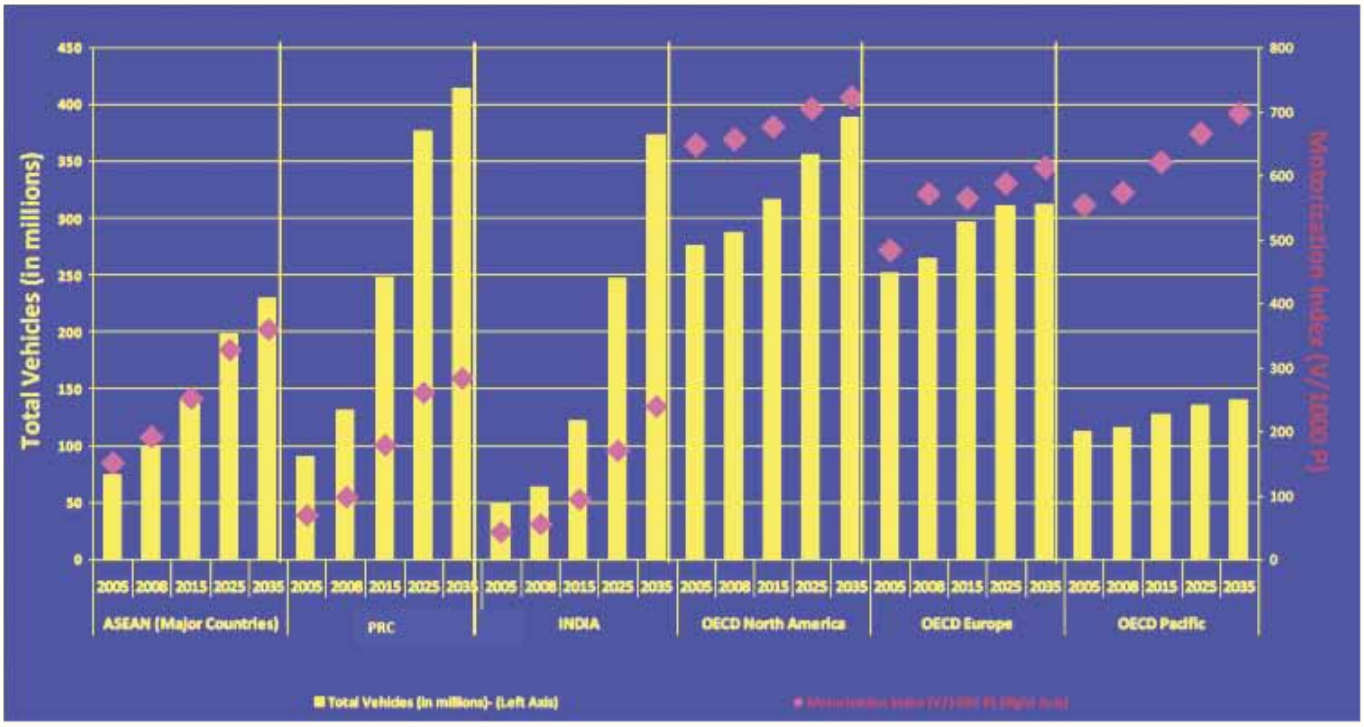
Figure 3: Observed growth in motorised vehicles in selected Asia and Pacific countries (Source: ADB, 2003)



[2] According to the World Bank, the Asia and the Pacific region covers 22 countries including Cambodia, China, Fiji, Indonesia, Kiribati, Korea, the People's Democratic Republic of Lao (Lao PDR), Malaysia, Marshall Islands, FS Micronesia, Mongolia, Palau, Papua New Guinea, the Philippines, Samoa, Solomon Islands, Thailand, Timor-Leste, Tonga, Vanuatu, and Vietnam.

This trend is expected to continue, and total vehicles in China and India are expected to match or surpass those in OECD North America or OECD Europe by 2035. However, vehicles per unit of population will still remain low relative to the industrialised (OECD) countries of today (see figure below).

Figure 4: Predicted growth in vehicles across the world (Source: Leather, 2009 based on IEA data)



- In urban areas, levels of motorisation are relatively high, and create congestion. For example in Jakarta the number of motorised vehicles has grown at a pace of roughly 9.5% per annum for the last 5 years, to reach roughly 5.5.million vehicles. 98% of the total is made up private vehicles serving 44% of trips with 2% public transport vehicles serving 56% (Soehodho, 2010).

Box 4: The explosion of two and three-wheelers

In comparison with other regions, countries in Asia and the Pacific are facing a large growth particularly in two and three-wheeled vehicles. IGES (2007) notes that Asia accounts for 75 percent of all two-wheelers owned in the world, .

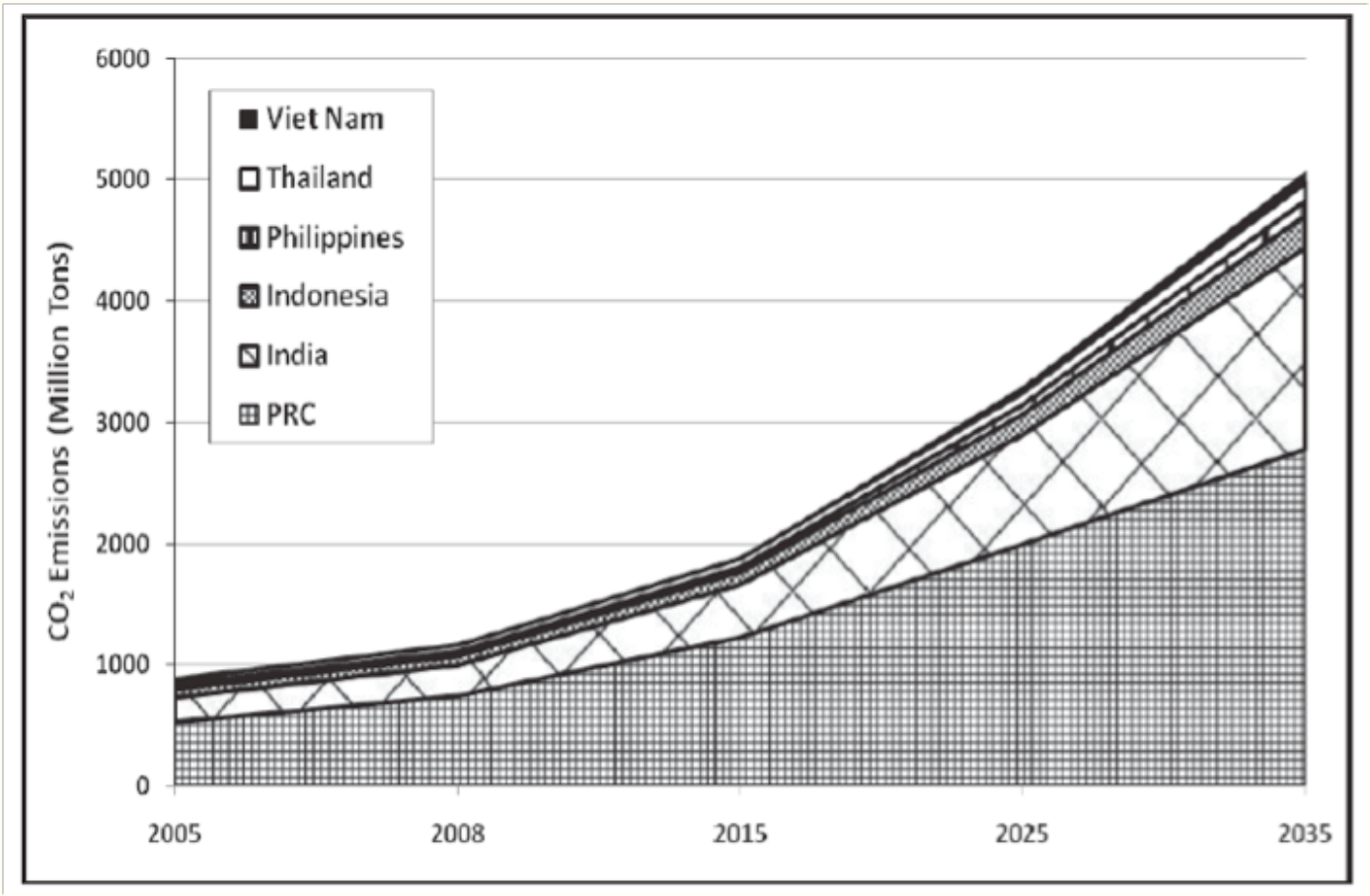
Acccording to WBCSD, 2004 and Dhakal, 2003 (in IGES, 2007), 80 percent of the vehicle fleet in Chennai, Shanghai and Wuhan were two wheelers. In Mumbai, Kathmandu and Kuala Lumpur, the figures were 50, 65 and 40 percent respectively.

These vehicles are financially more accessible, and are the first to be purchased as income grows. Whilst they require less road space and energy compared to four-wheelers, they are a growing concern especially for air pollution, noise, traffic accidents and road congestion. Ownership of two and three-wheelers is expected to be replaced by that of four-wheelers, as income grows.

As noted in Dalkmann, Sakamoto et al (2011), these trends translate directly into environmental, social and economic costs including:

- **Energy consumption and greenhouse gas emissions** – According to IEA (2008), transport currently consumes more than 50% of the world's liquid fossil fuels. This translates into around a quarter of global energy-related carbon dioxide (CO_2) emissions being generated by the transport sector.[3] Land transport accounts for roughly 73% of the sector's total CO_2 emissions, followed by aviation (11%) and shipping (9%). Emissions are projected to increase by 1.7 % per annum between 2004 and 2030.[4] More than 80 per cent of the predicted growth is expected to be in the road transport sector in developing countries (IEA, 2009). The figure below shows the trends of CO_2 emissions from the road transport sector in selected countries from Asia and the Pacific.[5] With the notable exception of Japan, it is predicted that under business as usual, transport emissions are expected to increase manifold over the next three decades and beyond.

Figure 5: Road transport CO_2 emissions based on Segment Y Ltd. Data (Source: Schipper, Fabian and Leather, 2009)

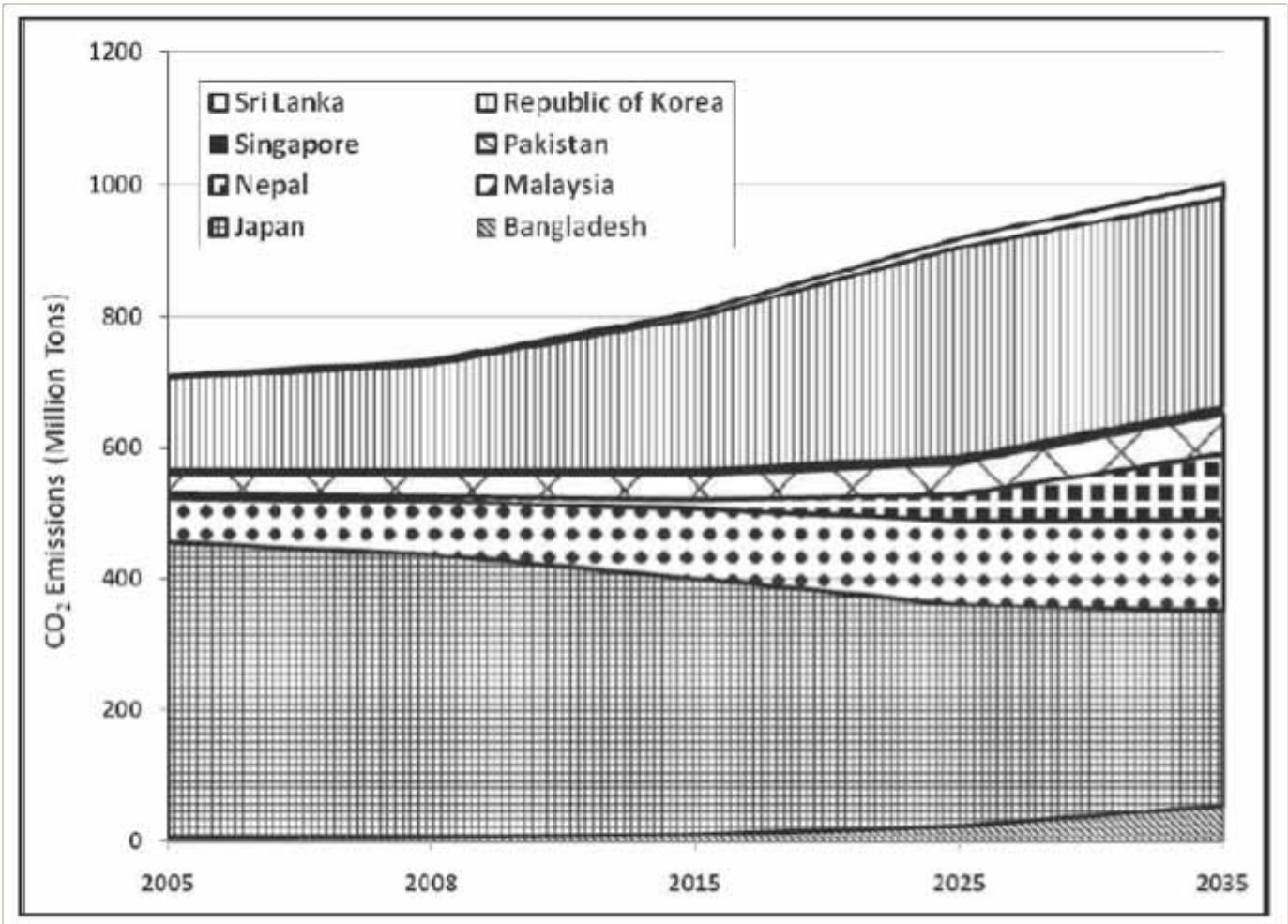


[3] IEA (2005) CO2 Emissions from Combustion 1971-2003. OECD/IEA

[4] IEA (2006) World Energy Outlook 2006, International Energy Agency. Accessed from http://www.worldenergyoutlook.org/2006.asp

[5] Note that the limitations in data quality prohibit direct comparisons between countries in Asia and the Pacific. The figures represented here are based on Schipper, Fabian and Leather (2009), in which the authors collected data from existing, published sources of information.

Figure 6: Road transport CO_2 emissions based on other data sources (Source: Schipper, Fabian and Leather, 2009)



Although climate change may not be the highest priority for developing countries, it is a strong co-benefit of sustainable transport systems (see Dalkmann and Huizenga, 2011). It is also increasingly recognised that mitigating carbon emissions may be a key way in which support can be provided to developing countries in the form of climate finance.

- **Congestion (and associated losses in productivity of urban areas)** - In urban areas the costs of congestion can be significant. For example the cost of congestion in Bangkok in 1995 was between 1 and 6 % of its annual GDP (Dextre and Cabrera, 2010) whilst in Jakarta chronic congestion, particularly in the peak periods, is estimated to cost a total of Rp12.8 trillion per annum, or approximately USD 1.4 billion [6] (Pelangi, 2007). The table below illustrates the extent of congestion costs from various cities and countries in Asia and the Pacific.

[6] Based on time value, fuel consumption and health costs.

Table 1: Congestion costs of countries or cities as % of GDP

(Source: World Bank, 2001 and Carisma and Lowder, 2007)

Country, Region or City	Year	Source	%GDP
Bangkok	1995	Misc	1.00-6.00
Dakar	1996	Tractebel	3.37
Manila	2000	Sigua and Tiglao	4
India	2003	Ghose, C	Rs 3 billion per annum
Japan	2000	MLIT	2
Korea, Rep. of	2008	Korea Transport Database	2.62

- **Degradation of human health (through air pollution, noise, vibration etc)** – Increasing levels of transport can degrade human health in a number of ways. To provide a couple of examples the health cost of local air pollution was 2.56% of GDP in Bangkok in 1995 (Dextre and Cabrera, 2010). In the European Union, research by Lambert (2002) and Martinez (2005) indicates that the economic cost of noise can reach nearly 0.5 per cent of GDP.

- **Reduction in human security (through traffic accidents)** - It is estimated that the cost of traffic accidents worldwide is approximately 518 billion USD, and represents between 1 and 1.5 per cent of GDP in low- and middle-income countries and 2 per cent in high-income countries (World Bank and WHO, 2004).

  Up-to-date information on costs associated with traffic accidents in Asia and the Pacific region are gen erally scarce. TRL (1997) in World Bank and WHO (2004) estimate annual costs of crashes in 1997 as 24.5 USD billion or 1% of GNP in developing Asia overall. A study for Bangladesh in 2000 notes an estimated cost of 745 million USD, or about 1.6% of its GDP (Babtie Ross Silcock and TRL, 2003).

- **Reduction of accessibility and severance of communities** - Heavily trafficked roads lead to the sever ance of communities as a result of both physical and psychological barriers. Although it should be noted that values will vary considerably depending on the regional context, Salensminde (2002) in VTPI (2007) note an extra cost of 0.54-0.62 USD per mile of vehicle activity shifted from non-motorised transport.

These figures illustrate the large economic, environmental and social costs of the current patterns of transport.

Figure 7: The consequences of rapid motorisation: congestion, poor air quality, climate change, and increased accidents. (Photo: Ko Sakamoto)

The rapid motorisation witnessed in the Asia and the Pacific region is driven by a number of fundamental changes to its economy and society, most notably;

- Population growth – witnessed across the region, especially in Cambodia (1.7% annual growth in 2009), Lao (1.8%), Malaysia (1.7%) Papua New Guinea (2.3%) and the Philippines (1.8%) (World Bank Indicators, derived from UN, 2009).

- Urbanisation – with an unprecedented number of people moving into cities in the region. The UN estimates that the percentage of people living in urban areas in Asia will increase from 41.7% in 2009 to 64.7% by 2050 (UN, 2010).

- Income growth – which allows motorised vehicles (especially two-wheelers) to become affordable to a larger proportion of the population.

Box 5: Freeway: No such thing

Policy makers respond to the growing demand for motorised transport by investing vast amounts of resources on costly infrastructure, including flyovers, ring roads and urban highways. The construction costs alone often amount to hundreds of millions, if not billions of dollars, choking the city of scarce resources needed for other important purposes such as education and healthcare.

For example an estimate by UNESCAP (2007) puts a figure for constructing one kilometre of road in Myanmar at around 470,000 USD. Costs can be significantly higher according to the terrain, requirement for relocating existing inhabitants etc.

Once built, these roads are often provided free at the point of use to users of private vehicles. As there is no incentive for users to rationalise their use of roads, the result is their overuse, leading to chronic congestion seen in many cities across Asia and the Pacific.

Pressure to build even more infrastructure to accommodate this new demand is thereby heightened, and a viscous cycle is created. As noted by former mayor of Bogota Enrique Peñalosa, "trying to solve traffic problems by building more, bigger roads is like trying to put out a fire with gasoline." (see Sakamoto, 2010)
To overcome this cycle, the following must be recognised:

- Catering to the growing demand for private motorised transport is unsustainable; financially, socially and environmentally. Demand must instead be managed.

- Road space is a scarce resource, and its use must be rationalised through e.g. congestion charging/road user charging.

More recently, many cities are revisiting their approach in infrastructure provision. For example the Municipality of Seoul is moving towards demolishing elevated urban highways, at more than 20 locations. It is easy to imagine the costs the city could have saved had it not built these highways in the first place.

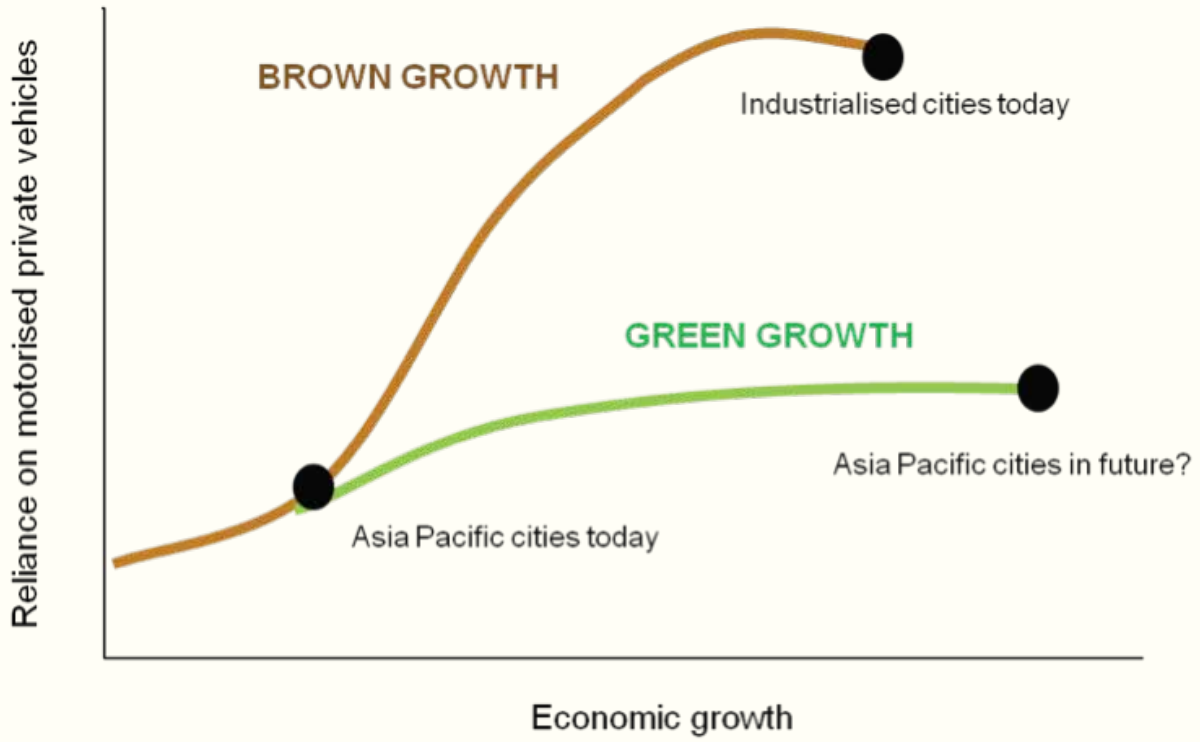
See Chapter 3 for a further discussion on how to manage the demand for private motorised transport, and the Annex for a case study of Seoul.

1.2 The opportunities of sustainable transport: Lower costs, more employment, value to regional economy

The current trends described in the previous section (1.1) call for a renewed approach towards developing urban transport. Most cities in the Asia and the Pacific region have yet to develop their urban infrastructure, including transport networks. As a result there is a significant opportunity to develop infrastructure in a way that ensures green growth, allowing for the development of the economy whilst maintaining environmental sustainability.

Key to this is to leapfrog to a sustainable and accessible form of transport system where mobility is provided mainly through public transport modes and where good urban planning facilitates shorter journeys that can be made through cycling or walking. This would be a departure from the car-dominated transport systems which are found in many industrialised countries today that results in the various forms of costs highlighted earlier (see figure below).

Figure 8: Leapfrogging towards a green economy



Developing countries can learn from the experience and expertise of developed countries to 'leapfrog' towards a green growth path (as highlighted in Figure 8) This leapfrogging approach is would help in creating a transport system that:

- Provides all citizens of the Asia and the Pacific region (regardless of income level) with good access to jobs, shops, schools, and other essential facilities.
- Provides businesses in the region with a reliable and efficient network that reduces business costs and improves access to markets, thereby providing a basis for sustained economic growth.
- Improves the quality of life for all citizens, through reduced congestion, noise, vibration, air pollution and traffic accidents.
- Protects the natural environment throughout the region and globally, through improved energy/resource efficiency, reduced greenhouse gas emissions, and the protection of the natural habitat.

The investments in public and non-motorised transport required for leapfrogging towards green growth are significant, and would be required upfront.

For example, construction costs for elevated urban railways are in the order of 40 million USD/km in developing countries as shown in Table 2 below (ADB, 2010). Subways (metros) can cost many times more than this amount.[7]

Table 2: Comparison of unit costs for various types of transport infrastructure
(Source: ADB, 2010)

Transport Mode	Hourly Capacity to Move People per $1 Million Capital Cost ($)	Capacity (person per hour per direction)	Street Cross Section Used (m)	Capital Cost ($ million per km)	Capacity per Meter Cross Section (persons per hour per meter cross section)
Footpath, 2 m wide	24,000	2,400	2	0.10	1,200
Bikeway, 3 m wide	20,000	3,000	3	0.15	1,000
Expressway, four-lane	5,665	8,500	20	1.5	425
BRT-high capacity	5,000	35,000	12	10	4,165
BRT-low capacity	4,500	6,000	8	3	2,250
Urban road, two-lane (low income)	4,500	4,500	9	1	500
Urban road, two-lane (high income)	2,600	2,600	9	1	290
Metro underground	1,000	60,000	na	60	na
Elevated rail	625	25,000	7	40	3,570
Urban elevated expressway, four-lane	565	8,500	7	15	1,215
Urban underground expressway, four-lane	170	8,500	na	50	na

BRT = bus rapid transit, km = kilometer, m = meter, na = not applicable.
Note: A range of values are possible depending on vehicle occupancy, system design and management, service characteristics, soil geology, and local construction costs.
Source: Independent Evaluation Department estimate based on empirical research

In the context of limited financial resources, every effort should be taken to control such costs, and consider cost-effective options such as Bus Rapid Transit (see Chapter 4) whose costs per kilometre are often a fraction of rail-based systems. As shown in Table 2, infrastructure for non-motorised transport, such as footpaths and bike-ways, tend to be most cost effective in moving people.

On the other hand, such investments in public transport have many extended benefits over a very long period of time, including:

- Lower congestion, accident and other costs attributed to private vehicles, which can add up to more than 10% of a country's GDP (World Bank 2001, in Dalkmann, Sakamoto et al, 2010). The lowering of such costs impact directly on business productivity, as wasted time is minimised.

- Increased employment, where figures from the US suggest that 36,000 jobs are created for each billion USD spent on public transport; a figure higher than the job creation impact of road maintenance/construction (see EDRG, 2009 in STPP, 2004). Furthermore, a review of 58 projects in the US by Garrett-Peltier (2011) suggests that investing in bicycle and pedestrian infrastructure create more jobs per unit of investment, compared to investments in roads only for cars (see Table 3 overleaf).

[7] Care should be taken in comparing costs and benefits across modes of transport, as the cost-benefit ratio depends heavily on the assumptions being taken, such as the time span to be considered, level at which services are priced, and so forth. In general, public transport systems, especially rail-based systems, are characterised by large initial costs, which are "paid back" over a very long time span (decades, if not centuries). Hence, policy makers should reflect on the long-term structural changes that such systems would bring about, when making decisions on infrastructure investments.

- Value to the regional economy, where a European study suggests that every dollar spent in public transport yields 2 to 2.5 dollars of value to the regional economy (see Weisbrod and Reno, 2009).

Table 3: Comparison of employment impacts of different types of road investments
(Source: Garrett-Peltier, 2011)

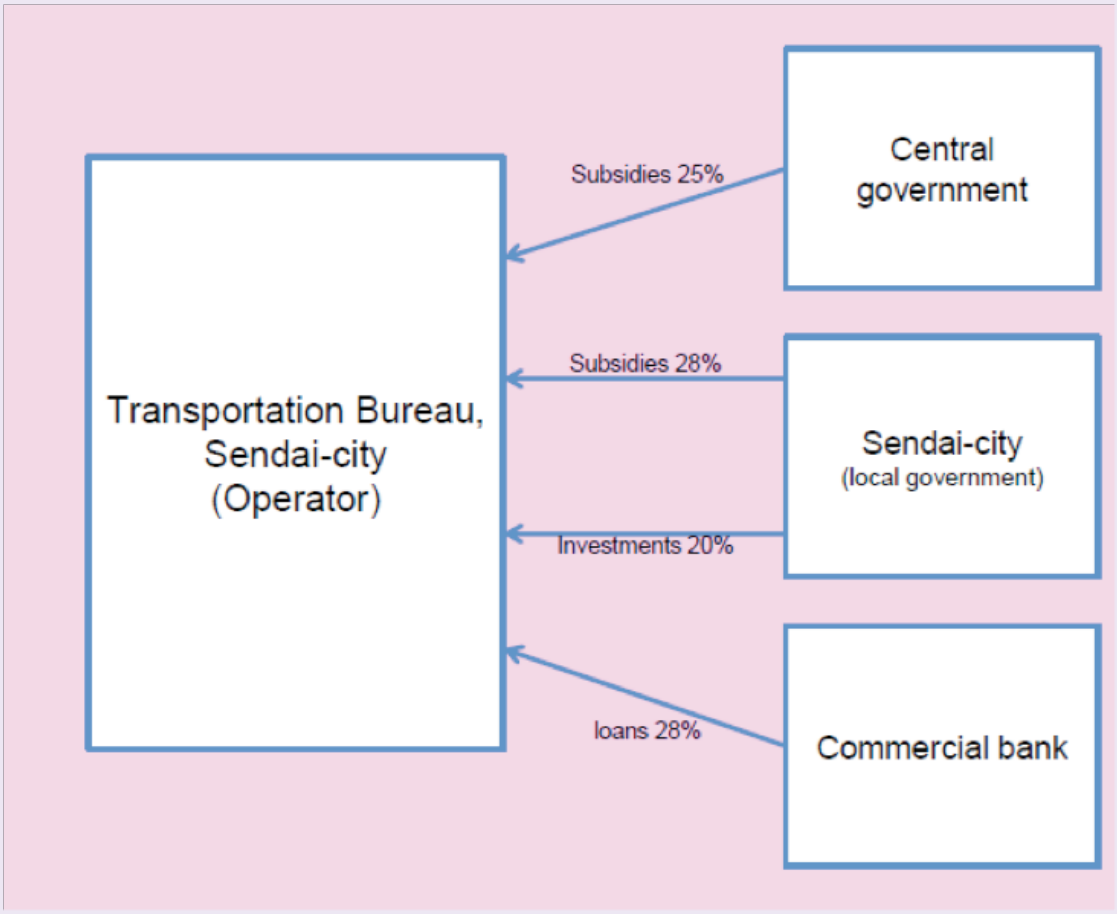
Project type	Road	Bicycle	Pedestrian	Off-street trail	Number of projects	Direct jobs per $1 million	Indirect jobs per $1 million	Induced jobs per $1 million	Total jobs per $1 million
Total, all projects					58	4.69	2.12	2.15	8.96
Bicycle infrastructure only		•			4	6.00	2.40	3.01	11.41
Off-street multi-use trails				•	9	5.09	2.21	2.27	9.57
On-street bicycle and pedestrian facilities (without road construction)		•	•		2	4.20	2.20	2.02	8.42
Pedestrian infrastructure only			•		10	5.18	2.33	2.40	9.91
Road infrastructure with bicycle and pedestrian facilities	•	•	•		13	4.32	2.21	2.00	8.53
Road infrastructure with pedestrian facilities	•		•		9	4.58	1.82	2.01	8.42
Road infrastructure only (no bike or pedestrian components)	•				11	4.06	1.86	1.83	7.75

Box 6: The case for investing in sustainable transport: The Japanese experience

Japan is a country that has historically invested significantly in its urban and intercity railways. Based on MLIT (2011), the large-scale development of the urban rail network in Japan started in the 1910s, driven mainly by private railway companies, who secured the profitability of their business by developing houses and commercial facilities along the railway line. As Japan entered the ear of high economic growth after the Second World War, public sector support (at both local and national level) began for the development of new railway lines and subways via subsidies and favourable loans, to meet the increasing demand for commuter traffic (see example of the Sendai city subway below). In more recent years (after 2000), the agenda has shifted to the improvement of existing infrastructure and rolling stock, especially the retrofitting of stations and other facilities to make them more accessible to the elderly and mobility impaired, and improving connectivity and interoperatability across the network.

Box 6 (continued)

Figure 9: Public support structure for the Sendai City Subway (Source: MLIT, 2011)



The economic, social and environmental benefits of Japan's rail network have been noted in several studies.

Yao and Ou (no date) notes the numerous positive benefits brought to land owners (in the form of increased rent), merchants (due to increased productivity) and residents (in the form of direct time savings etc). They quantify for the city of Nagoya, a total of more than 200 billion Yen (approximately 2.5 billion USD) in benefits as a result of urban rail transport (see table below).

Table 4: Benefits of certain urban rail transport in Nagoya (Source: Yao and Ou, no date)

Beneficiaries	After URT used		
	0-5 years	5-10 years	10-15 years
Land agent	130.1(70%)	146.5(73%)	151.5(73%)
merchants	24.6(13%)	28.3(14%)	31.2(15%)
residents	29.6(17%)	26.2(13%)	25.9(12%)

Smith (2003) considers the benefits of the Japanese Shinkansen system of High Speed Rail, and notes that for example:

- Time savings in the order of 500 billion Yen (approximately 6.2 billion USD) is generated every year, assum ing 85% of total passengers currently using the Shinkansen have shifted from other slower modes.
- Cities along the Shinkansen lines have received a large boost to the economy. In Kakegawa for exam ple, there was a rise in employment by 8%, commercial production by 38%, and industrial sales by 39% within four years of the city being connected to the Shinkansen line.

Box 6 (continued)

- The Shinkansen offers by far the most fuel efficient mode. Calculations show that 360 million additional litres of oil (equivalent of 1.1 million families' oil use) would have been consumed in 1985 absent the Tokaido Shinkansen (linking Tokyo with Osaka).

- A large amount of carbon emissions is saved, as the Shinkansen produces only 16% of emissions per person of a passenger car.

- Were journeys between Tokyo and Osaka to be taken by car, 1,800 extra deaths and 10,000 serious injuries would result each year.

Although it is difficult to compare numerically the full economic, social and environmental cost savings to the whole country as a result of the development of railways, the above figures indicate the large costs that may have resulted had Japan opted for a more motorised society.

For further information, see: Annex A-6 of this report.

Smith (2003) The Japanese Shinkansen: Catalyst for the renaissance of rail.
http://www.manchesteruniversitypress.co.uk/uploads/docs/240222_1.pdf

Yao and Ou (no date) Study on Sustainable Development Strategy of Urban Rail Transit Based on Externality.
http://www.seiofbluemountain.com/upload/product/200910/2008glhy12a21.pdf

1.3 Aim, scope and outline of this paper

In the context of the above, this report aims to provide a practical overview of policy options and strategies that can be introduced in developing countries in the Asia and the Pacific region, which would lead to the development of urban transport systems supportive of green growth.

More specifically, it aims to:

- Present a low carbon roadmap for urban transport that would contribute to low carbon green growth in developing countries in the Asia and the Pacific in the short (up to 2020) and medium (up to 2030) term.

- Provide an overview of policy measures that help push demand away from motorised private vehicles (cars).

- Provide a comparison of the strengths and limitations of different public transport modes.

- Provide ideas on how barriers to the development of sustainable transport can be removed.

- Present successful case studies from around the world, which may act as guidance to developing coun tries in the Asia and the Pacific.

The study focuses on urban passenger transport. Rural and intercity transport as well as freight transport are subject to a different set of problems and solutions and are covered in other literature.
The paper is primarily targeted at policy makers at the national level in developing countries within the Asia and the Pacific region (and especially East Asian countries). However, it also touches upon the important roles of sub-national governments and the private sector in supporting sustainable transport and how their actions can be supported by national level policy makers.

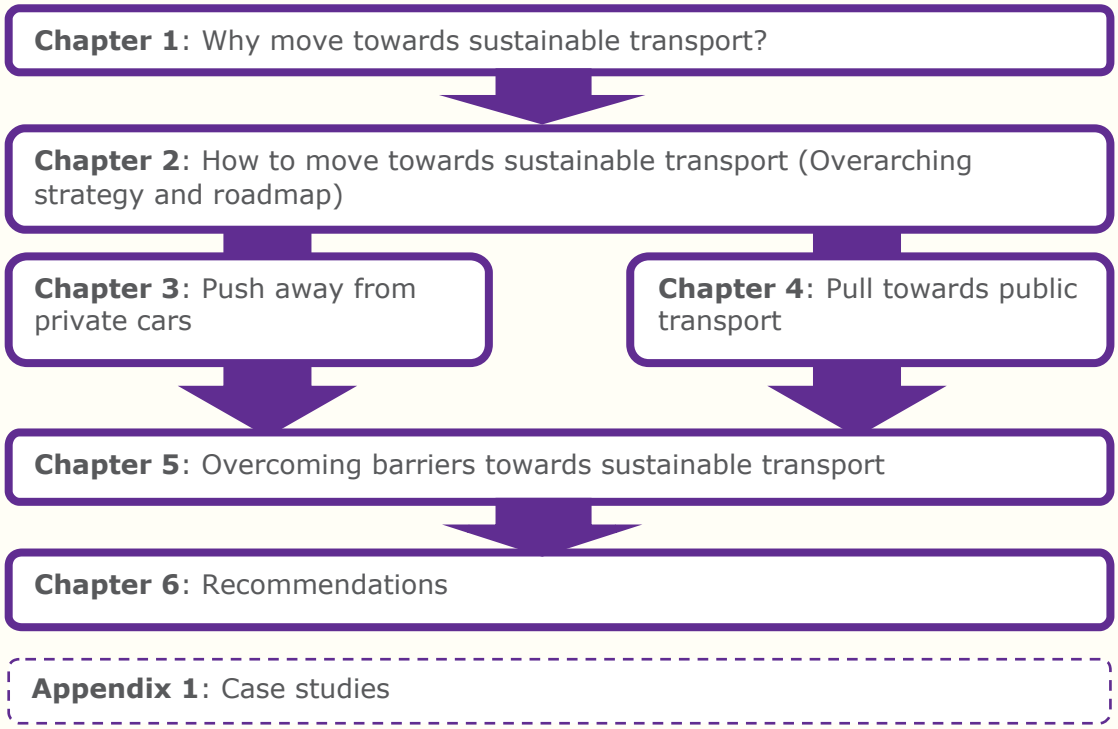
The report is structured to mirror the main objectives as follows.

- Chapter 2 provides a succinct roadmap containing the key strategies and policy measures that

collectively align urban transport with green growth. The two aims of 1) pushing demand away from motorised private transport and 2) pulling demand towards sustainable transport is introduced. It suggests an overarching strategy in the form of the so-called "Avoid, Shift and Improve" framework, and outlines how this can be practically implemented in the Asia and the Pacific region. It identifies the main components and policy options that need to be identified and implemented, and also considers their timing, sequence and complementary policies that need to be implemented. The main stakeholders that need to be engaged in implementing the policy options are identified, and matched against their potential actions.

- Chapter 3 focuses on the "push" aspect, detailing the types of policy measures required to reduce private car use.
- Chapter 4 focuses on the "pull" aspect, highlighting the ways in which public transport can be made more attractive. It provides a comparison of the different modes and options, highlighting the strengths and limitations of each mode, issues related to their introduction (e.g. financing, public resistance) and examples of where each option was successfully introduced.
- Chapter 5 focuses on the barriers towards implementing sustainable transport in the Asia and the Pacific region, and ways of overcoming such barriers through effective policy, financing, technology and capacity building.
- Chapter 6 presents the key recommendations to policy makers in the Asia and the Pacific region, focus ing in particular on local and national governments in the region.
- The Annex presents a number of case studies of where sustainable transport options have been success fully implemented throughout the world, including in the Asia and the Pacific region. The case studies serve as practical references for policy makers to replicate or upscale within their respective countries or cities.

Figure 10: Outline of the report



2 How to move towards sustainable transport

2.1 The aim: Push away from cars and pull towards public transport

In essence, the move towards sustainable transport requires;

- Managing and reducing the reliance on private cars (push)
- Making sustainable forms of transport, including public transport, more attractive (pull)

Figure 11: The push and pull approach (Source: Mueller et al, 1992)

As will be discussed in latter chapters, a number of policy measures can be used to achieve these two effects. Discouraging private car use may be achieved through a combination of parking restraint, car-free areas, congestion charging, license plate auctioning etc.

Encouraging public and other forms of sustainable transport can come through improving the service quality (frequency, cleanliness, comfort, punctuality and safety), as well as the provision of better infrastructure (e.g. bus lanes, cycle lanes, better pedestrian environment etc.)

2.2 The strategy: Avoid, Shift and Improve

To realise the aforementioned two aims, the "Avoid, Shift and Improve" Strategy is employed, which as noted in Dalkmann, Sakamoto et al (2011) recognises the need for:

- **Avoiding** or reducing the number of journeys taken - This is done through integrating land-use and trans port planning; designing denser, more compact settlements; and utilising telecommunication technolo gies such as teleconferencing[8]. Congestion charging, parking management and other types of transport demand management measures are a key part of this strategy. Freight transport volumes can be reduced by localizing production and consumption and by optimising logistics. The "Avoid" strategy is strongly associated with the "push" approach, as most of the policy measures under this strategy are aimed at limiting the growth in private car use.

- **Shifting** to (or preventing the shift away from) more environmentally efficient forms of transport - This is conducted through promoting public transport as well as non-motorised transport (e.g. walking and cycling). Public transport needs to be frequent, reliable, affordable and comfortable to provide a viable alternative to the car. Railways and waterways are generally greener methods of transporting freight, and shifting towards these modes reduces the environmental impact of freight transport. This strategy is strongly associated with the "pull" approach indicated earlier.

[8] Such technologies may not necessarily reduce the demand for travel activity by itself, and need to be combined with measures to reduce incentives to travel by private modes, such as road user charging, parking charges, vehicle tax and fuel tax.

- **Improving** vehicle and fuel technology to improve environmental efficiency - Enhancing the fuel economy of conventional engines; reducing the weight of vehicles and developing alternatives such as electric and hybrid vehicles, biofuels, and hydrogen fuel technologies can help reduce the environmen tal impact of each kilometre travelled. [9] Further efficiency gains can be achieved through an improve ment in the occupancy rate of vehicles, or through environmentally-friendly driving habits (eco-driving).

The Avoid-Shift-Improve strategy is applicable to both developed and developing countries, although there are some important differences in which it is applied to the different contexts. These differences are reflected in Table 5, which illustrates how the Avoid, Shift and Improve strategies are applied to developed and developing countries.

Developed countries have already reached a high level of vehicle ownership and use, and are required to reduce their absolute levels of CO_2 substantially. On the other hand, the challenge for developing countries is to mitigate increases in CO_2 in advance, so that total emissions are lower than what they would be under business as usual, or under "brown growth" (see Chapter 1).

Table 5: Avoid, Shift and Improve strategies in developed vs. developing countries
(Adapted from: Dalkmann, Sakamoto et al 2011)

Strategy	Developed Countries	Developing Countries in Asia and the Pacific
Avoid	Reduce vehicle kilometres (VKM) through Transport Demand Management (TDM), land use planning, localised production and shorter supply chains.	Avoid unnecessary generation of VKM through integration of land use and transport planning. Develop new urban areas around transit corridors (Transit Oriented Development)
Shift	Shift from private vehicles to Non-Motorised Transport (NMT) and Public Transport (PT) and aviation to rail/PT. Transfer freight from road to rail and water transport.	Enable conditions for the lowest-emitting modes (both freight and passenger) Prevent shift from NMT (such as walking and cycling) and public transport (such as buses, rickshaws etc) to private vehicles via improving the quality of public transport including paratransit.
Improve	Improve existing vehicles. Down-scale vehicle engine size. Electrify rail (for both freight and passengers).	Ensure future vehicles/fuels are cleaner, encouraging small efficient vehicles (including 2 wheelers which are used frequently in Asian countries). Design innovations for traditional NMT such as cycle rickshaws.

2.3 The tools: A menu of policy measures

Under these three broad strategies, a large number of measures are available to policy makers, which are generally categorised into the following 5 types (Dalkmann and Brannigan, 2007):

- **Planning instruments**, such as urban transport plans and regulation on land use can be used to encour age developments in land use that reduce trip lengths and avoid unnecessary trips. Transport master plans and integrated network planning can support the building of new transport infrastructure, includ ing for public transport, cycling, and walking.

- **Regulatory instruments** such as weight restrictions, fuel standards and vehicle emission standards can be used to restrict the use of certain motorized vehicles and influence the types of vehicles used.

[9] It is important that the generation of electricity, production of hydrogen and biofuels are all conducted in a sustainable manner

- **Economic instruments** such as vehicle and fuel taxes, road user charges and parking fees can be used to discourage the use of motorized vehicles. Revenues from such instruments can be used to improve alternative transport modes, especially public transport and non-motorised transport.

- **Information instruments** such as marketing can be used to increase the awareness of alternative modes and their benefits in economic, social and environmental terms. On-vehicle monitoring systems can improve the driving habits of motorists, and labels on new cars can help consumers chose the most envi ronmentally efficient vehicle.

- **Technology instruments** including the development of more efficient engines, fuels and vehicle design can help reduce the environmental burden of each kilometre driven.

A list of representative policy measures under the Avoid, Shift and Improve strategies is presented below, alongside several good and bad practices seen throughout the world. Information is provided for each policy measure on:

- Its type, i.e. planning, regulation, economic, information and technology

- The key stakeholders that would enable the delivery of the policy measure, including local (city/municipal) governments, national governments and the private sector.

- The climate mitigation potential of each policy (based on expert judgement).

Table 6: Overview of policy measures

Representative policy measures	Type of policy*	Key stakeholders**	Mitigation potential (over 10 years)****	Short Description	Good practice	Bad practice
Avoid						
Develop integrated transport and land use masterplans	P	L, N	H	Consider land use planning and transport at the same time, through an integrated process, so as to develop compact, transit-oriented cities and avoid urban sprawl.	Seoul's sustainable city plan	Lack of consideration of land use in most Asian cities
Manage parking	E, R, P	L, P	M	Limit the number of parking places in the city centre, and price parking fees above the cost of taking public transport into the city centre, to deter car use.	Seoul's Parking policy used to support Travel Demand Management.	Lack of adequate on-street parking prices and poor enforcement of parking regulation
Implement congestion charging/road pricing	E	L	H	Make car users pay for using the road, and increase the charge at the most congested times of day to deter motorists from driving excessively, especially in peak hours.	Electronic Road Pricing in Singapore	Failure to introduce Road Pricing in many cities.
Restrict/auction number of license plates for cars	R	L	H	Limiting the number of new car license plates permitted in a city to reduce the number of car sales in the city and help tackle congestion.	New car licence plate auctioning in Shanghai, China	Lack of fully effective car registration schemes, hindering the development of effective restriction/auction policies
Promote car-free city areas, pedestrian zones and low emission zones	P, R	L	M	Identifying areas of the city where either no vehicles will be permitted, or permitting vehicles to only vehicles or classes of vehicles meeting a prescribed standard of emissions to improve local air quality and cut congestion.	Seoul's voluntary No Driving Day Car free day in Jakarta, Indonesia.	Lack of low emission zones in majority of Asia and the Pacific countries.
Set vehicle registration tax	E	N	H	Varying vehicle registration tax based on weight or fuel efficiency to increase the cost of purchasing fuel inefficient vehicles.	Differentiated vehicle acquisition and ownership tax for low emission vehicles in Japan.	Very low automobile registration fees to encourage car purchase.
Remove fuel subsidies and tax fuel	E	N	H	Removing fuel subsidies and increasing fuel tax to reduce distances travelled, and to incentive consumers to purchase fuel efficient vehicles.	G20 and Asia and the Pacific Economic Cooperation (APEC) nations are planning to phase out support for fossil fuels.	Fuel subsidies still exist in many Asian countries.
Remove car-oriented subsidies	E	N	H	Remove subsidies for automobile manufacturing, and remove tax benefits for company cars to reduce the number of vehicles on the road.	Higher corporate car tax in the UK for vehicles emitting greater levels of CO_2 emissions	Many countries continue to provide large subsidies to the automobile industry.
Promote distance-based car insurance schemes	E	N, P	L	Vary the cost of car insurance based on distance travelled to incentivise a reduction in vehicle kilometres travelled.	Pay As You Drive (PAYD) car insurance schemes in North America.	Many PAYD schemes have been short-lived demonstrations or limited to specific consumer groups such as young drivers.

Shift						
Provide NMT infrastructure (accessible footpaths, cycleways)	P	L	L	Introduce new infrastructure for walking and cycling and ensure that new and existing cyclist and pedestrian facilities are attractive to existing and potential users.	Bogotá's "CicloRuta" cycle path networks (cover over 340 km and connects with major bus rapid transit routes, parks and community centres)	Bicycle use banned on major arterials and bicycle lanes removed in many cities.
Introduce cycle sharing schemes	P	L, P	L	Introduce bike sharing schemes in urban areas to increase the share of bicycle trips for short distance journeys.	Public cycle hire scheme in Guangzhou, China with docking stations at BRT stations.	High level of initial bike thefts
Develop public transport***	P	L, P	M-H	Ensure that public transport provision has the appropriate level of service and coverage to meet potential user demand to retain the modal share of public transport.	High quality, frequent bus services in Beijing, China.	Poor financial management of bus services in some Indian cities.
Develop dedicated lanes for public transport (buses and BRT)	P	L	M-H	Introduce dedicated lanes for public transport in congested urban areas to help guarantee fast and reliable public transport service.	Exclusive BRT lines in Beijing, Hangzhou, Guangzhou etc in China.	Invasion of BRT corridors by general traffic, leading to speed reduction and service quality.
Develop marketing campaigns	I	L	L-M	Inform the public about the travel alternatives available to them or about the environmental, economic and social impacts of (motorised) transport to encourage increased public transport patronage and public acceptance of sustainable transport interventions.	Advertising BRT on prime time television in Jakarta.	Poor communication of the concepts and features of the BRT system and differentiation between BRT and conventional bus systems.

Improve						
Promote and enforce vehicle efficiency standards	R	N	H	Set and enforce statutory vehicle efficiency standards to stimulate manufacturers to invest in and promote technological change and improve the fuel economy of vehicles.	South Korea's fuel economy rating scheme introduced in 2005.	Industry bodies such as ACEA, JAMA and KAMA have so far failed to meet voluntary standards.
Set fuel standards	R	N	M	Set statutory fuel standards to improve the quality of fuels.	Phasing out of lead from gasoline in Indonesia.	Poor quality fuels continue to be used across Asia.
Promote new vehicle technology and infrastructure	I, P	N, L, P	M	Support the development of new vehicle technology and infrastructure to reduce the level of greenhouse gas emissions and air pollution.	Modernisation of cycle rickshaws in India Alliance of 16 of the largest State-owned companies created in China to accelerate development of electric vehicles in China	Highly polluting two-stroke engines continuing to be used in many Asian countries.
R&D and promotion of new fuels	T	N, P	M	Develop and invest in research and policies to support the uptake of lower carbon fuels such as methanol, natural gas, liquid petroleum gas (LPG), ethanol, hydrogen, and electricity.	EU's electric vehicle initiative which aims to ensure that additional electricity demand is met by renewable electricity.	First generation bio-fuels with negative environmental impacts.
Develop Intelligent Transport Systems	T, P	N, P	M	Consider the range of new technologies that are available in the private, public and freight transport sectors, for example automatic toll collection, automated driving etc.	Intelligent transport systems in Korea including more efficient toll collection systems.	Limited technical expertise in developing countries could lead to the introduction of poorly designed schemes.

* P: Planning, R: Regulation, E: Economic, I: Information, T: Technology
** L: Local governments, N: National governments, P: Private sector
*** Public transport will be examined in depth in Chapter 4 of this report.
****: H = More than 25% reduction from BAU, M = Between 10-25% reduction from BAU, L= Less than 10% reduction from BAU. Note that mitigation potential depends heavily on degree of implementation, city context and how they are packaged with other policies.

2.4 The Roadmap: How to apply the ASI strategy in Asia and the Pacific

The different types of instruments need to be implemented in coordination with each other, based on the context in which they are being applied. Here, an attempt is made to provide a tailored roadmap for cities in the Asia and the Pacific region, which would match their characteristics and needs. For this, the following three steps are hereby pursued:

1. **Examining and understanding the city context:** As a first step, cities are classified based on their relative size and phase of development, which dictates to a large extent the transport patterns of the city. This will determine to a large extent the priorities in actions that need to be taken.

2. **Developing a long-term strategy/vision:** Once the city context is determined, a number of long term strategic directions adapted according to the city context are suggested. These will provide guiding visions of the development of the city and its urban transport system.

3. **Prioritising actions: T**he rough order in which specific policy measures are to be implemented are then be set out, according to the long-term strategy/vision.

Throughout these steps, local decision makers are encouraged to actively identify and link their current problems with the roadmap. This will allow the solutions to be fully aligned towards local needs, thereby increasing public acceptance.

2.4.1 Step 1: Examining the city context

The Asia and the Pacific region encompasses a large region with a diverse range of cities. As appropriate interventions in urban transport are closely linked to city development, it is important to firstly recognise the context in which transport policies are to be implemented. In this study, cities will be distinguished by:

- **Population size:** Three categories of cities are suggested - Small cities which are up to 500,000 inhabitants, medium size cities which are between 500,000 and 5 million, and large cities which are larger than 5 million.[10]

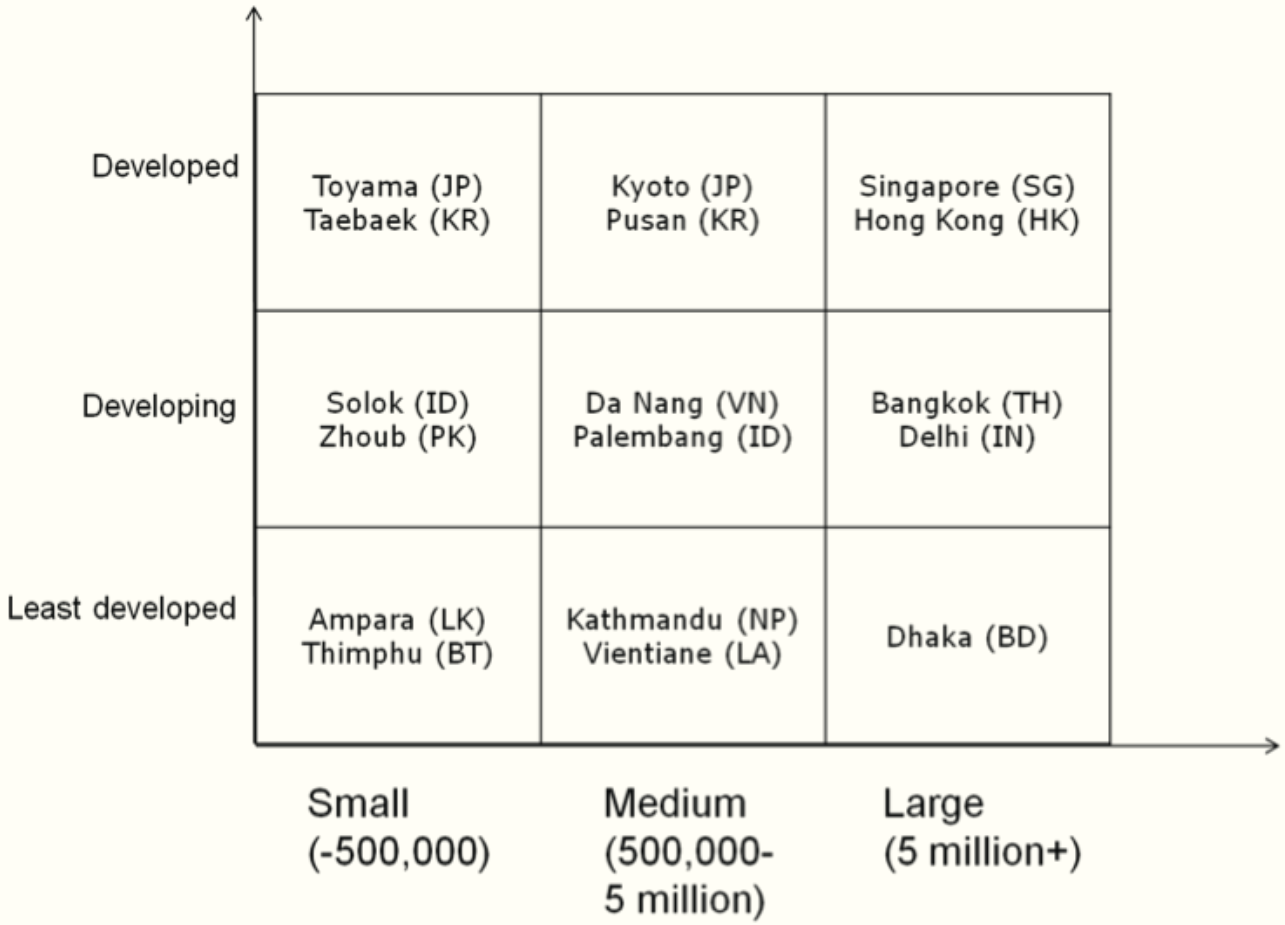
- **Level of development:** three levels of development are also proposed - cities found in least developed countries, developing countries and developed countries [11].

A combination of these two dimensions yields nine different categories of cities, as shown in the figure below with some examples of actual cities in the Asia and the Pacific region.

[10] Note that there is no standard definition of small, medium and large sized cities. In this study, thresholds used in ADB (2008) Managing Asian Cities are simplified into three categories. The ADB study is available at: http://www.adb.org/Documents/Studies/Managing-Asian-Cities/mac-report.pdf

[11] Definitions follow those used by the UN, found at: http://unstats.un.org/unsd/methods/m49/m49regin.htm

Figure 12: Types of cities



Their general characteristics and trends that face the transport systems in each of the categories of cities are as follows:

- **Small, least developed cities:** Such cities include Ampara in Sri Lanka and Thimphu in Bhutan, are generally economic centres within their respective regions, with little to no formal public transport systems. Vehicle ownership is still very low, but citizens with relatively high income are beginning to purchase private vehicles.

- **Medium, least developed cities:** These cities are often the capital cities of smaller, least developed Asia and the Pacific nations and include Kathmandu in Nepal and Vientiane in Laos. Public transport in these cities is generally limited to paratransit and buses (often informal and low in terms of service quality).

- **Large, least developed cities:** These cities are often the capital cities of more populous, least developed countries such as Dhaka in Bangladesh. Despite their large population, public transport systems have yet to be fully formalised, and the rapidly increasing traffic clogs up the streets.

- **Small, developing cities:** These cities are in countries in which rapid urbanisation and economic growth are seen. Cities such as Solok in Indonesia and Zhoub in Pakistan are likely to grow several-fold in the coming decades. Their transport systems are still informal, but as the city grows in wealth, its inhabitants are rapidly acquiring two wheelers and four wheelers.

- **Medium, developing cities:** Cities such as Palembang in Indonesia and Da Nang in Vietnam are regional centres of populous, rapidly developing economies. Their public transport systems are generally based on buses and minibuses, but suffer in terms of quality of service. Motorisation is rapid, and streets are increasingly becoming congested due to lack of transport demand management measures.

- **Large, developing cities:** This includes the megapolis of Bangkok, Thailand, and Delhi, India, as well as many other cities across the developing Asia and the Pacific region. They are often responsible for the growth of the national economy, but are becoming inefficient due to heavy congestion and limited high-capacity public transport such as metro systems and BRT. Some of such lines exist, but are not enough to operate as a full network.

- **Small, developed cities:** These cities are located in developed countries such as Japan and Korea, and face a rapidly ageing and shrinking population. Public transport in these cities is generally bus-based, but operators struggle to maintain profitable service due to the diminishing demand and high level of private car ownership.

- **Medium, developed cities:** These cities are regional centres within developed countries, with a highly developed network of public transport services, which are generally bus-based. These cities also face an ageing and shrinking population, and maintaining the current network and quality of service is a major challenge.

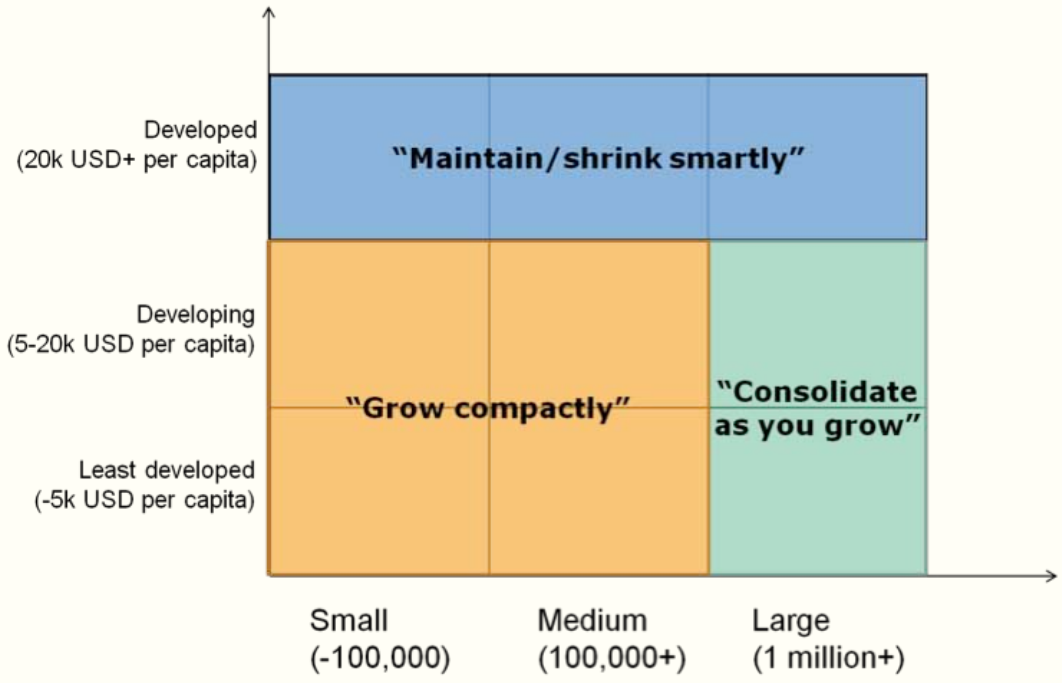
- **Large, developed cities:** These cities are often capital cities in developed countries, with decades of continuous investments in public transport networks including metro systems, urban rail and buses. These cities are not immune from heavy congestion, due to high car ownership and use by its citizens. Reducing dependency on private motorised vehicles is particularly challenging in these cities due to the fact that land use patterns are difficult to alter from their current state.

2.4.2 Step 2: Developing an overarching strategy/vision

Each of the types of cities identified in 2.4.1 requires an overarching strategy and vision [12] that would ultimately serve to improve the quality of life of its citizens. Such strategy/vision would ideally be generated through a participatory process, to reflect the specific needs of each city.

Here, no attempt is made to develop tailored strategies/visions for each and every city in the Asia and the Pacific region. Rather, a number of guiding suggestions are provided that would generally hold for the various types of cities identified. These are presented in the figure below.

Figure 13: Typified overarching strategy/vision for various city types



[12] In this study, the focus is on short (up to 2020) and medium (up to 2030) term. However, as decisions on transport today shape the transport patterns in the long term (several decades, if not centuries), it is imperative to consider the long term.

1. Small and medium size cities in least developed and developing countries are expected to grow significantly in the next few decades. An overarching strategy for such cities could be to "grow compactly", which would be made possible through careful land use planning integrated with transport network planning. The additional (housing) developments expected could take place along public transport corridors to promote transit oriented development, involving private operators of railways who may also be allowed to develop the land around the corridors and use the revenues to cover the cost of developing rail infrastructure.

2. The largest cities in least developed and developing countries are often already sprawled, and this is set to continue under business as usual. Here, the strategy would be to "consolidate as you grow", implying a revision of current land use regulations to encourage dense and mixed land use, and the development of high-quality public transport corridors to facilitate movement within and into the central business districts. In these cities, there is still a large scope for land use to change before people and businesses are locked in to a permanent situation. To leverage private resources, firms may be invited to bid for the right to build and operate the key transport corridors. A key consideration is how to regenerate and improve the quality of life in those often living in the slums in the outskirts of the city.

3. Cities in developed countries, irrespective of their size, are likely to face a decreasing and ageing population in the long run. Cities in currently developing countries such as China and Vietnam are also likely to follow this pattern during the timeframe of this roadmap (up to 2030). For these cities, a key overall strategy would be to "maintain/shrink smartly". City centres (which face hollowing-out) would need to be revitalised through improving the pedestrian/cycling environment, and providing high, quality and demand responsive public transport systems that can cater for the needs of all citizens, especially senior citizens. Private companies could be encouraged to offer tailored services (such as home delivery of groceries) to further address their needs. This strategy also applies to cities in developing countries, in which populations are shrinking and ageing due to the migration of young people into other (larger) cities.

Each of the above three types of strategies may be further broken down into variants, depending on the current modal split observed, and the existing patterns of public transport systems in each city. Such variations of the strategy are pursued in Chapter 4, where a focus will be placed on how to develop effective urban public transport systems to support green growth.

Box 7: A city with a long term vision: City Master Plan for Green Growth in Seoul, Korea

Seoul is the first city in Korea to establish and announce a 'Master Plan for Low Carbon Green Growth'. The master plan is a long-term green policy that provides a framework for Seoul to transform itself into a low-carbon green city. By 2030 the city is planning to reduce GHG by 40%, energy consumption by 20%, and raise new/renewable energy use by 20%.

The city has recognised the importance of making changes in the transport sector in order to meet these targets and have made this a key focus of the wider masterplan. Interventions proposed to reduce the level of emissions from the sector include:

- The use of green vehicles for all public transport
- Increasing usage of public transport to 70%
- Increasing levels of cycling by 10% by creating 207km of bike lanes
- Promoting activities such as Eco-Mileage, Eco-Drive and Eco-Tour to reduce the carbon intensity of citizen movement.

A new system of 'Energy City Planning' is to be established whereby climate change and energy use is to be considered in the city's planning processes, for example through engaging climate change energy experts when developing urban plans.

Seoul is also known for its efforts to remove urban elevated highways, as shown by the example of the Cheonggyechon Restoration Project in Annex 1.

Source: C40 Cities Climate Leadership Group (2008)

Box 7: A city with a long term vision: City Master Plan for Green Growth in Seoul, Korea - Continued

Figure 14: The restored Cheonggyechon River where a motorway once stood
(Photo: Ko Sakamoto)

2.4.3 Step 3: Prioritising actions

Under the three broad long-term strategies suggested in 2.4.2, specific policy measures can then be considered and prioritised in terms of their order of applicability/importance, and timing of implementation.

The table overleaf provides a rough approximation of some representative policy measures[13] that are to be implemented under each of the long-term strategies in:

- The very short term, i.e. within the next 5 years
- The short term, i.e. from now until 2020
- The medium term, i.e. from now until 2030

For convenience, information is again provided for each policy measure on:

- Its type, i.e. planning, regulation, economic, information and technology (see section 2.2)
- Support for the two aims "push" and "pull"
- The key stakeholders that would enable the delivery of the policy measure, including local (city/municipal) governments, national governments and the private sector.

[13] The policy measures listed here are those which are thought to be the most appropriate/ applicable to cities in the Asia and the Pacific region. It is not meant to be an exhaustive list of policy measures that can be used to promote green, sustainable transport.

Table 7: Policy priorities

Policy measure	Type of policy*	Key stakeholders**	Supportive of: Push	Supportive of: Pull	Priority under strategy/vision*** Grow compactly	Priority under strategy/vision*** Consolidate as you grow	Priority under strategy/vision*** Maintain/ shrink smartly
Avoid							
Develop integrated transport and land use master plans	P	L, N	✓		VS	VS	VS
Manage parking	E, R, P	L, P	✓		VS	VS	VS
Implement congestion charging/road pricing	E	L	✓		M	S	S
Restrict/auction number of license plates for cars	R	L	✓		S	VS	S
Promote car-free city areas and low emission zones	P, R	L	✓	✓	VS	VS	VS
Set vehicle registration tax	E	N	✓		VS	VS	VS
Remove fuel subsidies and tax fuel	E	N	✓		VS	VS	VS
Remove car-oriented subsidies	E	N	✓		VS	VS	VS
Promote distance-based car insurance schemes	E	N, P	✓		M	S	S
Shift							
Provide NMT infrastructure (accessible footpaths, cycleways, pedestrian zones)	P	L		✓	VS	VS	VS
Introduce cycle sharing schemes	P	L, P		✓	S	S	VS
Develop public transport****	P	L, P		✓	VS	VS	VS
Provide priority signalling for public transport	P, T	L	✓	✓	S	VS	VS
Develop dedicated lanes for public transport (buses and BRT)	P	L	✓	✓	S	VS	VS
Develop marketing campaigns	I	L	✓	✓	VS	VS	VS
Improve							
Promote and enforce vehicle efficiency standards	R	N	✓		VS	VS	VS
Set fuel standards	R	N	✓		VS	VS	VS
Promote new vehicle technology and infrastructure	I, P	N, L, P		✓	S	S	VS
R&D on new fuels	T	N, P		✓	S	S	VS
Develop Intelligent Transport Systems	T, P	N, P	✓	✓	M	S	VS

* P: Planning, R: Regulation, E: Economic, I: Information, T: Technology
** L: Local governments, N: National governments, P: Private sector
*** VS: Very short term priority (next 5 years), S: Short-term priority (from now until 2020), M: Medium-term priority (from now until 2030)
**** Details on the development of public transport will be elaborated in Chapter 4 of this report.

Key actions by each city group are described below:

- Cities that are associated with the "grow compactly" strategy would benefit from developing integrated transport and land use master plans at city level to set out a long-term vision of the city's development. Master plans should be locally driven and owned, and be backed by strong political support. It should also include strategies to leverage support from the private sector as well as civil organisations. They should be strongly linked to

a wider city strategy/vision as stipulated in local development plans, district plans etc. The master plan could include plans for the implementation of key policy measures, including parking management, restriction/auctioning of license plates for cars, promotion of car-free city areas and low emission zones which would all contribute to avoiding the growth of travel by private motorised vehicles.

The above can be supported by further measures taken mainly by the national government to set the right conditions to keep car ownership/use rates low, including the removal of fuel subsidies and taxing fuel, removal of subsidies on car use (e.g. tax breaks for corporate cars), setting vehicle registration taxes and license auctioning schemes.

Furthermore, these cities could stipulate how non-motorised transport infrastructure (such as fully-accessible footpaths and cycleways could be planned within the city, and how public transport systems with priority signalling and dedicated rights of way (e.g. bus lanes) could be developed. Information campaigns that highlight the benefits of public and non-motorised transport could further encourage would-be motorists to maintain use of alternative modes.

In addition, national governments can legislate and enforce vehicle and fuel standards to improve the energy efficiency of vehicles on the road.

- Cities belonging to the "consolidate as you grow" strategy would benefit from all the policy measures that were described for the "grow compactly" group. However, these would need to be undertaken at wider scale, reflecting the larger size of these cities. In particular, the development of public transport would not be limited to road-based systems such as buses and BRT, but also contain metros, subways and monorails with larger carrying capacity (see Chapter 4 for further details). New homes to accommodate the additional in-migration into the city can be planned along these public transport corridors to promote transit-oriented development.

- Finally, cities associated with the "maintain/shrink smartly" strategy are already likely to have implemented many of the policy measures that are listed, such as the development of public transport networks. However, a renewed emphasis could be placed to consolidate land use and revitalise city centres by revising regulations around land use and installing congestion charging schemes. The environment for pedestrians and cyclists could be further improved, and cycle sharing schemes could be rolled out. The integration of different public transport modes could further take place. In addition, national governments of these cities can immediately assist in the development and implementation of new low carbon vehicles and infrastructure (e.g. for electric vehicles), research and development of new fuels, and the development of Intelligent Transport Systems (ITS).

3 Pushing away from motorised private transport

3.1 Managing demand for private cars as a precondition for sustainable transport

As noted in Chapter 2, one of the key pillars to move towards sustainable transport is to maintain low dependency on, or reduce the use of private cars. This can be considered as a precondition for the successful operation of public transport systems.

Without controlling private cars, no type of public transport will ultimately be able to succeed in becoming financially and technically sustainable.

3.2 Policy measures supportive of the "push" approach

A number of policy measures and combinations thereof, are effective in this regard. These centre upon policies to be implemented at the local level, e.g;

- Integration of land use and transport planning
- Congestion charging/road pricing
- Parking management
- Promoting car-free city areas and low emission zones [14]
- Restriction and auctioning of number of license plates for cars

In addition, several other policies implemented at national level are important in setting the correct market signals to rationalise private car use. These include:

- Setting vehicle registration tax
- Removing fuel subsidies and tax fuel
- Removing car-oriented subsidies

Furthermore, innovative private-sector led policy measures can also be utilised, such as:

- Promoting distance-based car insurance schemes

Note that the above measures are complimentary to each other, and that their combined use will reap the highest impact in terms of reducing the use of private cars. All of these measures are generally implementable with very little financial resources and possess very short payback periods. In addition, many of the measures allow for the collection of additional revenue, which can be reallocated for use in financing sustainable transport (e.g. infrastructure and operation of public transport).

The following sections provide in factsheet format further information with regards to these policy measures, touching upon the key principles associated with the policy measure, what the measure involves, key benefits and strengths, barriers to implementation, how they can be implemented, successful examples and further references.

3.2.1 Develop integrated transport and land use masterplans

How people travel and how goods are transported are heavily influenced by what kind of urban structure is in place. It is imperative to build cities that cater to the mobility needs of people, not cars. Integrating decisions on land use with those for transport is therefore of vital importance, to ensure the move towards more sustainable cities. New neighbourhoods should ideally be built around a public transport corridor, to minimise reliance on the car.

[14] Note that some policies such as promoting car-free city areas can also be regarded as "pull" policies, as they actively support the development of public and non-motorised transport.

What does the measure involve?

This measure generally concerns the development of a masterplan and an associated institutional structure that allows for issues of urban land use (i.e. how land is allocated to functions such as commercial, residential or industrial) to be strategically linked to how the transport network is designed. The overall goal is to ensure that development of land (both new and regenerated) is conducted with the consideration of its transport-generating impacts, and minimise any potential problems in advance. More specifically, it aims to ensure that:

- Public transport, cycling and walking facilities are existent or newly provided at potential origins and destinations – e.g. shopping facilities, schools, hospitals, residential areas, commercial centres etc.
- Urban sprawl is contained, by zoning and restricting the ad-hoc development of land, especially in the outskirts of the urban area.
- Mixed land use is encouraged, so that a particular area of the city contains a good mixture of commercial and residential space, which in turn reduces the need to travel excessive distances for shopping, commuting etc.

What are the key benefits and strengths?

The promotion of dense, compact cities with mixed land use allows travel distances to be minimised, and fosters movements by sustainable modes such as walking, cycling and public transport. Increased density also allows for public transport to become profitable. Hence, the development of integrated transport and land use masterplans can be considered one of the single most important aspects of transport demand management. Other transport demand management measures (such as those introduced in this Chapter) as well as those relating to public transport enhancements (as explained in Chapter 4) may be considered within the context of these masterplans.

What are the barriers to implementation?

The integration of land use and transport planning is often jeopardised by:

- Lack of institutional integration, where one government department is in charge of land use planning, and another on transport.
- Lack of land rights, regulation and planning laws, which means private developers are free to develop land in ways which are not suited to sustainable forms of transport.
- Lack of a long-term strategy, which promotes ad-hoc planning and development without concern for the long-term viability of the city and its transport system.

How can they be implemented?

Integration of land use and transport planning could be fostered through:

- Establishment of a coordinating body at local level that links plans on transport with those on land use and formulates integrated master plans.
- Strengthening of land rights, regulation and planning laws, to ensure that private developments are done in ways to support sustainable forms of transport.

What are some successful examples?

- In Aguascalientes, Mexico, new private developments are combined with mixed land use, public transport routes, green spaces and bicycle/walking routes.
- In China, "ecocities" are now being built in e.g. Dongtan, Tianjin and Tangshan, which include regulations on vehicle access/egress, and parking. The proposed ecocity project in Changxing (Fengtai District, Beijing) includes a target to have 50% of the inhabitants within 600 metres of a MRT station, and 100% of the inhabitants within 400 metres of a bus stop (Stanley CT Yip, 2008).
- In Sweden, out-of-town shopping malls cannot be building without proving accessible by public transport.
- In Japan, suburban towns and cities are often built around railway corridors, allowing the public to access the city centre by rail.

Figure 15: Department stores built on top of railway stations in Tokyo, Japan
Photo: Ko Sakamoto

Further references

- Embarq (2010) Aguascalientes – Housing http://www.embarq.org/en/project/aguascalientes-housing
- VTPI (2011) How Land Use affects Transport: http://www.vtpi.org/landtravel.pdf

3.2.2 Congestion charging/Road user charging

Roads are not a free resource. Their use by private cars not only results tear and wear, but also congestion, air pollution, climate change, noise, vibration and other forms of environmental and social costs. Congestion charging/road user charging is one way to confront road users with these costs which otherwise would go unpaid. The charge should reflect the extra costs the road user causes.

What does the measure involve?

Congestion charging and road user charging can take many forms in practice. As noted in VTPI (2011), they can be implemented via:

- Road tolls – generally found on highways and bridges, where the fee is collected each time the motorist uses a stretch of road.
- Cordon tolls – where drivers are required to pay for entering a particular area, usually the city centre.
- Distance-based fees – where drivers are required to pay for each unit of distance travelled. This includes for example schemes currently being considered in Europe where cars are tracked via satellite and charged according to their movement

All of the above can be implemented so that the charge differs according to the level of congestion. Although real-time measurements of congestion could be reflected in the price, proxy indicators are utilised in practice, for example the time (hour) of day and day of the week.

What are the key benefits and strengths?

Congestion charging/road user charging rationalises road space so that they are used only by those who are prepared to pay for the costs they impose on wider society. It can cut down on traffic levels, and thereby the social and environmental costs mentioned before (see Annex for an example from London, UK).

The key strength of charging for road use is its flexibility: The price can be made to reflect the "real" costs of certain users to society, whereby for example a higher fee could be charged for heavy goods vehicles (which impose a larger degree of wear and tear on the infrastructure), or cars entering the congestion charge zone at the most congested times of the day can be made to pay a higher fee.

What are the barriers to implementation?

Implementing a congestion charge can be made difficult by:

- Opposition by the public, media, local businesses and politicians
- Lack of the technology required to monitor and enforce the scheme
- Lack of certainty over its impact on traffic (e.g. spillovers onto other roads)

How can they be implemented?

- Public opposition can be mitigated through strong political leadership, supported by public communica tion of the long-term benefits of congestion charging, including reduction of traffic and associated envi ronmental and social impacts.
- Extensive ex-ante modelling and piloting can help understand the consequences of the congestion charge on traffic patterns, including unexpected spill-over effects (increase in traffic on certain roads which are not under the congestion charge etc)
- Financial revenue raised from the scheme can be redistributed to support public transport and other forms of sustainable transport.

What are some successful examples?

- In Singapore, an Electronic Road Pricing scheme has been operational since 1975, mitigating the city from deadlock.
- In Stockholm Sweden, congestion charging was successfully on a permanent basis in 2007 through care ful public consultation and referendums.
- In London UK, the revenues from its congestion charge are used to improve bus service quality and other aspects of the public transport network (see Annex)

Figure 16: Double dividend: Revenues from the Congestion Charge in London are being used to partly finance buses (Photo: Ko Sakamoto)

Further references

- EEA (2008) Success stories within the road transport sector on reducing greenhouse gas emission and producing ancillary benefits. http://www.eea.europa.eu/publications/technical_report_2008_2
- TfL (2007) Congestion charging. http://www.cclondon.com/whatis.shtml.

3.2.3 Parking management

Every car journey begins and ends at a parking space. The availability and cost of parking space therefore has a direct impact on whether cars are used for a specific journey.

By restricting the supply of, or increasing the cost of parking in the city centre, journeys made by private cars can be significantly reduced.

What does the measure involve?

Parking management involves the combination of a subset of different measures, to target both on-street and off-street parking. According to Rye (2010):

- Parking regulation can limit parking outright, for certain times of the day, or the maximum length of stay in one location.
- Parking fees could be introduced where currently not existent, and increased where demand outstrips demand. Parking fees could be made flexible to reflect time of day, amount of demand, etc.
- Planning can consider dedicated residential parking areas, maximum parking standards for new build ings, Park&Ride facilities, and parking guidance systems to reduce the need for on-street parking in city centres.

Table 8: Best parking management measures for different problems (Source: Rys, 2011)

Problem	Responses and examples
The people who get to use parking spaces are those that arrive there first but this might not be the most beneficial use where parking spaces are scarce.	■ Restrict maximum length of stay in some parking spaces. Example: Shiraz, Iran; Kampala/Uganda. ■ Price: if priced, cheaper per hour for short stays than long stays. Example: Delhi, Nehru Place. ■ Provide and/or make people more aware of off-street parking. Example: Shiraz, Iran.
On-street parking causes safety and congestion problems.	■ Restrict parking on main roads at congested times. Example: Kampala, Beijing, Bogotá. ■ Restrict parking where it causes safety problems. ■ Price/advertise off-street parking to make it more attractive. Example: Beijing.
Poor management of on-street parking and/or lack of information about parking availability in areas of high demand leads to large amounts of traffic circulating looking for a parking space contributing to congestion and pollution.	■ Provide more information. ■ Price/advertise off-street parking to make it more attractive. Example: Beijing. ■ Park and ride. Example: Istanbul.
Parking regulations are not enforced or poorly enforced and enforcement and management is sometimes informal and/or corrupt.	■ Improve enforcement. Examples: Accra, Beijing. ■ Change organisational practices. ■ Change institutional structure. Examples: Kampala, Istanbul.
Parking on pedestrian areas (footways across street corners) makes streets inaccessible to pedestrians.	■ Better enforcement. Example: Bogotá. ■ Self enforcing measures. Example: Sarajevo.
Where on-street parking is priced then it is often cheaper than off-street parking so people look for a scarce space on street whilst off-street car parks lie half empty.	■ Change pricing structures. Example: Beijing. ■ Better advertise off-street parking. ■ Improve quality of off-street parking.
The fact that there is some (free) parking available in city centres encourages people to drive there.	■ Gradually reduce supply of and/or increase price of parking in town/city centre. Example: Shenzen. ■ Park and ride as alternative to city centre parking. Example: Prague. ■ Limit maximum lengths of stay to encourage short stay parking but to discourage commuters. Example: Istanbul.
Town and city centres are concerned about losing custom to edge of town developments with lots of parking so they respond by trying to make it easier to park.	■ Providing more, cheaper parking can encourage more people to drive thus making the city centre even more congested. ■ Use space-efficient modes *e.g.* BRT to improve relative accessibility of city centre instead. Example: Bogotá, Curitiba. ■ Use pedestrianisation and parking management to improve the city centre environment so that people enjoy the city centre more and come there more often. Example: Bogotá.

What are the key benefits and strengths?

Managing parking is a relatively straightforward measure that does not require expensive and complex technologies (such as the case with congestion charging for example). If implemented correctly, it can rationalise journeys made by private cars, thereby reducing congestion and other social/environmental costs. Furthermore, it can turn whole streets and neighbourhoods from a space to park cars, to where people can enjoy the shared built environment.

What are the barriers to implementation?

The management of parking is often made difficult by:

- Opposition from car owners (due to increased cost of car use), local businesses (due to fears over reduction in footfall) etc.
- Lack of rules and regulations on the quantity and price of parking space, both on-street and off-street.
- Lack of institutions to plan and adequately enforce parking space.

How can they be implemented?

The appropriate management of parking can be fostered by:

- Establishing institutions (e.g. a special commercial body working under a public organisation such as a local transport authority) that plans, provides and sets the terms for using parking facilities.

- Ensuring that parking fees are more expensive than the fare for public transport.
- Empowering institutions (normally the police) that enforce the parking rules and regulations.

What are some successful examples?

- In Shenzen, China, the demand for parking has dropped 30% after parking fees were increased. Traffic flow is expected to decrease by 4% in the long term.
- In Japan, car owners are required to demonstrate proof of parking before purchasing a car.

Further references

- Rye, T (2010) Parking Management: A Contribution Towards Liveable Cities. www.sutp.org
- Barter, P (2010) Parking Policy in Asian Cities http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1780012##

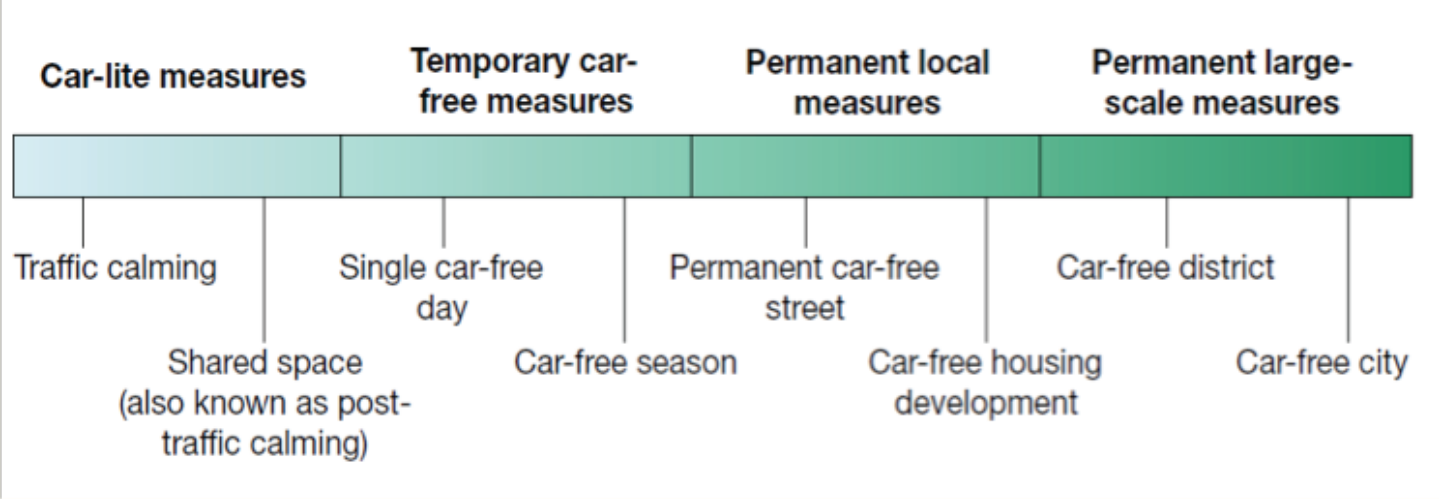
3.2.4 Car-free city areas

Cities built before the advent of the car were built for pedestrians. Cities which have kept or revitalised their car-free nature are now often the most liveable, and command higher property values. Developing cities can mirror this approach by ensuring that cities are designed for people, not for cars.

What does the measure involve?

The development of car-free areas can take many shapes and forms, depending on the context of the city. As noted by Wright (2005b), approaches could range from the traffic calming of a single street (via the introduction of e.g. speed bumps or chicanes) to a totally car-free city.

Figure 17: The wide spectrum of car-free development (Source: Wright, 2005b)



What are the key benefits and strengths?

By reducing dependency on the car, the city centre becomes more liveable, with less congestion, air pollution, noise, vibration and severance brought by heavy traffic. Land and property values can be improved as an effect. Businesses benefit from a higher level of footfall. The development of car-free areas within a city is relatively easier to enforce compared to e.g. parking regulations, as entry points into the zone can be secured against violating traffic, as opposed to policing a whole area. The technological requirements are also lower, compared to e.g. congestion charging.

What are the barriers to implementation?

Developing or maintaining car-free city areas have been made difficult by:

- Planning culture that prioritises the movement of cars, rather than people
- Opposition by businesses who fear a reduced level of commercial activity, and individuals who perceive the car as more convenient than walking

How can they be implemented?

Car-free city areas can be encouraged via:

- Developing an integrated transport and land use masterplan, with provisions for car-free areas especially for central shopping and business districts.
- Ensuring appropriate stakeholder analysis and outreach/marketing on the benefits of the scheme, espe cially the added business benefits (more footfall) and improved accessibility (shorter journeys)
- Proper design by skilled project team (including operational plans, conceptual designs and detailed engineering designs)

What are some successful examples?

- Car-free commercial trading streets in Japan, Korea and many Asian cities
- Pedestrianisation of Times Square in New York, USA
- Car-free residential area in Vauban-Freiburg, Germany
- Traffic-calmed residential blocks in Guangzhou, China

Figure 18: A place for people: Car free old city centre in Jakarta, Indonesia. (Photo: Ko Sakamoto)

Further references

- Wright L (2005b) Car-Free Development www.sutp.org
  ITDP (2010) Our Cities Ourselves http://www.itdp.org/documents/2010-OurCitiesOurselves_Booklet.pdf

3.2.5 Restriction of/auctioning license plates

The number of cars in developing cities is increasing exponentially, leaving cities increasingly congested, polluted and noisy. To curb the demand for car ownership, many cities are now implementing restrictions or auctioning of license plates, to directly control how many cars come onto the road in a given year/month.

What does the measure involve?

This measure involves directly limiting car ownership, by limiting the absolute number of vehicles to be sold and owned within the city area. Typically a cap is placed on the number of vehicle license plates that are issued within a timeframe (e.g. one month), without which cars cannot be sold, owned and used legitimately. As in the case of Shanghai and Singapore, vehicle license plates are auctioned on the market, often fetching very high prices that reflect their scarcity. Anyone wishing to own a car must purchase a license plate from the market.

What are the key benefits and strengths?

By limiting the absolute number of cars, cities can reduce the strain of ever-increasing car ownership, in the form of new road construction and parking space provision. Congestion, air pollution, noise and many other costs of motorised transport can also be reduced, compared to business as usual. This measure is different to others in that it aims to directly influence the absolute number of cars within the city. Research has shown that a person owning a car is less likely to use public or non-motorised transport, all else being equal. Hence, managing car ownership is likely to favour public transport patronage and contribute to the development of transit-oriented city development.

What are the barriers to implementation?

Limiting the number of licence plates is made difficult by:

- Opposition by the motoring lobby, who face a reduction in the sale of new cars
- Opposition by existing and future car owners

How can they be implemented?

The implementation of restrictions on/auctioning of licence plates is brought through:

- Setting a quota on the (increase in the) number of cars allowed in a specific period, e.g. one year.
- Putting in place a mechanism to distribute the license plates allowed under the quota (e.g. an auction ing system).
- Monitoring the car ownership and revising the number of quotas allowed.

What are some successful examples?

- In Shanghai China, licence plates for cars registered within the city are auctioned. The average price for a licence plate has in recent years exceeded 6000 USD. The revenues are used to support public trans port, including the construction of subway lines, and providing subsidies for buses and ferry services.

- Singapore has long implemented a wide range of measures to discourage car ownership, including a vehicle quota that allows for a controlled rate of increase in the vehicle population (1.5% in Fiscal Year 2009-10). The table below shows the current quotas for various types of vehicle categories and how they are set, based on the vehicle population of the previous year.

Table 9: Vehicle quotas in Singapore for the period Feb 2011 to July 2011
(Source: LTA, 2011c)

	VEHICLE CATEGORY	CATEGORY A Cars (1600cc and below) & Taxis	CATEGORY B Cars (1601cc and above)	CATEGORY C Goods Vehicles & Buses	CATEGORY D Motor-Cycles	CATEGORY E OPEN	TOTAL
1a)	Vehicle Population As at 31 Dec 2010	364,618	256,655	153,340	147,345	NA	921,958
1b)	Annual Allowable Increase in Vehicle Population [1.5% x vehicle population] [a]	5,469	3,850	2,300	2,210	NA	13,829
(A)	**Increase in Vehicle Population [b]**	**2,735**	**1,925**	**1,150**	**1,105**	-	**6,915**
2a)	Total Vehicle De-registrations (from Jul to Dec 2010)	5,348	4,525	3,181	3,731	-	16,785
2b)	Taxis de-registered without replacement [c]	17	-	-	-	-	17
2c)	Expired COEs [d]	9	50	0	33	155	247
(B)	**Replacements of De-registered Vehicles**	**4,033**	**3,444**	**2,386**	**2,832**	**4,354[e]**	**17,049**
3a)	Total Adjustments	-7,116	-3,155	-2,515	-346	-4,426	-17,558
(C)	**Adjustments for 6 Month Period [f]**	**-647**	**-287**	**-229**	**-31**	**-402**	**-1,596**
Total Quota for February 2011 to July 2011 Bidding Exercises (A + B + C)		6,121	5,082	3,307	3,906	3,952	22,368
Monthly Quota for February 2011 to July 2011 Bidding Exercises		**1,020**	**847**	**551**	**651**	**659**	**3,728**
Monthly Quota for August 2010 to January 2011 Bidding Exercises		1195	958	409	664	618	3,844

Further references

- China Daily (2011) Shanghai number plates worth more than a car http://europe.chinadaily.com.cn/china/2011-01/07/content_11810034.htm
- Litman T (2004) Mobility Management www.sutp.org
- LTA (2011b) Bid for a COE to Register a New Vehicle.

http://www.onemotoring.com.sg/publish/onemotoring/en/lta_information_guidelines/buy_a_new_vehicle/bid_coe.html

- LTA (2011c) Vehicle quota system. URL : http://www.lta.gov.sg/corp_info/doc/COE_Quota_Allocation_RV.pdf

3.2.6 Vehicle and fuel taxes / removal of car-oriented subsidies

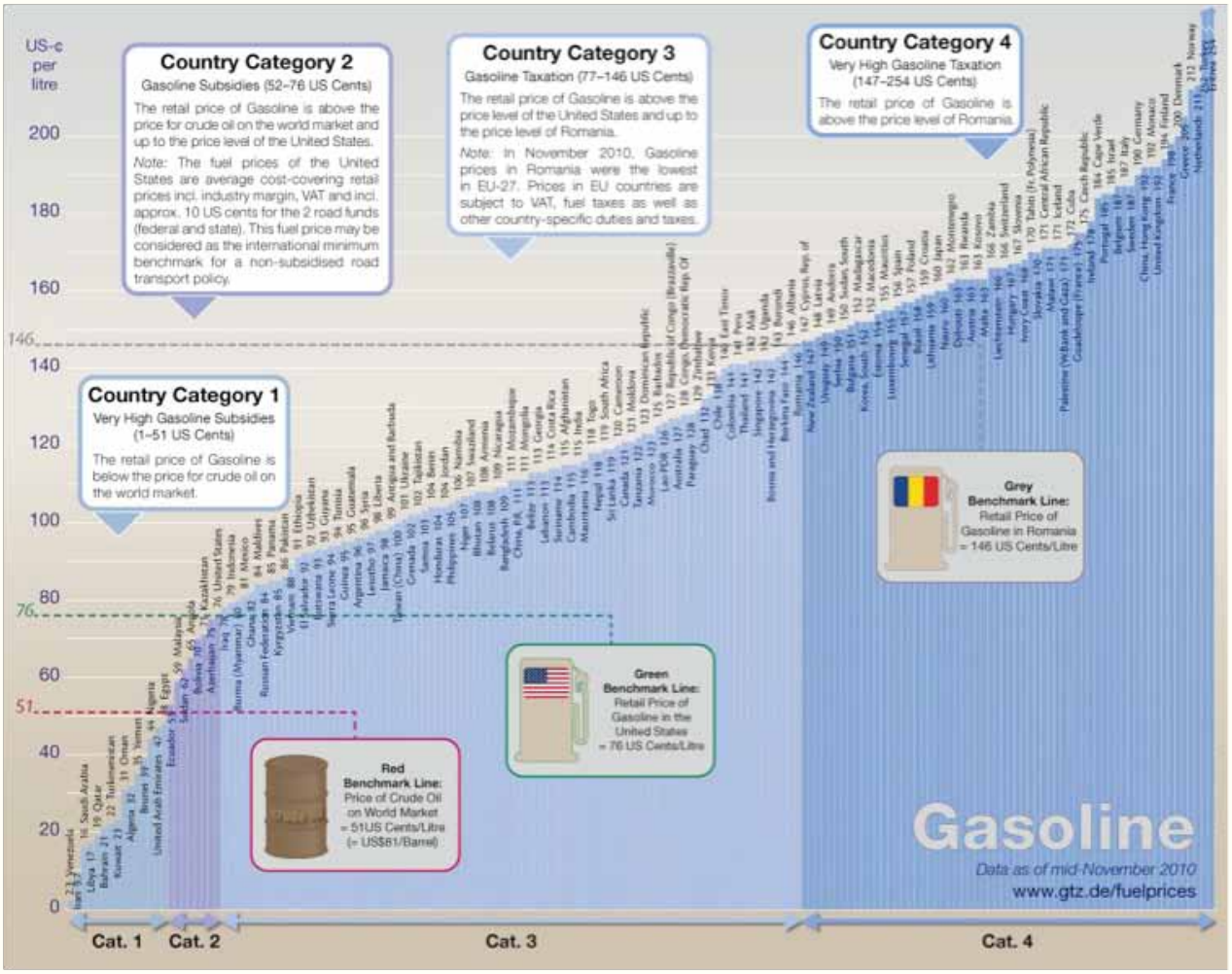
As with any other goods and commodities, the price of purchasing and running a car defines its level of demand. Historically, vehicles and fuels have been favoured in financial terms, through subsidies and tax breaks, thereby reducing incentives to move towards sustainable transport patterns. It is imperative that such financial preferences be removed, and that vehicles and fuels are priced in ways that reflect their costs to society and the environment.

What does the measure involve?

Taxes on, or subsidies for vehicles and fuels are often applied at the national level, and are often designed to promote (either intentionally or otherwise) the use of private vehicles. To move towards sustainable transport;

- Fuel subsidies (commonly applied in countries in Asia and the Pacific) should be removed and instead fuels should be taxed so that pump prices (as a rule of thumb) reflect at least the European average (see figure below).[15]

Figure 19: Variance of gasoline prices by country, reflecting prevalence of subsidisation (Source: Wagner, 2011)



- The sale and ownership of vehicles should be taxed, and subsidies removed. Following practice in coun tries such as the UK, Japan, France, Germany and Spain, the tax on vehicles could be made to reflect their environmental performance, so that those cars with less fuel consumption would be made cheaper compared to those which are fuel inefficient.

What are the key benefits and strengths?

By removing subsidies on vehicle production and consumption and implementing a tax, the overall demand for private cars would be reduced and sustainable modes would be made more attractive in financial terms.

Taxes on fuels and vehicles are relatively easier to administer and enforce, compared to more localised charges such as parking charges and congestion charges. Transaction costs (i.e. the costs associated with their collection) are also relatively low. These taxes have the ability to raise a significant amount of revenue, which could hypothetically be invested in aspects of sustainable transport.

[15] According to Wagner (2011), as of November 2011, this equates to 146 US cents per litre for Gasoline, observed in Romania, and 136 US cents per litre for diesel, observed in Luxenbourg.

What are the barriers to implementation?

Removal of financial preferences on vehicles and fuels can be met with:

- Opposition from industry, particularly the motoring lobby
- Opposition from consumers, who perceive an increase in the cost of transport

How can they be implemented?

To overcome the aforementioned barriers:

- The removal of subsidies can be done gradually, to mitigate any large price changes within a short period. Targeted subsidies (e.g. in the form of cash payouts) can be provided to the most vulnerable members of society that may be affected by a rise in the fuel price.
- The revenue from the higher level of tax can be used to finance sustainable transport, for example the construction of public/non-motorised transport infrastructure and operation of public transport.
- The level of vehicle taxes can be linked to the environmental performance of the vehicle, so that higher polluting vehicles will need to pay more in tax.

What are some successful examples?

- In Indonesia, efforts have taken place to reduce the level of fuel subsidies, coupled with measures to reduce public opposition (see Annex)
- In Ghana and other African countries, revenues from fuel taxes are being used to maintain road infra structure in a consistent manner.

Further references

- GTZ (2010a) International Fuel Prices http://www.gtz.de/en/themen/29957.htm
- Ellis, J (2010) The Effects of Fossil-Fuel Subsidy Reform: A review of modelling and empirical studies http://www.globalsubsidies.org/files/assets/effects_ffs.pdf
- Litman T (2004) Mobility Management www.sutp.org

3.2.7 Distance-based car insurance schemes

Traditional forms of car insurance ask for a flat fee for a certain amount of insured period, e.g. one year. The fee normally does not reflect the amount of driving. Linking the insurance premium to the volume of vehicle use (kilometres driven) can serve as a financial incentive for drivers to use their cars less.

What does the measure involve?

Distance-based car insurance is a relatively new concept, but one that has been increasingly adopted by private insurance companies across the world. It involves changing the insurance premium based on the amount of driving that actually takes place, rather than the more conventional method of charging for a fixed annual fee that does not reflect the volume driven.

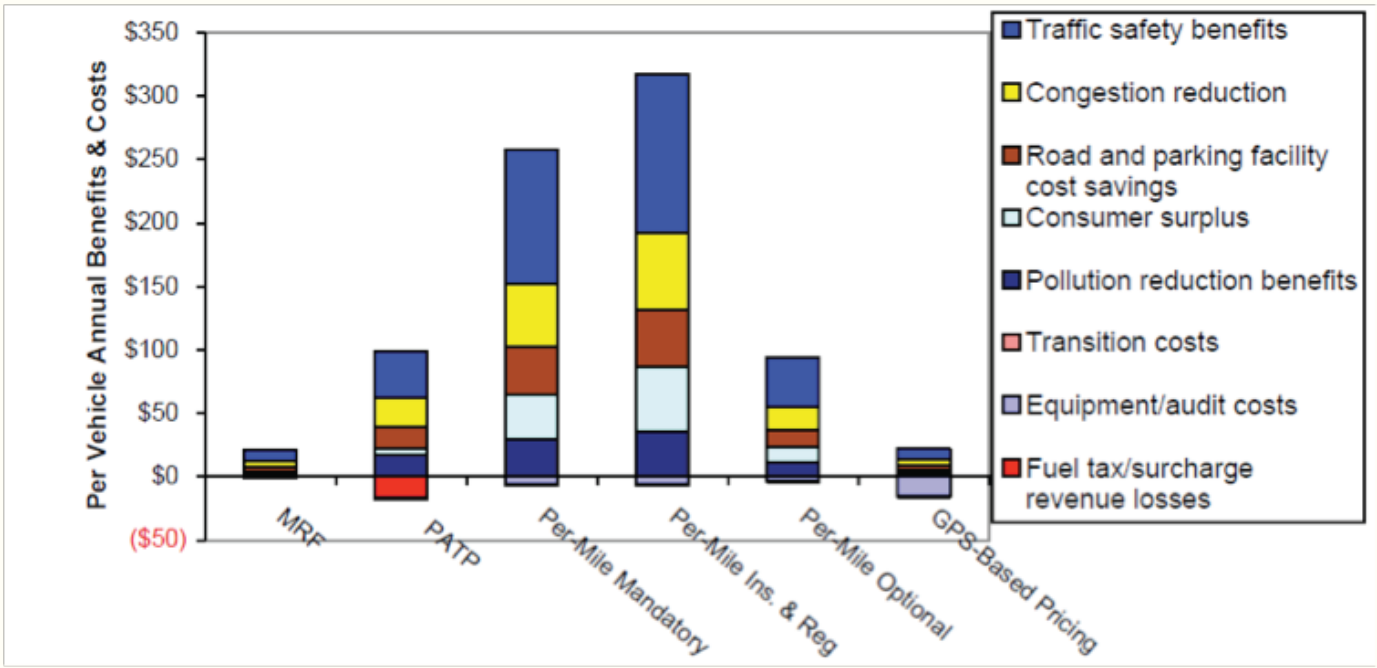
What are the key benefits and strengths?

Insurance companies save money by reducing their exposure to payouts, as this is directly related to the amount driven. Drivers are given a financial incentive to reduce the level of driving, to save on the insurance premium.

As a result, total travel volume is reduced, and the costs of private car use to society and the environment are mitigated.

A recent study by Litman (2011) shows that in a hypothetical case where all US motorists are made to pay a distance-based insurance premium (applied strictly per mile of travel actually travelled), the benefits (above the current system) will be seen in traffic safety congestion reduction, road and parking facility cost savings, consumer surplus and pollution reduction (see figure below).

Figure 20: Monetised benefits of a distance-based insurance scheme (Source: Litman, 2011)



As distance-based car insurance schemes are generally a private-sector driven scheme, it has the potential to be upscaled without large investments by the public sector. However, such private sector initiatives will only succeed if there is a strong legal framework in place, which mandates drivers to take out car insurance.

What are the barriers to implementation?

Barriers to the wider diffusion of such schemes include:

- Lack of awareness on the part of both insurance providers and consumers
- Costly upgrades on procedures, computer programmes etc required by insurers and brokers
- Larger transaction costs
- Less predictability and uncertainty perceived by users of the scheme

How can they be implemented?

Over time, the uncertainty and lack of awareness of distance-based insurance schemes may fall. To escalate their uptake:

- Governments can provide active support for such schemes through e.g. tax incentives
- The insurance industry can work collectively to promote such schemes, e.g. via a coordinating marketing campaign

What are some successful examples?

- In South Africa, a company provides distance-based vehicle insurance where monthly premiums are based on the distance driven in the preceding month. Driving distance is monitored via a GPS system

- In Australia, a company has initiated a Pay-As-You-Drive scheme where car users are asked to report on their odometer reading at the beginning of the policy period, and purchase a certain amount of distance to be covered by insurance.

Further references

- Real Insurance (2011) How Pay As You Drive Works http://www.payasyoudrive.com.au/howitworks.aspx
- Litman (2011) Distance Based Vehicle Insurance as a TDM Strategy http://www.vtpi.org/dbvi.pdf

4 Pulling new demand toward public transport

4.1 Making public transport a mode of choice

In parallel with measures to control the growth in private cars, aggressive measures are required to improve the competiveness and quality of public transport, in terms of affordability (price), comfort, convenience, speed and safety. These can generally be categorised as follows:

- **Reserve road space and give priority to public modes:** A certain amount of road space should be (re-)allocated specifically for public transport and non-motorised transport, e.g. in the form of bus lanes and cycleways. This allows for increased frequency, faster speeds, fewer delays and better reliability of public transport. Safety is also improved, as interaction with the general traffic is reduced. Signalling and junction design should allow public transport to gain priority over private cars.

Box 8: Planning for optimal road space use

To ensure that enough road space is allocated for public and non-motorised transport, the process of road design should be driven by a process that involves the various existing divisions within transport/land use authorities, and different levels of government, including the borough/ward/district level usually in charge of local roads, the city government in charge of larger collector/distributor roads as well as most forms of public transport, and national governments in charge of strategic roads and highways.

Public transport routes and networks should be considered in their entirety, and any pinch points should be eliminated through a combination of changes to road, signalling and junction design.

Figure 21: Dedicated bus lanes reduce delays to public transport in Jakarta, Indonesia (Photo: Ko Sakamoto)

- **Formalise services and integrate modes to improve connectivity and convenience (also with non-motorised transport):** Public transport in developing countries is often provided by informal providers. Such services should ideally be formalised, and brought under the control of an urban transport authority who would be responsible for integrating the various modes of public transport, so that they form part of a single system/network (see Box 9 and Chapter 5 for further details).

This network should cover a spectrum of services covering local services (typically catered by conventional buses, taxis and bicycles) and intra-zonal travel (typically catered by express buses, BRT and rail-based public transport systems).

Figure 22: Colour coded buses in Seoul providing a network of express (red) and local (blue) services (Photo: Ko Sakamoto)

- **Build quality infrastructure:** Infrastructure for public transport, such as bus/train/metro stations should enable easy access to all users, including those with mobility impairments. Ensuring good design standards from the outset also reduces further expenditures in future, as retrofitting/redesigning old infrastructure is often more costly and technically difficult. In the context of climate change, it is also important that infrastructure is designed and built with resilience against extreme weather events (such as flooding) as well as likely changes to the physical environment (such as sea level rises).

Figure 23: Transport infrastructure must be planned to be resilient against impacts of climate change (Photo: Ko Sakamoto)

- **Maintain infrastructure and vehicles:** Both infrastructure and vehicles need to be appropriately maintained, so that cleanliness, comfort and safety are maintained. Maintenance is crucial to ensuring that the large capital investments made in transport infrastructure and vehicles are fully effective. Budgeting for transport projects should ensure that maintenance costs are factored in from the beginning, and made available on schedule and without delay.

- **Provide information to the public:** The benefits of using public transport, including financial savings to households, improved health and lower burden to the environment need to be communicated to the public, e.g. through targeted campaigns. Furthermore, new technologies such as real-time information systems should be employed to further improve the attractiveness of public transport and non-motorised transport systems (see photos below).

Figure 24: Real-time public transport information board in Guangzhou, China (Left) and information board showing distances to key locations in London, UK (Right) (Photos: Ko Sakamoto)

- **Make it affordable:** Public transport fares should be set at rates which allow all members of society their use. Conversely, the price of using private cars should be higher than that of using public transport, e.g. through congestion charging and parking fees (see Chapter 3).

Achieving the above requires strong institutional coordination and adequate financing. These elements are further discussed and detailed in Chapter 5.

Box 9: The importance of integration through a strategic vision

It is important to consider how the different modes of public can be integrated, for example to ensure that conventional bus services, taxis and public bicycles act as effective feeders to forms of mass transit including BRT, light rail and metro systems. Such an approach can be most effectively managed if one body is given overall reasonability for the city's transport network and therefore the development and implementation of the vision (see Chapter 5).

Competition should not be between different modes of public transport, but rather between a system of transport that is built around the private car, versus one based upon a network of public transport systems.

Figure 25: Integration of different public transport modes as seen in Madrid (Photos: Ko Sakamoto)

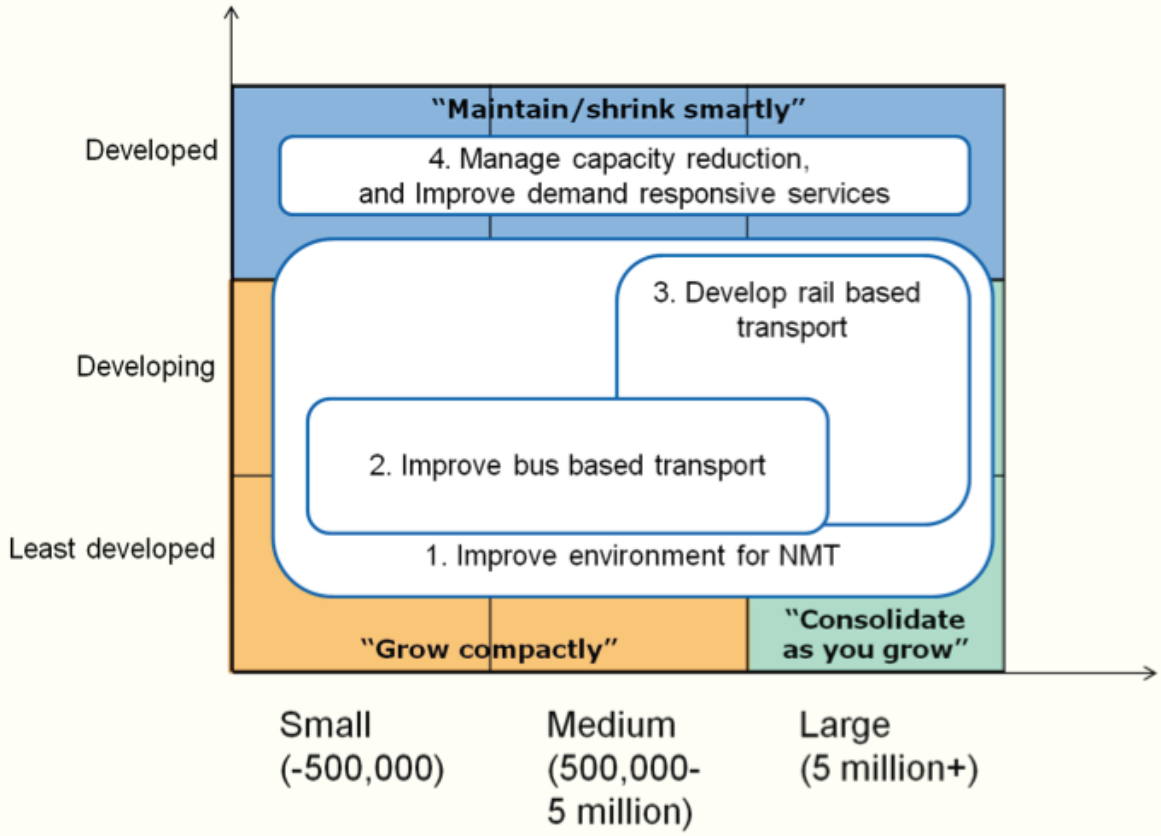
4.2 Key priorities for cities in Asia and the Pacific

The optimal combination of public transport modes depend heavily on the context of the city. On one side of the spectrum, a small low income city in which financial resources are constrained would likely need to prioritise the development of non-motorised solutions, such as walking and cycling, coupled with less-formal means of public transport such as cycle rickshaws and motorcycle taxis. On the other hand, a relatively developed megacity would likely benefit from investing in high-capacity formalised systems, such as Bus Rapid Transit (BRT) or rail-based Mass Rapid Transit (MRT). Minibuses and buses would play an important part of the public transport mix throughout the spectrum of cities.

Other factors such as geographical layout and terrain, land-use patterns and existing movement patterns dictate the optimal mixture of public transport system. It therefore goes without saying that the public system should be developed specifically to each city context.

Here, a number of typified priorities can be outlined for cities in the Asia-Pacific region. The figure below transposes a number of such representative priorities on the matrix of cities introduced in Chapter 2.

Figure 26: Typified public transport strategies for various city types



These priorities are detailed as follows:

1. **Improve environment for non-motorised transport:** For all cities in the region, a fundamental priority should be to improve the environment for non-motorised transport, i.e. walking and cycling. Irrespective of what other forms of public transport is existent, walking will always constitute the first and last leg of the journey, and therefore the improvement of the pedestrian environment should be a key consideration for cities of all sizes and level of income. Walking and cycling are often the most affordable of all transport options. Therefore, investments in walking and cycling infrastructure can be thought to be highly progressive.

2. **Improve bus based transport:** In parallel to the enhancement of non-motorised transport options, cities of all sizes and income levels should focus on the improvement of bus based transport systems. Buses are typically responsible for the vast majority of passengers carried on public transport, and their role in providing affordable mobility is unrivalled. As will be shown in detail in subsequent sections, buses are flexible in their routing, and can cater for low (minibus) to very high levels (BRT) of demand.

3. **Develop rail based transport:** In addition to the first two strategies, medium to large size cities with more financial means may wish to invest in rail-based mass transit options such as MRT and subways. Such systems have the benefit of allowing for very large levels of demand to be met, but are highly capital intensive. Land use policy could be synchronised with their development, so as to enable transit-oriented development around railway corridors.

4. **Manage capacity reduction and improve demand responsive services:** Finally, for cities which face a shrinking population, the reduction in capacity needs to be managed carefully, so that public transport services can maintain their financial feasibility despite the reduced demand. Taking also into account the new requirements of the ageing population, a key concept would be to move towards demand-responsive services (e.g. demand responsive bus services), which provide door-to-door access from the home to essential facilities including hospitals and shopping areas. Furthermore, home delivery services could be provided to offset shopping journeys.

4.3 Understanding the contribution of each mode of public transport

In the sections which follow, we examine a number of public transport modes in further detail, namely public bicycles, paratransit, conventional buses, BRT and trolley buses, light rail, heavy rail and metro systems, taxis and waterborne transport systems.

In choosing the optimal combination of public transport modes, it is important to keep in mind the relative strengths and weaknesses of each mode. The table below summarises the key characteristics of public transport modes with regards to their carrying capacity, distance to be covered, unit costs and payback period. Furthermore, it assesses their applicability in terms of city size (in population terms), stage of economic development and geographical constraints. Note that the figures shown are generalised, and that they vary according to each specific circumstance.

Table 10: Main characteristics of public transport modes

Type of public transport	Characteristics				Applicability*****						
					City Size			Stage of development			Geographical constraints
	Capacity*	Distance range**	Cost***	Payback period****	Small	Medium	Large	Least developed	Developing	Developed	
Public bicycles	L	L	L	L	✓	✓	✓	✓	✓	✓	Relatively flat conditions
Paratransit	L-M	L-M	(L)	L	✓	✓	✓	✓	✓		NA
Conventional buses	L-H	M	(L)	L	✓	✓	✓	✓	✓	✓	NA
BRT and trolley buses	H	L-H	M	L-M		✓	✓	✓	✓	✓	Requires adequate space for bus lane
Light rail	H	L-H	H	M-H		✓	✓		✓	✓	Construction on steep gradients technically/financially difficult
Heavy rail and metro systems	H	M-H	H	H			✓		✓	✓	Construction on steep gradients technically/ financially difficult
Taxis and demand-responsive transport	L	L-H	(L)	L	✓	✓	✓	✓	✓	✓	NA
Waterborne transport systems	L-M	L-M	L-M	L-M	✓	✓	✓	✓	✓	✓	Requires water mass (river, canal or sea)

* Capacity: L = up to 1000 people/per direction/hour, M = up to 10,000 people/per direction/hour, H = above
**Distance range: L= up to 5 km, M= up to 20 km, H=above
***Unit cost: L= up to 100,000 USD/km, M=up to 1 million USD/km, H =above. Figures in parentheses do not include cost of road building.
**** Payback period: L=within 5 years, M: within 10 years, H: More than 10 years
***** City size and stage of development uses same scale as those developed in Section 2.4.

Based on these characteristics, the relevance of these modes for the different types of city strategies is summarised in the table below, and explained further.

Table 11: Applicability of each type of public transport to city strategies

Type of public transport	Grow compactly	Consolidate as you grow	Maintain/ shrink smartly
Public bicycles	H	H	H
Paratransit	H	M	L
Conventional buses	H	H	H
BRT and trolley buses	M	H	M
Light rail	L	M	H
Heavy rail and metro systems	L	M	M
Taxis and demand-responsive transport	M	M	H
Waterborne transport systems	M	M	M

Note: H = High applicability, M = Medium applicability, L= Low applicability

With the above in mind, the details of each mode and their characteristics are explored in the following sections. Information on each mode is provided in an easy-to-read two-page format, which includes:

- A table with a summary of the key characteristics
- A basic introduction to the mode
- The key strengths of the particular mode
- The key process of implementation
- Barriers to implementation and options for overcoming them
- Further sources of information (references)

4.3.1 Public bicycles

Guangzhou, China. Photo: Ko Sakamoto

Capacity	Low: 1-2 persons per vehicle / 1,000 people per hour per direction.)
Geographical range	Low: Typically up to 3 km
Cost of implementation	Low: In the US context, capital costs range from $3,000 and $4,500 per bike. Operating costs including maintenance, distribution, staff, and storage range from $1,200 and $1,700 per bike (Midgley 2011)
Payback period	Low: Depending on the pricing structure, public bicycle systems can return a profit within 2-3 years, as is the case with the Bixi scheme in Montreal.
Applicable city size	Small, medium and large
Applicable stage of development	Least developed, developing and developed
Strengths	• Relatively cheap implementation • Generates no air pollution or GHGs during usage and very little noise • Very low road space requirements • Helps improve accessibility of the poor and social cohesion
Limitations	• Only covers short distances (typically under 5km) • Requires strong management and maintenance • Cycling is generally difficult in terrains with steep slopes
Barriers to implementation	• Lack of knowledge of technology to support bike sharing • Lack of political support for non motorised transport • Lack of financial resources for initial set up and operation
Examples of successful implementation	• Guangzhou, China • Taizhou, China – Eversafe public Bike System

Introduction

Public cycling schemes are one kind of public transport system that uses non-motorised technology. In recent years, they have become popular in Europe, Latin America and Asia and complement other modes such as buses and trains, acting particularly as a viable alternative for short-distance journeys.

Strengths of public bicycle systems

Bike sharing schemes are particularly suited to use in Asian cities for a number of reasons:

- **Low road space requirements:** Cyclists use less than a 3rd of the road space used by private motor vehi cles and pedestrians less than a sixth (Hook, 2005). Modal shift to cycling therefore helps reduce conges tion levels.

- **Reduces dependence on imported oil:** A modal shift to cycling can help reduce a country's reliance on high and variably priced imported oil and therefore help improve a country's energy security.

- **Improve accessibility and social cohesion:** A large percentage of the population of Asian cities is low income and relies on non motorised transport to access work and services. Improving provision of cycling facilities can therefore help to improve accessibility and promote social cohesion for all members of society.

- **Support improvements to health:** Cycling and other forms of non-motorised transport generate no air pollution, no green house gasses and little noise leading to environmental and health benefits. Cycling can also improve health by reducing obesity and associated cardiovascular and other diseases.

Process of implementation

In Guangzhou, China, one of the fastest growing cities in the world, a successful bicycle sharing scheme was developed through:

- The development of infrastructure for cycling, including the provision of:
  - Bike lanes alongside the BRT corridor
  - Direct connecting tunnels from the BRT to metro stations
  - Greenways supporting cycling and walking with night lighting and family-friendly exercise equipment along previously polluted canals (ITDP, 2011)
- Integrating cycling in wider planning decisions on public transport for example by ensuring that bike parking and bike sharing was included in the design of the BRT stations. In Guangzhou this was achieved through the launch of the bike sharing program in June 2010 along the BRT corridor.

Barriers to implementation and options for overcoming them

	Type of barrier	Options for overcoming barrier
Political	Limited political support leads to a lack of cycling facilities in many cities, with traffic systems designed to increase vehicle speeds at the expense of cyclist's safety. Regulation in some cities bans bicycle use on main roads.	• Ensure support for cycling and other NMT at the highest political level, e.g. from the mayor. • Ensure recognition of cycling by the public as a "mode of choice", by marketing its healthy, green and economic advantages.
Financial	Cycling is often not considered to be a part of the transport system, and no budget is allocated to bike sharing systems, and bicycle infrastructure. There may be a lack of financial resources for the initial set up and ongoing operation of bike sharing schemes.	• Reserve e.g.10% of the transport budget for investment in NMT facilities, as per the "Share the Road" scheme advocated by UNEP. • Invite the private sector to provide financing for bike sharing schemes, in return for advertising rights, as in London and Paris. • Consider international sources of funding (such as grants from the Asian Development Bank) to support the implementation/ operation.
Institutional/ capacity	There may be a lack of knowledge and capacity to support the design and implementation of bike sharing schemes. Fragmented responsibility for transport and corruption may endanger the effective operation and enforcement of the scheme once established.	• Ensure there is a department within the city's transport and construction departments responsible for cycling and walking. • Learn from successful bike sharing schemes introduced in other cities worldwide.
Techno - logical	Technology to support the implementation of operation of bike sharing schemes may not be readily available	• Learn from the technologies implemented in other cities for bike sharing schemes, including low-cost options found in Asia (see references below).

Further sources of information (references)

Hook, W (2005) Sourcebook Module 3d: Preserving and Expanding the Role of Non-motorised Transport, GTZ, Eschborn.

GTZ (2010) Non-motorised transportation

ITDP, 2011 Sustainable Transport Cities Award http://www.itdp.org/index.php/news/detail/sustainable_transport_award_cities_guangzhou/

Midgley, P (2011) Bicycle-sharing schemes: enhancing sustainable mobility in urban areas

http://www.un.org/esa/dsd/resources/res_pdfs/csd-19/Background-Paper8-P.Midgley-Bicycle.pdf

4.3.2 Paratransit

Manila, Philippines Photo: Ko Sakamoto

Capacity	Low to medium: Highly variable due to the mixed vehicle types utilised.
Geographical range	Low to medium
Cost of implementation	Low
Payback period	Low
Applicable city size	Small, medium and large
Applicable stage of development	Least developed, developing
Strengths	• Demand responsive • Affordable for those on low income • Flexible service tailored to users' needs
Limitations	• Poor traffic safety, levels of service and vehicle maintenance • Paratransit vehicles tend to be slow (Cervero, 2007) • Lack of integration with other modes of transport
Barriers to implementation	• Services are not formalised and are therefore difficult to regulate
Examples of successful implementation	• A dynamic and wide-ranging paratransit sector has evolved in cities like Jakarta and Manila (Cervero, 2007)

Introduction

Paratransit is an alternative mode of flexible passenger transportation that does not follow fixed routes or schedules. Paratransit has emerged as one of the key transport modes in the developing countries. A range of vehicles can be used to provide paratransit services for example motorcycle-taxis in Bangkok, Jeepneys in Manila, vans in Indonesia and Rio de Janeiro, and rickshaws in India (Tangphaisankun et al, 2010). At their simplest they may consist of a taxi or small bus that will run along a more or less defined route and then stop to pick up or discharge passengers on request. At the other end of the spectrum the most flexible paratransit systems offer door-to-door service from any origin to any destination in a service area.

Strengths of paratransit

Travel by paratransit offers a number of benefits in the developing cities context:

- **It provides a flexible service that is responsive to fluctuating demand:** Due to their unrestrained operation and range of vehicle sizes utilised, ranging from human powered rickshaws (becaks, tricycles) and three-wheel motorized scooters (bajas, tuktuks) to small buses (bemos, opelets, mikrolets), the paratransit sector offers a wide range of services in terms of seating capacity, speeds, geographic coverage, levels of comfort, and fares (Tangphaisankun et al, 2010). Some vehicles serve local trips of a few blocks whilst others serve more intermediate and long distance travel.

- **It is affordable for those on low income:** Services, although generally low in service quality and comfort, are cheap and therefore accessible to the large proportion of the population in developing cities with limited income (Cervero, 2007).

- **Provides employment for the local population:** The informal transport sector is an important source of urban employment in developing cities (Cervero, 2007).

Process of implementation

For the paratransit sector to more effectively support sustainable urban transport, efforts are required to formalise the service and promote integration with other modes. If successful this will enable paratransit to act as a feeder for other forms of mass transit, helping to retain the modal split of public transport as a whole. Personal behaviour and attitudes towards the services provided by paratransit and public transport will be important for the future development and success of such a solution (Tangphaisankun et al, 2010). There is a need not only for services to be improved but for the improvements to be effectively communicated to local residents to support a change in public perception and behaviour.

Such action is already beginning to occur. India is taking action to help ensure improved regulation and formality of the auto rickshaw sector. In Mumbai for example auto rickshaw drivers are required to convert their driving licenses into smart cards that track and document driver details and offenses. Drivers that have not done so will be suspended from operating. The aim is to improve service provision and prevent drivers from overcharging, and refusing service (The City Fix, 2010).

Barriers to implementation and options for overcoming them

	Type of barrier	Options for overcoming barrier
Political	• Heavy opposition to the formalisation of services may make political leaders reluctant to take action.	• Ensure that the process of formalising paratransit provides financial benefits for incumbent operators by providing rights of operation under license.
Financial	• Operators tend to operate on a subsistent day-to-day survival basis investing very little in the ongoing maintenance and replacement of their vehicles.	• Formalise the paratransit service. • Rights to operate routes should be linked to specific performance based indicators, such as environmental performance of vehicles used, safety, punctuality etc.
Institutional/capacity	• Paratransit has often not been systematically considered in transport plans (Tangphaisankun et al, 2010)A lack of professional management leads to public dissatisfaction with the level of service and safety which limits patronage	• Develop an urban transport agency responsible for the formalisation and regulation of the service. • Build the capacity of the new institution to develop and implement an effective strategy for the integration of paratransit with other modes. • Consider accessing international capacity building support (see Chapter 5).
Technological	• Limited investment in new technology. Vehicles are often old and poorly maintained and therefore have poor safety levels and emit high levels of air pollution and carbon emissions.	• Set standards for vehicle performance, enforced via contract, to help improve the level of maintenance and safety of vehicles and encourage private operators to invest in new vehicle technology. • Ensure appropriate technologies are transferred (see Chapter 5)

Further sources of information (references)

• Cervero, 2007 Paratransit in South East Asia, a market response to poor roads?
• World Bank (2002) Cities on the move
• Tangphaisankun, A et al (2010) A Study in Integrating Paratransit as A Feeder System into Urban Transportation and Its Effects on Mode Choice Behaviour: A Study in Bangkok, Thailand http://www.civil.ist.utl.pt/wctr12_lisboa/WCTR_General/documents/02546.pdf
• The City Fix (2010) Taxis: the new frontier of sustainable development http://thecityfix.com/taxis-the-new-frontier-of-sustainable-transportation/

4.3.3 Conventional buses

Jakarta, Indonesia. Photo: Ko Sakamoto

Capacity	Low to High: Overall capacity depends on operating patterns
Geographical range	Medium
Cost of implementation	Low
Payback period	Low
Applicable city size	Small, medium and large
Applicable stage of development	Least developed, developing and developed
Strengths	• Very efficient, flexible and cheap mode of transport • Buses operate in mixed traffic and are easy to put into service.
Limitations	• Heavy congestion in many developing cities has a negative impact on service quality, reliability, energy consumption, economy and overall profitability (UITP)
Barriers to implementation	• Lack of political commitment to full regulatory reform • Limited investment in new vehicles or maintenance • Government subsidies often required for loss making state owned operations (Meakin, 2004b)
Examples of successful implementation	• Bus franchising in Hong Kong (Meakin, 2004b) and Santiago, Chile (Gwilliam, 2005)

Introduction

Approximately 80% of all public transport passengers worldwide are carried by buses (UITP) Traditionally bus services have been provided by the public sector. However, numerous private bus operators have appeared in cities in developing countries often operating on routes duplicating public sector routes, using small vehicles and refusing to carry exempt or reduced fare passengers. These operators are often informal in nature, and undermine the quality of bus services, as well as road safety (due to lack of driver training) and air quality (due to lack of vehicle maintenance and renewal).

Strengths of conventional busses

From an economic, environmental and social point of view, the bus is one of the most extensively implemented forms of public transport. Particular strengths include:

- **Efficient use of resources:** Buses, especially when fully loaded are a much more efficient in terms of energy and carbon emissions per person, as well as roadspace use compared to private vehicles.
- **Flexibility:** Compared to fixed-track systems such as LRT and MRT, bus routes can be redesigned relatively easily to adapt to new patterns of demand.
- **Accessibility:** Services are generally cheap and therefore accessible to poorer urban residents.
- **Can support other public transport modes:** If integrated effectively, bus services can provide a very valu able feeder service to other modes of public transport such as light and heavy rail and waterborne trans port.

Process of implementation

A large number of developing countries have taken steps to improve arrangements for urban bus services by formalising and coordinating services. The aim is to support the development of a stable basis on which public and private players could contribute in a more effective way to a sustainable urban transport system. Some key elements in this regard include:

- Setting up a transport authority at the city level that is tasked with defining the urban public transport network in the city, and planning routes for bus services in close coordination with other modes (such as LRT and MRT).
- Providing an appropriate regulatory arrangement for operators, e.g. via securing service on key routes by issuing of franchises on the basis of competitive tendering (Gwilliam, 2005).
- Regulating carefully the performance of private operators, including service frequency, safety, vehicle environmental performance and punctuality, e.g. via performance-based contracts.
- Ensuring that the fare structure and ticketing procedures are fully integrated with all other modes of public transport.
- Careful planning of subsidies, so that they are targeted specifically at disadvantaged groups (e.g. through discounted travel cards) as opposed to a more generic subsidy for the whole sector.

Barriers to implementation and options for overcoming them

	Type of barrier	**Options for overcoming barrier**
Political	• There can be substantial opposition from incumbent operators (either public or private) against changes.	• Involve current operators in the discussion on the alternative structure, and ensure that benefits from the new system are shared with the existing operators.
Financial	• Government subsidies are often required for loss making state owned operations (Meakin, 2004b) • Financial incentives to improve vehicle quality are lacking	• Consider removing outright subsidies for the entire bus industry, and replace them with more targeted subsidies towards disadvantaged groups, or routes which are deemed socially necessary. • Introduce competition by e.g. requiring operators to compete for the right to operate exclusively for a period of time, re-tendered periodically to ensure costs do not rise rapidly • Use climate finance to invest in newer, low-emission vehicles (see example of Hanoi in Annex).
Institutional/capacity	• Fragmented ownership is common with no one operator having responsibility for the effective operation of a route. • Responsibility for public transport has been often been formally delegated to lower level jurisdictions which have generally been less involved in formulating reform policies.	• Establish a dedicated transport authority, preferably responsible to a local government jurisdiction at the same level, to set routes and ensure an effective and transparent bidding, monitoring and enforcement process (Meakin, 2004b) • Ensure the administrative agency is expert and trustworthy. (Gwilliam, 2005).
Technological	• Private investors are unlikely to be willing to invest in new lower carbon vehicles if there are no incentives to do so.	• Build in performance targets in the contractual arrangements surrounding bus operators, for example mandating the maximum age of vehicles, and/or the performance level of engines (i.e. that meet emission and fuel economy standards).

Further sources of information (references)

Gwilliam (2005) Bus Franchising in Developing Countries: Some Recent World Bank Experience
Meakin, R (2004b) Sourcebook Module 3c: Bus Regulation and Planning, GTZ, Eschborn.

4.3.4 Bus Rapid Transit (BRT) and trolley buses

Guangzhou, China: Photo Ko Sakamoto

Capacity	High: 20 000 to 35 000 people per hour per direction.
Geographical range	Low to High
Cost of implementation	Medium
Payback period	Low to medium
Applicable city size	Medium and large
Applicable stage of development	Least developed, developing and developed
Strengths	• Relatively economical to develop • Provide greater operational flexibility than metro/rail systems • Popular with all income groups and profitable at relatively low fares • Provide a higher speed service due to segregation from the main traffic • Reduced level of pollutants and noise levels
Limitations	• Require separate lanes which need to be effectively enforced • Some locations physically do not permit a full separate lane for BRT
Barriers to implementation	• There can be a lack of political support • Limited technical and institutional capacity to support development • A lack of knowledge and understanding of the benefits of BRT schemes by policy makers • Strong lobby of taxi and paratransit operators against BRT
Examples of successful implementation	• Guangzhou, China • Bogotá, Columbia • Sao Paulo and Curitiba, Brazil

Introduction

BRT is a mass transit system using designated rights of way lanes. BRT systems offer similar performance and speed of service to metro systems but use bus rather than rail vehicle technology.

Strengths of bus rapid transit and trolley bus:
BRT systems offer a high quality transit service at an affordable cost. Particular strengths of BRT and trolley bus systems include:

- **The option of incremental development:** BRT systems offer greater flexibility than some other forms of mass transit such as metro systems, enabling them to accommodate future growth of the city more quickly and at less cost. Developments such as signal prioritisation and interchanges which improve speed and capacity can be added on a staged basis.
- **Effectively support the sustainable development of cities:** BRT systems support the development of more sustainable urban form through densification of major corridors. BRT systems can enable developing cities to leapfrog the car dependant development path and avoid the negative costs associated with uncontrolled growth.
- **Lower implementation costs than other forms of mass transit:** BRT systems can provide a high quality and capacity services at a fraction of the cost of other options – LRT typically costs 4 times more, and MRT 10 times more per kilometre (Embarq, no date). BRT systems provide more equitable access as a result of lower fare prices and as a result of their lower implementation cost can reach larger geographical areas that rail systems (ITDP, 2010)

Process of implementation (based on Wright, 2005b)
There are a number of steps that can be taken to support the effective development of BRT systems:

- Collect background information on population, transport trends etc to provide a sound basis for decision making

- Develop a transport model to support assessment of future conditions
- Undertake a review of the different transit options available
- Establish a vision and organisational structure for the planned system considering the expected impacts, regulatory and legal issues, proposed tariffs and operational costs
- Engage the public in the planning and design to ensure the service is tailored to local needs
- Identify locations for corridors, stations and depots
- Select technology to be used for fare collection, busses and service information
- Consider the options for ensuring the new BRT system is integrated with other modes
- Develop an implementation plan including construction, maintenance and monitoring

Also see ITDP (2010) for further details.

Two cities in the Asia and the Pacific who have successfully introduced BRT schemes include:
- Guangzhou China – which now boasts one of the world's largest BRT system carrying 800,000 people daily (see section 5.4 for further details)
- Ahmedabad, India – which was financed partly by a national grant and is one of the largest in India (see Section 5.3 for further details)

Barriers to implementation and options for overcoming them

	Type of barrier	Options for overcoming barrier
Political	• Politicians may face opposition from rail and automobile lobby groups, and existing transit operators making it challenging to gain commitment to stimulate change (Wright, 2005b).	• Highlight that the political rewards for those that commit to BRT systems (such as in Curitiba and Bogotá) can be high (Wright, 2005b) • Develop an outreach programme highlighting that BRT often brings improved profitability and working conditions
Financial	• Although financial constraints are less of a problem than for other modes of mass transit as a result of relatively low start up costs and operational cost effectiveness they may still present a barrier.	• Review the financial models of cities who have successfully introduced BRT systems • Consider engaging the private sector in development and operation of services • Consider international sources of funding to support the implementation/ operation.
Institutional capacity	• A lack of institutional/technical capacity limits the introduction of BRT systems. Employees of municipal agencies may not optimally design BRT systems as they tend use private transport as their primary mode of travel.	• Consider international sources of funding (such as by the ADB) to support capacity building and institutional development. • Raise awareness of the benefits of schemes that have been successfully implemented in other cities and the process of design and implementation for these schemes.
Technological	• A lack of knowledge and understanding of BRT systems and knowledge sharing regarding successful schemes implemented in developing countries (Wright, 2005b)	• Consider accessing support from international agencies and non-governmental organisations to enable technology transfer • Undertake visits to cities where BRT schemes have been successfully implemented.

Further sources of information (references)
Wright, L (2005b) Sourcebook Module 3b: Bus Rapid Transit, GTZ, Eschborn.
ITDP (2010) Bus Rapid Transit Planning Guide. http://www.itdp.org/index.php/microsite/brt_planning_guide/
Embarq (no date) What is Bus Rapid Transit? http://www.embarq.org/en/node/28

4.3.5 Light rail

Seville, Spain. Photo: Ko Sakamoto

Capacity	High: 170 persons per 6-axle tram and 250-350 per multi-articulated light rail vehicle, Approximately 12 000 passengers per direction per hour.
Geographical range	Low to High
Cost of implementation	High: The cost varies based on a number of factors including the extent of grade separation, geological conditions and the price of labour/material (Wright and Fjellstrom, 2004). The capital costs of US light rail systems are on average 21.6 million USD per km.
Payback period	Medium to High
Applicable city size	Medium and large
Applicable stage of development	Developing and developed
Strengths	• Light rail systems are flexible and expandable. • Produce no tailpipe emissions (Wright and Fjellstrom, 2004 • Intermediate capacity between metro and bus and applicable to a range of different passenger capacities and city sizes • Effective at supporting modal shift from cars if well designed • Positive impact on the development of the city
Limitations	• Requires the provision and enforcement of a segregated lane • Limited to relatively wealthy cities due to the initial set-up costs • Costs may limit the geographical extent of the service • Construction on steep gradients is technically and financially difficult.
Barriers to implementation	• High levels of initial investment required • Implementation is institutionally demanding
Examples of successful implementation	• Putra light rail in Kuala Lumpur • LRT in Japanese cities (Hiroshima) for city revitalisation • Large scale implementation of LRT in over 20 French cities

Introduction

Light rail transit (LRT) is an electric rail form of transport ranging from a conventional on-street tramway to segregated rapid transit systems. Light rail systems bridge the gap between conventional bus services that run on the highway and urban heavy rail or underground metropolitan railways (UITP). Light rail systems have only been implemented in relatively wealthy developing cities. Recent examples include the elevated Putra and monorail system in Kuala Lumpur (Wright and Fjellstrom, 2004)

Strengths of light rail

Light rail systems have a number of key strengths including:

- **No tailpipe emissions:** Light rail systems generally produce no emissions from the tailpipe, thus contributing to local air quality.
- **Can support city development:** LRT can have a positive impact on the development of land at inter change points, for example seen as a result of Shanghai's Pearl Line (GTZ, 2010)
- **Helping to maintain modal split of public transport:** If well designed and planned light rail systems are attractive to passengers and will contribute to maintaining the modal split of public transport modes, even as the income level of the city and its inhabitants grows.
- **Intermediate capacity between light rail and bus:** The intermediate capacity means that light rail systems offer a sound solution for small cities, even those where passenger demand is below 3000 passengers per hour per direction (pphpd) (Knutton, 2005). However LRT is also applicable to larger cities making the approach very flexible to a range of different circumstances.

Process of implementation

LRT has proved to be particularly successful in France and is changing the face of French cities. By 2005 over 20 French cities had introduced or were planning LRT. Key success factors include:

- **Adoption of an integrated approach to transport and urban regeneration:** The French approach has looked to return the streets to the people instead of the motor car. French cities have combined the intro duction of a tramline with pedestrianisation of city centres, the reorganisation of the local road network and a restructuring of the underlying bus network to support, not compete with, the tramway.
- **A local business tax covering the cost of implementation:** Since the early 1980s businesses have been required to pay a local transport tax (the Versement Transport) which provides a constant and reliable source of funding.
- **Dedicated rights of way:** which provide some separation from normal road traffic to improve operational reliability and increase average speeds.
- **Technological advancements supporting an effective service:** Technological solutions have enabled vehicles to be matched with local aspirations and requirements including seating arrangements, onboard facilities, and driver's cab and control panel.

Barriers to implementation and options for overcoming them

	Type of barrier	Options for overcoming barrier
Political	• A high level of political support is required to ensure that rights of way can be secured. Tram lines in many developing cities have been removed to make way for the increasing numbers of private cars.	• Highlight the benefits of LRT, for example supporting the development of the city and a modal shift from private vehicles to help secure the buy-in of senior politicians • Consider selecting a political champion for LRT to help raise awareness and drive action
Financial	• High level of initial investment required to develop the necessary infrastructure (Wright and Fjellstrom, 2004). In most cases subsidies from local government are required.	• Consider international sources of funding to support implementation/ operation. • Review good practice internationally and consider transferable lessons
Institutional capacity	• The development and enforcement of LRT is institutionally demanding (GTZ, 2010) and may therefore be challenging for cities in developing countries where there is often a fragmented institutional set-up.	• Consider setting up a central body responsible for the operation, maintenance and administration of urban transport and ensure that there is a team with dedicated responsibility for LRT.
Technological	• Developing countries may not be aware of, or have the capacity to implement the latest technology enabling effective and accessible services to be offered. • The rate of development may not be able to keep pace with the rapid rate of expansion of developing cities	• Raise awareness of the benefits of modern LRVs with up-to-date technology and high levels of comfort and facilities including passenger information. The introduction of low-floor vehicles extended the appeal to the whole community (Knutton, 2005) • Consider accessing international support for technology transfer, e.g. via Official Development Assistance provided by bilateral and multilateral donors.

Further sources of information (references)

Wright, L and Fjellstrom, K (2004) Sourcebook Module 3a: Mass Transit Options, GTZ, Eschborn.
Knutton, M (2005) Light Rail Transport: changing the face of French Cities International Railway Journal

4.3.6 Heavy rail and metro systems

Bangkok, Thailand. Photo: Ko Sakamoto

Capacity	High: Approximately 1000 persons per vehicle / Peak capacity can be 45,000 people per hour per direction by typical values are between 20 000 ad 30 000 (GTZ, 2010).
Geographical range	Medium to High
Cost of implementation	High: Dependant on a number of factors e.g. management/organisational structure and land /labour costs. Costs are in the order of 55-207 million USD per km
Payback period	High
Applicable city size	Large
Applicable stage of development	Developing and developed
Strengths	• High capacity service • High frequency and reliability of service • Lowest energy use per person per kilometre of the mass transport options
Limitations	• Due to the high capital/operational costs rail based systems are most appropriate in cities with a large population where passenger capacities are expected to exceed 25 000 passengers per direction per hour (GTZ, 2010)
Barriers to implementation	• Lengthy construction times • A high level of investment is needed for the required infrastructure • High level of skill required for example for maintenance and operation etc • Require exclusive rights of way (GTZ, 2010) • Construction on steep gradients is technically and financially difficult.
Examples of successful implementation	• Bangkok Metro • Kuala Lumpur Star metro

Introduction

Metropolitan railways are urban, electric transport systems with high capacity and a high frequency of service. Metros are totally independent from other traffic, road or pedestrians. They are consequently designed in tunnel, viaducts or on surface level but with physical separation. In Asia, Metro systems are being developed or expanded in many developing cities including Bangkok, Singapore, and Delhi.

Strengths of heavy rail and metro systems

Metropolitan railways are the optimal public transport mode for a high capacity line or network service. Heavy rail and metro systems:

- **Offer one of the lowest level of CO_2 emissions per person carried:** Systems that have the most positive environmental impact longer term are those which can halt or reverse the trend for a declining modal share of public transport observed in may developing cities
- **Provide a system capable of meeting high demand:** Heavy rail and metro systems are reliable and can offer a high frequency service therefore providing effective solutions in corridors with a high trip volume (more than 700 000 trips per day), generally in cities with more than 5 million inhabitants or linear spatial development and with at least 18,000 USD per capita annual income at the city level (Wright and Fjellstrom, 2004)
- **Can have a positive long term impact on land use:** If managed effectively major transit interchanges along the route can catalyse high density development.

Process of implementation

High levels of ridership are supported by a number of factors including:

- Densification of land use around stations;
- The introduction of policies and measures to make it more difficult to travel by car in central areas, or along the corridors served by rail;
- Effective integration with existing transport modes and policies which can act as feeder services and good interchange facilities between modes;
- The development of complimentary mass transit systems (GTZ, 2010)

Both metros and suburban railways need an institutional body with professional expertise to be responsible for the allocation of funds and distribution of earnings. The body should also be responsible for setting fares and for ensuring that the timetable is integrated with other transport services in the urban areas (Wright and Fjellstrom, 2004)

Barriers to implementation and options for overcoming them

	Type of barrier	Options for overcoming barrier
Political	• Suburban railways have historically been given lower priority. Where integration with other modes of transport is poor levels of ridership can be disappointing (GTZ, 2010) • In some cities, rail based MRT is favoured for its high profile, where other more cost effective options are available	• Highlight the benefits of suburban railways for example supporting a reduction in the level of congestion in cities and associated environmental, safety and health benefits where a shift from privatised vehicles is supported by the provision of a rail service that is well integrated with other modes. • Consider other modes such as BRT and assess the cost effectiveness of different solutions
Financial	• Very high construction costs are incurred as systems are often built underground or on elevated infrastructure. Operation costs require subsidies unless population density is very high. (GTZ, 2010).	• Finance rail development via land value taxes (see Chapter 5) • Consider support provided by bilateral and multilateral development banks (such as the ADB) to provide long-term loans to help secure capital funding.
Institutional capacity	• The development of MRT is instructionally demanding with high standards of operational, maintenance and administration needed. The culture, managerial standards and attitudes found in many developing countries do not effectively support the development of metro systems (GTZ, 2010).	• Consider setting up a central body responsible for the operation, maintenance and administration of urban transport, which have responsibility for setting the vision for light rail and managing the subsequent development infrastructure and overseeing its operation in strong alignment with other modes of transport (see example of Singapore in Annex).
Technological	• The implementation of metro systems requires a high level of technical knowledge that may be lacking in some developing cities.	• Raise awareness of the technologies used cities where schemes have been successfully implemented. • Consider accessing international support for technology transfer, e.g. via bilateral and multilateral ODA providers.

Further sources of information (references)

Wright, L and Fjellstrom, K (2004) Sourcebook Module 3a: Mass Transit Options, GTZ, Eschborn.

4.3.7 Taxis

Photo: GIZ Urban Transport Photo CD

Capacity	Low
Geographical range	Low to High
Cost of implementation	Low
Payback period	Low
Applicable city size	Small, medium and large
Applicable stage of development	Least developed, developing and developed
Strengths	• Highly flexible, demand responsive and tailored to users' needs • Provides an alternative to ownership of a private vehicle • Provides a transport service to those that may not be able to access other modes, such as the elderly or disabled • Provides revenue for local authorities, via license fees
Limitations	• Low capacity (very inefficient use of road space) • Generally not accessible to the urban poor due to the high price • Poor maintenance of vehicles and distances travelled can lead to significant levels of air pollution (UN, 2011)
Barriers to implementation	• Poor regulation of services • A lack of financial resources to modernise vehicle fleets
Examples of successful implementation	• Electric taxis in China's Guangdong Province's Shenzhen City (Clear Air Portal, 2010)86% of taxis running on alternative fuels in Brazil

Introduction

The taxicab got its name from the invention of the taximeter which measures the distance and the time a car has travelled. As the name suggests, the taxi provides a tailored, demand-responsive door-to-door transport mode, thus giving a direct alternative to car ownership. Taxi growth has been particularly strong over the past 20 years in cities with rapid population and economic growth (UN, 2011).

Strengths of taxis

The strengths of taxi services include:

- **Flexibility:** Taxis offer a very flexible, demand responsive, door to door service
- **Providing an alternative to owning a private vehicle:** An efficient and reasonably priced taxi service within a city can help to reduce the level of ownership of private vehicles and therefore reduce conges tion and associated health, safety and environmental issues within the city centre
- **Improved accessibility for vulnerable groups:** Taxis provide an essential means of transport for those who are not able to travel by other modes of public transport, for example the elderly and disabled.
- **Providing a source of income for national and local governments:** Taxis can be a major contributor to national economies by creating job opportunities and tax revenues for local authorities through distribu tion of specific licenses and other sources (UN, 2011).

Process of implementation

There are a number of actions that can be taken to improve the contribution of taxis to the development of a sustainable urban transport system[17] , including:

- **Modernising vehicle fleets to lower levels of air pollution and carbon emissions:** In Brazil approximately 86% of taxis currently run on alternative fuels and there are plans to increase the levels of eco-cars in the

urban taxi fleets further as part of efforts to ensure the sustainability of the World Cup in 2014 (Ernst and Young 2010). It may be possible to secure international financing to support vehicle replacement, such as in Egypt where funding has been secured from the African Development Bank (AfDB 2011)

- **Supporting the use of taxis as a feeder for mass transit:** Ensuring that taxis are considered in urban trans port planning processes and that there is inter-modal integration of taxis with other mass rapid transit schemes can help ensure their usage as a feeder for other forms of public transport (UN, 2011)
- **Ensuring the effective regulation of services:** Ensuring that a central body is responsible for the regulation of taxi operations can help to improve the quality of the service and therefore usage levels.
- **Supporting improvements in vehicle standards:** Setting standards for vehicles and ensuring that these are enforced to will help to ensure improved maintenance of taxis.

Barriers to implementation and options for overcoming them

	Type of barrier	Options for overcoming barrier
Political	• There may be opposition to the formalisation of services which would support improvement in the quality, safety and costs effectiveness of services...	• Highlighting the benefits of formalising the service, to help ensure political buy in at the highest level • Consider appointing a political champion to drive change
Financial	• Taxi owners in developing countries may not have the financial resources available to be able to invest in lower emissions vehicles or the ongoing maintenance of their vehicles.	• National governments could consider securing funding from international sources to support the replacement of the taxi fleet with lower carbon vehicles such as the taxi replacement projects in Egypt funded by the African Development Bank (2011)
Institutional capacity	• Institutions may lack the capacity to be able to effectively regulate taxi services in developing cities which can lead to poor quality services and overcharging.	• Clearly define responsibility for the regulation of taxis services, possibly through the establishment of a central body responsible for urban transport that should set and enforce standards for vehicles.
Technological	• A lack of standards for vehicles and or enforcement of standards may lead to the poor maintenance of vehicles therefore increasing levels of air pollution and C02 emissions.	• Set and enforce standards for vehicles and learn from best practice internationally of schemes that have supported an improvement in taxis services and both in terms of reliability and environmental performance

Further sources of information (references)

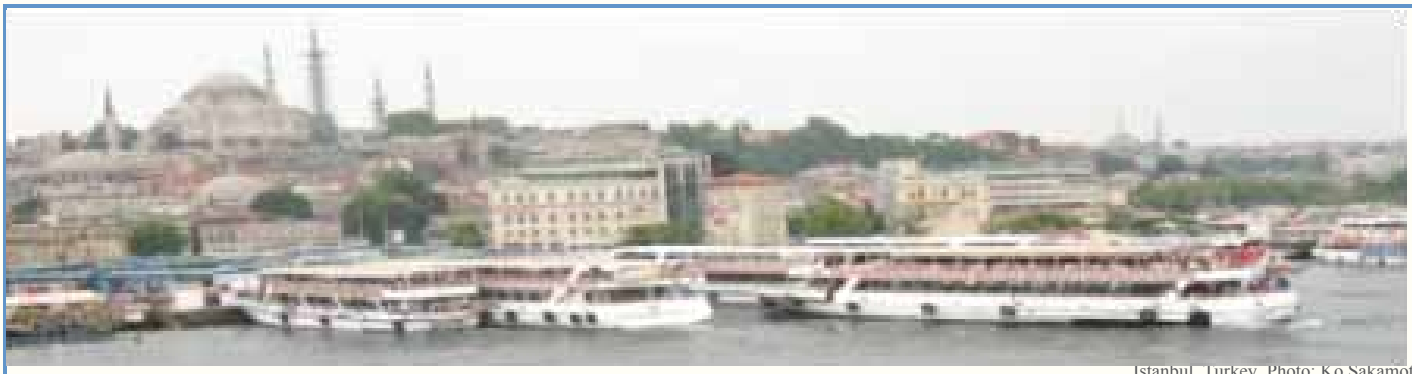
AfDB (2011) Taxi replacement project http://www.afdb.org/en/projects-operations/project-portfolio/project/p-eg-ie0-004/

Clear Air Portal (2010) Electric Taxis hit roads in South China City http://www.cleanairinitiative.org/portal/node/6341

UN (2011) Expert Group meeting on Sustainable Urban Transport: Policy options for modernising and greening taxi fleets in Latin America Cities http://www.un.org/esa/dsd/susdevtopics/sdt_pdfs/meetings2011/egm201105/Aide%20Memoire%20Taxis%20EGM%20Latin%20America-070211-English.pdf

[17] An expert group has been convened to explore the policy options for modernising and greening taxi fleets in Latin American Cities. This group aims to address the question of how taxi systems can be developed that are environmentally sustainable while also being safe, reliable, accountable, customer-focused, and commercially viable (UN 2011). Similar approaches may be explored in Asia and the Pacific, e.g. as part of the Environmentally Sustainable Transport (EST) Forum.

4.3.8 Waterborne public transport (WPT)



Istanbul, Turkey. Photo: Ko Sakamoto

Capacity	Low to Medium
Geographical range	Low to Medium
Cost of implementation	Low to Medium: The costs of initial set-up are less than for other modes of transport and are more associated with the cost of developing terminals and fare management systems.
Payback period	Low to Medium
Applicable city size	Small, medium and large
Applicable stage of development	Least developed, developing and developed
Strengths	• Can help reduce congestion by using available space on the water • Provides reliable and direct connections, supporting land borne modes • Reduces the need to develop costly bridges to cater for private cars • Provides a unique way for tourists to discover a city (UITP) • Generally low levels of carbon emissions per person • Can support economic growth
Limitations	• Only applicable in cities that have an accessible waterway • Vessels themselves tend to be slow in speed
Barriers to implementation	• Services many be operated by a number of small private organisations making effective regulation and coordination difficult
Examples of successful implementation	• Waterbus service in Dubai introduced in 2007 Ferries providing extensive channel crossing services in Istanbul

Introduction

Waterborne transport is the use of ferries or other waterborne vessels in the transportation of passengers via waterways. They are typically found in cities which are built around rivers, canals, bays and seafronts.

Strengths of waterborne public transport

WPT has a number of strengths including:

- **Supporting a reduction in congestions levels:** Modal shift to waterways if managed effectively can help to reduce level of congestions in city centres Travel by waterway is direct and reliable saving commuters significant levels of time by enabling them to avoid the congested road network.
- **Cost savings for both users and implementing bodies:** The cost for WPT tend to be relatively low ensuring that the mode is accessible to most city inhabitants. In addition less infrastructure development is required than for other modes of transport (Amola, 2009)
- **Effective usage can stimulate economic growth:** The provision of WPT can help to stimulate the develop ment of waterfront areas and support economic growth by enabling direct and cost effective transpor tation of goods within cities and beyond
- **Provide positive social benefits:** WPT provides a positive contribution to cultural activities and events and if effectively implemented and regulated provides a comfortable, healthy and safety form of transport for its users (Amola, 2009)
- **Can contribute to the overall sustainable urban transport system:** if well integrated with other modes, WPT can provide an invaluable contribution to the development of a sustainable, low carbon urban transport system (Amola, 2009)

Process of implementation

Dubai in the United Arab Emirates has a long tradition of relying on riverboats. A new ferry service is due to be launched in 2011. The aim of the service is to provide an alternative mode of public transport to those who want to avoid the city's heavy traffic congestion. The ferry service aims to build on the successful launch of water buses in 2007 which serve various Government offices and service departments on the two banks of Dubai Creek. There are a number of factors that will help support the success of the scheme:

- **Provision in an area of high demand:** The service will cover the congested central business districts areas of Deira and Bur Dubai in addition to new developments along the coast. It will link existing and future residential and commercial developments including offshore projects. The first phase of the ferry service will focus on Dubai Creek and operations will centre around four main stations linked with Metro stations and the public bus service.
- **Integration with other public transport modes:** The city's Marine Agency will spend Dh1.5 billion on differ ent modes of marine transport. There are plans to ensure that the new service is integrated with all modes of public transport in the city including buses, metro and marine transport. The new ferry stations will be linked to the respective Metro hubs by means of air-conditioned walkways. Bus stops, taxi stands and links to walkways will also be provided (Gulf News 2009).

Barriers to implementation and options for overcoming them

	Type of barrier	Options for overcoming barrier
Political	• WPT needs to be integrated with other modes of public transport as part of a strategic overall city transport plan which may not be a political priority.	• Cities should consider setting up a central body with responsibility for all of the city's transport systems responsible for setting a strategic vision for transport and ensuring integration between modes and the ongoing sustainability of the network.
Financial	• Small private companies are likely to operate the service in developing countries which may lack financial resources to invest in modernising vessels used.	• Authorities could introduce standards for vessels to ensure that standards are maintained. • Effective regulation of the service can help ensure healthy competition which would drive up the standards of service.
Institutional capacity	• WPT in developing countries can be poorly regulated, decreasing passenger safety – for example as a result of overcrowding. • Institutions may lack the capacity to be able to effectively integrate WPT with other modes.	• Set and enforce service standards for the legal capacity of vessels to ensure public safety and the quality of the service provided. • Develop and implement a strategic vision for integrated public transport to ensure the service is well used and supports modal shift from private motorised transport.
Technological	• A lack of funding, regulation or awareness of technologies means vessels are likely to be poorly maintained. The latest fare collection technology is unlikely to be used which could improve service efficiency.	• Raise awareness of international best practice and transferable lessons that can be applied. • Consider accessing international financial or technology transfer support to improve the capacity and quality of the service.

Further sources of information (references)

Amola, G (2009) Contribution of Waterborne Public Transport to Sustainable Waterfronts: Case studies of Hammarby Sjostad (Stockholm) and HafenCity (Hamburg) http://www.infra.kth.se/fms/pdf/MScThesAmola2009.pdf
Gulf news (2009) RTA plans new public water transport http://gulfnews.com/news/gulf/uae/traffic-transport/rta-plans-new-public-water-transport-1.49460
UN (2009) Inland Waterborne transport: connecting countries http://www.unwater.org/downloads/181794E.pdf

5 Overcoming barriers towards sustainable transport: How to make it all happen

As noted in Dalkmann (2010), the actual implementation of the policy measures described in earlier sections of this report requires the removal of several barriers, including:

- **Political** – including low or wavering levels of leadership and government commitment to certain meas ures, as well as poor public acceptance.
- **Financial** – restrictions on expenditure and budget has a particular impact upon resource intensive meas ures. Infrastructure and advanced technologies often require substantial financial investments, a large part of which are incurred upfront.
- **Institutional and human capacity** – some policy options and strategies require a certain institutional struc ture, which may not be in place. Responsibilities between different agencies can be subject to poor co-ordination, co-operation and integration. Legal power to influence the activities of the private sector, such as developers can be lacking. There is an often inefficient or insufficient legal framework in place, which leads to corruption. Knowledge and human capacity (for policy formulation, management, and enforcement) is not always available.
- **Technological** – where appropriate technologies may not be readily available within a country due to ineffective transfer of technologies across borders, and a lack of domestic research and development.

The table below provides a rough overview of the main barriers attributed to each policy measure.

Table 12: Main barriers for each policy measure

Policy measure	Main barriers			
	Political	Financial	Institutional and capacity	Technological
Avoid				
Develop integrated transport and land use master plans			✓	
Manage parking	✓		✓	
Implement congestion charging/road pricing	✓		✓	
Restrict/auction number of license plates for cars	✓		✓	
Promote car-free city areas and low emission zones	✓		✓	
Set vehicle registration tax	✓		✓	
Remove fuel subsidies and tax fuel	✓		✓	
Remove car-oriented subsidies	✓			
Promote distance-based car insurance schemes			✓	✓
Shift				
Provide NMT infrastructure (accessible footpaths, cycleways)		✓	✓	✓
Introduce cycle sharing schemes		✓	✓	✓
Develop public transport	✓	✓	✓	✓
Provide priority signalling for public transport	✓		✓	✓
Develop dedicated lanes for public transport (buses and BRT)	✓		✓	✓
Develop information campaigns	✓		✓	
Improve				
Promote and enforce vehicle efficiency standards	✓		✓	✓
Set fuel standards	✓		✓	✓
Promote new vehicle technology and infrastructure	✓	✓	✓	✓
R&D on new fuels	✓	✓	✓	✓
Develop Intelligent Transport Systems	✓	✓	✓	✓

* P: Political, F: Financial, IC: Institutional and Capacity, T: Technological

Generally, the political and institutional challenges facing policy measures such as congestion charging, development of public transport and non-motorised transport infrastructure are common across all city types. This suggests the need for countries and cities to share good practice and learn from each other as they implement these policy measures. Here, the Asia and the Pacific region could build upon existing initiatives including;

- ASEAN, which may provide a platform at the highest political level for the major Asian countries to develop and coordinate their policies towards sustainable transport.
- The Environmentally Sustainable Transport (EST) Forum, which is coordinated by UNCRD and brings together Environmental and Transport ministers from countries within the Asia and the Pacific region. This Forum may play an important role in developing key regulations (e.g. on vehicles and fuels) to apply across the region. The Forum may also provide a platform for information sharing and technology transfer.
- Alliances between cities, such as the Clinton C40 Initiative or ICLEI, to which many Asian cities are mem bers. Such alliances may help transfer good practice and knowledge at the local level. Initiatives in other world regions including CIVITAS of the European Union can also be replicated in the Asia and the Pacific region, to provide a transport-specific platform for knowledge sharing and inter-city cooperation.

Furthermore, of particular importance is how international support within the region (in particular on financing) can be tailored to the needs of the Asia and the Pacific region (see Box below).

Box 10: Receiving international support for sustainable urban transport

There is a range of sources of international finance available to developing countries to support the development of sustainable transport. These include both traditional sources of finance through, for example, Official Development Aid (ODA) and specific sources of climate finance, which provide ring-fenced support for climate mitigation activities.

ODA is provided by Governments of industrialised countries either bilaterally or through multilateral institutions such as the World Bank. Although historically channelled into road building it can also be mobilised to support sustainable transport if the demand for such funding is clearly communicated by local and national government, Binsted et al (2010) Climate finance can support a broad range of actions in the transport sector, including the development and implementation of strategies, policies, projects and enabling measures.

Further information on accessing international finance to support sustainable transport can be found in the following guidance documents:

- Sakamoto(2010) which provides an overview of sources available to finance sustainable urban transport including both traditional sources and climate finance
- Binsted et al (2010)'Accessing Climate Finance for Sustainable Transport: A Practical overview' which focuses specifically on how sources of climate finance can be accessed to support sustainable transport interventions

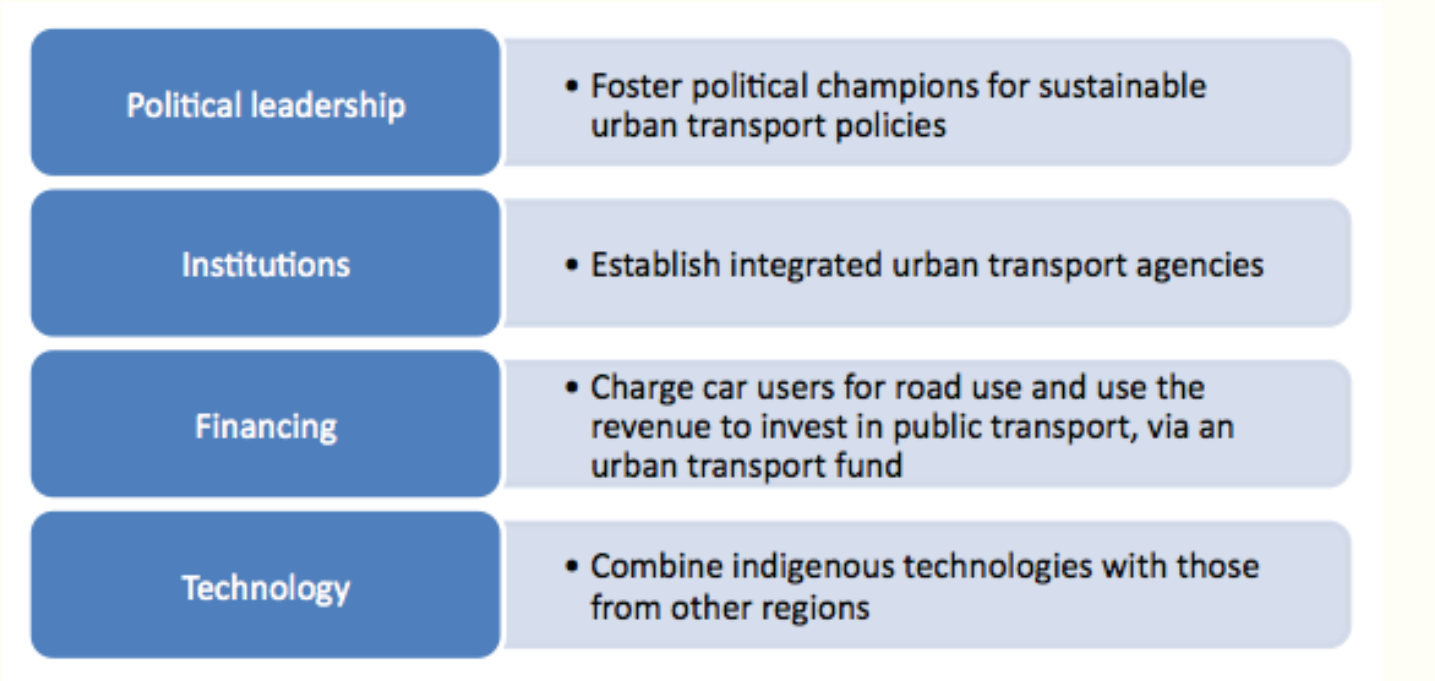
In addition to the provision of finance, international support for capacity building and technology transfer can also be received:

- Capacity building support can be provided to facilitate the establishment and development of institu tions, provide training in policy development and help developing countries to meet the eligibility requirements for climate finance.
- Developing countries can benefit from technologies developed in either developed or developing countries. The UNFCCC has produced a handbook containing details of technologies for the transport sector and the Bridging the Gap Initiative have published a paper on transport-related climate friendly technologies (see Bongardt and Schmid, 2009).

For further information:
Sakamoto K (2010). Financing Sustainable Urban Transport - GTZ Sourcebook for Decision-Makers in Developing Cities. Eschborn, German Technical Cooperation (GTZ). URL:
http://www.sutp.org/index.php?option=com_content&task=view&id=2293&Itemid=1%E2%8C%A9=en
Binsted A, Bongardt, D, Dalkmann, H and Sakamoto, K (2010) Accessing Climate Finance for Sustainable Transport. URL: http://www.transport2012.org/bridging/ressources/files/1/956,TD05_FinGuid.pdf

Despite the availability of international support, it is clear that local stakeholders must be at the forefront of overcoming the different barriers. To this end, a number of key "building blocks" can be considered, as shown in the figure below. The relative importance of each of the building blocks depend heavily on the context of each city; however all cities need to ensure that no bottlenecks are created with regards to these building blocks.

Figure 27: Building blocks towards the development of a sustainable urban transport paradigm



5.1 Political leadership: Foster political champions for sustainable urban transport policies

The first building block is to foster champions of sustainable urban transport at a high political level, for example the mayor of a city.

Cities which have seen a successful transition towards sustainable urban transport practices have in great part benefitted from strong leaders. Political leadership, as shown through the cases studies in the Annex, has been one of the most important reasons for success for many sustainable urban transport schemes. These include for example:

- Urban development based around Bus Rapid Transit systems in Curitiba Brazil, Bogota Colombia and Guadalajara Mexico, enabled by the visions of local leaders such as Jamie Lerner, Enrique Peñalosa and Emilio Gonzalez Marquez respectively.
- The demolition of urban highways in Seoul, South Korea led by then Mayor Lee Myung Bak
- The implementation of the congestion charge in London, UK, enabled through the leadership of then Mayor Ken Livingstone.

To replicate such examples of political leadership, the following specific actions could be taken:

- Existing forums such as the C40 Initiative or ICLEI (Local Governments for Sustainability) could be used to link mayors of different cities across Asia and the Pacific, and to share good practice at the highest level of governance. Mayors could share experiences amongst each other, in how to promote sustainable transport practices and package them in a way that appeals to the public. New forums focusing specifi cally at cities within Asia and the Pacific could also be considered, for example a "CIVITAS Initiative for Asian Cities", replicating the forum developed in Europe.
- National governments as well as international organisations/forums such as UNESCAP or the UNCRD sponsored Environmentally Sustainable Transport (EST) forum could support such leadership by mayors in

their countries by providing prizes (e.g. "sustainable transport awards") to recognise their actions and commitments.
- Budgetary support provided from the national government to cities could be made partly conditional upon good governance that supports and delivers sustainable transport policies.
- Educational organisations such as universities could mainstream the issue of sustainable transport and urban development within their curriculums to promote such thinking for the next generation of leaders. International organisations such as development agencies could actively provide scholarships for such courses to ensure their strong uptake.

5.2 Institutions: Establish integrated urban transport agencies

A second building block would be to develop the core institutions that would formulate, implement and enforce the sustainable urban transport policies listed in Chapter 2.

At city level, integrated urban transport agencies (as shown in the example of Singapore's Land Transport Agency in the Annex) could be established, tasked with overseeing:

- The development of key policies to manage transport demand (e.g. parking regulation, congestion charging and so forth)
- The integrated planning of public transport services and non-motorised transport
- The enforcement of traffic regulations including exclusive rights of way for public transport

At national level, transport ministries (in close coordination with their environmental and finance ministry counterparts) could renew their focus on:

- Designing and implementing fiscal measures such as fuel and vehicle taxes, as well as phasing out environmentally harmful subsidies (e.g. on fossil fuels and traditional forms of vehicle manufacturing)
- Promoting private investments in more environmentally efficient vehicle and fuel technologies through e.g. tax cuts/rebates, and subsidies/grants for research and development
- Supporting local governments via the providence of guidance on best practice in e.g. public transport management and operations.

In parallel with these institutional reforms, capacity building of staff should also take place, with increased focus on:

- Policy development capability in sustainable urban transport
- Financial management to ensure sustainable transport policies receive appropriate and sustained funding
- Management and operation of public transport systems (especially with regards to contractual management of private operators/infrastructure providers)
- Monitoring environmental impacts, including on carbon emissions
- Communication techniques/skills to ensure that the benefits of sustainable transport policies are understood and supported by the general public.

As noted before, such skills could be enabled through a mixture of changes to the curriculum of educational institutions and professional training, supported in some cases by international donors.

Box 11: Changing how policies and projects are assessed

The degree to which the integrated urban transport authority supports the development of sustainable transport depends heavily on how policies and projects are assessed.

Project appraisal in its current form generally focuses on how time and vehicle operating costs can be reduced. Investments in road infrastructure for private vehicles are often justified on grounds that they lead to shorter journey times by the car, and less strain on vehicles.

On the other hand, this practice does not adequately reflect the fact that:

- Over time, road building without adequate measures to rationalise their use leads to congestion, thereby negating any initial time savings.
- Road traffic brings about many external costs, including air pollution, noise, carbon emissions and com munity severance (see Chapter 1).
- The beneficiaries of the project may be skewed towards richer members of society who can afford private vehicles.

It is important that decision making processes properly reflect these important issues. Ways in which this can be done include:

- Conducting Strategic Environmental Assessments (SEAs) and Environmental Impact Assessments (EIAs) that scope the potential negative implications on the environment arising from the policy and project levels respectively.
- Conducting a carbon-footprint analysis of policies/projects before they are implemented.
- Conducting Equality Impact Assessments (EqIAs) to understand any adverse impacts on people of lesser incomes etc.

The Asian Development Bank (ADB) for example is developing a carbon footprinting tool for use in assessing the impacts of its investments on carbon emissions. The use of such tools can also be considered for local and national governments across the Asia and Pacific region.

See ADB (2010) at : http://www.adb.org/Documents/Evaluation/Knowledge-Briefs/REG/EKB-REG-2010-16/default.asp

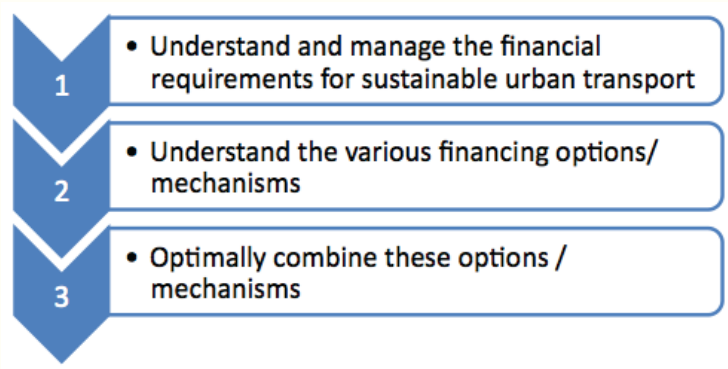
5.3 Financing: Establish an urban transport fund at local level

The development and enhancement of public transport and non-motorised transport infrastructure/operations require financial resources for their implementation.

With the exception of Least Developed Countries (LDCs), it is not always the case that absolute levels of financial resources are lacking. Rather, as noted in Sakamoto (2010), there is a systematic bias towards them being used for unsustainable transport modes such as urban highways and flyovers. This often reflects the political as well as institutional setup of the current transport sector, whereby investments in large road infrastructure projects (e.g. urban expressways and flyovers) are favoured by investors, donors and developing country politicians/decision makers alike.

In order to shift these financial resources towards more sustainable forms (including the various public transport modes described in Chapter 4), three key steps are required by policy makers in developing countries, as follows:

Figure 28: Three steps towards financing sustainable, urban transport (Source: Sakamoto, 2010)

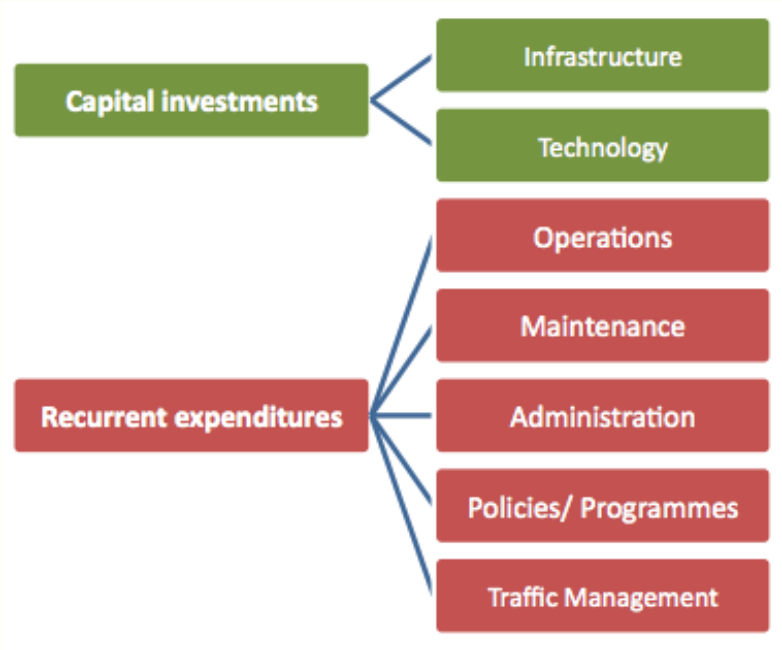


As noted in Sakamoto (2010), financing requirements for sustainable transport arise for both capital investments and recurrent expenditures, as follows:

- **Capital investments for infrastructure** – generally apply to fixed assets such as railways, busways, cycle paths, tramlines, stations, roads and bridges. It also applies to **investments** in new technologies, such as energy efficient vehicles, as well as Intelligent Transport Systems (ITS) and other forms of system-wide technologies. These investments are generally large scale, and require the strong support of national governments, international donors and the private sector.

- **Recurrent expenditures** - require a continuous stream of financial resources to cover the **operation** of public transport, paratransit and other transport services, the **maintenance** of infrastructure[18], **administrative costs** for institutions, support for **policies and programmes** – such as legislation, regulation and traffic rules, air quality management programmes, safety campaigns, and **traffic management** – including signalling, bus lanes, priority at crossings etc. Such expenditures should generally be met by users of the transport system (e.g. via road tolls, public transport fares etc).

Figure 29: Aspects of urban transport that require financing (Source: Sakamoto, 2010)



Policy makers have a number of options to choose from, in meeting the above types of costs. Financing instruments are available at local, national and international level, and can be combined to collectively meet the requirements of the city in terms of its public transport needs. This is shown in the table below, and detailed further.

[18] This includes rolling stock and vehicles for e.g. public transport.

Table 13: Overview of financial instruments (Adapted from Sakamoto 2010)

Level of implementation	Instrument	Amount typically generated	Ability to support:						
			Infrastructure	Technology	Maintenance	Operations	Institutions/ capacity	Policies	Traffic Man.
Local	Parking charges	$			X	X	X		X
	Road pricing/ congestion charge	$$	X	X	X	X	X	X	X
	Employer contributions	$$	X		X	X			
	Fare box revenues	$$				X			
	Public transport subsidies	$				X			
	Land development/ value taxes	$$$	X			X			
	Public private partnerships	$$	X	X	X	X			
	Advertising	$			X	X			
National	Fuel taxes/ surcharges	$$$	X		X	X	X	X	X
	Vehicle related taxes and charges, including auctioning of quotas	$$$	X		X	X	X	X	X
	Loans and grants	$$	X				X		
Global	Climate Investment Fund	$	X	X	X	X	X	X	X
	Global Environment Facility	$				X	X	X	X
	Multilateral/ bilateral climate funds	$	X	X	X	X	X	X	X

- Local sources of financial resources include revenues from parking charges, road pricing and congestion charges. These charges are generally levied on private motor vehicle users, and therefore serve the twin objectives of deterring excessive use of private modes, and raising revenue for cities to use in improving public transport.

Employer contributions as seen for example in France as Versement Transport, levy a charge on employers for every staff that they employ. The collected resources are used to invest in public transport infrastructure, most notably LRT schemes.

Farebox revenues can in some countries be sufficient to cover the operating costs of public transport, especially where demand is high. However in many cases, subsidies from the local or national government are needed to maintain service levels. Revenue from advertising could supplement any shortfall in farebox revenue.

In addition to the above, large investments required e.g. for rail-based public transport infrastructure can be sourced from land development/value taxes, which essentially recoups the increase in land values as a result of the public transport investment.

- The abovementioned financing sources can be further augmented with taxes levied at the national level, for example on fuels (fuel tax) and vehicles (vehicle tax). These sources constitute a steady and large scale source of financial resources, which can play a central role in the development of public transport infrastructure.

The challenge is to ensure an effective institutional setup to allow these nationally administered taxes to flow into local-level investments. One such way is to develop a national fund from which resources can be redistributed to the local level, subject to certain criteria. The Jawaharlal Nehru National Urban Renewal Mission (JNNURM) explored in the Annex is one working example.

- Finally, a number of international sources of finance are available to further support sustainable transport options. A number of bilateral and multilateral donors already provide support for sustainable transport, as represented by the Asian Development Bank (see Box below)

Climate related funds and mechanisms such as the Global Environmental Facility (GEF), the Climate Investment Funds (CIF) and Clean Development Mechanism (CDM) have already provided support for projects in many developing countries (see Binsted et al, 2010).

In addition, it is currently anticipated that climate finance post 2012 will be significantly upscaled through the so-called "Nationally Appropriate Mitigation Actions" (NAMA) framework, and the associated Green Climate Fund, to which 100 billion USD/annum is currently pledged by developed countries (for both mitigation and adaptation in total).

Box 12: The Sustainable Transport Initiative of the Asian Development Bank (ADB)

In the context of its Sustainable Transport Initiative (STI), the Asian Development Bank (ADB) is increasingly shifting its relative size of investments from road to rail and general urban transport (which would include public transport and non-motorised transport infrastructure), as depicted in the figure below.

ADB is also taking steps to evaluate the carbon footprint of the activities it supports (see ADB, 2010).

These initiatives provide a good example for other donors active in the region to follow, in increasing the support provided to the development of sustainable transport.

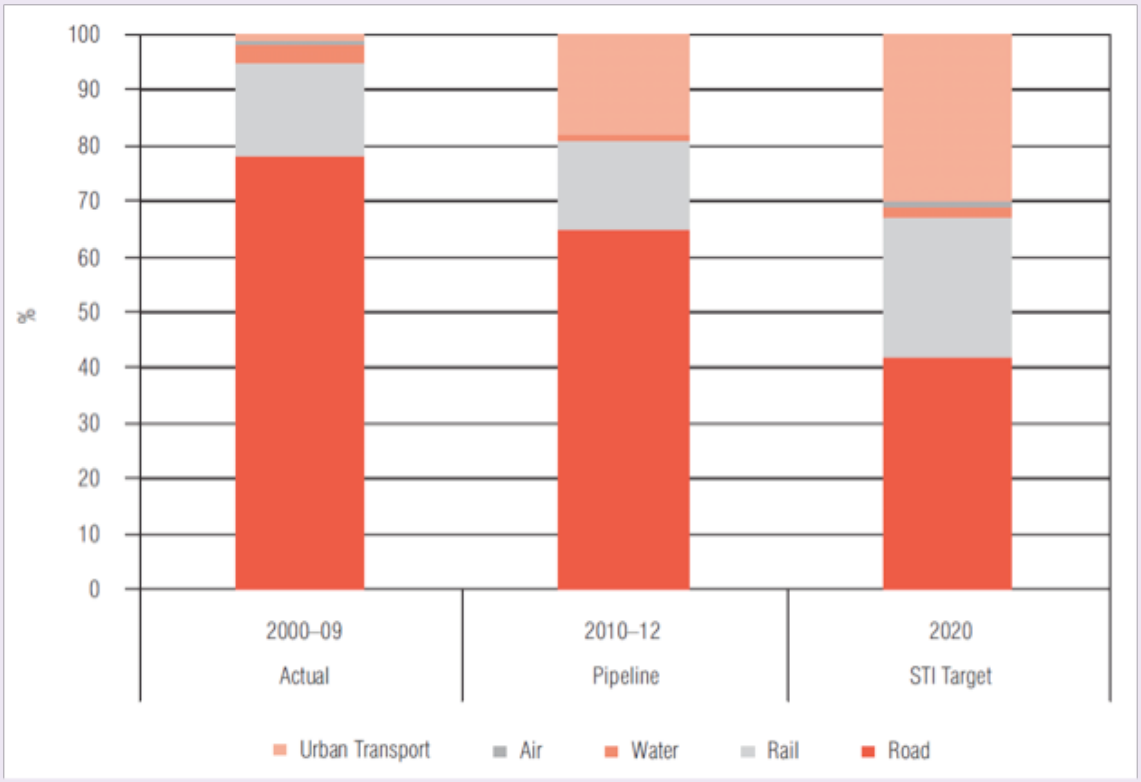


Figure 30: ADB's Sustainable Transport Initiative: Subsector shares of transport lending – Actual, Pipeline and Target (Source: ADB, 2010)

Box 13: The role of the private sector in financing sustainable transport

As a public good, it is in many ways justified that public finance is used to cover the costs for transport infrastructure and operations. At the same time, much of public transport operations in developing countries is conducted by private entities, for example by private bus, rickshaw and motorcycle taxi operators.

Given the constraints in the availability of public finance, as well as potential efficiency gains that can be reaped through private enterprise, it is important that private sector capital (including those from e.g. pension funds) is fully mobilised, but in a way that endorses the overall aims of sustainable transport.

There is a central role for governments (at both local and national level) in ensuring that the activities of the private sector are fully aligned with the goal of sustainable transport.

First, governments can help set the right market signals for providers of sustainable transport to flourish. This contains many of the measures described in Chapter 3, such as the taxation/charging of private vehicles, fuels and road space.

Second, governments can develop regulatory frameworks that enable private companies for the right to operate public transport services, under a framework that is set by a public body (see Section 5.2 for further details). The public body could also ensure a minimal level of infrastructure provision, including termini, on-street stations and rights of way (e.g. bus lanes, priority signalling etc.) In return, public transport operators can be asked to adhere to certain service standards (e.g. investing in new buses, enhancing frequency levels and undertaking driver training).

Such arrangements would also help private companies access favourable loans, by ensuring a long term and predictable revenue stream. This would help solve the current situation facing many informal operators, whereby the unpredictability of their revenue stream hampers their efforts to access formal financial streams (e.g. commercial banks) and invest for the long term. There have been several attempts to improve access to finance towards informal operators. As noted in Cervero (2000), Nigeria has worked with the World Bank to initiate a pilot scheme for financing the purchase of vehicles to be used by private operators. Credit is provided at favourable terms to individual operators through a transport association, in cooperation with local banks. In Brazil, a national bank has been established that extends micro-credit to van operators.

Figure 31: A large part of public transport in developing countries such as the Philippines is operated by small and informal private companies/individuals
(Photos: Ko Sakamoto)

Box 13 (continued)

Third, governments can establish Public Private Partnerships (PPP) where a public sector agency develops a contractual agreement with a private sector company, mainly for infrastructure projects.. Public-private partnerships are often used for the development of transport infrastructure. As noted in Sakamoto (2010), specific modalities include:

- **Design and Build partnerships**, whereby a project is tendered and a private contractor is selected via a competitive bidding process.
- **Build-Operate-Transfer (BOT)** whereby the contractor invests in, and operates, infrastructure and associated services for a fixed period of time, after which ownership reverts back to the public sector.
- **Build-Own-Operate (BOO) or Design-Build-Finance-Operate (DPFO)**, where the private sector builds, owns and operates a facility, which it sells to its users.
- **Private Finance Initiative (PFI)**, where the public sector purchases the services from the private sector through a long-term agreement.

There are both pros and cons to PPP. On one hand, there are a number of arguments for PPP. Private finance can often fill a gap in public resources and ensure that much needed transport infrastructure and services are delivered. PPP can also lead to quality improvement of public services. Performance-based penalties/rewards can be built into PPP contracts to ensure a continuing improvement in standards. Furthermore, PPP can facilitate the utilisation of private sector know-how, expertise and human resources, and if implemented properly ensure that risks are allocated to the party best able to manage each particular risk. Budgetary predictability is often enhanced, and the public sector can focus on outputs and benefits from the start of a project

On the other hand, there are a number of dangers in using PPP. Unless the contract is clearly specified and monitoring of performance is in place, the private contractor could "cut corners" in order to maximise profits. The negotiation (and often renegotiation) of contracts with private companies require a lot of manpower and expertise within the public sector body. Not all risks can be hedged. In the worst instance, the private contractor may go bankrupt, passing the whole risk back to the public sector since it effectively underwrites the investment. PPP can also be an excuse for simply putting off costs into the future. There is no guarantee that in the future the government will have the necessary funds to maintain its agreed commitments.

See: Sung Jick Eum (2007) Financing and Urban pricing http://chinaurbantransport.com/english/fur_ppt.htm GTZ Sourcebook Module 1c - Private Sector Participation in Urban Transport Infrastructure Provision www.sutp.org

The above types of financial instruments need to be optimally combined, to cover both the capital investments in infrastructure and the recurring expenditures as noted before and shown in Table 13.

As noted in Sakamoto (2010), capital investments for infrastructure and technology need to be matched by large resources. The key financing sources include:

- Revenues from vehicle and fuel taxes administered by the national government and redistributed to local governments.
- Development charges or added land value taxes.
- Private sector financing (see box on the role of the private sector earlier)

On the other hand, the recurring cost of maintenance of physical assets could be financed by the users of the transport system, through e.g.

- Fuel taxes.[19]
- Road user charges.

[19] As a rule of thumb, a level of revenue equal to 10 US cents per litre of fuel is usually adequate to cover the costs of maintenance for the whole road network of a country.

The operation of public transport can also be covered by:

- Fare box revenue
- Earmarking sales and property taxes
- Capturing increases in land value and property development
- Revenues from road user charges and parking charges which can be earmarked for improving public transport operations

Box 14: Coupling public transport financing with regulatory reform (Based on Sakamoto, 2010)

It is important that the provision of financing for public transport is coupled with a wide-ranging reform of the regulatory environment surrounding public transport operations. The key points for regulatory reform, taking the example of buses, are as follows:

- Private companies can often provide services more cost effectively, but only under competitive terms in a well-regulated market to ensure that prices users face are kept low. Public authorities should determine the required routes, and ask private companies to tender for the right to operate those routes.

- Bus operators should be carefully regulated of their performance, including service frequency, safety, vehicle environmental performance and punctuality. These can be monitored and enforced through performance-based contracts, where companies lose their right to operate a route if they do not meet the performance targets.

- Fares should be set to allow integration between modes, preferably at the local level. Ticketing can also be integrated, so that one system can be used for all types of public transport modes (e.g. buses, BRT, LRT, and MRT)

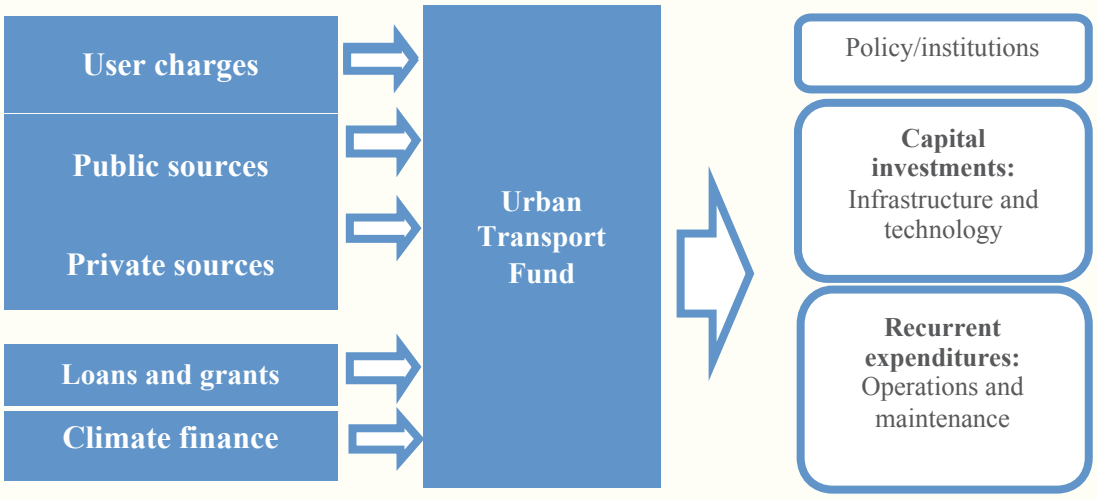
- Subsidies to operators should be carefully determined so as not to undermine the financial sustainability of the city budget, and thereby the collapse of the transport operator. Where subsidies are used to support the poor, subsidies that target disadvantaged groups (e.g. through discounted travel cards) are likely to be more effective compared to subsidising the whole system across all users.

To manage multiple financial sources appropriately and effectively, an urban transport fund should be considered by all cities, which would effectively collect the financial sources (including user fees, local taxes, transfers from central government, ODA, and climate finance) into one centralised budget, and allocate this to the funding needs of the city.

The urban transport fund could be administered by the integrated transport authority (as suggested in Section 4.2). The concept of such a fund is shown in the figure below.

The disbursement of resources from such a fund should be carefully administered, so as to reduce cost overruns and abuse of resources (see box overleaf).

Figure 32: Concept of an urban transport fund (Adapted from: Sakamoto, 2009)



Box 15: The importance of managing expenditures (Based on Sakamoto, 2010)

Equally important to securing adequate financial resources is to manage the expenditures carefully. Indeed, unsustainable cost structures are a major source of failures of public transport systems.

Flyvbjerg et al., (2003) highlights that substantial cost escalation is the rule rather than the exception in many public transport investments. Taking the railway sector as an example, average cost overruns of 45% are seen. Tunnels and bridges experience on average overruns of 34% and, road construction 20%. No country has been immune from such overruns. Some examples quoted in Lewis-Workman (2010) include:

- Boston, USA Central Artery (estimated USD 6 billion, actual USD 14.6 billion = 143% overrun);
- Tokyo, Japan Oedo Subway (estimate JPY 682.6 billion, actual 1,400 billion JPY = 105% overrun); and
- UK-France Channel Tunnel (Estimate GBP 2.6 billion, actual GBP 4.65 billion = 79% overrun).

To manage these cost increases, it is imperative that an accurate understanding of project risks is formed, and incentives built in to mitigate cost overruns. Some concrete steps include:

- Incorporating the risk of cost overruns in transportation project evaluation and decision making, e.g. through systematically checking and correcting for over-optimistic forecasts on project performance (e.g. ridership of public transport).
- Planning in advance for delays and long implementation phases which translate into substantial cost escalations. This is particularly important for larger projects which have a larger impact on the transport budget if their expenditures are not controlled.
- Design subsidies and procurement procedures so that payment for contractors can be linked to actual progress and performance. Use for example Performance Based Contracts (PBC), where the payment to the contractor is based on the amount of inputs (e.g., cubic meters of asphalt concrete, number of working hours) This approach can potentially achieve cost savings from 10% to 40% and a multi-year financing of a maintenance program.

See: Lewis-Workman (2010) Predicted vs. Actual Costs and Ridership – Urban Transport Projects
Flyvbjerg et al., (2003) How common and how large are cost overruns in transport infrastructure projects? http://www.informaworld.com/smpp/content~db=all~content=a713868295~frm=abslink
Berechmana and Chenb (2010) Incorporating Risk of Cost Overruns into Transportation Capital Projects Decision-Making http://masetto.ingentaselect.co.uk/fstemp/0e2a5a16ece5dbdf575985a14311523d.pdf
Stankevich et al., (2005) Performance-based Contracting for Preservation and Improvement of Road Assets http://siteresources.worldbank.org/INTTRANSPORT/Resources/336291-1227561426235/5611053-1231943010251/trn-27_PBC_Eng_2009.pdf

5.4 Technology: Combine local technologies with those from other regions

Coupled with the adequate provision of financial resources, it is important that appropriate technologies are also made available to policy makers through technology development and transfer.

As shown in the table below, there are a number of technologies that are important for the development of sustainable transport. As noted in Dalkmann, Sakamoto et al (2011) these include:

- Conventional technologies involve the use of fossil fuels for vehicle propulsion, which is the main cause for air pollution and GHG emissions.
- Advanced transportation technologies aimed at energy efficiency,
- Switching from fossil fuels to renewable and clean technologies,
- Improvements in public transport and non-motorized transport systems and
- Infrastructure and travel demand management in order to reduce negative externalities which are caused by conventional technologies.

Table 14: Various technologies to support sustainable transport goals

(Source: Dalkmann and Sakamoto et al, 2011)

Sustainable Transport Goals	Technologies	Level of importance/significance*		
		2011	2020	2030
▪ Improvement in energy efficiency ▪ Reduction in air pollution and greenhouse gases ▪ Increased use of renewable resources ▪ Reduced use of non-renewable resources	▪ Improved internal combustion engines (ICEs)	+++	+++	+
	▪ Vehicle technology improvements (e.g. material substitution, aerodynamics)	+++	+++	+++
	▪ Retrofitting technologies	+++	+++	++
	▪ Hybrid and Plug-in hybrid electric vehicles	+	++	+++
	▪ Battery electric vehicles	+	++	++
	▪ Solar electric vehicles		+	+
	▪ Fuel cell vehicles		+	+++
	▪ Flex-fuel vehicles	++	+++	+++
	▪ Alternative fuel technologies – Biofuels, CNG, LNG, LPG[20] and hydrogen	+	+++	+++
	▪ Non motorized transport vehicles	+++	+++	+++
	▪ Public transport systems	+++	+++	+++
	▪ Intelligent transport systems	+	+++	+++
	▪ Use of Information technologies for traffic management (smart infrastructure)	++	+++	+++
	▪ e/tele-technologies for travel demand reduction	++	+++	+++
	▪ Integrated ticketing	+++	+++	+++
	▪ Eco-driving and speed control	++	+++	+++
▪ Waste minimization ▪ Reduction in land pollution	▪ Material substitution, use of composite materials	++	+++	+++
	▪ Recycling technologies	++	+++	+++
▪ Reduced noise pollution	▪ Electric vehicles, hybrids		+++	+++
	▪ Silencers, etc.		++	++
▪ Safety	▪ Vehicle safety technologies such as tyre-pressure monitoring, Adaptive cruise control/collision mitigation, Emergency brake assist/collision mitigation, etc.	++	+++	+++

+++: Central, ++: Highly Relevant, +: Relevant

Authors' assessment based on IEA (2009), Petersen et al (2009) and others.

[20] Compressed natural gas (CNG); Liquefied natural gas (LNG); Liquefied petroleum gas (LPG)

These technologies need to be made available to developing countries in Asia and the Pacific, through technology transfer and dissemination through both public and private channels.

The transfer of technology, in the context of the UNFCCC negotiations, continues to be considered as one of the major building blocks of support provided to developing countries to enable mitigation actions.

Within the UNFCCC debate, the definition of transport technology has tended to focus mainly on those related to vehicles and fuels.

Here, efforts are needed to ensure that the post-2012 climate regime allows for all appropriate technologies (including those listed in the table above and especially those surrounding public transport and non-motorised transport systems) are made available to developing countries.[21]

[21] See Bongardt and Schmid (2009) for further details. http://www.transport2012.org/bridging/ressources/files/1/625,449,TechnoTransf.pdf

6 Key Recommendations for Policy Makers

In summary of the ideas presented in this report, a number of key actions can be suggested for policy makers in Asia and the Pacific, at local, national and international level.

Local Governments have a central role to play in the development and implementation of sustainable urban transport. In order to lead this effort, local governments and politicians may:

- Help set the institutional framework for the development of sustainable and integrated urban transport policies by setting up integrated urban transport authorities within their cities, covering all modes of trans port (including freight transport).
- Promote long-term urban planning such as via the development of integrated transport and land use master plans, coupled with local and district development plans.
- Help duplicate political leadership by utilising forums such as the C40 or ICLEI to exchange good prac tice. New forums focusing specifically at cities within Asia and the Pacific could also be considered, for example a "CIVITAS Initiative for Asian Cities", replicating the forum developed in Europe.
- Help set a favourable environment for the development of public transport and other forms of sustain able transport by implementing a basic package of policies to push car users away from private cars, including congestion charging, parking management, restriction/auction of licence plates, and promot ing car-free city areas
- Help ensure that adequate financial resources are available and properly managed, by setting up an urban transport fund that oversees investments in sustainable transport, especially public transport and non-motorised transport

National governments have a key role to play in catalysing actions at the local level. They may:

- Help foster local-level leadership through:
  - Providing prizes (e.g. "sustainable transport awards") to recognise the actions and commitments of local governments.
  - Making budgetary support provided from the national government to cities conditional upon good governance that supports and delivers sustainable transport policies. For example, national grants and loans can be provided to cities that have created the aforementioned urban transport authority, and those which also have in place a master plan for sustainable urban transport development (applying the principles of JNNURM in India, as noted in the Annex).

- Help set the right conditions for sustainable urban transport modes to be developed, thorough:
  - Designing and implementing fiscal measures such as fuel and vehicle taxes, as well as phasing out environmentally harmful subsidies (e.g. on fossil fuels and traditional forms of vehicle manufacturing)
  - Implementing regulatory measures such as vehicle efficiency standards and fuel standards
  - Promoting private investments in more environmentally efficient vehicle and fuel technologies through e.g. tax cuts/rebates, and subsidies/grants for research and development

- Provide guidance to cities on good practice in e.g. traffic demand management and public transport management/ operations, as well as how to set up urban transport institutions.

- Provide budgetary support for local actions through:
  - Transferring revenues from national taxes (e.g. fuel and vehicle taxes) to the local level (potentially an earmarked proportion of tax revenues)
  - Providing national grants and loans with favourable conditions (e.g. lower interest) for sustainable urban transport
  - Facilitating the matching of international sources (e.g. ODA and climate finance) to local level actions[22]

[22] As in the case with UNFCCC negotiations, national governments are generally given the mandate to negotiate terms and conditions on ODA, climate finance and other types of international monetary flows. As such, national level stakeholders must ensure that the support provided through such support feed into local-level actions.

International bodies (including UNESCAP and regional financing bodies such as the Asian Development Bank) can further support developing countries in the region by providing external assistance in technical and financial terms. They may in particular:

- Help foster local leadership by:
  - Providing scholarships for future leaders to receive education in sustainable transport policy
  - Providing prizes (e.g. "sustainable transport awards") to recognise their actions and commitments.

- Help enhance institutional and human capacity by:
  - Providing technical assistance in setting up the aforementioned integrated urban transport authority at city level
  - Providing training courses in sustainable transport policy (including for example public transport management and operations etc)

- Help set the conditions for reforming transport policies by:
  - Providing technical assistance projects on e.g. master planning, transport demand management, tax reform, regulatory reform etc

- Provide financial resources for the implementation of sustainable transport projects by:
  - Earmarking a certain percentage of Official Development Assistance to sustainable transport
  - Revising rules on climate finance in the context of the development of the framework around Nationally Appropriate Mitigation Actions (NAMAs) to make them more inductive to actions in the transport sector.

Annex: Successful case studies

Based on existing and available documents and information, this section identifies and analyses 9 successful case studies from around the world (including from the Asia and the Pacific region) that provide guidance to developing countries in the Asia and the Pacific.

One case study is analysed for each of the Avoid, Shift and Improve categories of policy measures, and for each of the three main types of barriers, namely political, capacity/institutional and financial as noted in Chapter 5.

Table 15: List of case studies covered

	Political	Capacity and institutional	Financial
Avoid	London, UK: The implementation of the Congestion Charge in combination with public transport improvements to boost public acceptability.	Seoul, Korea: Converting urban motorway to public spaces.	India: The use of national level grants (JNNURM) to incentivise sustainable local transport plans.
Shift	Guangzhou, China: Development of one of the largest Bus Rapid Transit networks through strong political vision and leadership.	Singapore: The development of a single transport agency to integrate all public transport modes, as well as linking to other policies such as congestion charges.	Japan: Use of value capture as a key financing source for the private railways.
Improve	Indonesia: Phasing out of fossil fuel subsidies through strong political leadership and communication to public on use of tax revenue.	China: Fuel economy standard development	Hanoi, Vietnam: The use of climate finance to improve buses

Each case study takes into consideration the following issues:

- What was the problem, and what was the solution introduced?
- What were the main results in environmental, social and economic terms?
- How was the practice financed?
- What were the barriers encountered in the implementation, and what were the success factors (in politi cal, financial, institutional, and technological aspects) that allowed these barriers to be overcome?

Further references are also provided, to allow the reader to obtain in-depth information regarding each case study if required.

The above aspects are presented in a standardised "factsheet" format for legibility and clarity.

A.1 Congestion Charge: London

Introduction: What was the problem, and what measure was introduced to solve it? Photo: Ko Sakamoto

In 2002 London suffered the worst congestion in the UK with average traffic speeds lower than 12km per hour. It was estimated that London lost between GBP 2 million to GBP 4 million every week in terms of lost time caused by congestion (TfL, 2007). In February 2003, the London Congestion Charging Scheme came in to force with the aim of helping to address these issues. The scheme covered a 22 square km area initially and was almost doubled in size in February 2007. Drivers pay a charge of GBP 8 to enter the zone between 7am and 6pm, Monday to Friday. Drivers found to be evading the charge are issued with a penalty charge notice. A number of vehicles are exempt from the charge including those that present positive environmental benefits compared to normal vehicles (hybrid cars and those that run on alternative fuels such as electric, hydrogen and liquid petroleum gas).

Results

By 2006 the congestion charging zone had reduced congestion in central London by 26% compared to 2002 levels (EEA, 2008). The table below highlights some of the boarder economic, environmental and social benefits of the scheme (EEA, 2009).

Type of benefit	Result
Environmental	• Estimated GHG emissions reductions of 16.4 % (2002 to 2003) • Reductions of NOX and PM10 within the congestion charging zone of 18% and 22% respectively by 2004. • A 37% increase in the number of passengers entering the congestion charging zone by bus during charging hours in the first year.
Social	• Increased pedestrian safety – with between 40 and 70% fewer accidents resulting in personal injury within the zone.
Economic	• GBP 122 million net raised in 2005/2006 (TfL, 2006). • Based on the GBP 8 charge the scheme is estimated to save GBP 2.5 million per year as a result of a reduction in vehicle km travelled, fuel consumption and CO_2 emissions. • The scheme achieves a cost efficiency of GBP 78 million when all costs and benefits are considered • It is thought that the congestion charge is boosting sales of hybrid cars - Honda and Toyota increased supply of hybrid vehicles in 2007

How was the practice financed?

Transport for London (TfL), the body responsible for London's transport system has overall responsibility for implementing and managing the scheme. The initial technology and infrastructure costs, of GBP 162 million, were covered by TfL's General Fund (EEA, 2009).

TfL is subsequently responsible for issuing penalty charge notices and controlling the charge payments with mobile enforcement units. The scheme is able to generate income that exceeds its operating costs, making a contribution of GBP 303 million to the public purse between 2002 and 2006 (EEA, 2009). Revenue from the scheme is being used to fund major public transport improvements including improving bus services and renovations to the London Underground.

Barriers encountered in the implementation

	Barrier	How the barrier was overcome
Political	There was a significant level of opposition to the introduction of the scheme, for example from the media, politicians and local residents and businesses in London.	• **Political climate and leadership:** The then Mayor of London, Ken Livingstone, was actively engaged in the project, setting out a clear vision and delivery plan and driving forward the introduction of the scheme using devolved powers. • **Communication and Information:** Formal and informal public consultation was undertaken throughout the development of the scheme with feedback reports subsequently made publically available. Media campaigns to raise awareness of the operation and implications of the scheme were given. • **Research and monitoring:** TfL undertook extensive traffic modelling prior to the implementation of the scheme and has monitored impacts post introduction. This has provided a robust evidence base to inform future scheme revisions and responses to criticisms of the scheme.
Institutional/ capacity	There was potential for a lack of clarity over responsibilities leading to poor implementation and ongoing management.	• **Clearly defined roles and responsibility:** Overall responsibility for the scheme has been allocated to one body TfL, who are responsible for the whole of London's transport network. This has ensured the effective designs, implementation and ongoing management of the scheme and that it is integrated with the wider transport strategy for London.
Financial	The scheme had high initial implementation costs of GBP 162 million.	• **Highlighting the long term financial benefits of the scheme:** A clear vision and delivery plan for the scheme helped to raise awareness of the long term financial benefits both in terms of the expected revenue generation from the operation of the scheme and the cost savings as a result of reduced congestion, helping to justify the initial costs. • **Recycling revenue to benefit public transport:** Part of the revenue is now used to support wide-ranging improvements to public transport, in particular an increased number of buses.
Technical	Up to date technology (such as automatic number plate recognition) was required.	• **Extensive trials:** Extensive trials were conducted using the new technology to ensure that there were no technological issues. The costs and benefits of different technological options were explored prior to the scheme design and implementation to ensure that the most cost effective long terms solutions were used.

Further references

- EEA (2008) Success stories within the road transport sector on reducing greenhouse gas emission and producing ancillary benefits
- TfL (2007) Congestion charging. http://www.cclondon.com/whatis.shtml.
- TfL (2006) Impacts monitoring: fourth annual report. http://www.tfl.gov.uk/assets/downloads/FourthAnnualReportFinal.pdf

A.2 Converting urban motorway to public space : Seoul

Photo: Manfred Breithaupt in GIZ Urban Transport Photo CD (2010)

Introduction: What was the problem, and what measure was introduced to solve it?

In Seoul, the capital of the Republic of Korea, a road and an elevated four lane highway was constructed in the 1960s and 1970s to cater for the growing levels of traffic, covering the historical Cheonggyechon stream. These carried nearly 170,000 vehicles per day. By the late 1990s however, the area was suffering from deprivation of green spaces, pollution and safety concerns regarding the structure of the elevated highway. Mayoral candidate Lee Myung Bak (who is now the President of Korea) included the demolition of the elevated highway and the restoration of Cheonggyechon as a key part of his successful bid in 2011, and this became one of his administration's priorities once he was elected.

Results

The project created a 5.8km stretch of landscaped pathway running alongside the uncovered Cheonggyecheon stream, thereby creating a high-quality public area for citizens to enjoy.

Type of benefit	Result
Environmental	• Re-establishment of lost natural habitats, leading to the reappearance of plant and animal species • Improvement in water quality • Reduction of traffic noise, vibration, and pollution • Increased flow of air, leading to a 2-5 degree reduction in temperature.
Social	• Creation of a large public area for recreation, attracting more than 18 million visitors by end of 2008. • Barrier-free access to the public area via the provision of lifts and free wheel chairs (although scope for accessibility enhancement remain)
Economic	• Huge growth in development capital (e.g. in residential construction). Property prices have risen at double the rate of other areas of the city. • Number of businesses in the vicinity of the restored area has risen. • Limited adverse impact on traffic speeds in the central business district (Only 12.3%)

How was the practice financed?

The project was financed wholly through the Seoul Metropolitan Government's own domestic resources. The total cost of the project was over 386 billion won (USD 281 million).

Barriers encountered in the implementation

	Barrier	How the barrier was overcome
Political	Stakeholders voiced perceived negative impacts, including reduction to mobility, loss of business and adverse impacts on congestion elsewhere in the city.	• Strong political support was provided by the Mayoral candidate Lee Myung Bak who received the public mandate to move ahead with the project through his successful bid for the mayoral elections in 2001. • Measures were taken to reduce business opposition, including provision of extra parking spaces, reduced parking fees, improved loading and unloading systems, promotion of Cheonggyecheon businesses, subsidies and grants for business restructuring and special arrangements with vendors that were to be displaced.
Institutional/ capacity	There were concerns that the project would stall due to the lack of institutions to oversee the public consultation exercise, and to build consensus amongst key stakeholders.	• The Seoul Metropolitan Government supported by the Seoul Development Institute, established the "Cheong-gyecheon Restoration Centre to facilitate the required back-ground research, development planning and activities. • In addition, a Citizen's Committee was established to collect public opinion, communicate the goals of the project and build consensus amongst all stakeholders.
Financial	Some opposition was heard with regards to the budget being too expensive for the city to imple-ment	• The Seoul Metropolitan Government carried all the costs associated with the project from their own domestic funds.
Technical	There were concerns that the demolition of the expressway would lead to heavy traffic congestion across the city.	• Extensive modelling work and real-life trials (using road blocks) were conducted before the project implementation, to estimate any adverse impacts on other routes. • The project was augmented by several measures to curb private vehicle use, including a large public campaign on public transport use, development of bus-only lanes, provision of downtown shuttle buses, provision of traffic information/guidance facilities etc.

Further references

• Park KD (no date) Cheonggyecheon Restoration Project. http://www.wfeo.org/documents/download/Cheonggeycheon%20Restoration%20Project_%20Korea.pdf

• CABE (no date) Cheonggyecheon Restoration Project. http://webarchive.nationalarchives.gov.uk/20110118095356/http:/www.cabe.org.uk/case-studies/cheonggyecheon-restoration-project

• Seoul Metropolitan Facilities Management Corporation (2011) Welcome to Seoul's Pristine Stream Cheong Gye Cheon. http://english.sisul.or.kr/grobal/cheonggye/eng/WebContent/index.html

A.3 National grants for sustainable local transport plans: India

Photo: Kodukula (2008) in GIZ Urban Transport Photo CD (2010)

Introduction: What was the problem, and what measure was introduced to solve it?

There has been an ever increasing demand for mobility in Indian cities as a result of rapid economic growth and a fast growing urban population. This has exerted huge pressure on the city's existing resources and has made development patterns unsustainable.

The country's Jawaharlal Nehru National Urban Renewal Mission (JNNURM) aims to support the development of sustainable infrastructure as part of a wider process of urban renewal. Cities identified by the Mission are expected to formulate comprehensive City Development Plans (CDPs) for a period of 20-25 years outlining the cities overall strategy, specific programmes and policies and financial plans. Based on the CDPs, more detailed plans are to be developed for land use, environmental management and urban transport projects. Selected projects will then be funded by Central and State Government.

The JNNRUM provides a platform for local government in selected Indian Cities to access significant financial support from Central Government for urban infrastructure projects. To access the funding cities are required to undertake a set of institutional, structural, and fiscal reforms, necessary to improve their urban service delivery systems (Binsted et al 2010).

Results

Type of benefit	Result
Environmental	• The funding will only support sustainable transport projects helping to ensure a reduction in the level of carbon emissions from the transport sector in Indian cities as well as supporting a number of other environmental co-benefits such as reduction in air pollutant levels.
Social	• Funding supports the improvement of bus services improving accessibility for the urban poor.
Economic	• The programme provides an incentive for cities to undertake fiscal reforms and seek innovative sources of finance which will help to ensure the ongoing sustainability of transport projects implemented. • The requirement for the development of City Development Plan will help to ensure better integration of land use and transport planning supporting cities to follow a more economically efficient development path.

How was the practice financed?

The mission is financed with money from central Government supported by matched funding from local states and municipalities. In December 2005 at the inception of the mission the total support from the Government was expected to be Rs. 50,000 crores (USD 11.1 billion) with matching contribution from states and municipalities

giving a total fund of around Rs. 100,000 crores (USD 22 billion). During 2008-09 the commitment from central Government was enhanced by Rs. 16,500 crores (USD 3.7 billion) making the total fund volume Rs. 116,500 crores (USD 26 billion).

112 transport and transport related projects have been funded. The total financial support for these as of 2010 amounts to USD 2 billion, 23% of the total allocated to the 478 approved infrastructure projects.

Examples of sustainable urban mobility projects supported under the JNNURM are:

- **Bus Rapid Transit System (BRT):** BRT proposals are in various stages of appraisal and implementation. BRT has been implemented successfully in several Indian cities including Ahmedabad[23] , Pune, Bhopal or Jaipur.
- **Bus replacement:** A total of 15,260 busses are to be funded in 61 eligible cities across India. Specification requires that the buses used are modern low floor buses which include Intelligent Transport system features (Binsted et al 2010).

Barriers encountered in the implementation

	Barrier	How the barrier was overcome
Political	Bureaucracy at the state and local level presents a barrier to accessing such funding	• The requirement for cities to establish a multi sector City Development Plan in order to access the funding will help ensure that the process has support at the highest political level within a city.
Institutional/ capacity	The institutional set up in many Indian cities leads to fragmented responsibility for the planning, implementation and operation of transport services and therefore a poor quality, unsafe and inefficient public transport service.	• Cities must prove that they have reformed their institutional structure prior to being able to access funding. • A major exercise of training and skill development of the public officials and other public functionaries is planned to make such officials aware of the nuances of urban transport planning and the specific issues involved in managing city transport (Ministry of Urban Development Government of India (2010.
Financial	Financial sources have focused on providing for motorised transport infrastructure. Corruption has led to financial resources not being used effectively to support sustainable transport projects	• In addition to institutional reforms cities are required to demonstrate that they have undertaken the fiscal reforms required to enable them to improve their urban service delivery systems in order to access the funding. As part of this process cities are encouraged to explore innovative means or sourcing transport revenue, such as from land development fees in the case of Pimpri-Chinchwad (CSE, 2009)
Technical	Officials may lack the knowledge to enable them to take advantage of the latest technology to support the implementation and management of sustainable public transport	• A knowledge management centre is being established as part of India's National Urban Transport Policy (NUTP) to service the needs of all urban transport professionals (technical advice, data provision etc) (Ministry of Urban Development Government of India, 2010).

Further references

• Binsted A, Bongardt, D, Dalkmann, H and Sakamoto, K (2010) Accessing Climate Finance for Sustainable Transport http://www.transport2012.org/bridging/ressources/files/1/956,TD05_FinGuid.pdf

[23] Ahmedabad won in 2010 the Sustainable Transport Award provided by ITDP.
Centre for Science and Environment. 2009. Fact Sheet – Action for sustainable mobility in Indian cities. URL: http://www.cseindia.org/campaign/apc/pdf/Tracking_action.pdf
Ministry of Urban Development Government of India (2010) National Urban Transport Policy http://www.urbanindia.nic.in/policies/TransportPolicy.pdf

A.4 Building a world class Bus Rapid Transit network: Guangzhou

Introduction: What was the problem, and what measure was introduced to solve it? Photo: Ko Sakamoto

Guangzhou is one of the fastest growing cities in the world. Rapid motorisation had taken place in the city for three decades leading to congestion and a poor local environment. In 2010 Guangzhou began to implement a scheme to improve public transport, the local environment and reduce levels of greenhouse gas emissions from the transport sector. A key part of this package was the development of a Bus Rapid Transit (BRT) network.

Results

The city's BRT system was launched in February 2010. It currently carries 26,900 passengers per direction per hour with a daily ridership level of roughly 800 000.

The scheme is the first in China to include bicycle parking at the stations and to include direct tunnels between metro and BRT stations. To further support the uptake of non-motorised transport, new bicycle lanes were developed running parallel to the BRT stations and a bike sharing scheme launched in June 2010 with 1,000 bikes initially (ITDP).

Type of benefit	Result
Environmental	• The BRT system is well integrated with other public transport modes including bike sharing and metro recognised through its success at winning the 2011 Sustainable Transport Award from ITDP.[24] • As part of the integrated process polluted waterways have been reclaimed as public space. • Bicycle lanes developed are tree lined improving the local environment. • It is estimated that the scheme have reduced CO_2 emissions by approximately 20 000 tonnes a year (The New York Times, 2010) through supporting a modal shift of 10-15% from private vehicles.
Social	• Platforms are at grade with the bus floor ensuring easy access for mobility impaired groups.
Economic	• BRT is estimated to have saved 30 million passenger hours in the city in the 1st year of implementation. • The scheme operation does not require a Government subsidy (ITDP, 2010). • Guangzhou's BRT has opened up a range of employment and business opportunities for people who were previously restricted by the time and cost required to move along the Zhongshan Avenue corridor. • The BRT and metro fare system are integrated helping to ensure seamless transitional between the two modes.

[24] Further information can be found on ITDP's website http://www.itdp.org/index.php/our_work/detail/guangzhou/

How was the practice financed?

The infrastructure costs were 4.4m USD per kilometre and were financed by the Government. The system is regulated by the Public Transport Management Office (planning) and BRT Management Co. (control) (ITDP, 2010). There are seven operating companies in three large corporate groups who are responsible for managing the operation of the service. This makes some aspects of regulation more complicated, but helps to ensure a good service by providing regulators with more options. Bus operators are paid per kilometre rather than per passenger.

The Institute for Transportation & Development Policy (ITDP) led the design and planning of the project working with a local agency the Guangzhou Municipal Engineering Design and Research Institute (GMEDRI) (ITDP, 2010).

Barriers encountered in the implementation

	Barrier	How the barrier was overcome
Political	• There was significant opposition to the introduction of the scheme from drivers (The New York Times, 2010) and the media.	• There was strong and unwavering political support for the scheme from the city's Major. In addition all of the key provincial and city level officials have ridden and endorsed the system (The City Fix, 2010)
Institutional/ capacity	• As the provision of the new BRT scheme was to be integrated with improvements to non motorised transport and the metro, there was a need to ensure clearly defined responsibility and effective communication	• Responsibilities were clearly defined with the Public Transport Management Office having overall responsibility for regulating the service. The BRT Management Company was assigned responsibility for the management of the service overseeing the private companies who are responsible for operational delivery (ITDP, 2010).
Financial	• In order to ensure the long term sustainability of the BRT system there is a need to ensure that private operators are able to make a profit	• Guangzhou's high demand corridors, significant existing congestion and adequate road space offers favourable conditions for BRT. The high quality service is therefore expected to cover all operating costs including bus depreciation and the installation, operation and maintenance of a fare collection system (Guangzhou BRT website http://www.gzbrt.org/en/what-is.asp)
Technical	• Some technical glitches have been observed. For example the schemes faced a few operational problems as demand returned to normal after the Chinese New Year Holiday ended in February.	• The city has obtained support from the Institute for Transportation and Development Policy (ITDP) to help ensure the ongoing sustainability of the system. Minor route changes and the gradual introduction of express routes and larger buses, will result in significant operational improvements to ensure increasing passenger demand continues to be met (The City Fix, 2010)

Further references

• The City Fix (2010) Guangzhou's BRT: Revolutionizing Perceptions of Bus Travel in China http://thecityfix.com/guangzhous-brt-revolutionizing-perceptions-of-bus-travel-in-china /
• The New York Times (2010) Chinese Cities find bus only lanes an alternative to cars and subways http://www.nytimes.com/cwire/2010/07/16/16climatewire-chinese-cities-find-bus-only-lanes-an-altern-10489.html
• Hook, W, Fjellstrom, K and Diaz, O (2006) Options for Financing Bus Rapid Transit in China http://www.itdp.org/documents/China%20BRT%20Financing,%20Final.pdf
• ITDP (2010) Guangzhou Opens Asia's Highest Capacity BRT System http://www.itdp.org/index.php/news/detail/guangzhou_opens_highest_capacity_brt/

A.5 A single transport agency for an integrated solution: Singapore

Photo: Limanond (2010) in GIZ Urban Transport Photo CD (2010)

Introduction: What was the problem, and what measure was introduced to solve it?

Singapore like many other cities possessed a number of public bodies with separate functions within urban transport, including the Registry of Vehicles, Mass Rapid Transit Corporation, Roads & Transportation Division of the Public Works Department and Land Transport Division of the then Ministry of Communications.

In 1995, the Land Transport Authority (LTA) was developed as a statutory board under the Ministry of Transport, with the mission of "providing an efficient and cost-effective land transport system for different needs."

The stated objectives of the LTA are:

- To deliver a land transport network that is integrated, efficient, cost-effective and sustainable to meet the nation's needs.
- To plan, develop and manage Singapore's land transport system to support a quality environment while making optimal use of our transport measures and safeguarding the well-being of the travelling public.
- To develop and implement policies to encourage commuters to choose the most appropriate transpor tation mode.

Results

Type of benefit	Result
Environmental	• Environmental protection and sustainability has been incorporated as a central objective of the LTA.
Social	• A high quality public transport supports the daily life of citizens.
Economic	• Congestion is mitigated through the policies set and managed by the LTA, including the vehicle quota system, and the electronic road pricing scheme

As a result of the establishment of the LTA, Singapore now benefits from an integrated transport agency that executes most government functions relevant to land transport, including;

- Policy development on land transport
- Planning, design, development, and management of all land transport infrastructure and services
- Regulation of MRT, bus and taxi systems
- Design, building and operation of MRT
- Vehicle registration and licensing – including the private vehicle quota system

The LTA also possesses its own Academy, which conducts research and training.

How was the practice financed?

LTA was created by a merger of four governmental agencies, and is not thought to have incurred significant increases to the financial burden of the government of Singapore.

Barriers encountered in the implementation

	Barrier	How the barrier was overcome
Political	Reform of institutions often involves high political risks, as existing institutions may be tied to a certain political group.	• Singapore owing to its status as a city state with a single-tier government was able to mitigate some of the complexities normally involved with setting urban transport policy.
Institutional/ capacity	Transport policy is often fragmented as a result of multiple institutions. Human capacity is often not sufficient to develop high quality public transport and implement policies to manage the demand for private modes.	• The creation of LTA brought under one roof the expertise and skills of the four previous government agencies. Government employee expertise was supplemented with contracted specialists and consultants wherever necessary. • Technical expertise is brought into the LTA through a Board of Directors comprising 15 representatives of business, academia, transport professionals, labour and community organisations.
Financial	There is a tendency for transport organisations to assume functions which can be better left for the private sector, thus increasing the cost base and increasing the burden on the public purse.	• Strong financial discipline has been kept to contain the costs of providing a high-quality urban transport system. • Public transport is run on a commercial basis, by private companies, under the regulation and coordination of the LTA.

Further references

- LTA (2011a) About LTA. http://www.lta.gov.sg/corp_info/index_corp_abt.htm
- Meakin (2004) Urban Transport Institutions. http://www.sutp.org/dn.php?file=1B-UTI-EN.pdf

A.6 Financing railways through value capture: Tokyo, Japan

Photo: Ko Sakamoto (2009)

Introduction: What was the problem, and what measure was introduced to solve it?

In Tokyo Japan, 12 public railway companies operate subways and trams, and are responsible for a large part of the overall public transport network (Saito, 2011).

The major private railway companies developed themselves as urban developers or local service businesses supporting the lives of people living along the railway line. In addition to operating the railway the major private railway companies operate the local bus and taxi services and the shopping and recreational facilities owned by railway affiliates.

Private railway companies were largely permitted the right to develop in areas where there was no previous railway line. As a result there was a need for companies to construct the line as well as increase the population near the line and attract additional passengers through the provision of entertainment. The companies promoted business diversification from the point that the railway lines were constructed, developing housing and department stores at terminals and along the corridors (Saito, 2011). The Tokyu railway line in Tokyo is the leader in terms of business diversification in the Japanese private railway industry. The private rail company formed the Tokyu group which has over 400 affiliated companies and more than 100 000 employees.

Results

Type of benefit	Result
Environmental	• Integrated developments encourages local residents to travel by public trans port rather than private vehicle leading to lower levels of carbon emissions from the transport sector and local air pollution.
Social	• The process supports community development along the railway line. • Railway towns are generally well maintained, planned effectively, offer afford able and high quality housing in addition to commercial areas and neighbour hood amenities (Saito, 2011)
Economic	• Enables companies developing and operating railways to maximise profits. • The model supports the long term sustainable development of cities integrating transport and land use planning. • Railway construction promotes under-developed areas near the city centre. Increased property values as a result can be captured to finance further invest ment. (Padeco, 2000)

How was the practice financed?

The typical private railway company has three business departments, namely railway, bus and real estate. The revenues and earnings by department vary for the different companies. Some have a strong focus on the railway department with modest diversification whilst for others the bus or development operation may dominate. The Tokyu group is renowned for its efficient railway management and in addition to sound real estate management. The company has 4 departments – rail, hotels, real estate and other. Total sales are 4, 783 billion yen. The majority of the revenue and earnings is generated by the railway and real estate departments making up 49% and 33% of the total revenue respectively (Saito, 2011).

The Japanese's set up illustrates how the value of land can be captured and used to invest in transport. Diversification allows the companies to be flexible by enabling them to invest revenues from one business area in the development of another. For example if railway and urban improvement are carried out simultaneously the deficits from railway companies under optimum fares can be covered by the internalisation of profits from development.

Barriers encountered in the implementation

	Barrier	How the barrier was overcome
Political	The ability for railways to develop land surrounding it is often limited.	• Well respected government policies on land use and transport development provide incentives for private railway operators to develop the land surrounding the railway line.
Institutional/ capacity	Private corporations under the Japanese private railways model require various types of managerial expertise, for example in real estate, rail transport and retail.	• Private railway companies have been managed very successfully leading to not only an improved passenger service at a lower cost but also supporting community development along railway lines and helping to prevent unplanned development along railway lines (Saito, 2011).
Financial	In areas where new railways lines are to be developed historically local demand has been low which causes services to have to operate at low capacity hindering the ability to be able to make a profit	• The broad portfolio of the private railway companies enables them to develop housing at terminals and along the corridor to increase the local population and to attract additional passengers through the provision of services such recreational facilities, department stores and supermarkets and hotels locally.
Technical	A diverse range of technical skills is required to support the development of the railway itself in additional to the surrounding land	• Companies have often formed cooperatives enabling them to draw on the technical, financial and management teams from a range of companies who are specialised in the different business areas (Padeco, 2000).

Further references

- Padeco (2000) Study on Urban Transport Development, World Bank
- Saito, T (2011) Japanese private railway companies and their business diversification, Japan Railway and Transport Review

A.7 Phasing out fuel subsidies: Indonesia

Photo: Ko Sakamoto (2011)

Introduction: What was the problem, and what measure was introduced to solve it?

Fossil fuels are currently subsidised in many countries enabling residents to purchase fuel at a lower cost than the market price. Such subsidies encourage excess fuel consumption and discourage energy substitution, as well as undermine the financial sustainability of the state budget. Indonesia has long subsidised fossil fuels, but recognised that such subsidies were no longer sustainable. The increasing fuel subsidy dramatically reduced the ability of the government to be able to fund programs which are oriented to the improvement of lives for the poor including education, health and support for the development of infrastructure (Bank of Indonesia, 2008).

To help address this issue the government increase the price of subsidized premium fuel, diesel, and kerosene in 2000 and 2001.

- 2000: Price of gasoline increased by 15%, diesel 9% and kerosene 25%
- 2001: Price of gasoline increased by 26%, diesel 50% and kerosene 14%

In 2002 a presidential decree announced the intention to reduce fuel subsidies in phases ultimately aiming to set gasoline prices at 100% of the international market price and diesel at 75% (IISD, 2010). Further price increased occurred in 2005 (gasoline increased by 87.5%, diesel 104.7% and kerosene 185.7%) and 2008 (28.7% on average) but the subsidies have yet to be completely removed.

A number of financial measures were introduced to protect low income households from price increases. This included an unconditional cash transfer programme introduced in 2005 (IISD, 2010) and a Food Sustainability Programme whereby the cost of staple foods was subsidised for low income families (Bank of Indonesia, 2008).

Results

Type of benefit	Result
Environmental	• Removal of subsidies and the corresponding increase in fuel prices act as an incentive for individuals and industry to invest in more energy efficient technologies and change consumption behaviour.
Social	• Fuel subsidies are a very inefficient form of social welfare (the wealthiest 40% of the population in 2008 captured 70% of the subsidy IISD, 2010). The removal of fuel subsidies and provision of financial support for low income families, if managed effectively, should therefore help to reduce social inequality.
Economic	• The removal of fuel subsidies will reduce the economic burden on the national government, freeing up resources for the support of programmes in other sectors such as education and health. Prices increases in 2005 and 2006 reduced the Indonesian state budget deficit by 4.5 billion and 10 billion USD in 2006 (IISD, 2010)

The removal of subsidies in Indonesia has not been as effective as had initially been hoped. For example as a result of strong public opposition in 2003 the proposed price increases on diesel were 6.5% in comparison to the 21.9% proposed and plans to float fuel prices on the international market in 2009 were abandoned (IISD, 2010). There is a need to ensure ongoing political commitment to a long term strategy to ensure the effective removal of subsidies and maintenance of the new prices over time.

How was the practice financed?

The programmes that aimed to protect low income households from the price increases were funded by the National Government. Rp 14.1 trillion of direct cash assistance was allocated to 19.1 million families in 2008. The Food Sustainability Program subsidised the price of rice, made available to the same families over a 12 month period Fund. Support for the education of children of Government employees in the lowest income categories was also funded.

Barriers encountered in the implementation

	Barrier	How the barrier was overcome
Political	There was heavy opposition to the removal of subsidies from the public due to a lack of understanding of the negative effects of the subsidies and of the opportunity to more effectively support low income households through well designed reform of policies (IISD , 2010).	• Reforms in Indonesia were introduced in a gradual programmed way and combined with a number of financial incentives that aimed to protect low income households from price increases (IISD, 2010). • Outreach programmes have aimed to raise public of the benefits of fossil fuel subsidy reform. • In order to support the successful removal of the subsidies in other countries future political leaders should pledge their intention to remove subsidies prior to election and ensure that action to deliver on the pledge is taken within the first year of office.
Institutional/ capacity	There were a number of challenges that needed to be overcome initially relating both to the preparation and implementation of reforms and subsequent monitoring (IISD, 2010)	• Ongoing government investment is needed to build sounds demographic databases that can be used to ensure effective social welfare policy making and implementation (IISD, 2010)
Financial	There was concern that the removal of fuel subsidies would disproportionately affect the urban poor	• The cash transfer and food sustainability programmes have been broadly successful despite challenges to the initial set up and ongoing management. Their introduction has helped to reduce the level of public opposition to price increases (IISD, 2010).
Technical	Cheap fuel prices have encouraged a reliance on fuel intensive technologies rather than supporting investment in fuel efficiency or research and development into the use of alternative fuels.	• The removal of fuel subsidies is promoting Indonesia's long term interest in diversifying its energy supply and supporting action on the development of renewable energy and energy conservation (IISD, 2010) which will help to secure long term energy security.

Further references

- Bank of Indonesia (2008) Press release government explanation on Government of Indonesia decree regarding the reduction of fuel subsidy and other related policies
- IISD (2010) Lessons learnt from Indonesia's attempts to reform fossil fuel subsidies
- Resosudarmo, B (2007) Searching for equitable energy price reform for Indonesia.

A.8 Improving fuel economy standards: China

Introduction: What was the problem, and what measure was introduced to solve it? Photo: Ko Sakamoto (2010)

China has introduced a target to improve its fleet wide average fuel economy of 42.2 miles per gallon by 2015 (GFEI, 2010).

The introduction of fuel economy standards in China in 2005 was driven by the country's concern regarding its demand for increasing oil imports due to a rapid growing transportation sector. By 2030 it is projected that road transport will account for 43% of China's oil consumption 80% of which would have to be imported (Oliver H et al 2010). The standard also reflected the country's desire to:

- Encourage international vehicle manufacturers to bring advanced and efficient technologies to China;
- Catalyse its own vehicle manufacturers to improve its product offerings and to position China as a leader in electric vehicle technology (Oliver H et al 2010);
- Slow the trend that has been observed towards larger and more powerful vehicles (Eads, 2011).

The standards introduced progressively higher taxes for heavier cars, based on 16 vehicle weight categories. The standards were tightened in 2008 with a further revision planned for 2012 and perhaps in successive four-year periods (ICCT, 2009). A number of other measures have been introduced with the aim of catalysing improved fuel economy – these include:

- An excise tax on vehicles introduced in 2006 to provide a stimulus for the sale of small vehicles
- Subsidies for 16 manufacturers to produce fuel efficient cars approved by the government in 2010. 3,000 yuan (460 USD) will be granted per vehicle if it is proved that they will improve fuel consumption by over 20%.

Results

Type of benefit	Result
Environmental	• In 2006 1.3 billion litres of fuel were saved with gasoline demand cut by almost 2%. It is expected that China will save 2.3 billion litres (1.7 million tonnes) of gasoline per year as a result of the standards • It is estimated that 1.4 million tonnes of CO2 emission were saved in 2006 (Oliver H et al 2010). • The Chinese standard was successful in reducing the average fuel consumption (measured as litre/100km) of the new national LDPV fleet (by 11.5%) (Oliver H et al 2010). • Fuel economy standards and development of vehicle technology in China will have an influence of the development of standards, technology the overall fleet economy in other Asian countries. • Improved fuel economy will have a positive impact on air pollution levels if well enforced. (GFEI, 2010)
Social	• Reduced level of air pollution will have a positive impact on health, for example reducing the incidence of respiratory diseases • Financial savings could be directed towards education and health
Economic	• 10 million RMB (1.5million USD) saved in 2006 from the cut in demand for gaso line. Savings are expected to rise over time as levels of motorisation in Chinese cities continue to rise rapidly (GFEI, 2010). • Subsides are expected to support major growth in EV sales and associated jobs post 2020.

How was the practice financed?

The overall development and management of the fuel economy standards was led by the Chinese Government. The key technical body involved were the China Automotive Technology and Research Centre (CATARC) who undertook the feasibility and testing and subsequently proposed the appropriate standards. In 2001 The China Energy and Sustainable Programme added details to the fuel economy concept by commissioning a study by four Chinese institutes that were influential in policy making concerning auto industry and energy. Vehicle manufacturers did not dedicate significant levels of resources to scrutinise or influence the regulatory ideas that were being considered by central agencies.

Barriers encountered in the implementation

	Barrier	How the barrier was overcome
Political	To ensure the successful development and enforcement of standards there was a need to gain political support across a range of departments	• A steering committee was developed made up of key departments from 6 government agencies to raise awareness of the programme and ensure political buy in.
Institutional/ capacity	The group responsible for drafting the standards had limited data to support the development of the standards at the start of the process.	• A range of data was collected including fuel-consumption data on all LDPVs made/sold in China and information on other countries fuel-economy policies
Technical	There were concerns that the development of standards would not be able to be matched in practice by the vehicle manufacturers.	• Experts from vehicle manufacturing companies were consulted on the development of the standards in 2002 and 2003. Despite these activities engagement of the industry could have been improved. • The standards were made more stringent over a 5 year period which, as aligned with the companies' general cycle for launching new models and testing technology, was felt would give time to modify products.

Further references

- Eads, G (2011) 50by50 Prospects and Progress. Available from http://www.globalfueleconomy.org/Documents/Publications/prospects_and_progress_lr.pdf.
- Global Fuel Economy (GFEI) (2010) Improving vehicle fuel economy in the ASEAN Region. Available from http://www.globalfueleconomy.org/Documents/Publications/wp1_asean_fuel_economy.pdf.
- Oliver, H, Gallagher, K, Tian, D and Zhang, J (2009) China's fuel economy standards for passenger vehicles http://web.hks.harvard.edu/publications/getFile.aspx?Id=364

A.9 Using climate finance for improving bus transport: Hanoi

Photo: Menckoff (2009) in GIZ Urban Transport Photo CD (2010)

Introduction: What was the problem, and what measure was introduced to solve it?

Travel in Hanoi is dominated by private vehicles, predominantly motorcycles and to a lesser extent bicycles and cars, with less than 8% of trips being made by public transport. The city's authorities recognised that increased use of public transport would be essential to ensure the future sustainability of the city.

The City initiated the Hanoi Urban Transport Development Project (HUTDP), the objectives of which are to;

- Increase the efficiency and cost-effectiveness of the city's transport system;
- Develop public transport-compatible urban growth plans;
- Promote a shift to more environmentally-sustainable transport modes and urban development plans;
- Promote the replication of these approaches in the country and region;
- Lower Hanoi's transport-related greenhouse gas emissions, relative to a business-as-usual scenario (GEF, 2007)

The medium term focus of the policy is on the provision of a new Bus Rapid Transit system in the city. 2 BRT lines have been introduced that cover a total length of 24.5km along which there are 50 stations. In 2010 the average usage of the system was 240 000 passengers a day (MVA). Investments in road infrastructure will be integrated with land-use plans in order to generate a transit friendly urban landscape.

Results

Type of benefit	Result
Environmental	• The project has supported an improvement in the urban environment in Hanoi • The BRT system is projected to reduce GHG emissions by between 1.70 and 2.23 million tonnes by 2002 (GEF, 2006) • By 2020 it is expected that between 352,000 and 379 000 people will be using the BRT system per day, with 20% of those representing a shift from private vehicles (GEF, 2020)
Social	• The project has improved the accessibility of the urban poor
Economic	• BRT provided a lower cost solution than rail based forms of mass transit • The project has resulted in a high capacity busway on two major corridors helping to secure the ongoing growth and prosperity of the city • The project has supported poverty alleviation in Vietnam by sustaining the economic growth and physical development of Hanoi (GEF, 2006)

How was the practice financed?

A range of funding sources have been utilised including international climate finance through Global Environment Facility (GEF) and the World Bank and through Hanoi's City Government at the local level. The World Bank and GEF funded the initial Feasibility Study and Preliminary Design for the BRT system in Hanoi which was undertaken by MVA (a consultancy firm) and executed under the Project Management Unit under the Hanoi People's Committee. The study covered the physical engineering and systems design for the system (MVA). Funding from GEF has covered a range of other actions including undertaking feasibility studies on the following:

- Enhancing access to BRT by non-motorised transport
- Integrating land use and transport planning in the city

Co-funding was used to support strategic initiatives that reduce the barriers to the implementation of the project and maximise environmental benefits. Implementation of the infrastructure to support the BRT system was funded by the International Development Association (IDA) and the National Government.

Barriers encountered in the implementation

	Barrier	How the barrier was overcome
Political	There was political nervousness over a possible negative reaction of motorists to BRT.	• A public consultation, communications and media strategy was developed. GEF co-financing helped to reduce the risks related to successful project implementation by increasing understanding of the implementation process and the key benefits, as well as ensuring that the needs of the diverse stakeholder groups were addressed (GEF, 2006)
Institutional/ capacity	Deficiencies in plans at the start of the project in 2006 highlighted that there was a need for institutional strengthening and capacity building to ensure successful implementation of the BRT scheme and integration of land use and transport planning processes (GEF, 2006).	• The initial scoping study presented a series of recommendations on the organisational structure required. The study involved international bus planning, operations and maintenance experts and at a local level engaged those with expertise of institutional and planning studies of the development of public transport in Hanoi (MVA). • The city is in the process of establishing a high level authority responsible for coordinating the planning, regulation and operations of different public transport modes.
Financial	The full costs of implementation could not be covered within the local budgets available.	• GEF funding was secured to support the implementation of the BRT scheme. It is unlikely that the scheme would have been considered by the local authorities without this funding (GEF, 2006).
Technical	Local institutions were unaware of the latest technologies to support the effective implementation and operations of BRT schemes.	• Securing support from international sources of climate finance helped to ensure effective technology transfer. Study tours were conducted to identify transferable lessons from other cities who have successfully introduced BRT schemes

Further references

- MVA (no date) Hanoi Bus Rapid Transit (BRT) http://www.mva.com.hk/download/SHT/SHT%2018.pdf
- GEF (2006) Hanoi Urban Transport Development Project (HUTDP) Project Executive Summary http://gefonline.org/projectDetailsSQL.cfm?projID=2368
- GEF (2007) Vietnam – Hanoi Urban Transport Development

References

ADB (2006) Urbanization and Sustainability in Asia: Case studies of good practice. URL: http://www.adb.org/Documents/Books/Urbanization-Sustainability/summary-booklet.pdf

ADB (2008) Managing Asian Cities. URL: http://www.adb.org/Documents/Studies/Managing-Asian-Cities/mac-report.pdf

ADB (2010) Sustainable Transport Initiative. Operation Plan. Staff Working Paper, May 2010. URL: http://www.adb.org/documents/policies/sustainable-transport-initiative/Sustainable-Transport-Initiative.pdf

AfDB (2011) Taxi replacement project. URL: http://www.afdb.org/en/projects-operations/project-portfolio/project/p-eg-ie0-004/

Amola, G (2009) Contribution of Waterborne Public Transport to Sustainable Waterfronts: Case studies of Hammarby Sjostad (Stockholm) and HafenCity (Hamburg). URL: http://www.infra.kth.se/fms/pdf/MScThesAmola2009.pdf

Babtie Ross Silcock and TRL (2003) Guidelines for Estimating the Cost of Road Crashes in Developing Countries. Department for International Development. URL: http://www.transport-links.org/transport_links/filearea/publications/1_807_R%207780.PDF

Bank of Indonesia (2008) Press release government explanation on Government of Indonesia decree regarding the reduction of fuel subsidy and other related policies.

Barter, P (2010) Parking Policy in Asian Cities. URL: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1780012##

Berechmana and Chenb (2010) Incorporating Risk of Cost Overruns into Transportation Capital Projects Decision-Making. URL: http://masetto.ingentaselect.co.uk/fstemp/0e2a5a16ece5dbdf575985a14311523d.pdf

Binsted, A, Bongardt, D, Dalkmann, H and Sakamoto, K (2010) Accessing Climate Finance for Sustainable Transport. URL: http://www.transport2012.org/bridging/ressources/files/1/956,TD05_FinGuid.pdf

Bongardt, D and Schmid, D (2009) Technology Needs Assessment in the Transport Sector - Evaluation of TNA Country Reports and the UNFCCC TNA Handbook. URL: http://www.transport2012.org/bridging/ressources/files/1/625,449,TechnoTransf.pdf

Carisma B and Lowder S (2007) Estimating the Economic Costs of Traffic Congestion: A Review of Literature on Various Cities & Countries.

CABE (no date) Cheonggyecheon Restoration Project. URL: http://webarchive.nationalarchives.gov.uk/20110118095356/http:/www.cabe.org.uk/case-studies/cheonggyecheon-restoration-project

C40 Cities Climate Leadership Group (2008) Seoul to become a Global Climate-Friendly City by 2030. URL: http://www.c40cities.org/docs/ccap-seoul-131109.pdf

Centre for Science and Environment (2009) Fact Sheet – Action for sustainable mobility in Indian cities. URL: http://www.cseindia.org/campaign/apc/pdf/Tracking_action.pdf

Cervero (2000) Informal Transport in the Developing World. URL: http://www.unhabitat.org/pmss/getElectronicVersion.aspx?nr=1534&alt=1

Cervero (2007) Paratransit in South East Asia, a market response to poor roads?

China Daily (2011) Shanghai number plates worth more than a car. URL: http://europe.chinadaily.com.cn/china/2011-01/07/content_11810034.htm

Clear Air Portal (2010) Electric Taxis hit roads in South China City. URL: http://www.cleanairinitiative.org/portal/node/6341

The City Fix (2010) Guangzhou's BRT: Revolutionizing Perceptions of Bus Travel in China. URL: http://thecityfix.com/guangzhous-brt-revolutionizing-perceptions-of-bus-travel-in-china /

The City Fix (2010) Taxis: the new frontier of sustainable development. URL: http://thecityfix.com/taxis-the-new-frontier-of-sustainable-transportation/

Dalkmann, H (2010) Case study of a transport MRV NAMA: TDM Measures in Jakarta, Indonesia. URL: http://www.slocat.net/wp-content/uploads/2009/11/TRL-Jakarta-final-report.pdf

Dalkmann, H and Huizenga C (2010) Advancing Sustainable, Low Carbon Transport through the GEF, an advisory document. URL: http://www.slocat.net/advancing-sustainable-low-carbon-transport-through-the-gef-an-advisory-document/

Dalkmann H, Sakamoto K et al. (2011) Transport: Investing in energy and resource efficiency - in "Towards a Green Economy". Geneva: UNEP. URL: http://www.unep.org/greeneconomy/Portals/88/documents/ger/GER_10_Transport.pdf

Dextre J and Cabrera, F (2010) Background paper on transport externalities and their quantification. UNEP Green Economy Report. Unpublished.

Eads, G (2011) 50by50 Prospects and Progress. URL: http://www.globalfueleconomy.org/Documents/Publications/prospects_and_progress_lr.pdf

EDRG (2009) Job Impacts of Spending on Public Transportation: An Update. Prepared for American Public Transportation Association. URL: http://www.apta.com/gap/policyresearch/Documents/jobs_impact.pdf

EEA (2008) Success stories within the road transport sector on reducing greenhouse gas emission and producing ancillary benefits. URL: http://www.eea.europa.eu/publications/technical_report_2008_2

Ellis, J (2010) The Effects of Fossil-Fuel Subsidy Reform: A review of modelling and empirical studies. URL: http://www.globalsubsidies.org/files/assets/effects_ffs.pdf

Embarq (2010) Aguascalientes – Housing URL: http://www.embarq.org/en/project/aguascalientes-housing

Embarq (no date) What is Bus Rapid Transit? URL: http://www.embarq.org/en/node/28

Flyvbjerg et al., (2003) How common and how large are cost overruns in transport infrastructure projects? URL: http://www.informaworld.com/smpp/content~db=all~content=a713868295~frm=abslink

GEF (2006) Hanoi Urban Transport Development Project (HUTDP) Project Executive Summary. URL: http://gefonline.org/projectDetailsSQL.cfm?projID=2368

GEF (2007) Vietnam – Hanoi Urban Transport Development.

Global Fuel Economy (GFEI) (2010) Improving vehicle fuel economy in the ASEAN Region. URL: http://www.globalfueleconomy.org/Documents/Publications/wp1_asean_fuel_economy.pdf.

GIZ (2010) International Fuel Prices. URL: http://www.gtz.de/en/themen/29957.htm

GTZ (2010b) Non-motorised transportation. URL: www.sutp.org

Gulf news (2009) RTA plans new public water transport. URL: http://gulfnews.com/news/gulf/uae/traffic-transport/rta-plans-new-public-water-transport-1.49460

Gwilliam (2005) Bus Franchising in Developing Countries: Some Recent World Bank Experience. URL: http://siteresources.worldbank.org/INTURBANTRANSPORT/Resources/bus_franch_gwilliam.pdf

Hook, W (2005) Sourcebook Module 3d: Preserving and Expanding the Role of Non-motorised Transport, GTZ, Eschborn. URL: www.sutp.org

Hook, W, Fjellstrom, K and Diaz, O (2006) Options for Financing Bus Rapid Transit in China. URL: http://www.itdp.org/documents/China%20BRT%20Financing,%20Final.pdf

IEA (2005) CO2 Emissions from Combustion 1971-2003. OECD/IEA

IEA (2006) World Energy Outlook 2006.

IEA (2008) World Energy Outlook 2008.

IEA (2009) Transport, Energy and CO2: Moving towards Sustainability

IGES (2007) Airp Pollution Control in the Transportation Sector: Third Phase Research Report of the Urban Environmental Management Project. URL: http://enviroscope.iges.or.jp/modules/envirolib/upload/836/attach/836_air_pollution_control_transportation.pdf

IISD (2010) Lessons learnt from Indonesia's attempts to reform fossil fuel subsidies

International Road Federation (2010) World Road Statistics 2010 - Data 2003-2008

ITDP (2010) Bus Rapid Transit Planning Guide. URL: http://www.itdp.org/index.php/microsite/brt_planning_guide/

ITDP (2010) Guangzhou Opens Asia's Highest Capacity BRT System. URL: http://www.itdp.org/index.php/news/detail/guangzhou_opens_highest_capacity_brt/

ITDP (2010) Our Cities Ourselves. URL: http://www.itdp.org/documents/2010-OurCitiesOurselves_Booklet.pdf

ITDP, 2011 Sustainable Transport Cities Award. URL: http://www.itdp.org/index.php/news/detail/sustainable_transport_award_cities_guangzhou/

ITPS (2010) Transport System in a Low Carbon Society. Final Report.

Knutton, M (2005) Light Rail Transport: changing the face of French Cities International Railway Journal.

Lambert (2002) International meeting on acoustic pollution in cities Madrid 2002. URL: http://www.inrets.fr/ur/lte/publications/publications-pdf/Lambert-publi/Madrid-2002.pdf

Lewis-Workman (2010) Predicted vs. Actual Costs and Ridership – Urban Transport Projects

Litman (2011) Distance Based Vehicle Insurance as a TDM Strategy. URL: http://www.vtpi.org/dbvi.pdf

Litman T (2004) Mobility Management. GTZ, Eschborn. URL: www.sutp.org

LTA (2011a) About LTA.URL: http://www.lta.gov.sg/corp_info/index_corp_abt.htm

LTA (2011b) Bid for a COE to Register a New Vehicle. URL:
http://www.onemotoring.com.sg/publish/onemotoring/en/lta_information_guidelines/buy_a_new_vehicle/bid_coe.html

LTA (2011c) Vehicle quota system. URL : http://www.lta.gov.sg/corp_info/doc/COE_Quota_Allocation_RV.pdf

Martínez Sandoval, Avelino (2005). Ruido por tráfico urbano: Conceptos, medidas descriptivas y valoración económica, (Urban traffic noise: Concepts, descriptive measures and economic value). la revista económica y administración – Universidad autónoma de occidente, URL:
http://bach.uao.edu.co:7778/pls/portal/docs/PAGE/UNIAUTONOMA_INVESTIGACIONES/REVISTA_ECONOMIK/NUMEROS/ECONOMIA2/RUIDO_0.PDF

Meakin, R. (2004a) Sourcebook Module 1b: Urban Transport Institutions. GTZ, Eschborn. URL:
http://www.sutp.org/dn.php?file=1B-UTI-EN.pdf

Meakin, R (2004b) Sorcebook Module 3c: Bus Regulation and Planning, GTZ, Eschborn. URL: www.sutp.org

Midgley, P (2011) Bicycle-sharing schemes: enhancing sustainable mobility in urban areas. URL:
http://www.un.org/esa/dsd/resources/res_pdfs/csd-19/Background-Paper8-P.Midgley-Bicycle.pdf

Ministry of Urban Development Government of India (2010) National Urban Transport Policy. URL:
http://www.urbanindia.nic.in/policies/TransportPolicy.pdf

MLIT (2011) Policy for Urban Railway in Japan. Unpublished presentation given at UNESCAP Workshop, Busan, 7 July 2011.

Müller, P., Schleicher-Jester, F., Schmidt, M-P. and Topp, H.H. (1992) Konzepte flächenhafter Verkehrsberuhigung in 16 Städten, Grüne Reihe des Fachgebiets Verkehrswesen der Universität Kaiserslautern No. 24

MVA (no date) Hanoi Bus Rapid Transit (BRT). URL: http://www.mva.com.hk/download/SHT/SHT%2018.pdf

The New York Times (2010) Chinese Cities find bus only lanes an alternative to cars and subways. URL;
http://www.nytimes.com/cwire/2010/07/16/16climatewire-chinese-cities-find-bus-only-lanes-an-altern-10489.html

OECD (2010) The Green Growth Strategy: How can we get to a greener Economy?
URL: http://www.oecd.org/dataoecd/23/63/46141709.pdf

Oliver, H, Gallagher, K, Tian, D and Zhang, J (2009) China's fuel economy standards for passenger vehicles. URL:
http://web.hks.harvard.edu/publications/getFile.aspx?Id=364

Padeco (2000) Study on Urban Transport Development, World Bank

Park KD (no date) Cheonggyecheon Restoration Project. URL:
http://www.wfeo.org/documents/download/Cheonggeycheon%20Restoration%20Project_%20Korea.pdf

Pelangi (2007) Paper to Celebrate 15 Years of Yayasan Pelangi Indonesia. URL:
http://www.pelangi.or.id/publikasi/2007/15_years_of_pelangi.pdf

Peñalosa, E (2005) Sourcebook Module 1a: The Role of Transport in Urban Development Policy, GTZ, Eschborn.
URL: www.sutp.org

Garrett-Peltier, H (2011) Pedestrian and Bicycle Infrastructure: A National Study of Employment Impacts. URL:
http://www.peri.umass.edu/236/hash/64a34bab6a183a2fc06fdc212875a3ad/publication/467/

Real Insurance (2011) How Pay As You Drive Works. URL: http://www.payasyoudrive.com.au/howitworks.aspx

Resosudarmo, B (2007) Searching for equitable energy price reform for Indonesia.

Rye, T (2010) Parking Management: A Contribution Towards Liveable Cities. GIZ. Eschborn. URL: www.sutp.org

Saito, T (2011) Japanese private railway companies and their business diversification, Japan Railway and Transport Review.

Sakamoto K (2010) Financing Sustainable Urban Transport - GTZ Sourcebook for Decision-Makers in Developing Cities. Eschborn, German Technical Cooperation (GTZ). URL: http://www.sutp.org/index.php?option=com_content&task=view&id=2293&Itemid=1%E2%8C%A9=en

Schipper L, Fabian B and Leather J. (2009) Transport and Carbon Dioxide Emissions: Forecasts, Options Analysis, and Evaluation. URL: http://www.adb.org/documents/papers/adb-working-paper-series/ADB-WP09-Transport-CO2-Emissions.pdf

Seoul Metropolitan Facilities Management Corporation (2011) Welcome to Seoul's Pristine Stream Cheong Gye Cheon. URL: http://english.sisul.or.kr/grobal/cheonggye/eng/WebContent/index.html

Smith (2003) The Japanese Shinkansen: Catalyst for the renaissance of rail. URL: http://www.manchesteruniversitypress.co.uk/uploads/docs/240222_1.pdf

Soehodho, S. (2010) Jakarta Urban Transport Problems and Their Environmental Impacts. Presentation given at International Climate Change Workshop on Research Priorities and Policy Development.

Stankevich et al., (2005) Performance-based Contracting for Preservation and Improvement of Road Assets. URL: http://siteresources.worldbank.org/INTTRANSPORT/Resources/336291-1227561426235/5611053-1231943010251/trn-27_PBC_Eng_2009.pdf

Stanley CT Yip (2008) Planning for Eco-Cities in China: Visions, Approaches and Challenges. URL: http://www.isocarp.net/Data/case_studies/1162.pdf

STPP (2004) Setting the Record Straight: Transit, Fixing Roads and Bridges Offer Greatest Job Gain, Surface Transportation Policy Project. URL: www.transact.org

Sung Jick Eum (2007) Financing and Urban pricing. URL: http://chinaurbantransport.com/english/fur_ppt.htm

Tangphaisankun, A et al (2010) A Study in Integrating Paratransit as A Feeder System into Urban Transportation and Its Effects on Mode Choice Behaviour: A Study in Bangkok, Thailand. URL: http://www.civil.ist.utl.pt/wctr12_lisboa/WCTR_General/documents/02546.pdf

TfL (2007) Congestion charging.URL: http://www.cclondon.com/whatis.shtml.

TfL, (2006). Impacts monitoring: fourth annual report. URL: http://www.tfl.gov.uk/assets/downloads/FourthAnnualReportFinal.pdf

UN (2009) Inland Waterborne transport: connecting countries. URL: http://www.unwater.org/downloads/181794E.pdf

UN (2009) World Population Prospects: The 2008 Revision. New York, United Nations, Department of Economic and Social Affairs

UN(2010) World Urbanization Prospects: The 2009 Revision. New York, United Nations, Department of Economic and Social Affairs. URL: http://esa.un.org/unpd/wup/Documents/WUP2009_Highlights_Final.pdf

UN (2011a) Composition of macro geographical (continental) regions, geographical sub-regions, and selected economic and other groupings, URL: http://unstats.un.org/unsd/methods/m49/m49regin.htm

UN (2011b) Expert Group meeting on Sustainable Urban Transport: Policy options for modernising and greening taxi fleets in Latin America Cities. URL: http://www.un.org/esa/dsd/susdevtopics/sdt_pdfs/meetings2011/egm201105/Aide%20Memoire%20Taxis%20EGM%20Latin%20America-070211-English.pdf

UNESCAP (2007) Promotion and Development of the Asian Highway:Upgrading of Asian Highway Priority Routes - Prefeasibility Study of Monywa - Yagyi - Kalewa Road in Myanmar. URL: http://www.unescap.org/ttdw/common/TIS/AH/files/prefeasibility_myanmar.pdf

VTPI (2011) How Land Use affects Transport. URL: http://www.vtpi.org/landtravel.pdf

VTPI (2007) Transportation Cost and Benefit Analysis II – Barrier Effect. URL: http://www.vtpi.org/tca/tca0513.pdf

Wagner, A (2011) International Fuel Prices 2010/2011 Data Preview. URL: http://www.gtz.de/de/dokumente/giz2011-international-fuel-prices-2010-2011-data-preview.pdf

Weisbrod G and Reno A (2009) Economic Impact of Public Transportation Investment. Prepared for: American Public Transportation Association. URL: http://www.apta.com/resources/reportsandpublications/Documents/economic_impact_of_public_transportation_investment.pdf

World Bank. (2001) Cities on the Move: A World Bank Urban Transport Strategy Review. URL: http://siteresources.worldbank.org/INTURBANTRANSPORT/Resources/cities_on_the_move.pdf

World Bank and WHO (2004) URL: World Report on Road Traffic Injury Prevention http://whqlibdoc.who.int/publications/2004/9241562609.pdf

Wright, L and Fjellstrom, K (2004) Sourcebook Module 3a: Mass Transit Options, GTZ, Eschborn. URL: www.sutp.org

Wright, L (2005a) Bus Rapid Transit, GTZ, Eschborn. URL: www.sutp.org

Wright, L (2005b) Car-Free Development. GTZ, Eschborn. URL: www.sutp.org

Yao and Ou (no date) Study on Sustainable Development Strategy of Urban Rail Transit Based on Externality. URL: http://www.seiofbluemountain.com/upload/product/200910/2008glhy12a21.pdf

Zegras, C (2006) Sourcebook Module 1c: Private Sector Participation in Urban Transport Infrastructure Provision, GTZ, Eschborn. URL: www.sutp.org