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Urban Transport and Climate Change

Module 5e

Sustainable Transport: A Sourcebook for Policy-makers in Developing Cities

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OVERVIEW OF THE SOURCEBOOK

Sustainable Transport: A Sourcebook for Policy-Makers in Developing Cities

What is the Sourcebook?

This *Sourcebook* on Sustainable Urban Transport addresses the key areas of a sustainable transport policy framework for a developing city. The *Sourcebook* consists of 32 modules mentioned on the following page. It is also complemented by a series of training documents and other material available from http://www.sutp.org (and http://www.sutp.cn for Chinese users).

Who is it for?

The *Sourcebook* is intended for policy-makers in developing cities and their advisors. This target audience is reflected in the content, which provides policy tools appropriate for application in a range of developing cities. The academic sector (*e.g.* universities) has also benefited from this material.

How is it supposed to be used?

The *Sourcebook* can be used in a number of ways. If printed, it should be kept in one location, and the different modules provided to officials involved in urban transport. The *Sourcebook* can be easily adapted to fit a formal short course training event, or can serve as a guide for developing a curriculum or other training program in the area of urban transport. GIZ has and is still further elaborating training packages for selected modules, all available since October 2004 from http://www.sutp.org or http://www.sutp.cn.

What are some of the key features?

The key features of the *Sourcebook* include:

- A practical orientation, focusing on best practices in planning and regulation and, where possible, successful experiences in developing cities.
- Contributors are leading experts in their fields.
- An attractive and easy-to-read, colour layout.
- Non-technical language (to the extent possible), with technical terms explained.
- Updates via the Internet.

How do I get a copy?

Electronic versions (pdf) of the modules are available at http://www.sutp.org or http://www.sutp.cn. Due to the updating of all modules print versions of the English language edition are no longer available. A print version of the first 20 modules in Chinese language is sold throughout China by Communication Press and a compilation of selected modules is being sold by McMillan, India, in South Asia. Any questions regarding the use of the modules can be directed to sutp@sutp.org or transport@giz.de.

Comments or feedback?

We would welcome any of your comments or suggestions, on any aspect of the *Sourcebook*, by e-mail to sutp@sutp.org and transport@giz.de, or by surface mail to:

Manfred Breithaupt
GIZ, Division 44
P. O. Box 5180
65726 Eschborn, Germany

Further modules and resources

Additional resources are being developed, and Urban Transport Photo CD-ROMs and DVD are available (some photos have been uploaded in http://www.sutp.org – photo section). You will also find relevant links, bibliographical references and more than 400 documents and presentations under http://www.sutp.org, (http://www.sutp.cn for Chinese users).

Modules and contributors

(i) *Sourcebook Overview and Cross-cutting Issues of Urban Transport* (GTZ)

Institutional and policy orientation

1a. *The Role of Transport in Urban Development Policy* (Enrique Peñalosa)
1b. *Urban Transport Institutions* (Richard Meakin)
1c. *Private Sector Participation in Urban Transport Infrastructure Provision* (Christopher Zegras, MIT)
1d. *Economic Instruments* (Manfred Breithaupt, GTZ)
1e. *Raising Public Awareness about Sustainable Urban Transport* (Karl Fjellstrom, Carlos F. Pardo, GTZ)
1f. *Financing Sustainable Urban Transport* (Ko Sakamoto, TRL)
1g. *Urban Freight in Developing Cities* (Bernhard O. Herzog)

Land use planning and demand management

2a. *Land Use Planning and Urban Transport* (Rudolf Petersen, Wuppertal Institute)
2b. *Mobility Management* (Todd Litman, VTPI)
2c. *Parking Management: A Contribution Towards Liveable Cities* (Tom Rye)

Transit, walking and cycling

3a. *Mass Transit Options* (Lloyd Wright, ITDP; Karl Fjellstrom, GTZ)
3b. *Bus Rapid Transit* (Lloyd Wright, ITDP)
3c. *Bus Regulation & Planning* (Richard Meakin)
3d. *Preserving and Expanding the Role of Non-motorised Transport* (Walter Hook, ITDP)
3e. *Car-Free Development* (Lloyd Wright, ITDP)

Vehicles and fuels

4a. *Cleaner Fuels and Vehicle Technologies* (Michael Walsh; Reinhard Kolke, Umweltbundesamt – UBA)
4b. *Inspection & Maintenance and Roadworthiness* (Reinhard Kolke, UBA)
4c. *Two- and Three-Wheelers* (Jitendra Shah, World Bank; N.V. Iyer, Bajaj Auto)
4d. *Natural Gas Vehicles* (MVV InnoTec)
4e. *Intelligent Transport Systems* (Phil Sayeg, TRA; Phil Charles, University of Queensland)
4f. *EcoDriving* (VTL; Manfred Breithaupt, Oliver Eberz, GTZ)

Environmental and health impacts

5a. *Air Quality Management* (Dietrich Schwela, World Health Organization)
5b. *Urban Road Safety* (John Fletcher, TRL; Jacqueline Lacroix, DVR; David Silcock, GRSP)
5c. *Noise and its Abatement* (Civic Exchange Hong Kong; GTZ; UBA)
5d. *The CDM in the Transport Sector* (Jürg M. Grütter)
5e. *Urban Transport and Climate Change* (Holger Dalkmann, Charlotte Brannigan, C4S; Benoit Lefevre, Angela Enriquez, WRI)
5f. *Adapting Urban Transport to Climate Change* (Urda Eichhorst, Wuppertal Institute)
5g. *Urban Transport and Health* (Carlos Dora, Jamie Hosking, Pierpaolo Mudu, Elaine Ruth Fletcher)
5h. *Urban Transport and Energy Efficiency* (Susanne Böhler, Hanna Hüging)

Resources

6. *Resources for Policy-makers* (GTZ)

Social and cross-cutting issues on urban transport

7a. *Gender and Urban Transport: Smart and Affordable* (Mika Kunieda; Aimée Gauthier)

About the authors

Holger Dalkmann holds a Diploma Degree in Geography from the University of Trier, Germany and worked as a lecturer (Transport and Spatial Planning, Mobility Management, Sustainable Mobility) at the University of Duisburg- Essen at the Department of Geography. Before joining the Transport Research Laboratory (TRL) in the UK he worked 10 years at the Wuppertal Institute for Climate, Energy and Environment as a project manager and coordinator for international transport policy. At the time of writing of the first edition of this publication, he acted as Programme Director for Sustainable Transport and Climate Change at TRL. Today, he is Acting Global Director Cities and Transport – Director EMBARQ.

Charlotte Brannigan holds a BSC degree in Geography (University of Huddersfield) and MRes in the Built Environment (Institute for Transport Studies at the University of Leeds). At the time of writing of the first edition of this publication, she worked as a Senior Consultant within the Environmental Assessment team in the Centre for Sustainability (C4S) at the Transport Research Laboratory (TRL), UK. Today, she is Senior Consultant, Sustainable Transport, at Ricardo-AEA.

Authors of the updated module

Benoit Lefevre, PhD is the Director of Transport and Climate at Climate and Energy Program and EMBARQ, World Resources Institute (WRI). He holds a PhD in economics and finance from Mines ParisTech and a Master's Degree in Environmental and Natural Resources Economics. He did his Post-doctorate work at the Center for Energy, Columbia University, New York. Prior to joining EMBARQ, he was the as the Director of the Urban Fabric Program (UFP) at the Institute of Sustainable Development and International relations (IDDRI) and as visiting scholar at the Global Metropolitan Studies (GMS) and the Institute of Urban and Regional Development (IURD), University of California, Berkeley. Benoit is also Lead Author for the Chapter 16 "Cross-cutting Investment and Finance Issues" of the 5th Assessment Report (AR5), Working Group III of the Intergovernmental Panel on Climate Change (IPCC). He has more than 10 years of experience in the field of transport and climate change.

Angela Enriquez is a Research Analyst, Transport and Climate at the Climate and Energy Program and EMBARQ, World Resources Institute (WRI). She holds a BA degree in Environmental Analysis and Design (University of California, Irvine) and a joint MSc degree in Regional Development Planning (Technische Universität Dortmund/University of the Philippines, Diliman). Angela is part of the core team leading the Low Emissions Development Strategy (LEDS) Transport Working Group. She has five years of experience in the transport field.

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Bridging the gap

Pathways for Transport in the Post 2012 Process

An initiative of GIZ, Veolia Transport, UITP, ITDP and TRL

This module update is partially based on the work of the Bridging the Gap Initiative. 'Bridging the Gap: Pathways for Transport in a Post 2012 Process'. The Initiative was formed at COP14 in Poznan in 2008 to encourage international recognition that land transport should play a more prominent role in addressing climate change in the post 2012 agreement and to 'bridge the gap' between the land transport sector and international climate change policy. The multi-stakeholder Initiative partners are GIZ, TRL, Transdev, ITDP and UITP. New partners CODATU, KOTI and Wuppertal Institute joined the Initiative in 2013. The partnership has made significant steps to encourage international action and to slow the growth in emissions from the transport sector over the last years, and continues to actively develop knowledge in this area. http://www.transport2020.org

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1. Introduction

Climate change is one of the major global challenges and greenhouse gas (GHG) emissions from transport are a key contributor to this. In a wider transport sector mitigation strategy, sustainable urban mobility provides a unique opportunity to address climate change while at the same time fostering sustainable development. About 40 % of the overall transport emissions are generated in cities and through low-carbon transport policies cities can also boost other policy objectives such as enhanced accessibility and mobility, improved air quality and road safety, reduced noise from traffic, increased energy efficiency and productivity and a range of other social and economic benefits.

This *Sourcebook* module is primarily focused on climate change mitigation options and provides advice on sustainable low-carbon transport policy instruments, focusing on the city level and relevant national framework policies.

For a more detailed approach on how to integrate adaptation to climate change into urban transport planning and policy and understand the synergies between mitigation and adaptation refer to GIZ *Sourcebook* Module 5f: *Adapting Urban Transport to Climate Change*.

After first introducing the challenges in addressing climate change for the transport sector (Section 2), this *Sourcebook* module is divided into two major sections:

Sustainable Urban Transport Instruments: Section 3 provides an overview of the sustainable low-carbon urban transport instruments that can be implemented to support mitigation strategies that aim to reduce GHG emissions.

Funding Options: Section 4 presents an overview of financial mechanisms available to support the implementation of sustainable low-carbon urban transport instruments. It introduces “non-climate specific” and “climate specific” funding sources that include various individual and collective partners from the public and private sectors at the international and national levels.

Other sub-sectors, which are beyond the scope of this module, should not be neglected when aiming to reduce GHG emissions from transport, particularly freight and commercial transport, aviation and maritime transport.

Freight: Freight transport is a significant source of GHG emissions. In urban areas, freight transport also contributes to air pollution, congestion, accidents and infrastructure deterioration (*e.g.* road surfaces). While this module does not include specific freight and logistics solutions, a number of instruments presented in this module can also foster freight transport efficiency (*e.g.* fuel taxation, road user charging, eco-driving).

For an overview on sustainable freight and logistics measures please see GIZ *Sourcebook* Module 1g: *Urban Freight in Developing Cities*.

Figure 1: *Emissions from an old school bus.*
© Allan Quimby (TRL), India, 2004

Aviation: National and international air passenger and freight transport is the fastest growing transport sub-sector. The International Civil Aviation Organization (ICAO) is tasked to tackle emissions from the sector internationally and provides improve the efficiency. Domestic aviation can be regulated at the national level or regional level, for example through the inclusion on the EU Emissions Trading Scheme, which is one of the few examples of action outside the international framework. From a city perspective airports require efficient passenger and freight transport links, which need to be planned and managed by city authorities.

Waterborne transport: Similar to aviation, there is a dedicated UN body on waterborne transport, the International Maritime Organisation (IMO) international, which deals with greenhouse gas emissions from this sector. Locally, port cites have an important role to play to design (mostly freight) transport links to the port that are integrated in the urban mobility concept.

Box 1: Key findings from the Fifth IPCC Assessment Report

The Fifth IPCC Assessment Report, released in 2014, summarises that the transport sector plays an important role in global climate change mitigation strategies, as it currently accounts for about 23 % of global energy-related greenhouse gas emissions. If current trends in motorisation persists transport greenhouse gas missions could double by 2050 (IPCC 2014).

There is substantial potential in both technical and behavioural mitigation measures for all transport modes. These could reduce total transportation CO_2eq emissions in 2050 by as much as 60% below the baseline and 30 % below 2010 levels (IEA 2014). In some cases, this mitigation potential could be tapped at very low or even negative net costs from a societal perspective along with generating substantial sustainable development benefits. However to realise this potential, the IPCC Report stresses the point that an integrated policy approach at all levels of government is required. A package that achieves low-carbon transport and fosters sustainable developed includes avoided journeys and modal shifts due to behavioural change, uptake of improved vehicle and engine performance technologies, low-carbon fuels, investments in related infrastructure, and changes in the built environment.

Travel demand per capita in developing and emerging economies is still substantially lower than in developed countries. Emission reductions in developed countries have to be deeper over the coming decades and growth in developing countries slower to stay on a pathway that is in line with a 2 degree Celsius warming stabilisation.

A number of short-term measures, such as eco-driving, vehicle fuel efficiency and improved logistics are available to cost-effectively reduce greenhouse gas emissions and also particulate matter (including black carbon), tropospheric ozone and aerosol precursors (including NO_X). In addition to the climate change mitigation aspect, this can also instantly improve human health and wellbeing.

Maintaining current shares of low-carbon modes in emerging cities of many developing countries is another important short to medium term measure, whereas the redesign of cities and regaining of modal share of walking, cycling and public transport often requires a long-term strategy.

2. Climate change: challenges for the transport sector

2.1 Man-made emissions are changing our climate

The Fifth IPCC Assessment Report makes it again very clear that human activities are "very likely a contributor to climate change" (IPCC, 2013). This includes the use of fossil fuels, changes in land use such as deforestation and agriculture, have led to wide-spread increases in global atmospheric concentrations of GHG. The full basket of GHGs covered by the Kyoto Protocol includes carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydro fluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6)[1] (IPCC, 2013).

[1] Nitrogen trifluoride (NF_3) was added in the Doha Amendment to the Kyoto Protocol in 2012. There are a variety of ways these gases are typically measured, such as parts per million (ppm), and less frequently parts per billion (ppb) or parts per trillion (ppt). Carbon dioxide equivalent (CO_2eq) is another form of measurement and expresses the equivalent weight of carbon dioxide for a given blend and volume of GHGs covered by the Kyoto Protocol that would have the same capacity to produce global warming effects when measured over a specific time (UNEP, 2012).

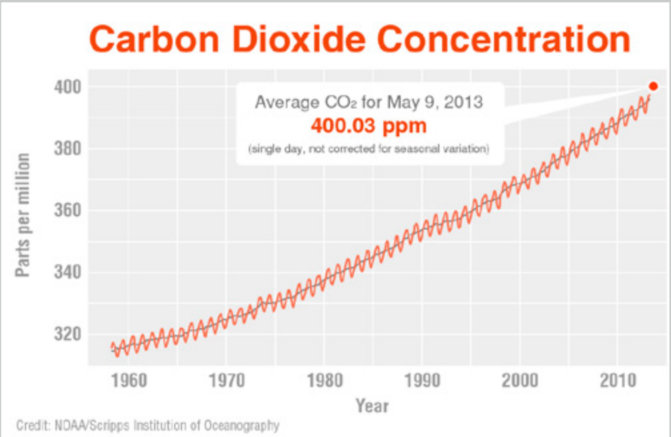


Figure 2: *Trend of observed concentration of carbon dioxide.*
© NASA, 2013

The IPCC suggests that once the observed concentration of CO_2 reaches 450 ppm, the result will be an increase in temperature of 2 degree Celsius (°C), which is commonly regarded as the threshold to prevent dangerous climate change impacts and damages (UNFCCC, 2002). In May 2013, the concentration of CO_2 was greater than 400 ppm for the first time in recorded history, as shown in Figure 2 (NASA, 2013). Assuming the current trend, the threshold may be exceeded in less than 25 years if leaders do not take aggressive actions to reduce GHG emissions (EEA, 2013).

The Intergovernmental Panel on Climate Change (IPCC) regularly publishes reports on climate change predictions. Box 2 provides an overview of the IPCC assessment reports. Table 1 summarises the impacts that climate change is projected to have on developing nations as estimated by the IPCC in its *4th Assessment Report 2007* (IPCC, 2007).

The effects of climate change include wide-spread melting of glaciers and ice caps, rising sea levels and changes in rainfall patterns that are likely to lead to increased drought in some regions. Heat-waves and extreme high temperatures are also very likely to become more common. Extreme weather events, including hurricanes and typhoons, may become more intense owing to increased energy being retained in the system, although it is not yet clear as to whether or not the frequency of these events will increase. It is expected that these trends will continue over the coming decades (IPCC, 2013).

Effects will vary greatly in different areas of the world. It is expected that effects will be stronger in developing countries, whose geography and lack of resources to adapt make them more vulnerable (IPCC, 2007, 2014). Based on the map in Figure 3, areas prone to drought are located along the most northern and most southern areas of the hemisphere. Countries along the Mediterranean Basin, in the Middle East and the western parts of Asia are susceptible to up to a 70 % decrease in river flow. The populations in Southeast Asia, however, are vulnerable to the rising sea levels. The maps also indicate that the majority of Africa, the Middle East through southern

Table 1: Projected effects of climate change on developing nations

Region	Projected effects of climate change
Africa	■ By 2020, projected that between 75 and 250 million people will be exposed to an increase of water stress. If this stress is coupled with increased demand, livelihoods will be adversely affected and water-related problems will be exacerbated. ■ Area suitable for agriculture, the length of growing seasons and yield potential are expected to decrease, further adversely affecting food security and malnutrition in the continent. ■ Decreasing fisheries resources in large lakes may lead to negative effects on local food supply as a result of rising water temperatures. ■ Sea level rise may affect low-lying coastal areas with large populations by the end of the 21st century, and Mangroves and coral reefs are projected to be further degraded. This is likely to have further consequences for fisheries and tourism.
Asia	■ An increase in flooding, rock avalanches and effects on water resources are likely to be experienced in the next two to three decades as a result of glacier melt in the Himalayas. Following this, river flows are projected to decrease as the glaciers recede. ■ Freshwater availability is likely to decrease, particularly in large river basins, in Central, South, East and Southeast Asia as a result of climate change. This could potentially adversely affect more than a billion people by the 2050s through population growth and increasing demand from higher standards of living. ■ Coastal regions will be at risk due to increased flooding from the sea and some mega-deltas flooding from the rivers. Effects will be experienced particularly in the heavily populated mega-delta regions in the South, East and Southeast Asia. ■ Pressure on natural resources and the environment associated with rapid urbanisation, industrialisation and economic development could be compounded with the effects of climate change to impinge on sustainable development of most developing countries in Asia. ■ Effects on agriculture include increased crop yields of up to 20 % in East and Southeast Asia, and decreases of up to 30 % in Central and South Asia by the mid 21st century. These effects coupled with rapid population growth and urbanisation, are likely to lead the risk of hunger remaining high in several developing countries. ■ Adverse health effects are projected to increase, including endemic morbidity and mortality due to diarrhoeal disease (associated with floods and droughts) in East, South and Southeast Asia, and the abundance and/or toxicity of cholera in South East Asia due to increases in coastal water temperature.
Latin America	■ Tropical forest is projected to be gradually replaced by savanna in eastern Amazonia through increases in temperature and associated decreases in soil water. Biodiversity loss through species extinction in many areas of tropical Latin America is a risk. ■ Salinisation and desertification of agricultural land may occur in drier areas as a result of climate change. This could lead to reduced productivity of certain crops and livestock productivity could decline with adverse effects for food security. Soybean yields could increase in temperate zones. ■ Low-lying areas may experience increased flood-risk due to projected sea-level rise. Sea surface temperature increases are likely to have an adverse effect on Mesoamerican coral reefs, causing shifts in the location of south-east Pacific fish stocks. ■ Water availability for human consumption, agriculture and energy generation are projected to be significantly affected by changes in precipitation patterns and the disappearance of glaciers.
Small Islands	■ Small island display characteristics that make them particularly vulnerable to the effects of climate change, sea-level rise and extreme events (both the Tropics and higher latitudes). ■ Coastal conditions are projected to deteriorate, including erosion of beaches and coral bleaching. These effects could affect local resources, such as fisheries and reduce the value of these destinations for tourism. ■ Sea-level rise can exacerbate certain problems including inundation, storm surge, erosion and other coastal hazards. These effects can threaten vital infrastructure, settlements and facilities that support the livelihood of island communities. ■ Water resources in many small islands are projected to be affected by climate change. They may become insufficient to meet demand during low rainfall periods. ■ Non-native species invasion may be increased as a result of higher temperatures, particularly on middle and high latitude islands.

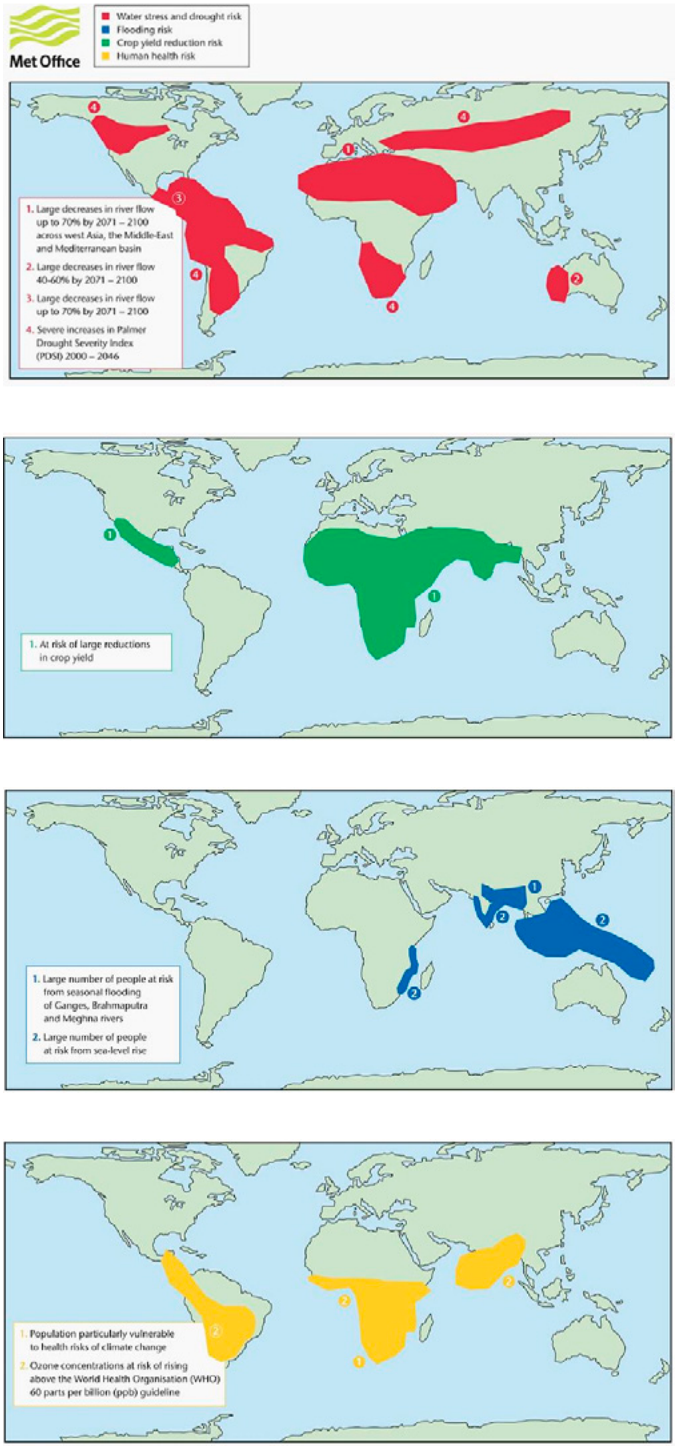
Source: adapted from IPCC, 2007a

Box 2: The International Panel on Climate Change (IPCC)

The Intergovernmental Panel on Climate Change (IPCC), established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) in 1988, is the leading international body for the assessment of climate change. The IPPC assesses the scientific, technical and socio-economic information relevant for the understanding of the risk of human-induced climate change and regularly publishes reports on climate change predictions. The IPCC has published four assessment reports on climate change in 1990, 1995, 2001 and 2007. Each report is divided into three main parts:

- Physical science of climate change;
- Impacts, adaptation and vulnerability;
- Mitigation of climate change.

Their most recent report, the 5th Assessment Report, is being released in four parts between September 2013 and November 2014. The first part, Climate Change 2013: The Physical Science Basis was released in September 2013. It sustains that warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The report finds that human influence on the climate system is clear, evident from increasing GHG concentrations in the atmosphere, positive radiative forcing, observed warming, and increased understanding of the climate system. The findings support the need to limit climate change through substantial and sustained reductions of GHG emissions. Part two and three of the 5th Assessment Report, as well as a final synthesis report, will be released by November 2014. (IPCC, 2013)



Figures 3a,b,c,d: *Maps of global impacts of climate change.*
© Met Office, 2011

Asia, as well as countries in the south-western part of North and Central America, face high risks of a great reduction in crop yield. Health risks associated with climate change include effects on the respiratory system caused by the concentration of the ozone; this will affect Sub-Saharan Africa, southern Asia and the majority of Latin America (Met Office, 2011).

Box 3: Climate change effects

Bangladesh

- Bangladesh is vulnerable due to low lying land, high risk of cyclones, dependency on agriculture and the poverty of its inhabitants.
- Severe floods used to occur once every twenty years. They are now occurring every five to seven years, taking place in 1987, 1988, 1995, 1998, 2004 and 2007.
- Floods in 2004 were some of the most severe in decades, leaving 1 000 people dead and 30 million people homeless. It is estimated that the floods caused GBP 4 billion of damage.
- A 45 centimetres (cm) sea level rise would reduce Bangladesh's land area by 11 % and force 5.5 million people to migrate. A 100 cm rise would remove 20 % of the land area, causing 15 million people to migrate. Rainfall is predicted to increase by 10 to 15 % by 2030 and the higher temperatures increase the frequency and intensity of cyclones (WDM, 2006).

China

- From 1950 to 1975 China lost an average of 1 560 square km of land to desert each year. By 2000, nearly 3 625 square km were going to desert annually. Soon 40 % of China could turn into scrubland.
- The Gobi desert in central China has expanded by about 64 750 square km since 1994 and its sands are now within 160 km of Beijing. This has resulted in the capital being subjected to severe sand storms effecting human health.
- The growth in desert has meant villages being buried under sand and the loss of agricultural land has decreased food production. Official reports also warning that China is losing about USD 7.7 billion a year because of desertification (Pocha, 2006).

Ethiopia

- Since 1980, Ethiopia has experienced five major droughts. With an economy that is highly dependent on agriculture, these droughts have impacted the crop yield, poverty level and economic development.
- In 2004, almost half the nation reported having experienced transient poverty due to the droughts. Additionally, agro-pastoral and pastoral households have suffered severe asset loss.
- It is predicted that there will be a decrease of precipitation across northern regions and in the southern areas there will be an increase in precipitation up to 20 %.
- According to the country's First National Communications to the UNFCCC, the average temperatures are predicted to rise up to 3.6 °C by 2070 (World Bank, 2009).

It is also important to note that transport not only contributes to but is impacted by climate change. Rising sea levels, variable temperatures and increased frequency and severity of storms have caused physical damage to infrastructure as well as service disruption. The impacts of climate hazards on land transport systems include corrosion from rising sea level, deterioration of materials from the variable temperatures and physical damage to the road network caused by debris from high winds (Mehrotra *et al.,* 2011).

2.2 Transport's contribution to emissions

The transport sector accounts for about 23 % of global energy related CO_2 emissions and its share of global energy use is increasing more rapidly than in other sectors (IEA, 2011; IEA, 2013a). Between 1971 and 2006, energy use in the transport sector doubled (IEA, 2011). Figure 4 shows the trend in world fuel use by transport mode. The majority of transport energy consumption is from road transport. Road transport (*i.e.* freight and passenger) represents around 73 % of total transport energy use (IEA, 2012c). Urban transport accounts for about 40 % of the energy used in the transport sector (IEA, 2013a).

Transport is still highly dependent on petroleum products. The transport sector's share of total global oil consumption increased from 45.4 % in 1971 to 61.5 % in 2010 as represented in Figure 6 (IEA, 2012a). Road transport accounts for 47 % of global oil consumption (IEA, 2012a).

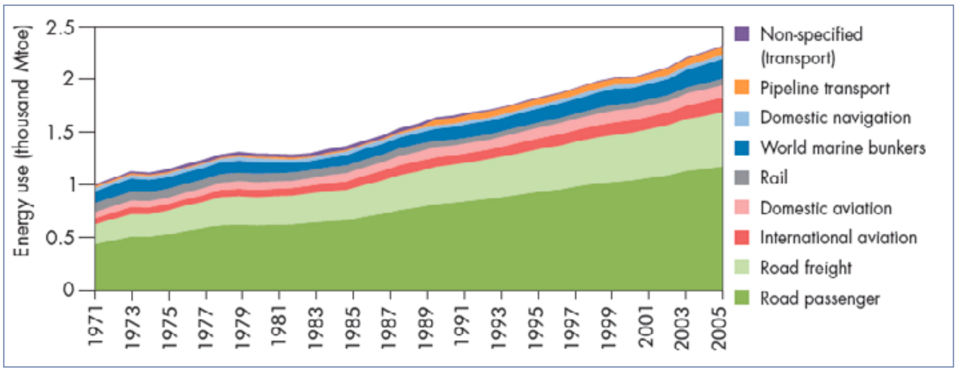


Figure 4: *Global energy use by transport mode.*
© IEA, 2011

Figure 5: *Traffic jam in the centre of La Paz.*
© Gerhard Menckhoff, La Paz, 2005

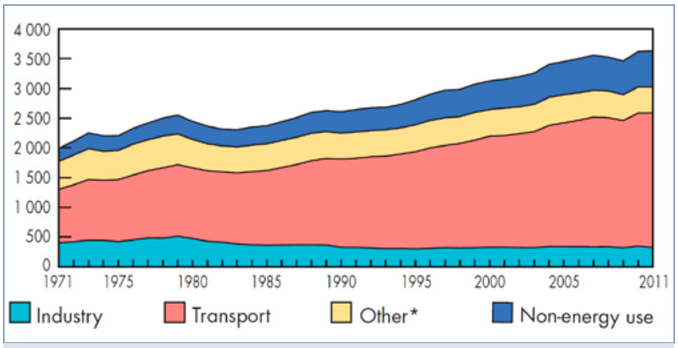


Figure 6: *Total final oil consumption by sector (Mtoe).*
© IEA, 2013, Key World Energy Statistics
Note: *Other includes agriculture, commercial and public services, residential and non-specific other.

As a consequence of burning fossil fuels over the past three decades, GHG emissions from transport have risen faster than those from all other sectors and are projected to rise more rapidly in the future if current trends continue over the coming decades. Between 2000 and 2010, the GHG emission levels increased about 20 % from the transport sector (UNEP, 2012). In 2011, the transport sector accounted for 22 % of global energy-related CO_2 emissions (IEA, 2013b).

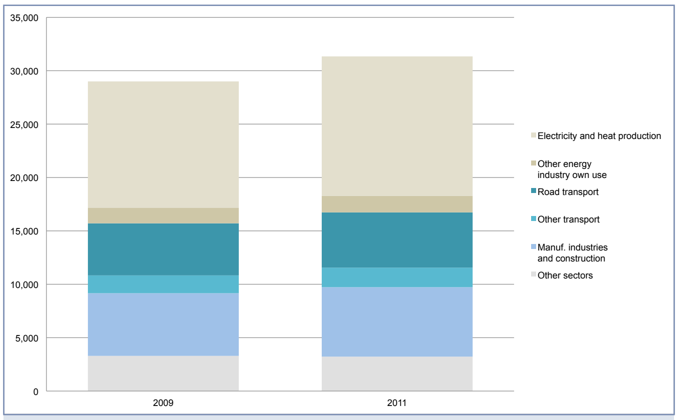


Figure 7: *World CO_2 emissions by sector (million tonnes of CO_2).*
© IEA, CO_2 Emissions From Fuel Combustion Highlights 2011 and 2013

Transport emissions also include black carbon, a by-product of incomplete fuel combustion from cars and trucks. Black carbon particles also have a negative impact on human health, a particular worrying fact in South Asia, where black carbon concentration is high (EPA, 2012).

For more information on transport drivers and trends, see Chapter 1 of Bongardt *et al.,* (2013).

2.3 Mitigation action in transport is needed to reduce global CO_2 emissions: filling the 2 °C emissions gap

The reduction of GHG emissions has become a priority on international and many national agendas. Box 4 provides an overview of the United Nations Framework Convention on Climate Change (UNFCCC) process and milestones. In the 2010 Cancun Agreements, many leaders formally pledged to implement actions to reduce their emissions by 2020. The map in Figure 8 outlines the

Box 4: The United Nations Framework Convention on Climate Change (UNFCCC)

The UNFCCC is an international treaty that 195 countries ('Parties to the Convention') have joined to consider how they can collectively limit average global temperature increases and manage the negative impacts that climate change will cause. It entered into force in 1994 and the first Conference of the Parties (COP) took place in Berlin in 1995 and continues to be held annually.

The early UNFCCC negotiations culminated in the adoption of the Kyoto Protocol in 1997 — an international climate change agreement that legally binds developed countries to emission reduction targets. The Kyoto Protocol's first 'commitment period' started in 2008 and ended in 2012. A second commitment period from 2013 to 2020 was later negotiated, and the roadmap to developing a successor to the Kyoto Protocol was initiated in 2007 at COP13 in Bali.

The 'Bali Road Map' outlined steps to be taken to develop a 'post 2012 outcome' to coincide with the end of the first commitment period of the Kyoto Protocol. This deadline has since been extended, and the UNFCCC is now aiming to adopt a successor agreement at COP21 in 2015 to cover the period until and after 2020. There have been a number of milestones reached over the last few years that will support the realisation of this goal. These include the following:

- COP15 in 2009 – the Parties agreed to 'take note' of the Copenhagen Accord, which contains non-binding emission reduction pledges from developed countries and mitigation action pledges from developing countries;
- COP16 in 2010 – the Cancun Agreements, a set of decisions that include provisions for greater transparency in emission reporting, the establishment of a 'Green Climate Fund' and bringing GHG emission reduction targets under the UNFCCC process, were largely accepted by the COP;
- COP17 in 2011 – the Durban Platform for Enhanced Action was adopted. It outlines a roadmap for implementation that include an agreement about the second commitment period of the Kyoto Protocol, the commission of a review of climate science, and the launch of a new platform of negotiations – the Ad hoc Working Group on the Durban Platform for Enhanced Action (DEA) – to streamline the negotiation process;
- COP18 in 2012 – the Doha Amendment to the Kyoto Protocol was adopted, wherein the 191 parties to the Kyoto Protocol agreed to a second commitment period from 2013 to 2020. In this amendment, the parties agreed to reduce the emissions of seven GHGs to 18 % below their 1990 levels by 2020. It advances the Durban Platform roadmap, the extension of the Kyoto Protocol, streamlining of negotiations, and highlights the issue of climate change related 'loss and damage.'

For more information about the UNFCCC refer to:
http://unfccc.int/essential_background/convention/items/6036.php
http://unfccc.int/essential_background/items/6031.php
http://cancun.unfccc.int
http://unfccc.int/key_steps/durban_outcomes/items/6825.php
http://unfccc.int/kyoto_protocol/doha_amendment/items/7362.php

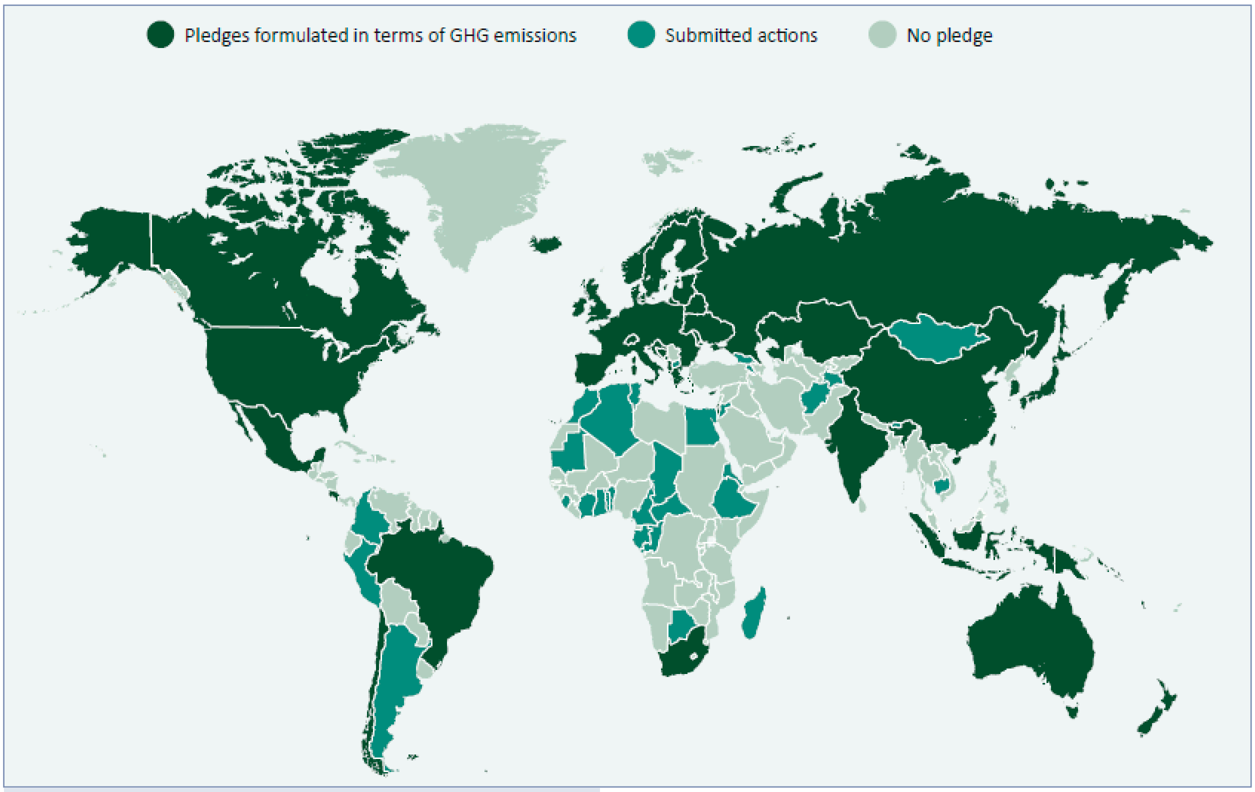


Figure 8: *Map of GHG emissions pledge status.*
© UNEP, 2012

pledges of countries in terms of GHG emission reductions and submitted actions.

Based on hypothesised levels of implementation of the pledges and rules of accounting, the United Nations Environmental Programme (UNEP) has identified four case scenarios beyond the "Business-as-Usual" (BaU) scenario that highlight potential trajectories of the global emissions.

Assuming countries would fulfil their pledges, it is projected that by 2020 there is a reduction potential of up to 6 gigatonnes of carbon dioxide equivalent ($GtCO_2eq$) below the BaU scenario. To put this figure into perspective, in 2005 the total emissions produced by cars, buses and trucks in the world was 5 $GtCO_2eq$ (UNEP, 2010).

For the 2010 climate change summit in Cancun, the UNEP published the *Emissions Gap Report* where it was revealed that even if the countries implemented their pledges, a gap would still exist between the pledges and the emissions reductions required to stay below the 2 °C target (UNEP, 2012). This gap is known as the "emissions gap."

Since then, UNEP has published *The Emissions Gap Report 2012* with updated data that estimated that the transport sector has significant potential in reducing its annual global total GHG emissions by 1.7 to 2.5 $GtCO_2eq$ by 2020 (Figure 9). In order for transport to contribute to minimising the emissions gap, the transport system must become more sustainable. As will be discussed in Section 3, the efforts to reduce emissions from transport on the city level include the promotion of non-motorised transport (NMT), such as walking and cycling, public transport as well as the implementation of smart urban planning policies and designs. Complementary measures from the national level that foster energy efficiency and low/carbon technologies and fuels are important, but will not be sufficient to achieve the necessary emissions reductions without local policies.

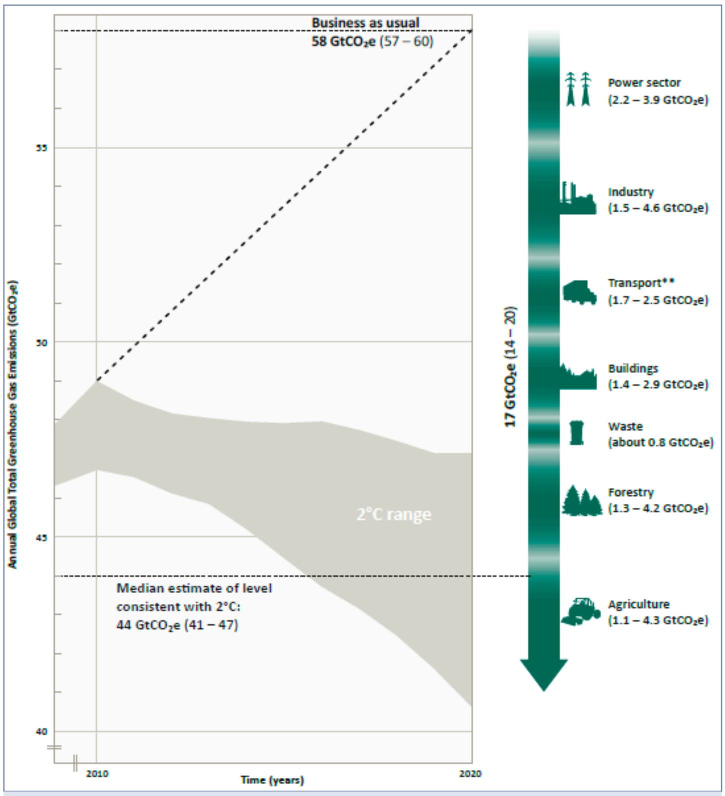


Figure 9: *How to bridge the gap: results from sectoral policy analysis.*
© UNEP, 2012
Note: Including shipping and aviation.

Figure 10: *In Hanoi two-wheelers represent the major motorised transport mode.*
© Manfred Breithaupt, Hanoi, 2006

2.4 Urgent and long-term commitment to be differentiated by region

2.4.1 An urgent agenda

The urbanisation in developing countries is both rapid and large-scale. By 2030, almost all of world's demographic growth will be located in cities in developing countries, the population of which will double from two to four billion people (UN DESA, 2011). Accommodating two billion inhabitants in urban areas means building the equivalent of seven new cities with a population of ten million each year, or in other words seven times Shanghai, every year. The speed of this urban growth is historically unprecedented: it took London 130 years to grow from one million to nearly eight million inhabitants. It only took Seoul 25 years to achieve the same demographic leap (Lefevre, 2009). The urbanisation boom in developing countries is certainly an opportunity, but also undeniably one of the main environmental challenges of the century. The current tendencies of urban dynamics are alarming in terms of climate change because they are giving an increasingly important role to private motorised vehicles to the detriment of NMT and public transport. Figure 11 shows two alternative

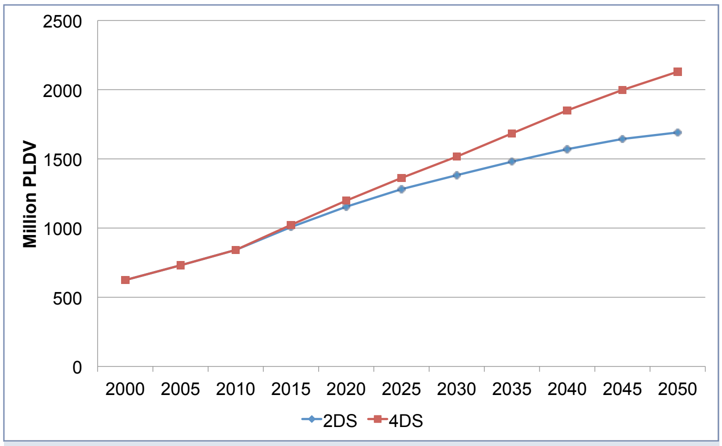


Figure 11: *Projected world passenger light-duty vehicle (PLDV) stock until 2050 under two scenarios.*
Source: Energy Technology Perspectives 2012, http://www.iea.org/etp
Note: *The 4 °C Scenario (4DS) takes into account recent pledges made by countries to limit emissions and step up efforts to improve energy efficiency. The 2 °C Scenario (2DS) describes an energy system consistent with an emissions trajectory that recent climate science research indicates would give an 80 % chance of limiting average global temperature increase to 2 °C.

projections of the global passenger vehicle stock resulting from scenarios which reflect a different set of policy actions. The energy and environmental implications of each projection differ considerably.

Considering the life span of urban structures, the type of urban growth that cities of the developing countries will experience in the next three decades will determine the level of their energy consumption and GHG emissions in the second half of the century. Barcelona in Spain, for example, houses and employs a population 20 % larger than that of Atlanta in the United States (US), but on a surface area 26 times smaller, and using 11 times less energy per capita for urban transport. Depending on whether cities in developing nations follow the development pathways of cities like Atlanta or Barcelona will therefore have considerable implications for the level of climate change experienced by the end of the 21st century (Lefevre, 2009).

Figure 12: *In Delhi cars are increasingly replacing two-wheelers in the modal mix.*
© Abhay Negi, Delhi, 2005

The spatial distribution of activities (the urban structures), which obviously have a significant impact on the demand for transport and thus, on transport energy demand and can even be much more resilient. The structuring effect of transport infrastructure (*i.e.* the layout of the road infrastructure and availability of public transport infrastructure) influences the spatial organisation of cities, which can then dictate the relative dominance of different transport modes, and thus the level of energy consumption and GHG emissions related to transport. The rate of urbanisation and development of cities means that taking action to design for sustainable transport is both a matter of urgency and a long-term commitment.

2.4.2 Different agendas per region

The current and projected growth of GHG emissions varies by region. At present industrialised countries is the main source of transport emissions. While the transport GHG emissions per year in developing countries are still relatively low, the rate of growth of emissions in emerging nations is significant, particularly in China, India and Indonesia. In light of these trends, it is urgent for developed nations to focus on intensively reducing their emissions, while developing nations should benefit from leapfrogging and aim at managing and limiting their increase of emissions. The level of GHG emissions due to transport is growing faster in emerging economies than in less developed countries because of urbanisation and the rapid growth of an emerging middle class adopting a carbon-intensive consumption pattern, for example as expressed in increased ownership and use of private motorised vehicles.

Figure 13: *Broad bike and pedestrian lanes encourage people to shift to non-motorised traffic modes.*
© Sheyra Gadepalli, Bogotá, 2005

2.5 How to reduce emissions from transport: a general framework

The ASIF framework was developed to break down the drivers of GHG emissions that result from transport to identify the categories of projects that can reduce them (Schipper and Marie-Lilliu, 1999). ASIF describes the four basic components that drive transport energy consumption and emissions:

Carbon emissions = [A. Activity (pkm=trips x km)] X [S. mode Share (% pkm)] X [I. fuel Intensity (quantity per km)] X [F. Fuel mix (emissions per quantity)].

The framework (Figure 14) highlights the fact that there are multiple factors influencing each of the ASIF components, with many affecting more than one component. It also allows the identification of the categories of projects to tackle each component and can highlight how policy can have contradictory effects on other components. And last but not least, it pinpoints the responsibilities and the key role of each stakeholder.

For instance:

- **A** = a function (f) of [population, demographics (age, gender, etc.), income (trip rates and distance tends to rise with income), economy and its composition, urban form and size (spatial distribution of actors), etc.]
- **S** = f [income (influence value of time and thus demand for speed, comfort and privacy, vehicle ownership, etc.), motorisation rate, infrastructure provision (affect the willingness to choose NMT options, availability of certain fixed public transport options, modal attractiveness through effects on reliability), service provision (quality), relative costs (out of pocket and perceived costs), urban form and size (spatial distribution of actors), etc.]
- **I** =f [vehicle technology (influenced by vehicle emission standards, income levels, fuel and vehicle costs), driving cycles (influenced by road conditions, congestion levels), etc.]
- **F** =f [carbon content of fuels, potential for alternative fuel types] (Schipper, L. *et al.*, 2000).

The ASIF framework is the foundation for the A-S-I strategy framework: *Avoid, Shift, Improve*, which identifies the three primary ways to reduce GHG emissions from transport on the demand-side, with the objective of promoting alternative mobility solutions and reducing GHG emissions from transport:

- ***Avoid/Reduce*** addresses the need to improve the overall efficiency of the transport system by implementing instruments that reduce the need to travel and the trip length.
- ***Shift/Maintain*** seeks to improve trip efficiency by promoting modal shift from the most energy consuming urban transport mode (*i.e.* cars) towards low-carbon modes. In particular, the shift towards:
  - Non-Motorised Transport (NMT): The healthiest and most environmentally-friendly options (*i.e.* walking, cycling).
  - Public Transport (PT): Although public transport (*i.e.* bus, rail) also generates emissions, lower specific energy consumption per passenger kilometre (pkm) and higher occupancy levels imply that the associated GHG emissions per pkm are lower compared to cars.

  In places where the share of NMT and public transport is already high, the main objective is to maintain the modal share.
- ***Improve*** focuses on vehicle fuel efficiency, low-carbon fuels and energy carriers as well as on the optimisation of transport infrastructure. It seeks to improve the energy efficiency of transport modes and related vehicle technology. Furthermore, the potential of alternative energy use is acknowledged (GIZ, 2011).

This strategic framework can support decision-makers to design coherent and integrated policies to foster sustainable low-carbon transport. This will be detailed in Section 3.1.

☞ Download the A-S-I factsheet from: http://www.sutp.org/dn.php?file=FS-ASI-EN.pdf.

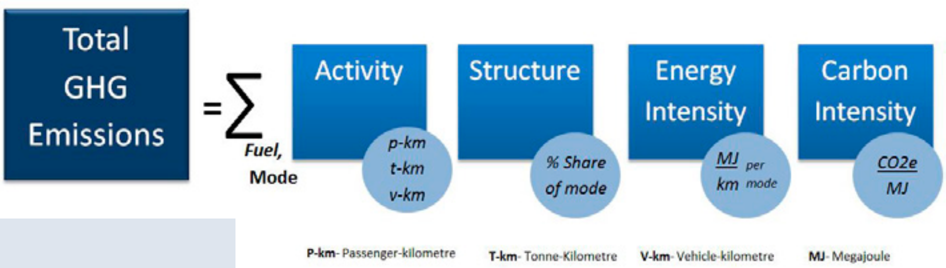


Figure 14: *ASIF Formula.*
Source: Authors based on Schipper and Marie-Lilliu, 1999

3. Tackling the problem: sustainable transport instruments

A sustainable transport system is one that:

- "allows individuals, companies and societies to meet their basic mobility needs in a way that preserves human and ecosystem health, and promotes equity within and between successive generations,
- is affordable, efficient, offers a choice of transport mode, and supports a competitive economy, as well as balanced regional development, and
- limits emissions and waste within the planet's ability to absorb them, uses renewable resources at or below their rates of generation, and uses non-renewable resources at or below the rates of development of renewable substitutes, while minimising the impact on the use of land and the generation of noise" (ECMT, 2004).

To avoid a bias in favour of private motorised transport, an integrated transport planning approach should be adopted. This should design and incorporate efficient transport modes, leapfrogging technological development, and smart infrastructure designs that reduce the need to travel.

There are numerous modules of GIZ's Sustainable Transport *Sourcebook* for Policy-makers in Developing Cities that are of relevance to transport and climate change. These modules discuss in more detail many of the principles mentioned here. Where appropriate, the most relevant modules have been identified throughout the text. Published GIZ *Sourcebook* modules are listed in Box 5.

Figure 15: *Public transportation: buses and vans accessing the roadside market place in Ghana.*
© Allan Quimby (TRL), Ghana, 2004

Box 5: GIZ's Sustainable Transport Sourcebook for Policy-Makers in Developing Cities

GIZ's *Sourcebook* modules cover a wide range of sub-topics of sustainable urban transport. Many of the policy issues discussed in these modules have direct implications for GHG emissions, *e.g.* the promotion of non-motorised transport (Module 3d) will help reduce CO_2 emissions. As of August 2014, the full range of *Sourcebook* modules are as follows:

1a: The Role of Transport in Urban Development Policy
1b: Urban Transport Institutions
1c: Private Sector Participation in Urban Transport Infrastructure Provision
1d: Economic Instruments
1e: Raising Public Awareness about Sustainable Urban Transport
1f: Financing Sustainable Urban Transport
1g: Urban Freight in Developing Cities
2a: Land Use Planning and Urban Transport
2b: Mobility Management
2c: Parking Management
2d: Transportation Demand Management
3a: Mass Transit Options
3b: Bus Rapid Transit
3c: Bus Regulation and Planning
3d: Preserving and Expanding the Role of Non-motorised Transport
3e: Car-Free Development
4a: Cleaner Fuels and Vehicle Technologies
4b: Inspection & Maintenance and Roadworthiness
4c: Two- and Three Wheelers
4d: Natural Gas Vehicles
4e: Intelligent Transport Systems
4f: Eco Driving
5a: Air Quality Management
5b: Urban Road Safety
5c: Noise and its Abatement
5d: The CDM in the Transport Sector
5e: Urban Transport and Climate Change
5f: Adapting Urban Transport to Climate Change
5g: Urban Transport and Health
5h: Urban Transport and Energy Efficiency
7a: Gender and Urban Transport: Smart and Affordable

All *Sourcebook* modules are available to download from http://www.sutp.org. For Chinese users a special website is available (http://www.sutp.cn). All are available in English, whilst most of the *Sourcebook* modules are also available in Chinese and Spanish and some in Romanian, Indonesian, Vietnamese, Thai and French.

3.1 Overview of sustainable urban transport instruments

To reduce emissions from the transport sector, decision-makers should first identify and set policy objectives and then agree on a systematic approach to achieve them. In the context of this module, the ***Avoid-Shift-Improve (A-S-I)*** framework can be used by policy-makers in developing cities to identify transport policies aimed at reducing GHG emissions from vehicle travel.

There are various types of policy instruments that can help decision-makers develop urban transport systems that are more sustainable and less carbon intensive. These policy instruments generally foster behavioural changes successfully and positively impact travel behaviour. These include:

- ***Planning*** can reduce the need to travel by bringing people and the activities they need to access closer together. Planning can also enable the implementation of new transport infrastructure (walking, cycling, rail, other public transport and road).
- ***Regulatory measures*** can be used to restrict the use of certain motorised vehicles, but also influence the types of vehicles used and standards that they should adhere to (both in terms of vehicle performance and road regulations).
- ***Economic instruments*** can be used to discourage the use of motorised vehicles, which will promote the use of alternative modes or reduce the need to travel. Instruments can also improve accessibility and mobility for those without a private vehicle, through investment in transport infrastructure.
- ***Information*** in easily accessible formats can increase the awareness of alternative modes. Information can also be provided related to improving driver behaviour, resulting in reduced fuel consumption.

- ***Technology*** can be used to reduce the impact of GHG emissions from transport through developing cleaner fuels and improving vehicle efficiency.

These instruments, which are detailed in Section 3.2, can be implemented regionally (*e.g.* multi-modal transport network) or citywide (*e.g.* parking restrictions) at a particular time of day (*e.g.* road pricing) and can have different levels of intensity (*e.g.* fare policy for types of users). It is rare for one instrument to tackle all the pressing transport issues or meet all of the implementing agency's objectives; therefore, it is important to develop

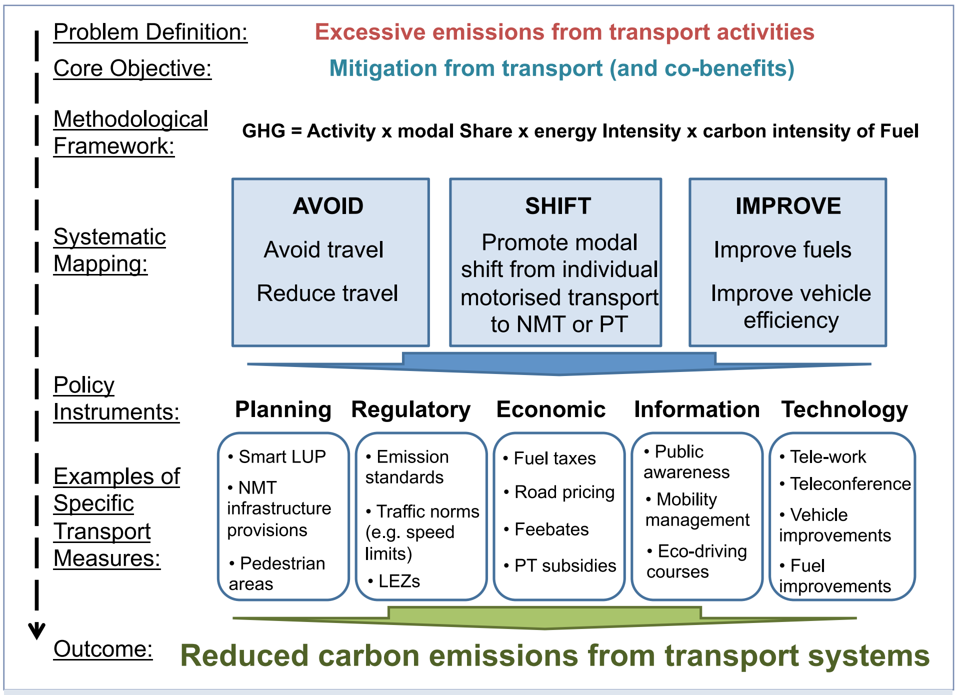


Figure 16: *Sustainable transport instruments and their impact on carbon emissions.*
Source: Gomez, J. based on Dalkmann and Brannigan, 2007
Note: *LUP = Land-use planning. NMT = Non-motorised transport. PT = Public transport. LEZs = Low-emission zones.

Box 6: Online toolkits

Listed below are examples of web-based toolkits where information can be found that is useful for supporting sustainable, low-carbon transport programmes and projects. These include case studies and guidance on the instruments discussed in this section.

The Sustainable Urban Transport Project (GIZ-SUTP) aims to help developing world cities achieve their sustainable transport goals, through the dissemination of information about international experience, policy advice, training and capacity building.

In addition to the *Sourcebook*, the website provides capacity building trainings, case studies and links for further reading about topics on sustainable transport http://www.sutp.org.

A comprehensive compendium of urban transport tools to support experts in designing and implementing sustainable urban transport strategies and measures has been developed by GIZ. The collection "Tools for Sustainable Urban Transport Experts" is structured in (I) Standards and Toolkits, (II) Quantification Tools, (III) Planning Guides and (IV) Cost Comparisons. The toolkit can be downloaded here: http://www.sutp.org/news-archive-mainmenu-156/sutp-articles-main-menu-236/3882-new-collection-released-tools-for-sustainable-urban-transport-experts.

The Low Emission Development Strategies Global Partnership (LEDS GP) aims to enhance coordination, information exchange, and cooperation between countries and international programmes to promote low emission climate resilient growth. Under the LEDS GP, the Transportation Work Stream, led by EMBARQ, the sustainable transport programme of the World Resources Institute (WRI), in partnership with the U.S. Department of Energy's National Renewable Energy Laboratory (NREL), promotes low emission development in the transport sector and has developed a Transportation Assessment Toolkit. The toolkit provides resources on transport systems and the necessary tools to evaluate best options. It also includes links to transport-related data, tools for decision-making, case studies, research papers and other information available at ledsgp.org/transport.

a comprehensive policy strategy that is coherent and integrated and packages various instruments in order to achieve maximum results that promote sustainable low-carbon transport (UCL, 2012).

Figure 16 summarises the key strategy responses to reduce GHG emissions, available sustainable urban transport instruments, key decisions individuals make regarding mode choice as a result of strategy implementation, and the resulting impact on carbon emissions.

3.2 Existing sustainable urban transport policy instruments

The following sub-sections provide an overview of the sustainable transport instruments available (planning, regulatory, economic, information and technology) and their potential contribution to reducing GHG emissions from transport. The described instruments aim at both behavioural and technological changes.

At the end of each sub-section, two tables are provided detailing the instruments' contribution to GHG reductions, the estimated costs, co-benefits, implementation considerations of instruments, level of implementation and responsible/interested stakeholders. A checklist for successful implementation is also provided.

3.2.1 Planning instruments

Planning instruments include all measures that focus on "smarter" planning of infrastructure (*i.e.* planning that helps reduce or optimise transport, encompassing both public transport and non-motorised modes such as cycling and walking).

Land use planning

Smart infrastructure design will influence both the demand for and the efficiency of transport. The need to travel can be reduced when the various forms of land use (such as residential houses, offices, shops, public services, etc.) are not separated in different city quarters but mixed within close proximity of one another – a strategy termed "mixed land use". A smart mixture can significantly reduce the need to travel (or distances travelled) – and thus energy consumption and emissions. In addition, smart infrastructure design will also include NMT modes like walking and cycling right from the beginning, *e.g.* by including pedestrian footways and areas or cycle paths in the infrastructure design. Good access to public transport can be a major contributor to cutting emissions as public transport is, in most cases, much more energy efficient and thus will have lower energy consumption and emissions per kilometre travelled.

Taking a more general perspective, the density of an area (*i.e.* number of people and businesses per square km) will be a crucial factor affecting energy consumption and emissions. Low density development where places of employment, residential areas and key services are separated can lead to a strong reliance on motorised private vehicles, and consequently high transport energy demand. Concentrated city designs, on the other hand, that work towards higher

Figure 17: *Useless sidewalk.*
© Carlos F. Pardo, Pattaya, 2005

densities, with a variety of land uses and services within close proximity, will reduce travel needs and emissions.

In addition, public transport will be more efficient in high-density cities. When major activity centres are concentrated locally, there will be a high demand for transport between these centres, which can be served by efficient and – due to high demand – frequent public transport services. It has been estimated that benefits or savings from effective land use planning, combined with various traffic management schemes can create energy savings of 20 to 30 % for bus operators (Martin *et al.,* 1995; in Karekezi *et al.,* 2003) and generates additional savings for other road users.

Parking management within a city or region can affect the relative price and convenience of driving. It can also affect land use density, accessibility and walkability. As another example, traffic calming measures can affect the relative speed, convenience and safety of NMT (VTPI, 2013a). Some of these issues are discussed further in the section on regulatory and economic instruments.

☞ Please see GIZ *Sourcebook* Module 2a: *Land Use Planning and Urban Transport* for further information.

Box 7: Land use planning

Land banking (where land is reserved for specific development uses) has been implemented in various cities including Singapore, Hong Kong and Curitiba alongside public transport corridors. The use of this mechanism has enabled the provision of low-income housing in transit friendly locations (Hook and Wright, 2002).

Planning for public transport modes

The provision of new and improved public transport is essential to reduce emissions of GHGs can include buses, rail, light rail, metro and underground systems. Attractive, accessible and reliable public transport systems can provide the basis for alternative mode use in cities.

The two key options to improve public transport are the expansion of systems or services and improvements to the operation of systems and services. The expansion of services can include fixed guideways, express bus services, local bus services, or services which extend the geographical coverage of bus network. System/service and operational improvements may include splitting routes, transfer improvements, co-ordination of schedules, through ticketing and increased vehicle frequency. Services may also be improved through the provision of passenger amenities (*e.g.* bus shelters, station improvements, safety and security enhancements, vehicle comfort improvements, signage and elderly/mobility impaired access) as well as full integration of public (and other) transport systems, both regarding physical infrastructure and fare systems.

Figure 18: *Uncoordinated public transport can cause congestion: traffic jam in a central business district.*
© Hans-Jörg Sommer, Delhi, 2005

However, in order to significantly reduce GHG emissions, sufficient ridership is required to avoid public transport vehicles running below full capacity. At the same time, it is not unlikely that public transport systems that manage to attract ridership from previous private car users, reduce congestion on roads, which may encourage induced additional car travel. This potential rebound effect needs to be carefully addressed.

Public transport improvements in cities, in particular in developing countries need to be accompanied by supporting measures that discourage car travel and encourage public transit, such as road user charges and parking pricing. The following factors can be considered as vital for the effectiveness of transit investment in reducing emissions of GHGs (FHA, 1998):

- The level of improvement in transit frequency, coverage or amenities;
- The extent to which increased transit investment reduces motor vehicle fuel consumption (which depends on the extent to which transit causes shifts in mode of travel, improvements in traffic flow, and any offsetting increases in travel due to improved traffic flow); and
- The extent to which any increases in transit fuel consumption offset these reductions.

Options to improve public transport include the implementation of Bus Rapid Transit (BRT) systems. BRT systems have most notably been implemented in Bogotá (Colombia) and Curitiba (Brazil), with others including, Jakarta (Indonesia), León (Mexico) and Seoul (South Korea), with projects underway in cities like Cape Town (South Africa), Dar es Salaam (Tanzania), Hanoi (Vietnam), Lima (Peru), Mexico City (Mexico) and Johannesburg (South Africa). The key features of BRT systems are outlined in Box 8 and some examples are shown in Box 9.

Figure 19: *Exclusive bus lanes for the BRT line in Quito.*
© Klaus Banse, Quito, 2002

Box 8: Key features of BRT systems

- Segregated busways;
- Rapid boarding and alighting;
- Clean, secure and comfortable stations and terminals;
- Efficient pre-board fare collection/verification;
- Free transfers between routes;
- Clear and prominent signage and real-time information displays;
- Transit prioritisation at intersections;
- Modal integration at stations and terminals;
- Clean bus technologies;
- Sophisticated marketing identity; and
- Excellence in customer service (Hook and Wright, 2002; Wright and Fulton, 2005).

Box 9: Examples of BRT systems

Columbia: Bogotá's TransMilenio BRT system was launched in 2000. As of August 2007 it consisted of 84 km of busway, 515 km of feeder routes, and carried 1 400 000 passengers a day. Its success has been helped by a range of complementary measures including new cycleways (increasing mode share from 0.58 % to over 4 %), pedestrian upgrades and car-free events. Every Sunday 120 km of arterial roadways are closed to private motorised vehicles from 7:00 to 14:00. Car restriction measures have also been implemented, including restricting access to 40 % of motorised vehicles on weekdays during peak periods (between 6:00 and 9:00, and 16:00 and 19:00). On-street parking has been eliminated from many streets (Wright and Fulton, 2005 and http://www.transmilenio.gov.co).

Brazil: In Curitiba, Brazil, BRT implementation achieved an increase in patronage by 2.36 % a year for over two decades. This increase in ridership year on year was enough to secure public transport mode share when it was recorded to be declining in other Brazilian cities (Rabinovitch and Hoen, 1995 in Hook and Wright, 2002). In addition, public space within the city has been improved through converting parking bays into pedestrianised areas. The city's pedestrian zones also act as feeder services to the BRT by easing pedestrian movements towards stations (Wright and Fulton, 2005).

China: Beijing's first exclusive BRT line became operational on 30 December 2005. It is 16 km in length and has 17 stops along the route, linking a number of residential areas with four commercial circles in the city's southern districts. In the first two months of operation it attracted average daily passenger flows of 80 000 commuters.

Experience with BRT systems shows that they can contribute to reducing emissions Congestion problems are reduced substantially through increases in patronage (mode shift from private vehicles), and increasing fuel economy when efficient buses are used. Additional co-benefits are likely, such as improved local air quality (reductions of SO_X, NO_X, PM and CO emissions), and improved public transport.

☞ For more detailed information, please see GIZ *Sourcebook* Modules 3a: *Mass Transit Options*; 3b: *Bus Rapid Transit*; and 3c: *Bus Regulation and Planning* as well as the comprehensive *BRT Planning Guide*. In addition, the *Sourcebook* Module 5d: *The CDM in the Transport Sector* has a strong focus on BRT projects.

Case Study 1: Access Africa Programme

The Access Africa Programme, initiated by the American Institute for Transportation and Development Policy (ITDP), aims at the promotion of clean, healthy and liveable cities by the deployment of a custom-tailored transportation system. The programme, implemented in Ghana, Senegal, South Africa and Tanzania, includes the encouragement of Bus Rapid Transit (BRT) Systems by facilitating exchange of information and the provision of technical or legal assistance.

As part of the programme, the California Bike Coalition (CBC), a growing network of small African bicycle retailers, was founded in 2003. The commercial partnership was established to produce good-quality bicycles that are available to the African market by using economies of scale. The member retailers receive support in repair and customer services. Moreover ITDP is working to enable ownership for locals who cannot afford new bicycles.

Another element of the Access Africa programme is the improvement of safety for cyclists and pedestrians. Beginning in 2000, the aim is to work directly on the planning and implementation of NMT infrastructure. In cooperation with municipal authorities, ITDP is developing master plans, “Safe Routes to School” programmes and securing access to public transport routes.

Due to its extensive and multi-level approach, the Access Africa Programme improves both mobility and air quality. By making a high contribution to the promotion of NMT and modal shift, CO_2 emissions are reduced to a great extend without high expense.

Case Study 2: Carsharing in Singapore (Car Clubs)

Shared-use vehicle systems such as carsharing have become more and more popular in recent years. Carsharing makes a fleet of vehicles available for use by the members of the carsharing group, while the fleet management is transferred to a central organiser. Users access the vehicles from shared-use lots such as transit stations, neighbourhoods or employment centres. This increases public transport ridership and decreases parking demand. In many cities, carsharing has become a rewarding alternative to buying an own vehicle, as members can use a car whenever they need one. Within a few minutes of booking, members can use their personal card to unlock the car from where it is parked.

After positive experiences mainly in Europe and North America, the former Communications Minister of Singapore, Mah Bow Tan, first mentioned carsharing as a promising endorsement for Singapore’s transport system in the mid-1990s. Only short time later, in 1997, the first carsharing company in Singapore, Car Co-Op, was launched by NTUC Income, a Singapore insurance company. As of January 2014, there are 4 car-sharing service providers in Sinagapore. Car Club (http://www.carclub.com.sg) and Whizzcar (http://www.whizzcar.com) operate under the tradition carsharing scheme where cars can be rented throughout city using cars owned and maintained by the company. Smove (http://www.smove.sg) offers the nation’s first all-electric vehicle sharing scheme that includes not only cars but bikes as well. Lastly, iCarsclub (http://www.icarsclub.com) allows you to reserve and use cars from private owner.

(Further details on car-sharing can be accessed online at http://www.carsharing.net; http://www.ecoplan.org/carshare/cs_index.htm.)

Planning for non-motorised modes

The encouragement and facilitation of walking and cycling is essential in any successful sustainable transport strategy. Cycling and walking as modes do not produce any direct emissions. As emissions from motorised transport are highest and fuel efficiency lowest at cold start of the engine, short trips are disproportionately polluting. These shorter trips are most suitable for non-motorised modes.

Transport authorities face difficulties when trying to achieve a mode shift to cycling and walking, as they are often viewed as unattractive alternatives to motorised transport, primarily due to the inconvenience and safety concerns experienced in developing country cities (World Bank, 2004). Lack of protection from the weather, the topography in some cities/countries, the health and physical fitness of the intended cyclists, and road safety and security (*e.g.* fear of bicycle theft) in general also add to the perceived unattractiveness of walking and cycling.

There are a number of improvements that can be made to encourage cycling and walking. These include the creation of continuous cycle networks, possibly featuring separate cycle lanes, or integration with other transport modes. Employers and educational facilities also have a role to play in encouraging walking and cycling, and could consider the provision of facilities such as lockers (for storing cycling/walking equipment), bicycle racks and showers.

A key instrument in encouraging a mode shift to walking and cycling is the use of awareness campaigns and information (see Section 3.2.4), which may also include the development of cycling and walking routes and maps (Hook and Wright, 2002).

☞ Please see GIZ *Sourcebook* Module 3d: *Preserving and Expanding the Role of Non-motorised Transport* as well as the GIZ *NMT training document* for more information.

Box 10: Non-motorised modes

China: In China, bike mode share increased in cities until the early 1990s, accounting for nearly 30 to 70 % of all trips. However, bike use fell sharply in Southern and Eastern provinces in the late 1990s. Wealthier residents have upgraded to taxis, mopeds or motorcycles. Bicycle use has declined largely due to public policies banning their use on major arterials, and upgrading major-urban arterials to high speeds. Bicycle lanes have also been removed (Hook and Wright, 2002). Road safety is another important barrier to increasing cycle use in China. Cyclists are often forced out of or on to the road by cars parked or driving in cycleways. Traffic deaths have doubled between 1990 and 2000, with cyclists accounting for 38 % of fatalities (approximately 38 000) (Karekezi *et al.,* 2003).

Colombia: Bogotá has been successful in increasing bike use from 0.58 to 4.0 % of all trips through improvements to cycling infrastructure. 330 km of new fully grade-separated bicycle lanes were constructed over three years, coupled with other complimentary bicycle measures (Hook and Wright, 2002). Following the implementation of cycling and other mode improvements, a study was undertaken in Bogotá involving interviews with 12 000 homes. Respondents were asked which works had improved the family's quality of life during the previous 5 years. The responses were as follows: parks (73.4 %), bicycle paths (68.6 %), pedestrian overpasses (67.8 %), roads (66.1 %), the TransMilenio BRT (64.8 %), sidewalks (64.5 %), public libraries (55.5 %) and public schools (37.9 %) (I-CE, 2007).

Chile: Experience in Santiago with a cycling project revealed that a 3 % decrease in car and taxi travel as a result of modal shift to bicycle is expected to reduce CO_2 emissions by 126 000 tonnes a year (approximately 1.15 %) (World Bank, 2006).

Africa: The implementation of 60 km of bikeways as part of a network in Tamale, Ghana, accounted for 65 % of transport trips. The network was fully integrated with the town and with other transport modes, such as taxis and lorries, which are used for long-distance travel (CIDA, 2002).

Planning instrument implementation – impacts and consideration

Table 2 shows the level of implementation of each of the planning instruments and potential responsible or interested stakeholders. Planning instruments, including the provision of public transport or non-motorised modes, are generally implemented on a regional or local level. Transport and land use authorities will typically act as the implementing authorities for such instruments, but will require assistance from non-governmental organisations (such as those interested in public transport and non-motorised modes, environmental or social issues), and public relations, to increase public awareness and acceptance.

Table 2: Planning instruments — Level of implementation and responsible/interested stakeholders

Type of instrument		Level of implementation			Responsible/interested stakeholder									
		National	Regional	City	Mayor/Equivalent	Transport Authorities (including public works)	Land use/planning authorities	City Administration (treasury/finance/taxation)	Public relations, Press and Media	Enforcement Authorities (police, others)	Non-Governmental Organisations (NGOs)	Private Sector (Industry/commercial)	Private sector – Public Transport Operators	Private Sector – Employers
Planning	Land Use Planning		✔	✔	✔		✔						✔	✔
	Public Transport		✔	✔	✔	✔	✔		✔		✔		✔	✔
	Non-Motorised Modes			✔	✔	✔	✔		✔		✔			✔

✔ = indicates level of implementation and responsible/interested stakeholders

Table 3 focuses on the contribution that planning instruments could make to reducing GHG emissions, and indication of likely implementation costs, the co-benefits that could be achieved through implementation of the instruments, and any further considerations for responsible authorities. Although relatively low cost, planning instruments may contribute significantly to reducing GHG emissions and achieving a variety of synergies and co-benefits with other development social, environmental and economic objectives.

Table 3: Planning instruments — Contribution to greenhouse gas reductions, estimated costs, co-benefits benefits, and implementation considerations of instruments

Type of instrument		Contribution to reduce greenhouse gas emissions	Potential cost of Implementation	Co-benefits/ negative (+ ? –)	Implementation considerations for responsible authorities
Planning	Land Use Planning	##	$	+ accessibility, social inclusion, air pollution	
	Public Transport	# – ###	$$	+ accessibility, mobility, economy	Service coverage/ frequency, cost
	Non-Motorised Modes	# – ###	$ – $$	+ Safety, accessibility, mobility, social inclusion, economy, air pollution	Safety

\# = Small contribution
\## = Medium contribution
\### = High contribution

$ = Low cost
$$ = Medium cost
$$$ = High cost

\+ = positive
? = unclear
– = negative

CHECKLIST A: Successful implementation of planning measures

- ☑ Ensure that new developments include **mixed land uses** (employment, residential, amenities) to reduce the need to travel.
- ☑ Ensure that **cyclist and pedestrian facilities** are attractive to existing and potential users. This includes considering safety (adequate lighting, separate from traffic where necessary), and accessibility (direct routes, connectivity).
- ☑ Aim to create **partnerships with local employers and businesses**, encouraging the implementation of additional ancillary facilities for cyclists and pedestrians, such as lockers/storage facilities, showers, bicycle racks, etc.
- ☑ Consider **integration with other modes**, *e.g.* integration between rail and bus (*e.g.* common fare, timetable), bus and cycling (allow transport of cycles, provide parking infrastructure) to encourage their use.
- ☑ Ensure **public transport vehicles and associated infrastructure** (public transport stations/hubs) are accessible (low floor vehicles, step-free buildings) and attractive (safe, lighting, waiting areas, information provision, etc.).
- ☑ Ensure that **public transport provision** has the appropriate level of service and coverage to meet potential user demand.
- ☑ Use appropriate **fare structures** to ensure adequate levels of patronage.
- ☑ Ensure **appropriate priority measures for public transport, cyclists and pedestrians**.
- ☑ Ensure provision of relevant **passenger travel information** (timetables, format of information, advertising).
- ☑ Integrate **stakeholders** from the public to increase awareness and acceptance of the measures.

3.2.2 Regulatory instruments

Regulatory instruments can be implemented by the public administration or the political bodies at the national, regional/provincial or local level and include fuel consumption regulation, access restrictions, traffic management measures, regulation of parking and limitations placed on speed. Measures aim to either discourage travel, or deny access completely to certain traffic/vehicles.

Access restriction

In order to achieve a 'quick-win' in reducing emissions from vehicles, city authorities can implement measures that restrict the access to the city or city centre for certain types of motorised vehicles. When implemented successfully, such measures can be effective in reducing traffic volumes and associated GHG emissions. Furthermore, it can increase the attractiveness of public transport, improve the quality of public space and thus the quality of life in cities.

One such measure that has been implemented in many cities is the restriction of vehicles on certain days depending on their registration plate number. This type of scheme has been implemented in several cities, such as Athens, Bogotá, Lagos, Manila, Mexico City, Santiago, Sao Paulo and Seoul. Short-term benefits of the measure include a reduction in congestion and increases in vehicle speeds. In Bogotá, average travel speeds were reported to increase by 20 %. Implementing authorities should be aware that some people will be encouraged to purchase a second car, or retain older, more polluting vehicles that may have otherwise been scrapped, thus circumventing the system and keeping the vehicle fleet artificially large. To avoid this problem, schemes should be well-designed and limited to restricting vehicles just during peak periods and having the proportion of non-use days sufficiently large (World Bank, 2004) (see Section 3.2.4 and Box 12 for more information on car free days).

Figure 20: *Car free zone in the historical centre of Bogotá.*
© Sheyra Gandepalli, Bogotá, 2004

Low emission zones

Low emission zones (LEZs) are areas into which access is permitted only to vehicles or classes of vehicles meeting a prescribed standard of emissions. Local transport and planning authorities can determine an area within a city from which certain vehicles (usually older, more polluting vehicles) will be banned from entering. Such restrictions have obvious benefits for local air quality improvements, but could also reduce GHG emissions if the area is large enough and can encourage people to use alternative modes. However, this instrument assumes that emission standards are evident for vehicles being used within the city, and will require a high level of administration and technology to set up and enforce the restrictions.

☞ Please see GIZ *Sourcebook* Module 5a: *Air Quality Management* for more information.

Traffic management measures

Where the implementation of physical restraint measures is difficult, transport authorities may wish to use traffic management measures in order to smooth traffic flows. This helps ease congestion, and therefore improves fuel efficiency and reduces emissions.

Traffic signal systems aim to smooth traffic flow and can also give preference for example to public transport. The most efficient of these systems is area traffic control systems, where signals are linked across a whole network. However, careful design and committed institutional co-ordination is required in order to make the use of traffic signals a success. Traffic control systems can also be quite costly to run and maintain. 'Cell Systems' can be introduced to inner city areas, which use physical restrictions on cross-centre movements to keep through-traffic of private vehicles (not buses) from central areas.

In developed countries, traffic management has been estimated to reduce emissions by 2 % to 5 % overall (greater proportions in specific corridors or areas) through increasing fuel efficiency. However, it should be noted that improved traffic flows may encourage people to increase their travel. The resulting rebound effects nullifying efficiency gains, in particular in unsaturated travel demand contexts.

Regulation of parking supply

As with road space, the provision of parking is closely linked to demand. Parking in developing cities is a particular problem, where highways and walkways are often littered with parked vehicles. Parking supply restrictions can make car use unattractive and thus contribute to mode shift. These restrictions are often implemented alongside parking pricing measures (see Section 3.2.3).

Enforcement is a key issue with regard to the success of parking restrictions. In addition to avoid illegal parking other measures can be taken, *e.g.* instalment of bollards on pavements. Where possible, cities should avoid publicly-funded free car parking and try to ensure strong regulation to limit on-street parking where it can have adverse effects (World Bank, 2004).

Transport authorities should also work in partnership with employers and other commercial businesses, which have a role to play in reducing private parking allocations reserved for employees or customers. City-wide initiatives are likely to be more successful compared to solely applying restrictions to publicly-provided parking.

Speed restrictions

At higher speeds (generally above 55 km per hour) fuel efficiency is not ideal and fuels consumption increase along with speed for cars and trucks. In order to reduce emissions of GHGs from vehicles, the implementation of lower speed limits should be considered.

Regulation instrument implementation – impacts and considerations

Table 4 shows the level of implementation of each of the regulatory instruments, and potential responsible or interested stakeholders. Regulatory instruments, including physical restraint measures, traffic management measures, regulation of parking supply, low emission zones and speed restrictions are usually implemented on the city or regional level. Some measures work particularly well when implemented on the regional level as it reduces the likelihood of traffic problems moving to alternative routes/areas. Transport authorities are most likely to be responsible for implementation of the measures, whilst enforcement authorities will be responsible

Figure 21: *Huge parking demand in the centre of Delhi.*
© Abhy Negi, Delhi, 2005

for ensuring adherence to regulations. Awareness raising of measures to be implemented and reasons for their implementation is crucial for success, and the mayor, the public relations office or the media may play an important role in this respect.

Table 4: Regulatory instruments – Level of implementation and responsible/interested stakeholders

	Type of instrument	Level of implementation			Responsible/interested stakeholder									
		National	Regional	City	Mayor/Equivalent	Transport Authorities (including public works)	Land use/planning authorities	City Administration (treasury/finance/taxation)	Public relations, Press and Media	Enforcement Authorities (police, others)	Non-Governmental Organisations (NGOs)	Private Sector (Industry/commercial)	Private sector – Public Transport Operators	Private Sector – Employers
Regulatory	Physical Restraint Measures			✔	✔	✔	✔		✔	✔			✔	
	Traffic management Measures			✔		✔	✔		✔	✔			✔	
	Regulation of Parking Supply		✔	✔		✔			✔	✔				✔
	Low Emission Zone		✔	✔	✔	✔			✔	✔	✔	✔	✔	
	Speed Restrictions	✔		✔		✔			✔	✔				

✔ = indicates level of implementation and responsible/interested stakeholders

Table 5 assesses the contribution that the implementation of regulatory instruments could make to the reduction of GHG emissions, estimated costs, co-benefits and considerations linked to the implementation of such instruments. Instruments that are likely to have the greatest contribution to reducing GHG emissions include physical restraint and traffic management measures. Costs of implementation and operation vary greatly, but can depend on the level and method of enforcement. The main consideration for implementation authorities with the majority of regulatory measures is the displacement of traffic to alternative routes and areas, and ensuring that key services and facilities are still accessible despite restrictions. In order to avoid these problems, regulation measures should be implemented alongside others, such as the provision of public transport.

Table 5: Regulatory instruments – Contribution to greenhouse gas reductions, estimated costs, co-benefits and implementation considerations of instruments

	Type of instrument	Contribution to reduce greenhouse gas emissions	Potential cost of Implementation	Co-benefits/negative (+ ? –)	Implementation considerations for responsible authorities
Regulatory	Physical Restraint Measures	## - ###	$ - $$$	+ safety, air pollution, noise ? accessibility, mobility, social inclusion, economy	Traffic displacement, restricted access/mobility, alternative modes provision, enforcement
	Traffic management Measures	## - ###	$ - $$$	+ safety ? accessibility, mobility, social inclusion, economy, air pollution	Traffic displacement, restricted access/mobility, alternative mode provision, enforcement
	Regulation of Parking Supply	# - ##	$ - $$	+ air pollution ? accessibility, mobility, social inclusion, economy	Traffic displacement, restricted access/mobility, alternative mode provision, illegal parking/ obstructions, enforcement
	Low Emission Zone	# - ##	$$ - $$$	+ Safety, local air pollution, noise ? accessibility, mobility, social inclusion, economy	Traffic displacement, restricted access/mobility, alternative mode provision, enforcement
	Speed Restrictions	# - ##	$ - $$	+ safety, air pollution, noise ? accessibility, mobility, social inclusion, economy	Enforcement

= Small contribution
= Medium contribution
= High contribution

$ = Low cost
$$ = Medium cost
$$$ = High cost

+ = positive
? = unclear
– = negative

CHECKLIST B: Successful implementation of planning measures

Regulatory instruments place restrictions on personal travel and may conflict with other objectives such as access to employment, education and healthcare. They may also lead to increases in vehicle kilometres travelled as people search for parking spaces. To minimise these potential negative effects, a full sustainable transport strategy should be implemented by the local authority, including the provision of viable and attractive alternatives (public transport, cycling and walking) and awareness campaigns.

- ☑ Ensure adequate provision of **alternative modes** (public transport, walking, cycling) to maintain access to key services and activities where restrictions are in place.
- ☑ Raise **public awareness** of changes in regulations regarding transport restrictions, and the alternatives available.
- ☑ Create **partnership with neighbouring districts/municipalities** when implementing regulatory measures to ensure that unwanted traffic is not shifted to another part of the road network.
- ☑ Ensure the support of relevant authorities to guarantee **enforcement** of restrictive measures (access restraint, parking control, speed).

3.2.3 Economic instruments

While economic and fiscal instruments have often been used to generate revenue for infrastructure funding, these measures can also be used to influence behaviour, *e.g.* discourage the use of private vehicles (or others) and encourage more (energy-) efficient use of transport through the implementation of charges or taxes on transport. The use of these economic instruments often aims to internalise external costs, such as taking into account the effects of GHG emissions. The instruments discussed here include measures that can be implemented at the local level, such as road pricing and parking pricing and national policies such as fuel taxation and vehicle taxation, which are important framework measures.

Road pricing

The motivations for road pricing are various. They include raising revenue to pay for infrastructure, reducing congestion and reducing emissions. In general, road pricing increases the cost of running a vehicle thus encouraging the use of alternative modes or the reduction of vehicle use.

There are a number of key factors that affect the effectiveness of road pricing including: the level of fee charged; the current cost of driving per km; the responsiveness of travellers to the price of travel (measured in terms of price elasticity); and the nature and extent of pricing. When implementing pricing schemes, decision-makers should always consider the costs and technology required in enforcing the road pricing, collecting tolls etc., which can be potentially expensive to implement and run. Public acceptance is also a major issue when dealing with pricing schemes, as they are likely to have a disproportionate effect on low-income drivers.

Where revenue generation is the key objective, rates are set to maximise the revenues or to recover costs incurred. The revenue generated is often used for other road infrastructure projects, which increases then supply of additional capacity for car based travel. An additional problem with this approach is that shifts to alternative routes or modes are undesirable as revenues that feed the system would be reduced.

The two main road pricing options are: national road pricing schemes, where charges are applied to long-distance highway use; and local road pricing schemes, which typically cover city centre areas (often referred to as 'congestion charging' schemes).

To reduce peak-period vehicle traffic, road-pricing rates can be variable (higher during periods of congestion), following the principle of congestion management. Where congestion management is a key objective of road pricing schemes, reductions in GHG emissions are more likely to be achieved.

There are four main effects resulting from the implementation of road pricing schemes:

- Those drivers with flexibility in their travel will find an alternative route to avoid paying the charge;
- The charge will discourage some drivers from travelling;
- Some drivers will switch to an alternative transport mode to undertake their journey; or
- Driver will choose to continue with their originally planned journey and pay the charge.

In the first three cases, emissions may be reduced: by reduced congestion; by reduced travel; or by mode shift to (potentially) less emission intensive modes.

An important consideration for decision-makers is the displacement of vehicles on the road network to surrounding routes covered by road pricing, particularly when implemented locally. Traffic diversions may occur, with more vehicles seeking alternative routes, possibly using secondary or more environmentally sensitive routes to avoid the charge. Where possible, surrounding roads should also be included within the charging scheme to avoid this transference of vehicles. This effect should be a key factor when considering the boundary of the scheme.

Equity and public acceptability are always issues when implementing charge-based measures, and this is particularly so for road pricing schemes. Those benefiting from such schemes include the users of the improved public transport system – but also the drivers paying the charge, who may experience reduced congestion, higher speeds and shortened journey times. However, other low-income drivers are likely to experience disproportionate effects as they are unable to afford the charge, and possibly the cost (if available) of alternative transport. These low-income drivers can therefore become isolated as access is restricted. To overcome these disproportionate effects, implementing authorities may wish to consider supporting measures in tackling equity issues and increasing public acceptance, such as:

- Providing a direct rebate to low-income groups;
- Providing public transport subsidies for low income users; or

- Increasing the supply of public transport, including subsidised public transport fees.

Negative effects may also be experienced by businesses located within a cordon area or along a road-pricing route. Similar supporting measures may need to be implemented, including reduced charges for certain businesses/fleets within the city charging area.

Parking pricing

This instrument increases the cost of using a vehicle by raising the cost of parking. To increase the effectiveness of parking pricing, it should be coupled with limits to the physical availability of parking spaces, and it is recommended to introduce it on a region-wide basis. Parking pricing can be expected to typically reduce parking demand by 10 %–30 % compared with unpriced parking (VTPI, 2013b).

Implementing authorities should be aware of a number of considerations concerning parking pricing and availability measures. Where pricing is introduced or increased within urban centres, there is a risk of urban sprawl. Through-traffic may also increase as it is less desirable to stop within the central areas. In areas where parking is only partly under public control, it can be extremely difficult to implement. Finally, enforcement of parking charges is essential if the scheme is to be successful.

Figure 22: *Old parking meter in Mexico City.*
© Klaus Banse, Mexico, 2002

Although the next two instruments are usually applied at the national level only, it is nevertheless useful to briefly describe them in this module. In some instances, cities may use fuel tax surcharges, for instance.

Fuel taxation

Political administrations may consider the use of taxes on fuel at the national level. Fuel taxes increase the price of travelling and thus have an indirect effect on individual travel behaviour and decisions. Fuel taxes are a way

Box 11: Road pricing and congestion charging

Singapore: Singapore's cordon pricing measure, an Area Licensing Scheme (ASL), covers a 7.5 square km restricted zone in downtown Singapore. The restrictions are applied during the morning peak, between 7:30 and 10:30. Access to the restricted zone is made possible through the purchase of daily or monthly licenses at post offices and kiosks outside of the zone. Since 1989, the access restrictions have been extended to include carpools and trucks (which were previously exempt under the scheme). Singapore's ASL has been successful in reducing motorised traffic within the zone by 50 %, and private car travel by 75 %. The speed of the traffic has also been increased from approximately 18 to 30 km/h. The scheme was complimented by the doubling of parking charges (Hook and Wright, 2002).

South Korea: Road pricing was introduced to the #1 and #3 Tunnels linking downtown Seoul (South Korea) to the southern part of the city. Both corridors experienced high volumes of private vehicle traffic, leading to heavy congestion. Private cars with three or more passenger, buses, vans and trucks were exempt from the 2 000 won charge (USD 2.20), as was all traffic on Sundays and national holidays. The road pricing schemes resulted in a 34 % reduction in peak period passenger vehicle volumes in the two years following implementation. Average travel speeds also increased by 50 %, from 20 km/h to 30 km/h. As it was not an area-wide charging scheme, traffic volumes increased on alternative routes up to 15 %. However, average travel speeds also increased as a result of improved flows at signalled intersections and increased enforcement of on-street parking rules on alternative routes (World Bank, 2002).

London: The London Congestion Charge came into effect in February 2003. The Charging Zone covers an area in Central London (which was extended in 2007), and drivers of non-exempt vehicles must pay a charge of GBP 8 (USD 16) per day to enter and travel within this zone. The scheme is enforced by a network of Automatic Number Plate Recognition (ANPR) cameras that monitor vehicles entering and circulating within the Charging Zone. The scheme has resulted in an estimated 19 % reduction in traffic related CO_2 and a 20 % reduction in fuel consumption (Jones, G. *et al.*, 2005).

of charging the users of transport infrastructure relative to individual use. Implementing or increasing taxes on fuel can have two main effects:

- Fuel taxation raises the price of motorised travel per km. This action can lead to drivers trying to reduce the number of vehicle kilometres travelled.
- Fuel taxation is directly proportional to fuel consumption. This is an incentive to purchase fuel-efficient vehicles.

Both effects can contribute to reducing GHG emissions. The effectiveness of fuel taxation depends on the consumers' response to price increases. The implementation of fuel taxation is relatively simple, as tax collection only needs to be done at a few refineries or wholesalers.

Implementing fuel tax measures will not address the issue of congestion, which is often a localised problem. It may also be the cause of disproportionate effects on low-income drivers who are affected by the tax. However, in many developing countries it is the wealthier part of the population (*i.e.* those who can afford a car, that benefits most from low fuel prices).

Where the tax is implemented in smaller countries, there may be an issue regarding tax evasion, where drivers living close to borders can fill up abroad or smuggle in fuel, leading to revenues not being collected in the country where the vehicle is mainly driven.

☞ For more information on fuel taxation and an international comparison of fuel prices in more than 170 countries see the publication GIZ *International Fuel Prices*, available on the GIZ website http://www.GIZ.de/fuelprices.

Vehicle taxation

The main principle behind vehicle taxation is to charge vehicle ownership. Vehicle taxes are often regarded as an "access fee" to use the road network, and they are also important source of tax revenues. There are two key forms of vehicle taxation:

Table 6: Economic instruments – Level of implementation and responsible/interested stakeholders

	Type of instrument	Level of implementation			Responsible/interested stakeholder									
		National	Regional	City	Mayor/Equivalent	Transport Authorities (including public works)	Land use/planning authorities	City Administration (treasury/finance/taxation)	Public relations, Press and Media	Enforcement Authorities (police, others)	Non-Governmental Organisations (NGOs)	Private Sector (Industry/commercial)	Private sector – Public Transport Operators	Private Sector – Employers
Economic Instruments	Road Pricing	✔	✔	✔	✔	✔		✔	✔	✔	✔		✔	
	Fuel Tax Implementation/ Increases	✔						✔		✔				
	Vehicle Taxation	✔						✔		✔				
	Parking Pricing		✔	✔				✔	✔	✔				

✔ = indicates level of implementation and responsible/interested stakeholders

- Sales taxes are charged when the vehicle is purchased, sometimes contributing significantly to the overall cost of the vehicle. This form of taxation may discourage potential owners from buying a vehicle.
- Annual vehicle taxes/registration fees, which may have similar effects, but are a continuous financial burden rather than a one-off tax. They also apply to all vehicles rather than just new ones.

Vehicle taxes can be differentiated according to vehicle type, vehicle size or emissions, and noise levels. However, it is essential that central administration bodies exist for vehicle taxation schemes to be successful.

In terms of reducing GHG emissions, drivers may be encouraged to buy more fuel-efficient vehicles if tax rates are differentiated according to fuel consumption. However, vehicle taxation does not encourage them to use their vehicles efficiently. Therefore additional measures should be implemented to promote energy efficient transport (*e.g.* via fuel taxation).

Economic instrument implementation – impacts and considerations

Table 6 shows the level of implementation of each of the economic instruments, and potential responsible or interested stakeholders. Economic instruments, including road pricing, fuel tax implementation/increases and vehicle taxation are generally measures implemented at the national level, whereas parking pricing (like the regulation of parking) and congestion charging schemes are regionally and city level implemented instruments. Stakeholders that will be responsible for implementation and operation include the transport authorities and city administration (including treasury, finance and taxation departments). Enforcement authorities will also be important for the operation and success of instruments.

Table 7 assesses the contribution that the implementation of economic instruments could make to the reduction of GHG emissions, estimated costs, co-benefits and considerations linked to the implementation of such instruments. The instrument that is most likely to have the greatest contribution to reducing GHG emissions is road pricing, which is also likely to incur the highest implementation costs. Implementation costs for fuel and vehicle taxation instruments will depend on the extent of coverage and enforcement. The main consideration for implementation authorities with road pricing instruments is the displacement of traffic to alternative routes and areas, and ensuring that key services and facilities are still accessible despite restrictions. In order to avoid

Table 7: Economic instruments – Contribution to greenhouse gas reductions, estimated costs, co-benefits and implementation considerations of instruments

	Type of instrument	Contribution to reduce greenhouse gas emissions	Potential cost of Implementation	Co-benefits/negative (+ ? –)	Implementation considerations for responsible authorities
Economic Instruments	Road Pricing	# - ##	$$ - $$$	+ safety ? accessibility, mobility, social inclusion, economy	Traffic displacement, restricted access/mobility, equity impacts, enforcement, cost
	Fuel Tax Implementation/ Increases	#	$$	– mobility, equity	Level of tax, enforcement
	Vehicle Taxation	#	$$	– mobility, equity	Level of tax, enforcement
	Parking Pricing	# - ##	$ - $$	+ safety ? accessibility, mobility, social inclusion, economy	Traffic displacement, restricted access/mobility, alternative mode provision, illegal parking/ obstructions, enforcement, cost

# = Small contribution	$ = Low cost	+ = positive
## = Medium contribution	$$ = Medium cost	? = unclear
### = High contribution	$$$ = High cost	– = negative

these problems, regulation measures should be implemented alongside others, such as the provision of public transport.

☞ For more information, please see GIZ *Sourcebook* Module 1d: *Economic Instruments* as well as Schwaab/Thielmann (2001).

CHECKLIST C: Successful implementation of economic measures

Economic instruments can play an important part in both promoting energy efficiency in the transport sector and discouraging individual car use. Economic instruments can also help create revenues that may be used, *e.g.* to fund environmentally friendly public transport or to promote cycling.

- ☑ Ensure the adequate provision of **alternative modes** (public transport, walking, cycling):
  - Level of service
  - Service coverage
  - Cost
- ☑ Consider the **cost-benefit** of the economic instruments being implemented. Always adopt appropriate approaches (*e.g.* low tech versus high tech).
- ☑ Ensure that the necessary **administrative bodies** have been set up to oversee vehicle tax implementation and regulation.
- ☑ Raise **public awareness** of the economic instruments being implemented, reasons behind implementation, and the likely benefits. This will increase public acceptance.
- ☑ Create **partnerships with neighbouring districts/municipalities** when implementing certain economic measures – *e.g.* area-wide parking charges.
- ☑ Employ the services and support of relevant **enforcement authorities** to regulate the restrictive measures (road pricing/congestion charging, parking pricing).

3.2.4 Information instruments

There are a number of information instruments available to decision-makers to complement and sometimes provide even an alternative to more resource intensive instruments. These 'soft' measures may induce behavioural changes of transport users through raising awareness of alternatives modes, more efficient driving or vehicle purchasing choices. Typical examples are public awareness campaigns, mobility management and driver education and car labelling.

Figure 23: *Bicycles conquer the lanes: Initiative to encourage people to use other transport modes.*
© Shreya Gadepalli, Bogotá, 2003

Public awareness campaigns and mobility management

Public awareness campaigns can take many forms. Most often they are used to inform the public about the travel alternatives available to them or about the environmental, economic and social impacts of (motorised) transport. Marketing of sustainable transport solutions is essential when attempting to secure public acceptance, and therefore should always be taken into consideration when promoting sustainable transport policies.

Some larger cities have implemented 'car-free' days, banning cars from entering the city centre area on certain days. This can be combined with the promotion of alternative mode choices (public transport, cycling and walking). Information on public transport services may be distributed through 'mobility centres', set up in city centres as information and sales points.

Figure 24: *Increase public awareness: Drawing competition for children on a car free day in Surabaya.*
© Reinhard Kolke, Surabaya, 2001

Box 12: Public awareness campaigns

Columbia: Bogotá's' first 'Car Free Day' was implemented in 2000. Between 6:30 and 19:30 no vehicles were allowed to circulate within the entire urban area. This led to several million people travelling about the city by public transport, bicycle, roller blades, taxis and by foot (ITDP, 2001). Car free days have since been used within Bogotá to promote the city's bike and bus network.

Mexico: Through providing one car-free day per week in Mexico, reductions were realised in private car use, with mode share decreasing from 25 % to 17 % (Prointec Inocsa Stereocarto, 2001).

Further information on Car-Free campaigns can be found in the GTZ *Sourcebook* Module 3e: *Car-Free Development* as well as online at: http://www.world-carfree.net/wcfd.

The provision of education through schools or places of employment can also be beneficial in raising awareness, or through the provision of cycle training.

☞ For more information, please refer to GIZ *Sourcebook* Module 1e: *Raising Public Awareness about Sustainable Urban Transport* and the GIZ training document on *Public Awareness and Behaviour Change on Sustainable Urban Transport*.

Driver behaviour training and education/ eco-driving

The way in which a vehicle is driven or maintained has a direct impact on fuel consumption, and subsequently operating costs and emissions. Through the provision of 'Eco-Driving' education and training, driver behaviour may be altered to achieve greater fuel efficiencies. Estimates show that average fuel savings (and emission reductions) are in the range of 10 % to 15 %. Individual fuel saving potential may be even up to 25 %. Key methods of improving fuel efficiency can relate to driving style/behaviour (speed, braking and acceleration, engine idling, carrying capacity and cold starts) and vehicle condition (maintenance-engine, tyres, oil and air filter, and vehicle age) (see Box 13).

Driver training is particularly effective when commercial vehicles, such as bus, taxi or freight fleets, are included. The potential fuel savings can significantly contribute to (fuel) cost savings and constitute a strong incentive for eco-driving.

☞ For more information, please see GIZ *Sourcebook* Module 4f: *Eco Driving*.

Information instrument implementation – impacts and considerations

Table 8 shows the level of implementation of each of the information instruments, and potential responsible or interested stakeholders. Information instruments, including public awareness campaigns and driver behaviour training/eco-driving can be implemented at all levels; national, regional and city level. Responsible stakeholders are likely to include the transport authorities, public relations, press and media, non-governmental organisations and private sectors.

Box 13: Vehicle maintenance and driver behaviour

Vehicle maintenance

- **Engine** – the engine should be tuned regularly as a poorly tuned engine can increase fuel consumption up to 10 to 20 % (depending on the condition of the car).
- **Tyres** – vehicle tyres should be properly inflated and aligned to avoid increased fuel consumption, up to 6 %. For example tyres that are:
  - 0.2 bar under-inflated can lead to a 1 % increase in fuel consumption;
  - 0.4 bar under-inflated can lead to a minimum 2 % increase in fuel consumption; and
  - 0.6 bar under-inflated can lead to a minimum 4 % increase in fuel consumption.
- **Oil** – Oil should be changed regularly, as clean oil reduces wear caused by friction between moving parts and removes harmful substances from the engine. Replacing traditional lube oils with modern low friction lube oils can lead to additional reductions in fuel consumption in the range of 5 %.
- **Air filters** – Air filters should be checked and replaced regularly, as they keep impurities in the air from damaging internal engine components. Not only will replacing a dirty air filter improve your fuel economy, but it also will protect the engine. Clogged filters can cause up to a 10 % increase in fuel consumption (FTC, 2006).

Driver behaviour

- **Speed** – the faster a vehicle is driven, the more fuel is consumed. For example, driving at 105 kilometres per hour (km/h), rather than 90 km/h, increases fuel consumption by approximately 20 %. Driving at 120 km/h, rather than 105 km/h, increases fuel consumption by another 25 %. Maintaining a constant speed can also help to reduce fuel consumption.
- **Braking and acceleration** – Breaking and acceleration use a large proportion of the energy that is needed to power vehicles. It is estimated that nearly 50 % of energy needed to power a vehicle can go into acceleration. Therefore, drivers should anticipate driving situations if they are to reduce unnecessary breaking and accelerating.
- **Engine idling** – In situations where a vehicle is stationary with the engine running, fuel is wasted. Where lengthy waits (*e.g.* during periods of congestion) are anticipated, drivers should turn off their engines.
- **Carrying capacity** – Increasing the weight of a vehicle (through additional passengers, carrying items) can also decrease fuel efficiency. It is estimated that an additional 50 kg carried by a vehicle can reduce a typical vehicle’s fuel economy by 1 to 2 %.
- **Cold starts** – To avoid a number of cold starts, and high fuel usage/emissions, drivers should try to combine trips where possible. Several short trips taken from a cold start can use twice as much fuel as one trip covering the same distance when the engine is warm (FTC, 2006).

Table 8: Information instruments – Level of implementation and responsible/interested stakeholders

Type of instrument		Level of implementation			Responsible/interested stakeholder									
		National	Regional	City	Mayor/Equivalent	Transport Authorities (including public works)	Land use/planning authorities	City Administration (treasury/finance/taxation)	Public relations, Press and Media	Enforcement Authorities (police, others)	Non-Governmental Organisations (NGOs)	Private Sector (Industry/commercial)	Private sector – Public Transport Operators	Private Sector – Employers
Information	**Public Awareness Campaigns**	✔	✔	✔	✔	✔			✔		✔		✔	✔
Information	**Driver Behaviour Training and Education/ Eco-Driving**	✔	✔	✔		✔			✔		✔		✔	✔

✔ = indicates level of implementation and responsible/interested stakeholders

Table 9: Information instruments – Contribution to greenhouse gas reductions, estimated costs, co-benefits and implementation considerations of instruments

Type of instrument		Contribution to reduce greenhouse gas emissions	Potential cost of Implementation	Co-benefits/negative (+ ? –)	Implementation considerations for responsible authorities
Information	Public Awareness Campaigns	# - ##	$ - $$	+ accessibility, mobility, air pollution	
Information	Driver Behaviour Training and Education/ Eco-Driving	# - ##	$ - $$	+ safety, air pollution	

# = Small contribution	$ = Low cost	+ = positive
## = Medium contribution	$$ = Medium cost	? = unclear
### = High contribution	$$$ = High cost	– = negative

Table 9 assesses the contribution that the implementation of information instruments could make to the reduction of GHG emissions, estimated costs, co-benefits and considerations linked to the implementation of such instruments. Both information instruments are likely to have small to medium contributions to reducing GHG emissions and similar levels of costs.

CHECKLIST D: Successful implementation of information measures

Public Transport Authorities

- ☑ Ensure that **service and timetable information** is provided in a variety of media, considering newspapers, booklets, posters and formats (language, text size, etc.).

Public Authorities

- ☑ Early provision of **cycle training** (for children) may encourage long term travel behaviour change towards more sustainable modes.
- ☑ Ensure information provided is in a **variety of media** (personal, newspaper, booklets, timetable) and formats (consider language, font, size, etc.).
- ☑ Highlight the **wider benefits** of schemes beyond greenhouse gas emission reduction (so-called co-benefits), including: Local air quality, health, safety, access, mobility, noise, economy.

3.2.5 Technology improvements and instruments

The key aims in order to achieve reduced GHG emissions from transport are to change travel behaviour and/or the technology used. Planning, regulatory, economic and information instruments can be used to achieve behavioural change and/or technological change. For example, the use of fuel efficiency standards is a regulatory approach aiming at technological change.

Technological improvements may sometimes seem to be easier to implement than policies that may restrain vehicle demand and use, primarily as they require less behavioural and lifestyle change. However, technology improvements are most effective when implemented in conjunction with other instruments within a larger strategy. Technology improvements often focus on fuels, propulsion technology, other vehicle attributes, and use of communication and information technologies (Sperling and Salon, 2002).

Switching to fuels with reduced carbon contents provides the opportunity to reduce GHG emissions from transport, which provides an important additional element to an integrated low-carbon transport strategy. Fuels as alternatives to the use of gasoline and diesel include methanol, natural gas, liquefied petroleum gas (LPG), ethanol, hydrogen and electricity. These alternative fuels have a lower carbon-content compared with gasoline or diesel. However, when evaluating these options, it is important to consider their full life-cycle emissions. This comprises not only the direct (tank-to-wheel) emissions, generated by driving the vehicle, but also the indirect (well-to-tank) emissions, produced from transferring energy from the source to the vehicle. For this purpose, a well-to-wheel analysis, which takes into account both indirect and direct emissions, is crucial to determine the aggregate GHG emissions reduction potential these alternative fuels may achieve. For example, electric vehicles (EVs) that use electricity from a clean electricity grid produce less CO_2eq emissions than those of internal combustion engine vehicles (ICEVs) that use diesel and gasoline. However, if coal accounts for a high share of the electricity mix, the overall CO_2eq emissions can be higher than those from diesel or gasoline vehicles (Hawkins *et al.,* 2012). Therefore, it is always important to consider the full life-cycle when comparing the CO_2 emissions of alternative vehicles and fuels in order to minimise emissions, to conserve resources that are non-renewable and to implement appropriate mitigation technologies. A well-to-wheel analysis can include stages such as fuel and vehicle production, fuel refining, fuel transport, vehicle scrapping and transport infrastructure. With regards to air and noise pollution (particularly relevant in an urban context), EVs do make a substantial positive contribution compared with ICEVs.

GHG emissions vary greatly depending on the fuels and technologies used in transport. Table 10 shows the GHG emissions for various travel modes and fuels/technologies.

Table 10: GHG emissions from vehicles and transportation modes in developing countries

	Load factor (average occupancy)	CO_2 equivalent emissions per passenger km (full energy cycle)
Car (gasoline)	2.5	130–170
Car (diesel)	2.5	85–120
Car (natural gas)	2.5	100–135
Car (electric)*	2.0	30–100
Scooter (two-stroke)	1.5	69–90
Scooter (four stroke)	1.5	40–60
Minibus (gasoline)	12.0	50–70
Minibus (diesel)	12.0	40–60
Bus (diesel)	40.0	20–30
Bus (natural gas)	40.0	25–35
Rail Transit**	75 % full	20–50

All numbers in this table are estimates and approximations, and are best treated as illustrative.

* Ranges are due largely to varying mixes of carbon and non-carbon energy sources (ranging from about 20 % to80 % coal), and also the assumption that the battery electric vehicle will tend to be somewhat smaller than conventional cars.

** Assumes heavy urban rail technology ("Metro") powered by electricity generated from a mix of coal, natural gas and hydropower, with high passenger use (75 % of seats filled on average).

Source: Sperling and Salon, 2002

Case Study 3: Indian Cycle Rickshaw Modernisation Project

In close cooperation with members of the Indian bicyclgy ine and tourism industry, the American Institute for Transportation and Development Policy (ITDP) launched the "Cycle Rickshaw Modernisation Project" in 1999. The main driver behind this project was the massive pollution caused by exhaust gases, which has lead to increasing damage to the World Heritage monument Taj Mahal in the city of Agra, India.

Rickshaws have always played a fundamental role in Asia. However, over time more and more governments in Asia banned their traditional vehicle because of the perception of Rickshaws being obsolete. Furthermore, the traditional rickshaws weigh about 80 kg, making driving a highly exertive activity. Therefore, the use of motorised wheelers, and thus, the environmental pollution, increased dramatically in Asia over the last years.

With this background, the primary aim of the project was to design an efficient but simple rickshaw that reduces atmospheric greenhouse gases and protects the health of its driver. Using an appropriate technology, American and Indian engineers created a lighter, more comfortable and modern vehicle at a similar cost as the traditional ones, thus, these modern vehicles were affordable to their intended drivers.

The implementation of the project achieved not only an important improvement of air quality, but increasing levels of employment and income among the poor. Surveys demonstrated that earnings increased by 20 % to 50 % as drivers were able to work longer and gain new passengers. Additionally, the modernised wheeler attracted 19 % of its ridership from highly polluting two-stroke engine vehicles. Due to the substantial change of image, rickshaw drivers now enjoy a new economic status.

By 2005, over 100 000 modern cycle rickshaws have been manufactured by over 20 small businesses and sold in Delhi, Agra, Bharatpur, Brindavan, Mathura and Jaipur. The modernisation of cycle rickshaw technology in India has proven to be a cost effective way of reducing CO_2 emissions.

Based on these successes in India, ITDP is now replicating the project in Yogyakarta, Indonesia, in partnership with the Centre for Tourism Research and Development and Gadjah Mada University.

Technology instrument implementation – impacts and considerations

Technological instruments are usually initially implemented at the national or international level, with perhaps pilots or demonstration projects at the regional or local level, particularly when dealing with alternative fuels (see Table 11). Key stakeholders include national ministries, the private sector and non-governmental organisations.

Table 11: Technlology instruments – Level of implementation and responsible/interested stakeholders

Type of instrument		Level of implementation			Responsible/interested stakeholder									
		National	Regional	City	Mayor/Equivalent	Transport Authorities (including public works)	Land use/planning authorities	City Administration (treasury/finance/taxation)	Public relations, Press and Media	Enforcement Authorities (police, others)	Non-Governmental Organisations (NGOs)	Private Sector (Industry/commercial)	Private sector – Public Transport Operators	Private Sector – Employers
Technology	Cleaner Production	✔				✔			✔		✔	✔	✔	
	Cleaner Technology	✔				✔			✔		✔	✔	✔	

✔ = indicates level of implementation and responsible/interested stakeholders

For more information, please see GIZ *Sourcebook* Modules 4a: *Cleaner Fuels and Vehicle Technology*, 4c: *Two- and Three-Wheelers* and 4e: *Intelligent Transport Systems*.

Technological improvements to motorised vehicles are likely (in most cases) to have significant -benefits for reducing emissions of GHGs (see Table 12). However, in order to tap the full potential and also achieve the co-benefits (such as safety, accessibility etc.), technological improvements should in most cases be coupled with other transport policy instruments that aim to promote mode shift and reduce travel overall.

Table 12: Technology instruments – Contribution to greenhouse gas reductions, estimated costs, co-benefits and implementation considerations of instruments

Type of instrument		Contribution to reduce greenhouse gas emissions	Potential cost of Implementation	Co-benefits/negative (+ ? –)	Implementation considerations for responsible authorities
Technology	Cleaner Production	## - ###	$$$	+ air pollution	To achieve other co-benefits, needs to be implemented alongside instruments that aim to promote mode shift or reduce travel.
	Cleaner Technology	## - ###	$$$	+ air pollution, noise	

# = Small contribution	$ = Low cost	+ = positive
## = Medium contribution	$$ = Medium cost	? = unclear
### = High contribution	$$$ = High cost	– = negative

Figure 25: *TransMilenio bus lane next to a wide sidewalk in the centre of Bogotá.*
© Shreya Gadepalli, Bogotá, 2003

CHECKLIST E: Successful implementation of technology improvements

Technology improvements can often be indirectly influenced by public decision-makers (through regulations and funding). The funding of technological options is often cost-intensive and in competition with other expenses. Therefore a regulatory framework which enables the market forces seems to be the most efficient one. Local decision-makers could set incentives through specific regulations (like vehicle restrictions).

- ☑ Ensure that **planning, regulatory, economic and information instruments** are also implemented to complement the emission reducing benefits of technological improvements, through reducing traffic/congestion and realising wider benefits of air quality, increased accessibility and mobility, noise reduction, and safety and economic benefits.
- ☑ Raise **awareness** through the use of information instruments of the benefits of cleaner fuel use.
- ☑ Consider the **adverse effects** of new technologies (such as when implementing bio-fuels).

3.3 Strategies to reduce emissions of greenhouse gases and potential effects

The policy instruments presented in the previous section are most successful in reducing GHG emissions and achieving other co-benefits, when implemented as an integrated package of measures. This section focuses on the various combinations of measures and a more comprehensive approach.

3.3.1 A comprehensive approach

A comprehensive sustainable urban transport approach that takes advantage of a variety of instruments will have a larger impact on emission reductions and will result in more co-benefits through the improvement of transport systems. Taking a more comprehensive approach will typically include, *e.g.* the provision of cycling and walking facilities, attractive and reliable alternatives to the private vehicle; it will make use of measures that restrict the use of the car; it will help establish of good land use planning practices; it will promote technological improvements such as cleaner fuels; and it will set (monetary) incentives by applying appropriate economic instruments.

To achieve maximum benefits, a comprehensive sustainable transport strategy needs to simultaneously implement positive ("pull") incentives and negative ("push") incentives to adopt sustainable transport behaviours. It would, for example, be impractical and unfair to discourage driving without offering an attractive alternative. For example, if a city were to implement a "push" initiative like parking restrictions, the city should offer an associated "pull" incentive like a reliable transport service to encourage modal shift.

The level and intensity of intervention will differ from instrument to instrument. Some will be voluntary, some will work on an incentive basis, others will establish binding legal restrictions. Figure 26 outlines the spectrum of instruments that can be taken by decision-makers when implementing a comprehensive approach for GHG emissions reduction from transport.

Figure 26: *Strategy approaches*

Box 14: Suitable and Sustainable Solution for Beijing: Travel Demand Management (TDM)

Since 2007, Beijing has enforced several TDM measures in an effort to reduce traffic congestion. These measures include driving restrictions during peak hours, new car lottery to manage vehicle registration growth and area-differential parking charge standard in a designated area bounded by what is known as the 5th ring. However, some vehicles that produce higher emissions (*i.e.* passenger buses) are not restricted. These measures have achieved successful results that include alleviated traffic and improved air quality (BMPG, 2013). Between November 2007 and February 2009 the peak hour speed of traffic increased 14.7 % with the implementation of a vehicle restriction measure (Li *et al.*, 2010).

In April 2013, Beijing Municipal People's Government formally acknowledged the benefits of implementing traffic management measures and extended the enforcement of driving restrictions during peak hours to April 2014. In addition to recognising the reduction of traffic congestion and the improvement of the municipality's air quality, the Beijing government extended the timeframe for this driving restriction measure to align with the State Council's objective to strengthen environmental protection instruments that effectively reduce GHG emissions (BMPG, 2013).

For more information about GIZ's urban transport emissions reduction in Beijing, please refer to GIZ's Transport Demand Management in Beijing: Emission Reduction in Urban Transport website: http://www.tdm-beijing.org.

GIZ has also produced Reducing Carbon Emissions through Transport Demand Management Strategies: A review of international examples that is available at http://tdm-beijing.org/files/International_Review.pdf.

A successful policy mix or package for passenger transport is aimed at the three primary means to reduce GHG emissions from transport: Avoid, Shift and Improve.

As a guideline, Table 13 considers the GHG emissions of various transport modes. It highlights that although some of the larger higher capacity vehicles produce higher emissions per vehicle km (as would be expected), they also tend to have the lowest GHG emissions per average passenger km. In this particular case, it is the diesel articulated bus that has the lowest GHG emissions per average pkm. However, average occupation rates, *i.e.* the number of passengers actually using the vehicles, is crucial for emissions per passenger.

As mentioned earlier, taking a comprehensive strategy approach by implementing a range of sustainable transport instruments can help to achieve a reduction or stabilisation in the level of GHG emissions and other co-benefits. The table also shows that achieving a greater shift to public transport or non-motorised modes can bring greater benefits in terms of CO_2 and other GHG reductions.

Table 14 looks at a variety of mode shift scenarios and the potential emission reductions for an exemplary city. The scenarios developed by Wright/Fulton are based on the key assumptions that in the city some 10 million passenger trips per day take place and that the average distance per non-walk trip is 10 km (these assumptions are valid for a city like Bogotá with a population of 7.2 million inhabitants). The scenarios also include estimates for likely abatement costs per tonne of CO_2. The largest CO_2 reduction from the baseline[2] can be achieved by the implementation of a package of measures, including BRT, pedestrian upgrades and cycleways (highlighted). This is estimated to result in a reduction of more than 12 million tonnes of CO_2 from the baseline at mitigation costs of USD 30 per tonne of CO_2.

[2] The baseline calculations were developed in a simple manner – no assumed growth in private motorised vehicles over the 20 year analysis.

Table 13: Greenhouse Gas (GHG) emissions of selected transport systems[1]

Mode of transport	Maximum capacity (passengers per vehicle)	Average capacity (passengers per vehicle)	GHG emissions per vehicle-kilometre	GHG emissions per average passenger-kilometre
Pedestrian	1	1.0	0	0
Bicycle	2	1.1	0	0
Gasoline Scooter (two-stroke)	2	1.2	118	98
Gasoline Scooter (four-stroke)	2	1.2	70	64
Gasoline Car	5	1.2	293	244
Diesel Car	5	1.2	172	143
Diesel Minibus	20	15.0	750	50
Diesel Bus	80	65.0	963	15
Compressed Natural Gas Bus	80	65.0	1 050	16
Diesel Articulated Bus	80	160.0	1 000	7

Sources: Hook and Wright (2002)

[1] Values are intended to provide a relative comparison for discussion purposes. It is recognised that a more rigorous definition of emission factors would need to include an analysis of actual driving practices, vehicle types and models, local traffic conditions, actual occupancy rates, local fuel types and vehicle maintenance practices.

Table 14: Impact of mode shifts on carbon dioxide emission reductions

Scenario name	Mode shares	CO_2 over 20 years (million tonnes)	CO_2 reduced from the baseline (million tonnes)	Cost of infrastructure	Cost per tonne of CO_2 (USD)
BRT mode share increases from 0 to 5 %	Automobiles 19 % Motorcycle 4 % Taxi 4 % Mini-bus 48 % BRT 5 % Walking 19 % Bicycle 1 %	47.4	1.9	USD 125m (59 km of BRT at USD 2.5m/km)	66
BRT mode share increases from 0 to 10 %	Automobile 18 % Motorcycle 4 % Taxi 3 % Mini-bus 45 % BRT 10 % Walking 19 % Bicycle 1 %	45.1	4.2	USD 250m (100 km of BRT at USD 2.5m/km)	59
Walking mode share increases from 20 to 25 %	Automobile 19 % Motorcycle 4 % Taxi 4 % Mini-bus 47 % BRT 0 % Walking 25 % Bicycle1 %	45.9	3.4	USD 60m (400 km of pedestrian upgrades at USD 150 000/km)	17
Bicycle mode share increases from 1 to 5 %	Automobile 19 % Motorcycle 4 % Taxi 5 % Mini-bus 48 % BRT 0 % Walking 19 % Bicycle 5 %	47.4	1.9	USD 30m (9 300 km of cycleways at USD 100 000/km)	15
Bicycle mode share increases from 1 to 10 %	Automobile 18 % Motorcycle 3 % Taxi 5 % Mini-bus 46 % BRT 0 % Walking 18 % Bicycle 10 %	45.2	4.2	USD 60m (500 km of cycleways at USD 100 000/km, plus USD 10m promotional campaign)	14
Package: BRT, Pedestrian upgrades, cycleways	Automobile 15 % Motorcycle 3 % Taxi 3 % Mini-bus 34 % BRT 10 % Walking 25 % Bicycle 10 %	37.0	12.4	USD 370m (BRT USD 250m; footpaths USD 60m; cycleways USD 60m)	30

Source: Wright and Fulton, 2005

Box 15: Government support of electric vehicles in Asia

Facing rapid motorisation and increasing emissions and fuel costs, China and India have implemented technology-based actions in an effort to mitigate emissions from road motor vehicles through supporting use of EVs.

The China New Energy Vehicles Program, which began in 2009, deployed electric vehicles (EVs) in government fleets. The goal of the program was to stimulate EV development. The program has proven successful and China is experiencing significant breakthroughs in EV technologies, specifically for batteries and charging technologies. For more information: http://siteresources.worldbank.org/EXTNEWSCHINESE/Resources/3196537-1202098669693/EV_Report_en.pdf. At the city level, Beijing has decided to include EVs in the license plate quota. For further information, visit: http://sustainabletransport.org/new-vehicle-lottery-scheme-in-beijing-2014-2017.

In India, the "National Electric Mobility Plan (NMEM) 2020" was launched by the government to encourage investment in EV technologies in India. To access the report: http://dhi.nic.in/NEMMP2020.pdf.

As indicated in section 3.2.5, electricity generation from clean sources of energy is crucial to ensure that EVs effectively contribute to mitigate emissions. The fact that coal currently holds a large share in the electricity-mix of these countries indicates that the contribution of EVs to reduce GHG emissions in those countries will be marginal, if not negative. If progress is to be made in this regard, the use of renewable sources of energy to generate cleaner electricity is required.

Box 16: TRANUS, example of a decision-helping tool to design policies cost-efficient package of policies

Decision-helping tools that assist stakeholders with identifying a cost-efficient package of solutions and facilitating the policy-making process in the transport sector. LUTI models are a type of decision-helping tool that can be used to model the interaction between the transport and land-use systems. The results could then be used by stakeholders to identify the comprehensive strategy and combination of instruments that improve the transport system and reduces GHG emissions. This approach would only be effective if implemented within the framework of comprehensive urban planning (Lefevre, 2008)

TRANUS is a forecasting LUTI model that simulates the interactions between the transport system and the land use pattern. This tool can be used to test an instrument "alone" or a "package" of different instruments.

TRANUS is based on the principles of spatial interaction, and of the dichotomy between localisation decisions and the demand for transport. The interaction between activities in space generates the demand for transport; in turn, accessibility, determined by the balance of supply and demand for transport, conditions the localisation of residents and activities.

TRANUS enables to evaluate the effects of these policies on different levels of the organisation of traffic (by mode, operator, origin-destination, etc.), as well as on spatial (localisation of activities and homes, urban sprawl, etc.), economic (real-estate prices, well-being of different populations, etc.) and financial organisation (ratio of recovery of operation costs, etc.).

There are around twenty different integrated models, but TRANUS is widely applied and has been implemented both in cities in developed countries (Baltimore, Sacramento, Osaka, Brussels, etc.) and in cities in developing countries (Sao Paulo, Mexico, Caracas, Bogotá, etc.).

The software is free and downloadable at http://www.tranus.com/tranus-english.

3.3.2 Mitigation actions contribute to local and national development objectives

A key objective of many sustainable transport strategies is to achieve a high proportion of public transport and NMT mode use. The majority of developing cities still have a high mode share of public transport or NMT modes. Therefore, a key strategy to stabilise GHG emissions in developing cities is to maintain the high share of these transport modes.

Reducing GHG emissions may not be high on the local agenda of priorities for citizens. However, a range of co-benefits can be achieved through the implementation of low-carbon transport instruments, helping to meet local development priorities (see Table 15). Co-benefits, as mentioned earlier, include improved air quality and health benefits, reduced noise from traffic, increased road safety, and a range of social and economic benefits. It may therefore be beneficial to focus on the wider

Table 15: Sustainable transport instruments: co-benefits, synergies and conflicts with global concerns

Local instruments	Type of instrument	Co-benefits	Synergy with global concerns	Conflict with global concerns
Promoting mass transport and discouraging private cars	Planning, Regulatory, Information, Economic	Measures can reduce local air pollutant emissions, noise from traffic, increase safety and improve accessibility. There may also be additional social inclusion benefits as a result of increased public transport services.	Such measures can often reduce CO_2 emissions as they improve overall energy performance and reduce gasoline use. This further reduces congestion and associated CO_2 penalties from vehicles.	Inefficiency in operation of mass transport systems may tend to reduce their occupancy and promote private modes of transport and the gain may be less than expected.
Congestion pricing and traffic management	Economic, Regulatory	Measures can reduce congestion, leading to reductions in local air pollutant emissions, noise from traffic.	Instruments can reduce congestion, discourage car use, and result in fuel savings.	However the exact impact on CO_2 emissions depends on various factors.
Inspection and maintenance systems	Regulatory, Information	Changing driving conditions and driver behaviour may reduce air pollutant emissions.	Changing driving conditions and driver behaviour may improve fuel efficiency and thereby reduce CO_2 emissions.	However, effects need to be monitored.
Introducing category-based emissions/fuel-efficiency standards for vehicles	Technology		Such standards help to reduce local air pollutants and CO_2 emissions per vehicle km for particular vehicle categories (type or size).	If distance travelled by individual vehicles increases or if people switch to vehicles with bigger engines, the total volume of CO_2 might increase even if the standard are met.
Use and development of alternative fuels (*e.g.*, CNG or Propane fuels), Low-sulphur diesel, reformulated gasoline, biofuels (ethanol blended gasoline or biodiesel)	Technology		Depending on the fuel used, both positive and negative effects can be achieved for various pollutant emissions. Whilst generally alternative fuels may reduce CO_2 emissions, they may also contribute to them and increase emissions of other pollutants, including CO_2, NO_X, VOC, CH_4	

Source: adapted from Dhakal, 2006

benefits that low-carbon transport instruments may bring. Table 16 displays a range of low-carbon transport instruments and identifies their potential co-benefits.

Table 17 attempts to identify the effects of various sustainable transport instruments on local air pollution and GHG emissions. It shows that whilst most instruments can be beneficial to reduce local air pollution, they may be less beneficial or even counterproductive for GHG emissions. Those instruments that demonstrate clear benefits for the reduction of GHG emissions include the reduction of motorised travel and generating a mode shift from private motorised travel (cars, motorbikes) to public transport modes such as bus and rail. However, the instruments with perhaps the most mixed response to pollutant emission and GHG emission reductions are those relating to cleaner or alternative fuels, where GHG emissions can actually increase if crucial factors are neglected. Emissions reduction technologies and EVs are effective and necessary methods for reducing pollutant emissions, however, lifecycle emissions should be considered, as certain approaches could potentially increase overall emissions.

Table 16: Sustainable transport instruments: meeting local priorities

Instrument Type	Sustainable Transport Instrument	Meeting Local Priorities							
		Safety	Accessibility	Mobility	Social inclusion	Economy	Local Air Pollution	Equity	Noise
Planning	Land Use Planning	O	+	–	+	O	+	O	O
	Public Transport	O	+	+		+	O	O	O
	Non-Motorised Modes	+	+	+	+	+	+/?	O	O
Regulatory	Physical Restraint Measures	+	?	?	?	?	+	O	+
	Low Emission Zone	+	?	?	?	?	+	O	+
	Traffic management Measures	+	?	?	?	?	+	O	+/?
	Regulation of Parking Supply	O	?	?	?	?	+	O	O
	Speed Restrictions	+	?	?	?	?	+		+
Economic	Road Pricing	+	?	?	?	?	O	?	O
	Fuel Tax Implementation/ Increases	O	O	–	O	O	O	–	O
	Vehicle Taxation			–			O	–	O
	Parking Pricing	+	?	?	?	?	O	O	O
Information	Public Awareness Campaigns	O	+	+	O	O	+	O	O
	Driver Behaviour Training and Education/ Eco-Driving	+	O	O	O	O	+	O	+
	Individualised Marketing	O	+	+	O	O		O	O
Technology	End of Pipe Devices	O	O	O	O	O	?	O	O
	Cleaner Production	O	O	O	O	O	+	O	O
	Cleaner Technology	O	O	O	O	O	+	O	+

+ = Instrument is predicted to have a positive effect on meeting priority
– = Instrument is predicted to have a negative effect on meeting priority
? = Instrument could have both positive and negative effects on meeting priority
O = Instrument is not predicted to have an effect on meeting priority

Table 17: Sustainable transport instruments and their impacts on pollutant emissions and greenhouse gas emissions

	Local Air Pollution	**Greenhouse Gas Emissions**
Reduce motorised travel	⬇	⬇
Modal shift from cars/motorbikes to buses/rail	⬇	⬇
Improve vehicle efficiency	↓	⬇
Improve fuel quality (*e.g.*, lower sulphur)	⬇	↑
Add oxidation or 3-way catalyst	⬇	↑
Improve vehicle maintenance	⬇	↓
Switch to CNG	↓ to ⬇	↓ to ↑
Blend ethanol	↓ to ↑	⬇ to ↑

Source: Fulton, 2006

Legend: ↓ Green arrow: positive change, reduction in emissions. ↑ Red arrow: negative change, increase in emissions.

Case Study 4 demonstrates the estimated GHG emission reductions achieved through the implementation of a BRT, urban development measures and NMT measures in Bogotá.

Case Study 4: Estimated greenhouse gas emission impacts BRT, TDM and NMT measures in Bogotá

Two lines of a planned 22 corridor Bus Rapid Transit (BRT) system had opened in Bogotá, alongside 200 km of bike lanes and expansion of numerous sidewalks, 1 100 new parks, shaded promenades and 17 km pedestrian zone. This was complemented by a number of TDM measures, including restrictions on vehicle use (cars with license plates ending with one of four numbers not allowed to operate during the morning or evening peak, restricting 35 % of vehicle fleet), increases in parking fees by 100 %, increases in gasoline taxes by 20 %, and physical measures to prevent illegal parking on the sidewalk (bollards). Additional promotional measures were also implemented, including a full various car free days.

Over a four year period, the percentage of trips made by private cars and taxies decreased by 2.2 % (from 19.7 % to 17.5 %). Public transport trips increased by 1 % (from 67 % to 68 %) and bike trips increased by 3.5 % (from 0.5 % to 4 %). It has been estimated that the implementation of the combined measures has resulted in a reduction of CO_2 emissions by 318 metric tonnes per day from 1997 levels in absolute terms.

Approximately 90 % of these reductions can be attributed to mode shift and 10 % from efficiency gains within the public transit system. The CO_2 emissions benefit has been measured against the JICA (projected modal split for 2001) which has shown that the combined measures lead to a benefit of 694 metric tonnes of CO_2. It is estimated that the projected benefits per day of the change in mode split will rise to 5 688 metric tonnes per day by 2015 if projected impacts of the current plans for Bogotá's transport system are realised (Hook and Wright, 2002).

3.4 Overview of tools to track greenhouse gas emissions

To effectively manage emissions, cities should measure, report and track GHG emissions. Over the past decade, organisations in the public and private sectors have developed GHG inventories as part of an effort to manage GHG emissions on the national, regional and organisational levels (WRI, 2012).

The GHG inventories provide decision-makers with an understanding of which sectors are responsible for the highest level of GHG emissions. These inventories can also be used to identify areas for emissions reduction, manage GHG risks and monitor progress toward meeting GHG emissions reduction goals (WRI, 2012). This section provides an overview of the importance of GHG inventories and the different tools to managing GHG emissions.

3.4.1 Accounting and reporting of greenhouse gas emissions

As a first step to managing GHG emissions, local authorities should develop a GHG inventory. Decision-makers should prioritise inventory needs based on key objectives and significance of territorial GHG emissions. To identify territory GHG emissions, an inventory boundary must be established based on geopolitical borders where the respective local authority has jurisdiction. GHG emissions produced from sources within the boundary are known as direct emissions; however, some sources within the inventory boundary may result in GHG emissions outside of the boundary, which are referred to as indirect emissions (C40 *et al.,* 2012).

The framework in Figure 27 outlines the concept of direct and indirect emissions and their relationship with the international, national and local inventories. Direct emissions (Scope 1) from transport include urban transport systems. Transport activities that occur outside of the local inventory boundary, such as the purchased of electricity to power regional transport systems (Scope 2) and international air travel (Scope 3), produce indirect emissions (C40 *et al.,* 2012).

The local authority must create a credible report that aligns with other inventories. A template for a standard report can be found at http://www.ghgprotocol.org standards.

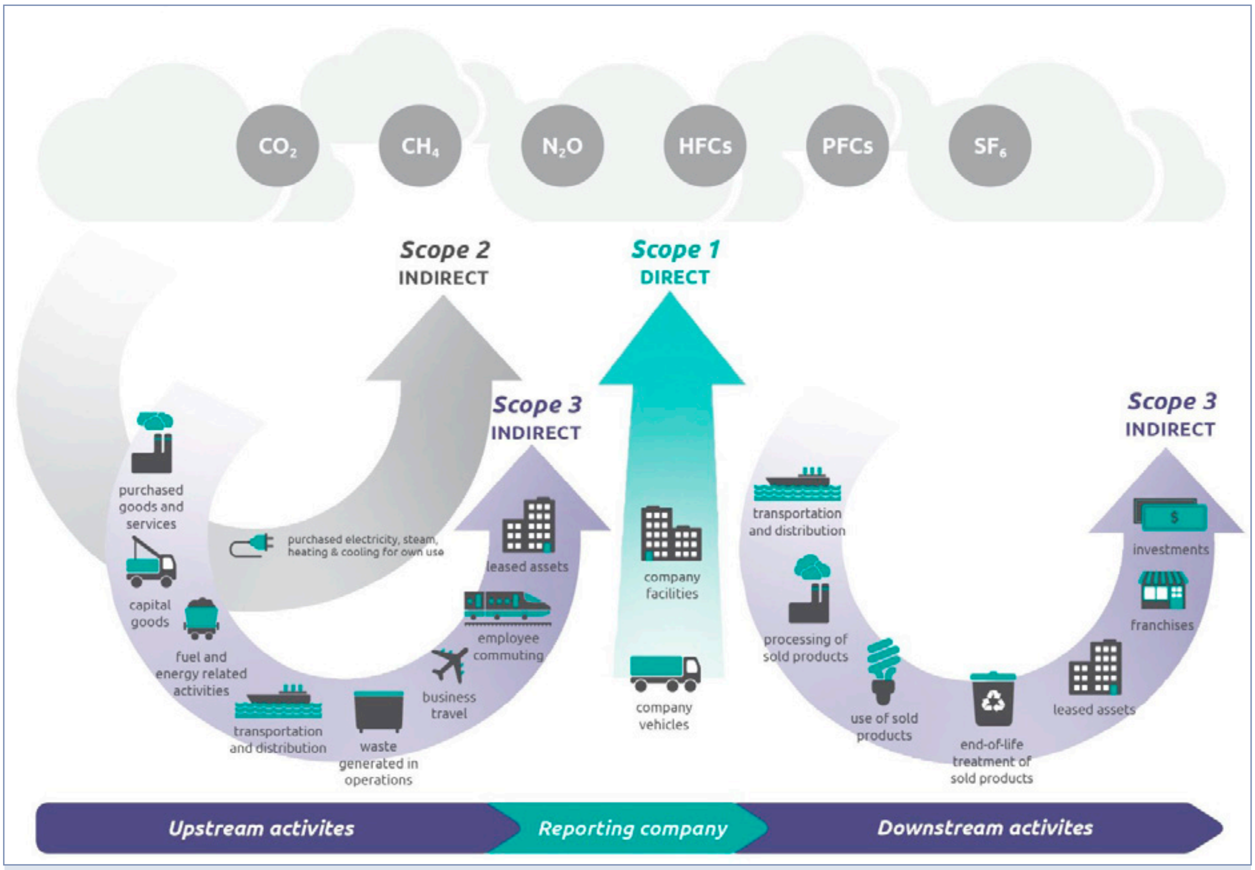


Figure 27: *Overview of GHG Protocol scopes and emissions across the value chain.*
Source: C40 *et al.*, 2012

3.4.2 Measures to assess an impact of policies and actions on greenhouse gas emissions

An assessment of actions and policies is important for the development of effective GHG emissions reduction strategies based on the expected effects of actions and policies on GHG emissions *before* implementation and the evaluation of the actions and policies *after* implementation. These measures should also complement the development and regular updating of the GHG inventory (WRI, 2012). This is key to access finance, assess effectiveness of a policy and action and refine and adjust accordingly.

3.4.3 Tracking of progress toward the greenhouse gas emissions reduction goal

Local authorities should use a GHG inventory report to track the effectiveness and performance of the actions and policies to meeting the emissions reduction goal. Where progress is not on track, monitoring can inform any necessary corrective action. Tracking is also useful for understanding the main activities and outcomes of the policy or action (WRI, 2012). For example, Germany has developed a model for GHG emissions from transport in German cities and uses a scheme for calculating the emissions from motorised transport activities. The general equation is displayed in Figure 28.

Transport demand is measured in vehicle kilometres travelled (VKT) or transport performance (pkm). Specific energy consumption is dependent on the vehicle design, vehicle load, traffic conditions and driving behaviour. Similarly, the specific GHG emission factor is dependent on the final energy carrier, considered GHGs, and the inclusion of upstream GHG emissions. Models are built around the type of transport mode, resolution and data availability. Currently there are five well-regarded models in use in the European Union (EU) and

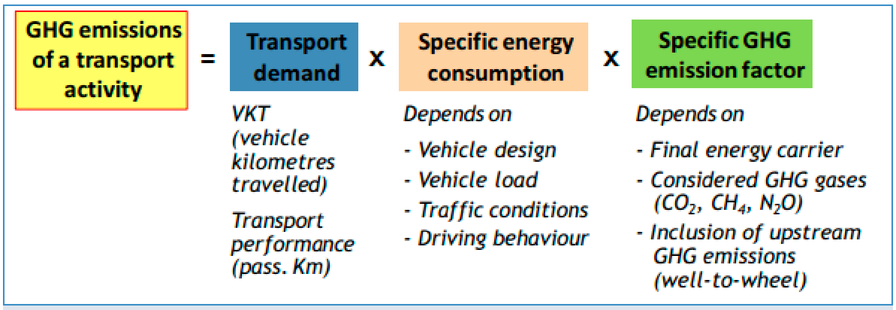


Figure 28: *GHG emission calculation scheme for motorised transport activities.*
Source: Dünnebeil *et al.*, 2012

US: HBEFA, TREMOD, COPERT, TREMOVE, and MOVES (Dünnebeil *et al.*, 2012).

There are many citywide GHG accounting tools that can aid local, regional and national governments in tracking their GHG emissions. These tools have a variety of features; some may address more than one of the following needs:

- Detailed estimations of current emissions (such as MOVES or HBEFA)
- Projections of future emissions
- Emissions changes from different fuel choices
- Costs of vehicle technology changes
- Suggested mitigation actions and corresponding emissions impact
- More general energy and economic implications of mitigation actions

The Partnership on Sustainable Low Carbon Transport (SLoCaT) has a website that offers a list of available tools to assess GHG emissions in the transport sector (http://www.slocat.net/?q=content-stream/187/ghg-assessment-tools).

An overview of GHG assessment tools for transport can be found in the GIZ report *Balancing Transport Greenhouse Gas Emissions in Cities – A Review of Practices in Germany*. See also Bongardt *et al.*, (2013) Low Carbon Land Transport – Policy Handbook.

3.5 Factors contributing to the success of sustainable transport instrument implementation

The following section presents additional considerations for responsible authorities when contemplating the implementation of sustainable urban transport policies within cities.

3.5.1 Institutional arrangements and key stakeholders

The majority of sustainable transport instruments are implemented at the municipal level, often requiring the involvement of multiple municipal and national level agencies. Authorities may lack skilled personnel, and be dependent on central government funds, international grants, technical support, legal approval and policy support. The organisation at the city and municipal level may also hinder smooth implementation of schemes (*i.e.* where cities are divided into districts).

The capacity of stakeholders to mitigate global GHG emissions can vary considerably. Their “capacity to act” influences both the policy options that local authorities, for example, consider and the options that they ultimately select (Lefevre, 2012). It cuts directly to the heart of whether a local authority can deliver on its ideas or plans, or whether it is primarily subject to decisions or actions by other stakeholders, such as regional, state or national government, the private sector or individual households.

It is also essential for the implementing authority to understand their strengths and their ability to influence other stakeholders. Another way of assessing the local

Box 17: "Capacity to act" – Greater London Authority

Assessing "capacity to act" can be challenging but some cities are forging ahead. For instance, the Greater London Authority (GLA) has assigned responsibility for different initiatives proposed in its climate action plan that it hopes will reduce citywide GHG emissions, including emissions from ground-based transport fleet/fuel, by 60 % by 2025. As the wedge analysis identified, local policy powers are capable of delivering a mere fraction of the total target: "Under all scenarios considered in this action plan, the mayor and the Greater London Authority alone cannot deliver more than 15 % of the necessary reductions. Responsibility for tackling climate change must be shared between the mayor, the London boroughs (5–10 % of requirement), London's companies and public sector organisations (35–40 %), Londoners (5–10 %) and national government (30 %)" (GLA, 2004). The GLA's calculation comes from an in-house assessment of where the mayor has significant policy control and where these powers are weaker.

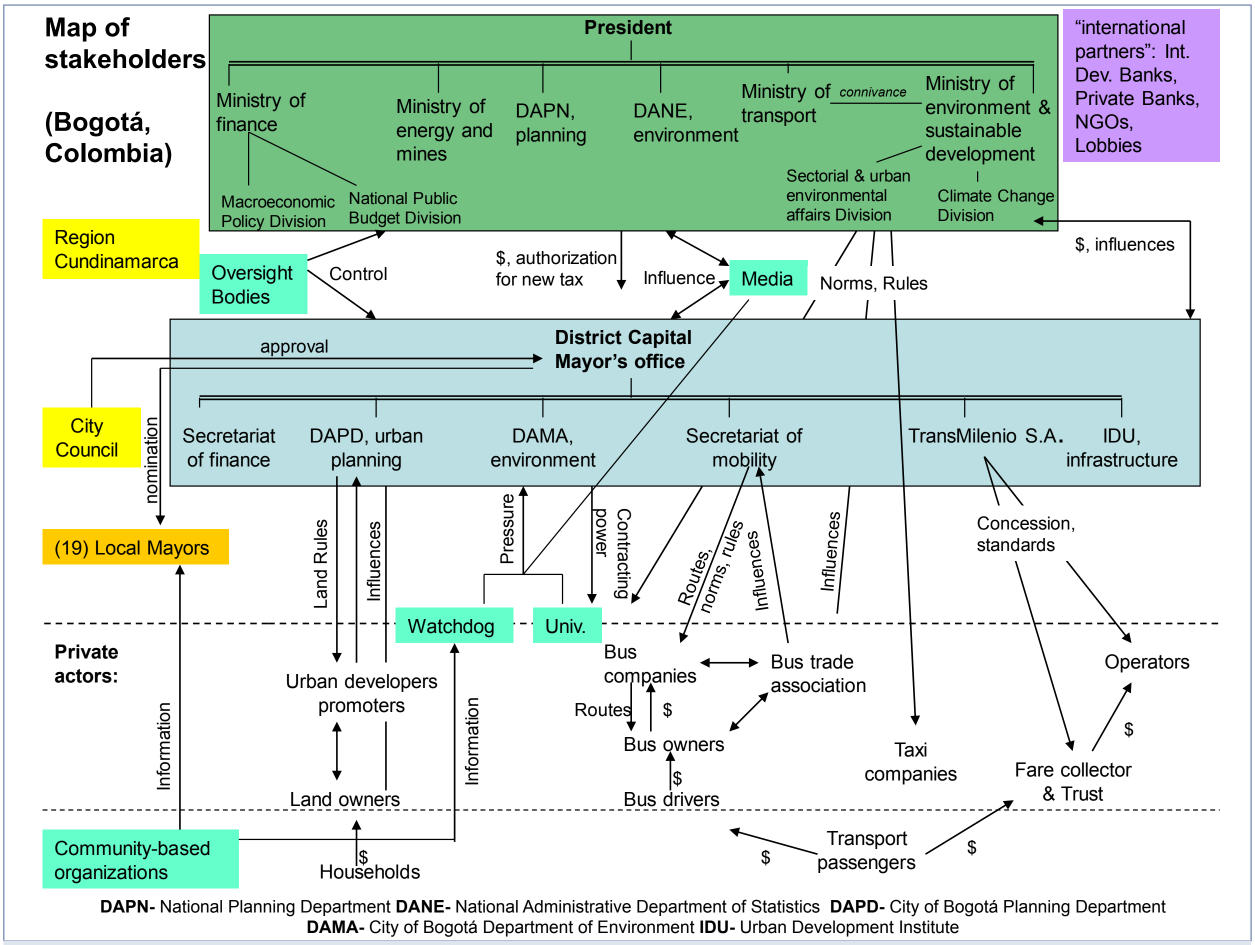


Figure 29: *Stakeholders and distribution of "capacity to act", Bogotá, Colombia.*

Source: Authors based on Lefèvre, 2009

"capacity to act" is to map the nature and strength of all stakeholders' influence, as shown in Figure 29 for the transport sector of Bogotá, Colombia (Lefevre, 2009). The stakeholder map illustrates the type of relationships between government agencies and external stakeholders: political (*i.e.* elected bodies), controlling (*i.e. contraloría, procuraduría, fiscalía*), transport providers, transport users and influencers (*i.e.* media, academia, NGOs). Influences can be financial, regulatory, normative, contractual, connivance, etc.

Finally, it is worth noting that the institutional capacity is also affected by the time constraints imposed as a result of the nature of political mandates, which are often linked to the (short) cycle of elections. In most cases, measurable emissions reductions require a longer horizon and often depend on long-term investment.

A review of "capacity to act" can therefore be seen as a fundamental precursor to each city's ultimate policy recommendations. It is impossible to speak generically about a municipality's "capacity to act" because the key attributes of a local authority – its institutional structures, its responsibilities and its powers of taxation – are all derived from state or national government allocations of authority.

The implementation of sustainable urban transport schemes can involve a great many number of stakeholders. The way in which these stakeholders are involved in the planning and implementation process may be instrumental to the subsequent success. For strategies to be successful, it is important that the implementing authority is able to form and maintain viable relationships and partnership with these stakeholders:

- Building a coalition
- Ensuring public support
- Mobilising private and public stakeholders are key factors of success.

Potential stakeholders include:

- ***Public Authorities***: A wide-variety of public authority departments and offices may be involved or at least interested in the planning, implementation and regulation of sustainable transport initiatives. Potential departments and offices may include: road transport office; legal office; public works office; press/public relations office; treasury/finance office; taxation office; parking office; traffic office; planning boards; environmental officers; and parliamentary offices.
- ***Transport Market Participants***: In addition to the public authorities, successful implementation will also rely on the involvement of transport market participants, such as industry partners, private transport users and PT institutions, operators and promoters.
- ***Non-Governmental Organisations (NGOs)***: Interested NGOs may include those involved in social and environmental issues (including international donors and agencies). The involvement of NGOs can provide additional benefits to project implementation, particularly if they have the relevant skills and technical knowledge to help guide implementation.
- ***Press and Media***: Support from the press and media will help to raise awareness amongst the public.

3.5.2 Financial feasibility

Many of the instruments described in this module have the advantage of being relatively low-cost. For example, smart land-use planning does not have significant associated costs; BRT systems can cost 10 times less than a heavy rail system (EMBARQ, 2013); and some economic instruments can even mobilise revenues.

When taking into account the financial feasibility of a policy, plan or project that would impact transport and climate change, it is always necessary to thoroughly assess the costs of policy measures and make them transparent in the decision-making process and to design the chosen instruments in a way that reflects the local financial capacities.

Cost-effectiveness of climate actions

While the requirement for cost-effectiveness should probably be proportional to GHG emission reduction goals, few local climate action plans consider the economic dimension. Energy–economy or sectoral energy models have made it possible to simulate different policies and especially to build sets of Marginal Abatement Cost Curves (MACCs) that are graphs that show the marginal cost of emission abatement for the various quantities of emission reduction (Etkin *et al.*, 2011). These mechanisms are efficient tools in seeking to reduce the global cost of a plan or strategy through a certain levelling of the marginal costs of specific initiatives. MACCs can support the development of a methodology to define and prioritise the actions to be launched, based on technical–economic criteria, and then organising the different actions required to build a cost-effective programme.

The use of socio-economic MACCs was for example adopted for the Low Carbon Development Scenario Analysis in Mexico (MEDEC). The MEDEC's main objective was to evaluate viable policies, programmes and projects that mitigate GHG emissions as well as to analyse and prioritise the cost/benefit per tonne mitigated and the corresponding co-benefits. The programmes considered in this study included land use, fuels and technology, public transport, NMT, TDM and freight transport, each of which corresponded to one or various measures.

3.5.3 Political will and support

Political support is essential when implementing and sustaining low-carbon transport measures. Controversial measures may result in (political) decision-makers facing strong opposition from the press and public – putting successful implementation at risk. It is thus crucial to secure public (and political) support as early as possible.

Many examples of successful sustainable transport projects implemented in developing cities have had the necessary strong political support, such as in Bogotá and Curitiba. Often good practice examples help to gain understanding and acceptance. International partnerships between cities could also help in the promotion of sustainable solutions. Once gained, this support needs to be maintained across a number of administrations.

There are varying levels of political support, ranging from simple support of a scheme or implementation of an instrument (allowing/letting it happen) up to strong leadership leading to the implementation of an instrument, despite public opposition.

Figure 30: *The BRT in Kunming: BRT lanes are being painted red.*
© Karl Fjellstrom, Kunming, 2003

**Box 18:
Political support in Kunming, China**

The city of Kunming, China, is twinned with Zurich in Switzerland. The partnership was formed to increase development co-operation. Kunming has benefited from the experiences and knowledge of Swiss partners in relation to local transport planning, particularly as they are recognised for demonstrating best practice in urban development throughout the world. The partnership has focused on capacity building rather than technological transfer, and local planning and management authorities have been trained, and a dialogue established between political decision-makers and experts from both cities. The successful formation of this partnership, partly through continued political support, has led to the development of a new master plan for urban transport in 1996, which incorporated the new skills obtained during the cooperation. Successful outcomes of the plan included the design and implementation of a Bus Rapid Transit (BRT) system in the city, including public transport priority.

4. Financial opportunities to fund transport mitigation actions

Many of the instruments presented in this module do not require large-scale investment; they can be implemented at relatively low cost and often provide economic benefits in the long run due to improved mobility, health benefits, reduced negative impacts such as congestion and air pollution etc. Some improvements, however, require significant amounts of investment, which cannot always be met by municipal authorities or national governments in developing countries.

In some cases international donors, multilateral development banks (MDBs) or bilateral development cooperation may provide funds either as loans or on a grant basis. If the investment yields an attractive return on investment, the private sector may also be interested in project finance. In addition to these funding options, climate change funding opportunities exist that can provide additional support. This section highlights support opportunities for planned investment that will mitigate GHG emissions in the transport sector.

With the wide range of transport funding and financing options, the landscape of transport finance is difficult to fully capture.

☞ For more information, please see GIZ *Sourcebook* Module 1f: *Financing Sustainable Urban Transport* and GIZ *Technical Document Accessing Climate Finance for Sustainable Transport: A practical overview.*

4.1 Overview of "non-climate specific" sources of funding for sustainable low-carbon transport

"Non-climate specific" funding sources are established forms of funding that can also be dedicated to support sustainable low-carbon transport strategies.

4.1.1 Public funding sources

The main players in funding urban transport are public authorities that usually fund infrastructure or the operation of a public transport system. Public funding sources for transport projects are diverse; these sources may include funding through local taxation that is allocated to transport or grants from international funding sources. It is the second largest flow of funding in the transport sector, after private finance, and will need to be filtered toward sustainable low-carbon transport. This is discussed in greater detail in Section 4.3.

National and local public sources

Domestic governments play a major role in financing sustainable low-carbon transport. Funds through local or national taxation and other government revenue streams can be allocated to local transport activities.

Four main sources of funding are open to local authorities when dealing with the financing of sustainable low-carbon transport:

- Local taxes are raised mainly from three sources: income, property and expenditure
- Transfer through another level of public bodies (often the State),
- Borrowing (most commonly from the domestic market but also incipiently but increasingly from international capital markets), and
- The pricing of services provided by the municipality ("user charge").

The respective shares of these four components are highly variable from one country to another and the revenue structure may play an important role in terms of sustainable development.

International public sources

Official development assistance (ODA), as defined by the Organisation for Economic Co-operation and Development (OECD), is a flow of financing as administered by official agencies to promote the economic development and welfare of a developing nation, which is concessional in character and contains a minimum grant element of 25 % (OECD, 2013b). ODA funds contributed by industrialised countries are typically divided into two categories: multilateral and bilateral assistance.

First, multilateral institutions, specifically MDBs, receive funding from international donors in order to provide financial assistance to support the economic development of a country or region. These institutions generally allocate funds in the form of grants, loans and risk-mitigation instruments (guarantees).

Bilateral assistance is composed of two elements: funds supplied by one country and given to another country and technical assistance provided by country-specific development agencies such as KfW (Germany), USAID (USA), JICA (Japan) and AFD (France).

Based on the latest available figures, ODA contributed approximately USD 14 billion to the transport sector in 2010 (OECD, 2013a).

4.1.2 Private funding sources

Contributions for transport from the private sector are also diverse. Private funding sources include institutional investors, project developers, corporations and households/individuals. Financial intermediaries in the private sector include commercial financial institutions, venture capitalists and private equity firms, and infrastructure funds. This is the largest source of funding for transport and it is key to redirect the flow of private funding sources toward sustainable low-carbon transport (see Section 4.3).

National and local private sources

Domestic private funding can be sourced from users of transport (direct beneficiaries), taxpayers that are non-users of a transport system and local businesses that support public transport for their employees (indirect beneficiaries).

Direct beneficiaries: Direct beneficiaries are persons that benefit directly from a transport system. These include:

- Users of the system that contribute to funding the system through the purchase of a fare ticket;
- Users of private vehicles that pay road tolls, congestion charges, parking fees, traffic fines, or other taxes related to fuels; and
- NMT users that pay fees such as bicycle rentals.

The revenue collected from public transport goes directly into the operation of the various modes of transport in the system. As for the revenue collected from tolls, taxes and other fees imposed on those using private vehicles, it is more difficult to determine the allocation of funds from these sources because many countries do not allow the pre-allocation of these resources.

Indirect beneficiaries: Persons or bodies that benefit from the existence and accessibility of a multimodal transport system are indirect beneficiaries. Those include:

- Employers whose employee utilises the transport system without any costs to the employers. Some companies realise the benefits of an efficient transport system and may contribute to the funding of a transport system or provide direct assistance with an employee's share of their daily transport costs;
- Businesses benefit from the existence of a transport system through the provision of customer access to the business and the movement of the firm's products; and
- Land owners who see an appreciation of the value of their land with the construction of transport infrastructure or the rerouting of public transport into their area are also indirect beneficiaries of a transport system.

International private sources

Foreign Direct Investment (FDI): Direct investments provided by an investor from a different country are FDI. These foreign investors generally have a long-term relationship and a lasting interest in the country that is a recipient of the investment (UNCTAD, 2007). Sources of FDI range from aid from government agencies, which is also considered ODA, to investments by private enterprises. In 2011, FDI inflows contributed approximately USD 42 billion to the transport sector (ITC, 2013).

International Borrowing: International borrowing, also referenced as external debt, is non-contingent, outstanding liabilities that require the future re-payment of principle and/or interest owed by a debtor to a creditor outside of their country (IMF, 2003). Debtors are generally governments. Creditors may be banks, other governments and international finance institutions, which includes the MDBs.

Venture Capital and Private Equity: Venture capital and private equity firms typically target project investment in technology and operating companies. Smaller, higher-risk equity investors are investing in low-carbon projects. Many development banks, such as the Asian Development Bank (ADB) and the International Finance Corporation (IFC), invest in private equity firms, which reinvest in businesses solving energy and environmental challenges (USAID, 2013).

Private sources may also be combined with public sector funding efforts through public private partnerships (PPPs). PPPs, as defined by the IEA, are "voluntary efforts in which government and the private sector collaborate to analyse public policy problems and jointly implement solutions" and act as a mechanism to leverage private sector financing (IEA, 2012b).

☞ For more information, please see GIZ *Sourcebook* Module 1c: *Private Sector Participation in Urban Transport Infrastructure Provision*.

4.2 Overview of "climate specific" international sources of funding for sustainable low-carbon transport

The UNFCCC has recognised that it is important for developed nations to provide financial assistance to developing nations in order to meet the international goals of reducing climate change (UNFCCC, 2013a). In order to achieve this, funding sources and carbon market mechanisms have been established to specifically provide assistance for climate change activities.

4.2.1 Funding options emerging from United Nations Framework Convention on Climate Change (UNFCCC) process

The landscape of climate finance is evolving as new forms of financial support emerge from the UNFCCC process.

Fast Start Finance (FSF)

After the UNFCCC Copenhagen Accord in 2009, developed nations committed to providing up to 30 million US Dollars (USD) in assistance for mitigation and adaptation activities (Binsted *et al.,* 2013). During the meeting in Cancun in 2010, it was agreed that the funds would be prioritised for vulnerable developing nations that include the least developed nations, Small Island developing states and Africa.

FSF was intended to fill the gap before the Green Climate Fund (GCF) came into force between 2010 and 2012. FSF is flexible and discretionary; funds can be dispersed through new or existing climate funds as grants, loans or other instruments. Some countries' contributions are dedicated to particular sectors or funds. It is unclear how much of these funds support transport projects; however, most are distributed through existing climate finance institutions.

Japanese Fast-Start Fund Initiative: The Japanese Fast-Start Fund Initiative was a national Japanese initiative launched in 2009. The fund aimed to support the economic growth of developing nations that were already working to reduce GHG emissions and that are most vulnerable to climate change. As part of the initiative, Japan pledged to invest USD 15 billion through fast-start financing up to 2012. By the end of their pledge, this initiative had invested approximately USD 1.27 billion in transport projects. The future of the initiative post-2012 is uncertain (UNFCCC, 2013b).

International Climate Initiative (ICI): The German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) established the ICI in 2008 to strengthen relationships between the German government and developing nations with the focus on climate change adaptation and mitigation in an effort to preserve biodiversity. The initiative is funded by the BMU who contributes EUR 120 million from their budget per annum, as well as Germany's Energy and Climate Fund (EKF) who contributes funds through the auctioning of emission allowances (ICI, 2013). Since its establishment, approximately USD 22 million has been spent to support the transport sector (Binsted *et al.,* 2013).

Green Climate Fund (GCF)

Sights are now set on the newest financing instrument to combat climate change – the GCF. Approved by the UNFCCC in 2010, the fund is intended to be scalable and flexible, comprising both a public and private financing arm. It is intended to be amenable to other successful climate financing tools, like the Low Emissions Development Strategy (LEDS) and NAMAs. The GCF intends to unite a large part of financial means to combat climate change. It is projected that the GCF will disburse its first money in 2014; however, it is unclear how much funding will be available for transport actions given that there are no sectoral windows (GCF, 2013).

4.2.2 Climate funds

Money earmarked exclusively for climate change – adaptation and mitigation – activities are known as climate funds. Those funds have specific requirements based on the size and scale of projects, scope and nature of interventions, and may limit accessibility of funds to certain levels of governments. Table 18 summarises the available funding and transport spending of these climate funds as of 2012.

Clean Technology Fund (CTF)

The Clean Technology Fund (CTF) provides incentives for national and regional governments in middle-income nations to increase the demonstration, deployment, transfer and replication of technologies that reduce GHG emissions. These concessional funds are channelled through MDBs and funds large-scale, country-initiated projects that focus on sustainable low-carbon transport, renewable energy and energy efficiency; however, CTF does not offer technical assistance. From 2008 to December 2012, approximately USD 373 million has been spent on sustainable low-carbon transport projects (CIF, 2013).

Global Climate Change Alliance (GCCA)

Launched in 2007 by the European Commission (EC), the GCCA was established to strengthen relationships between the EC and developing nations that are most vulnerable to climate change. The GCCA acts as a platform for partner countries to exchange experiences and discuss climate policy. Technical and financial support in the form of grants are provided to national governments in partner countries to integrate approaches that address climate change into development policies and budgets, as well as support to implement projects that promote climate-resilient, low emission development (GCCA, 2013). As of November 2012, approximately USD 10 million has been dedicated to transport projects through the GCCA (EC, 2012).

Sustainable Energy and Climate Change Initiative (SECCI)

SECCI was created in 2007 by the Inter-American Development Bank (IDB) as an initiative to encourage and increase investment in renewable energy and energy efficiency in Latin America and the Caribbean (LAC).

Table 18: Size of climate funds and transport spending as of 2012

Name	Acronym	Year Created	Admin	Total Spending Approved (million USD)	Total Spending on Transport (million USD)	Proportion	Transport Actions Supported
MULTILATERAL							
Global Environment Facility-5	GEF-5	2010	WB	452.0	45.3	10.0 %	6
Clean Technology Fund	CTF	2008	WB	2.3	372.6	16.2 %	43
Global Climate Change Alliance	GCCA	2007	EC	382.0	10.0	2.7 %	3
IDB Sustainable Energy and Climate Change Initiative	SECCI	2007	IDB	58.7	5.2	8.9 %	Unknown
ADB Climate Change Fund	CCF	2008	ADB	50.1	5.0	10.0 %	4
ADB Clean Energy Fund (Partnership Facility)	CEF(PF)	2007	ADB	72.3	0.87	1.2 %	2
BILATERAL							
International Climate Initiative	ICI	2008	BMU	640.0	23.0	3.7 %	9
Japan Fast Start Fund Initiative	n/a	2009	JICA	10 800.0	1 270.0	11.8 %	8

Source: Adopted from Lefevre and Leipziger, 2013

SECCI provides support for smaller-scale projects (*i.e.* under USD 100 000) and has the least demanding monitoring, reporting and verification (MRV) process. Funds are available to national, regional and local governments as well as the private sector in LAC. Through 2010, SECCI spent USD 5.2 million on transport (IDB, 2011). Additionally, the IDB created the Regional Environmentally Sustainable Transport Action Plan (REST-AP) in 2010 in order to finance more sustainable low-carbon transport projects and has subsequently financed USD 650 million in public transport development (Binsted *et al.,* 2013).

ADB Climate Change Fund (CCF)

ADB established the CCF in 2008 to support adaptation and mitigation activities in Asia with the majority of the funding dedicated to mitigation. The goal of the fund is to facilitate greater investment in addressing the causes and consequences of climate change in developing member countries. Technical assistance and grants as a component of investment projects are accessible to national governments, regional governments and the private sector in Asia (ADB, 2013a). Since its inception, only 4 transport projects have been funded receiving a total of approximately USD 5 million (ADB, 2012).

ADB Clean Energy Financing Partnership Facility (CEFPF)

The CEFPF is another ADB initiative that provides help in improving energy security and assistance with climate change mitigation activities for all levels of governments and the private sector in ADB's developing member countries. Financing is available for new, emission-reducing technologies through grant and non-grant resources (ADB, 2013b). Approximately USD 870 000 has been allocated to sustainable low-carbon transport projects; additionally, there are other multi-sector projects with a transport element (ADB, 2012).

4.2.3 The Global Environment Facility (GEF)

The Global Environment Facility (GEF), a multilateral funding source, was set up to fund projects and programmes aimed to protect the global environment. In principle, the GEF only provides co-funding (*i.e.* a significant contribution to the financing of the project needs to come from other sources). Such financing can either come from the national government or from other donor agencies. The financing may be also done by providing 'in-kind' work resources (e. g., preparation of the transport planning administration), credits and loans.

One of the six key objectives under the climate change focal area of GEF 5 is "Promote energy efficient, low-carbon transport and urban systems" (GEF, 2009). Intervention options include land use and transport planning, energy efficiency improvement of public transport fleet, TDM and promotion of non-motorised transport. Transport technologies, such as the promotion of low-carbon vehicles, may be considered in countries where reduction of GHG emissions may be achieved (GEF, 2009).

The projects that are funded under the GEF programme can vary greatly in size (from project development funds of USD 25 000 and medium-size projects worth up to USD 2 million, to full-size projects worth well in excess of USD 2 million). A total of USD 292.5 million has been allocated to urban transport projects since 1998, and several million more are earmarked through 2014 (GEF, 2013).

The 5th replenishment period of the GEF covers the period from July 2010 to June 2014. The total funding for sustainable low-carbon transport activities under the GEF 5 is approximately USD 45.3 million (GEF, 2013).

The individuals or groups (such as city government, transport operators, etc.) from a country that has ratified the Kyoto Protocol and are eligible to borrow from the World Bank or receive technical assistance grants from the United Nations Development Programme (UNDP) may apply for GEF funds. The proposed projects must indicate that it will improve the global environment and it must reflect national or regional priorities.

☞ For more information about GEF, please refer to their website http://www.thegef.org.

4.2.4 Carbon market mechanisms

Carbon market mechanisms channel incentives to reduce GHG emissions by implementing a market for emissions allowances and redeemable credits (Sakamoto *et al.,* 2010). Based on local system allowances, national limits or corporate sustainability goals, industries can decide to emit CO_2 or trade away the right to do so.

The carbon markets channel financial resources to low-carbon investments through project-based mechanisms such as Clean Development Mechanisms (CDM), Joint Crediting Mechanism (JCM), Joint Implementation (JI) and voluntary carbon trading.

Clean Development Mechanism (CDM)

The CDM allows industrialised countries with a GHG reduction commitment under the Kyoto Protocol to invest in emission reducing projects in developing countries. These are usually alternatives to what is considered to be more costly emission reductions in their own country. While CDM became a popular tool in other sectors like renewable energy and energy efficiency, only 32 of the more than 7 000 CDM projects are transport projects (CDM, 2013).

A second commitment period of the Kyoto Protocol has been secured but, with fewer countries involved than in the first commitment period and relatively low levels of country ambition for emission reduction, there is currently a low demand for Certified Emission Reductions (CER) and consequently low prices generated by CDM projects (UNFCCC, 2013a). In addition, certificates from 'new' (post 2012) CDM projects will only be accepted by the EU Emissions Trading System (ETS) from least developed countries (European Parliament and the Council of the European Union, 2009).

The CDM has long been recognised internationally, including by the UNFCCC, as a mechanism that is not well suited to the transport sector because of its limitations to prove a reduction in CO_2 by transport projects (UNFCCC, 2005). Key bottlenecks under the new CDM guidelines are: costly data requirements, complex procedures and additional requirements.

☞ For more information on the CDM in the transport sector, please refer to the GIZ *Sourcebook* Module 5d: *The CDM in the Transport Sector*. Additionally, further guidance on completing the project design documents for CDM is available at http://cdm.unfccc.int/Reference/Guidclarif/index.html.

Joint Crediting Mechanism (JCM)

Since 2011, the Japanese government has held consultations for the JCM with developing countries in efforts to create partnerships to reduce or remove global GHG emissions. The objectives of JCM are to support the diffusion of technology transfer, implement mitigation actions, and contribute to sustainable development tailored to the changing needs of developing countries (MoE, 2013).

The Japanese government and the partner country establish a Joint Committee (JC) that comprises representatives from both governments. The major responsibilities of the JC consist of the developing rules and guidelines for the implementation process of the JCM, establishing the MRV methodologies and issuing credits to the governments (MoE, 2013).

As of August 2013, Japan has signed bilateral contracts with Mongolia, Bangladesh, Ethiopia, Kenya, Maldives, Vietnam, Laos and Indonesia. An example of a sustainable low-carbon transport project through JCM is the feasibility study on the promotion of public transport through the establishment of a park and ride system in Vietnam (OECC, 2013).

Joint Implementation (JI)

The approach of the JI flexible mechanism is similar to CDM. However, with JI projects, industrialised countries with commitments under the Kyoto Protocol primarily transfer emissions with economies in transition such as Russia and Ukraine.

JI projects are also approved by the UNFCCC, and the resulting carbon units, Emissions Reduction Units (ERU), are traded the same way as CERs. As of 2012, there were four transport projects in the JI pipeline (UNEP, 2013).

Voluntary carbon market

Organisations, companies or individuals can opt to purchase carbon emissions credits in order to offset their own activities. These are usually in the form of Voluntary Emissions Reduction (VERs). Understandably modest in value, voluntary carbon offsets nonetheless accounted for about 54 million tonnes of CO_2eq being traded in 2008 and continues to grow (CDC Climat, 2013).

4.2.5 Nationally Appropriate Mitigation Actions (NAMAs)

Nationally Appropriate Mitigation Actions (NAMAs) were first referred to in the Bali Action Plan, which was a 'Decision' that was reached at the UNFCCC climate conference in 2007 (UNFCCC, 2007). The term continues to be, developed and refined, and has resulted in the development of numerous concepts and proposals for projects, policies, strategies and targets for low-carbon activities.

NAMAs are activities that developing countries conduct to contribute to climate change mitigation and also to support the sustainable development of their economies. NAMAs are voluntary and can be 'unilateral' actions by developing countries or 'supported' by developed countries, which under the UNFCCC, have committed to provide financial, technology and/or capacity building support to mitigation actions in developing countries. A third type of NAMA is a 'credited NAMA,' which refers to a NAMA that attracts finance via the carbon market by generating carbon credits, but unlike 'unilateral' and 'supported' NAMAs, the concept of 'credited' NAMAs has not yet been internationally approved and is still under discussion.

In general, the concept of NAMAs has not been clearly defined yet. Parties to the UNFCCC stress the importance of the diversity of NAMAs in order to reflect the diverse circumstances in the different countries. Thus there is a considerable potential for sustainable low-carbon transport interventions to be framed as NAMAs. What still is under negotiation is the MRV part of NAMAs. MRV of NAMAs will be in accordance with guidelines to be developed under the UNFCCC.

A review of publically available information on NAMAs has indicated that 80 'supported' NAMAs have been proposed. As of October 2013, 19 % of these 'supported' NAMAs were being developed in the transport sector — the only other sector with more NAMAs is the energy sector (Ecofys, 2013). The nature of these transport NAMAs is diverse, highlighting the broad scope of the NAMA policy instrument to support sustainable low-carbon transport in developing countries.

A list of proposed transport NAMAs is available in the Ecofys NAMA database: http://www.nama-database.org/index.php/Transport. This resource is complemented by a Transport NAMA Database, which contains detailed information about transport NAMAs that are at all stages from initial concept to implementation. The initiative is being led by GIZ, in partnership with the World Resources Institute (WRI), and aims at improving knowledge management and transfer, supporting the identification and matching of capacity building needs, financial and technical support, and demonstrating related progress that the transport community is making. The Transport NAMA Database can be accessed here: http://www.transport-namadatabase.org.

As an additional form of support for NAMAs, the British and German governments launched the NAMA Facility in November 2012 to provide access to support for NAMA activities in the form of grants and loans. Its current funds total USD 90 million and a first call for proposals, which attracted 47 submissions, was announced in July of 2013 (Jue *et al.,* 2013). The process highlighted strong demand for transport NAMAs, with the sector being one of the most frequently addressed in the proposals (BMU, 2013).

The potential for NAMAs to support sustainable low-carbon transport and development in developing countries is clear. There are, however, many aspects of the policy instrument that are under debate. NAMAs have been subject to much negotiation and academic and practical discussion and piloting. In this context a number of recommendations have been made. These are summarised in the GIZ *TRANSfer* document "*Navigating Transport NAMAs*," (Box 19) which is a 'Practical Handbook for the Design and Implementation of NAMAs in the Transport Sector' (GIZ, 2012).

Box 19: TRANSfer Handbook: Navigating Transport NAMAs

In an effort to promote global knowledge transfer of transport technologies, ICI has financed the GIZ's TRANSfer project that provides information to decision-makers about how to identify, measure and implement nationally appropriate mitigation actions (NAMAs) in the transport sector. NAMAs are discussed further in this document and additional information about the TRANSfer project can be found in the GIZ TRANSfer document "Navigating Transport NAMAs" that can be assessed at: http://www.transferproject.org

☞ For more information about NAMAs, please refer to GIZ *TRANSfer* Handbook *Navigating Transport NAMAs*: http://www.transferproject.org/index.php/hb.

4.3 Current financing flows and required shift towards sustainable low-carbon transport

National governments, bilateral assistance, MDBs and FDI have historically focused their funding priorities on infrastructure that benefits personal vehicles, while the private sector may invest in the operation of transport systems (Dalkmann *et al.*, 2013).

This situation is progressively changing. In June 2012, for example, eight MDBs made a commitment to invest USD 175 billion in the form of loans and grants to transport over the next decade and to increasingly focus on sustainable low-carbon transport in an effort to improve road safety, improve accessibility and mobility for the poor and to reduce transport-related GHG emissions (AfDB *et al.*, 2012).

4.3.1 Current financial flows

Table 19 identifies the key trends of financial flows in the transport sector, as well as the drivers of these trends.

The financing flows for the transport sector are as complicated as the landscape of funding sources. Data is not readily available to track financing flows, especially in the private sector. Figure 31 is a diagram of the money spent on transport from primary transport financial flows in recent years.

4.3.2 National public flows

Approximately USD 1 trillion is spent globally on transport investments per annum with the majority of

Table 19: Key trends and drivers of finance flows in the transport sector

	Key trends	Drivers of trends
Domestic public finance	■ Transport responsible for 1 to 12 % of all public expenditure in a typical country ■ National governments continue to be dominant source of funding ■ Majority of funding allocated to road building	■ Road infrastructure perceived as driver of economic growth ■ Road infrastructure considered to be a source of employment (*i.e.* for the construction industry) ■ Vehicle manufacturing regarded as strategic industry ■ Public policy often formulated by rich members of society ■ Strong consumer demand for private motorised vehicles (motorcycles and cars) due to rising income levels and availability of credit.
International public flows	■ Transport is a key target sector for MDBs and bilateral donors ■ Majority of transport lending goes to the road sector ■ Export credits used to support aviation and maritime transport	■ Focus on (export led) economic growth and infrastructure provision for poverty reduction ■ Lack of appetite from recipient countries for sustainable transport.
"Climate specific" international finance	■ Limited scale of climate funds ■ Limited applicability of CDM in transport ■ Increasing emphasis on NAMAs as a means to provide support for sustainable transport to developing countries	■ Shortage of overall resources for climate change mitigation ■ Difficulty in designing methodologies and eligible projects ■ Adopting a policy-based approach, NAMAs present the first substantive opportunity for sustainable transport to be supported by a UNFCCC mechanism.
Private flows	■ Directed towards goods, services and infrastructure which support the motorisation model of transport development	■ Exclusion of environmental and social costs from market prices ■ Investments in road building and motor vehicle manufacturing more lucrative to the investor compared to alternative, sustainable modes.

Source: Sakamoto *et al.*, 2010; Authors, 2013

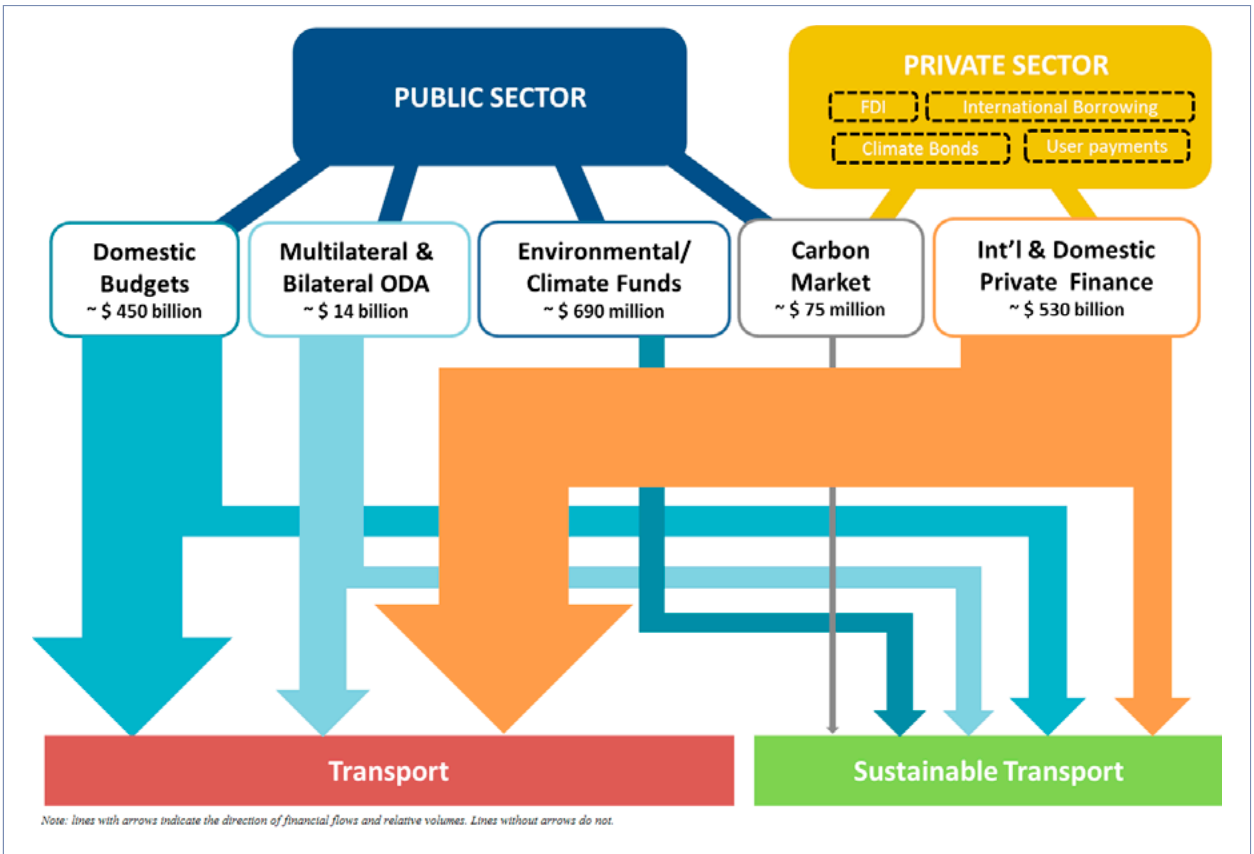


Figure 31: *Estimated annual financial flows in the transport sector.*
Source: Adapted from Sakamoto *et al.*, 2010. Updated by authors. Based on data from Dalkmann *et al.*, 2013; OECD, 2013a; Buchner *et al.*, 2012; UNFCCC, 2007; IMF, 2011

investments from domestic finance (public and private) (Sakamoto *et al.*, 2010).

Globally, domestic public finance dedicated to the transport sector accounts for approximately 5 % of the total national government expenditure (IMF, 2013). Transport's share in national budgets range from less than 1 % to more than 12 %, according to data from 2008 to 2011 (IMF, 2013).

4.3.3 International public flows

International public financing comes from ODA sources that include the funding from multilateral and bilateral assistance, climate funds and carbon credits from CDM and JCM.

Total annual transport ODA of USD 14 billion is approximately half bilateral (USD 7 billion) and half multilateral (USD 7 billion) (OECD, 2013a). Based on this OECD data, only about USD 3 billion of ODA funding was spent on mitigation activities in the transport sector.

ODA flows in transport are generally directed towards the construction of roads and intercity highways in urban areas. The World Bank, for example, has invested approximately USD 109.4 billion in transport projects between 1961 and 2010. Their investment in transport, specifically the construction of roads and highways, has increased significantly during this time period (O'Neill *et al.*, N/A). Other regional development banks have similar splits in their lending portfolios.

4.3.4 Private flows

Private investments are harder to track because they come from a multitude of sources, including financial institutions, institutional investors, and individuals, and may be distributed with or without intermediaries (IEA, 2012b). Contributions from the private sector can take the form of capital investments in infrastructure projects, contract operation of public transport systems, vehicle manufacturing and development, as well as informal transport (Zegras, 2006).

The World Bank and Public-Private Infrastructure Advisory Facility (PPIAF) have released an overview of global private investment in transport projects. In 2011, global private investments in medium and large scale transport projects reached USD 31.9 billion in 2011 of which USD 30 billion were investments in new projects and the remainder were investments in existing projects. The majority of private investments were spent on road, seaport and airport projects (WB-PPI, 2012).

4.3.5 *Future financial needs for sustainable low-carbon transport*

In the *Joint Statement to the Rio+20 United Nations Conference on Sustainable Development*, eight MDBs noted that the scale of investment that will be required to support sustainable transport in developing nations poses a significant challenge (AfDB, *et al.*, 2012). To stay below the 2 °C target, the estimated expenditures for mitigation actions in the transport sector from 2010 to 2050 will be USD 2.5 trillion annually for infrastructure (IEA, 2012d).

Domestic finance, private and public, provides over half of the share of financial resources for the transport sector. The financing shares by source for transport investment are presented in Figure 32. This chart also highlights that the MDB's contribution of USD 175 billion is insufficient amount in terms of annual contributions. While this is an unprecedented commitment by the MDBs, it is only a fraction of what is needed to finance sustainable low-carbon transport for the next ten years (Dalkmann *et al.*, 2013). However this funding can become instrumental to leverage more investment from other sources.

In order to have a meaningful impact on global transport projects, the national and local governments need to continue to leverage funding for sustainable low-carbon transport projects, while the private sector needs to commit greater investment. In addition to ODA, the international community must play a role in providing technical assistance, such as knowledge transfer of sustainable technologies and capacity-building, to developing nations in order to develop policies for sustainable transport (AfDB *et al.*, 2012).

An International Energy Agency report entitled *Global Land Transport Infrastructure Requirements: Estimating road and railway infrastructure capacity and costs to 2050* is a useful information paper that can be accessed at http://www.iea.org/publications/freepublications/publication/TransportInfrastructureInsights_FINAL_WEB.pdf.

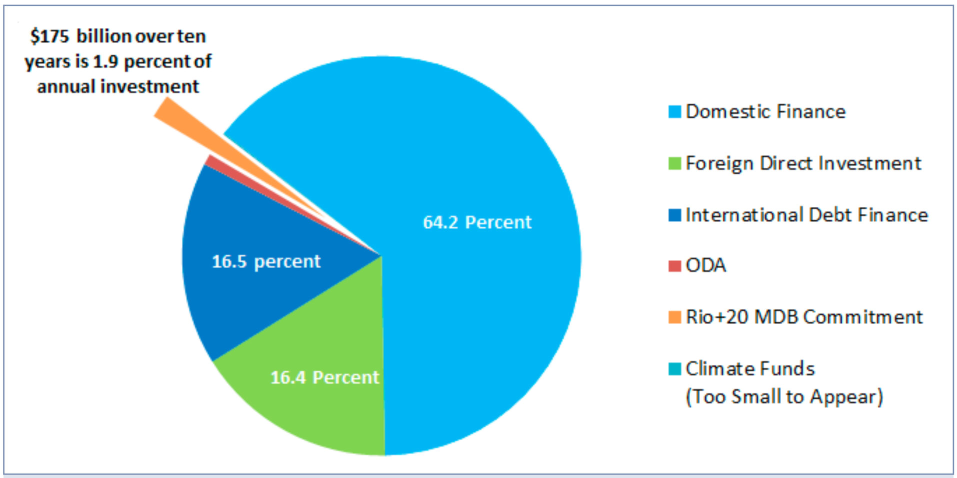


Figure 32: *Projected share of financing transport.*
Source: Authors, 2013

4.4 Developing a comprehensive financial strategy

As discussed in the previous section, the majority of finance for sustainable low-carbon transport activities does not come from climate funds but from more traditional sources of finance. Traditional funding sources are not always enough to fund sustainable transport activities and it is therefore necessary for climate funds to be "packaged" with these sources of finance in order to attract and provide sufficient financial support.

In recognition of the need for a comprehensive financial strategy to be established to support the development of sustainable low-carbon transport sectors in developing countries, this section outlines a number of the factors that need to be considered in order to increase access to funding and optimise the use of it.

4.4.1 Domestic budget re-allocation for sustainable low-carbon transport

The reallocation of domestic budgets can be a challenging task as there are a number of political and economic drivers that influence investment toward private motorised vehicle. These include the fact that road infrastructure is widely considered as a prerequisite for economic growth, there can be incentives (both real and perceived) for consumers to either purchase or aspire to purchasing motorised vehicles, and in some countries vehicle manufacturing is viewed as a strategic industry that needs to be supported (Sakamoto *et al.,* 2010). There is increasingly widespread recognition that this *status quo* has to change, and for this to translate into actual change in developing countries it has to be reflected in the allocation of transport budgets and specifically in the volume of finance dedicated to sustainable low-carbon transport.

It is by aligning domestic institutions and objectives that processes and funding can be streamlined to provide targeted support to climate change mitigation economy-wide but with a focus on any particular sub-sector, such as transport, that is considered nationally appropriate (UNDP, 2013). A number of developing countries have established National Climate Funds (NCFs) to support the collection, coordination and combination of funding sources in an effort to redirect the financial flows toward climate change mitigation activities. The Indonesia Climate Change Trust Fund (ICCTF) is an example of a national fund that has been established to facilitate investment in nationally appropriate climate change activities (ICCTF, 2013).

Box 20: Driving transport development from domestic source

India

In response to the crisis of urban development in India, the federal government created the Jawaharlal Nehru National Urban Renewal Mission (JnNURM) in 2005. The programme, a cross-agency initiative administered by the Ministry of Urban Development (MoUD), provides financing and technical assistance to 63 large cities across the country. The programme obliges cities to enact reforms legal and regulatory reforms, including the development of financing and implementation models for urban infrastructure projects, as a prerequisite for national assistance. To leverage the domestic support for urban infrastructure, the 63 JnNURM cities and the MoUD, submitted proposals to the GEF for technical assistance, capacity building, and physical investments to support efficient and sustainable bus transport. Ten cities received over USD 295 million in financing from a GEF grant and a World Bank loan. (MoUD, 2013)

Mexico

The Mexican government created the Federal Mass Transit Programme (PROTRAM) in 2009 as part of a National Infrastructure Fund. The programme supports mass transit infrastructure in large cities through federal loans and grants. PROTRAM was designed to be complimentary to the new National Urban Transport Transformation Project, an initiative of the World Bank that supports capacity-building and integrated planning at the local level. In 2012, the government's PROTRAM activities were submitted as a pilot NAMA to the UNFCCC with the help of Ecofys and EMBARQ Mexico. The bilateral NAMA secured USD 1 million from the World Bank's PMR fund in 2013. Those funds will ensure the cooperation and coordination of federal ministries in the implementation of the PROTRAM programme. (CTS Mexico, 2012)

☞ For information on a variety of financing and planning practices worldwide, please see GIZ/EMBARQ (2013) *Financing Sustainable Urban Transport, International Review of National Urban Transport Policies and Programmes*. While focusing on decision-makers in China, the study is also relevant for other countries facing similar challenges. It presents insights into financing arrangements for urban transport in eight countries: Brazil, Colombia, France, Germany, India, Mexico, The United Kingdom and the United States of America. Download the study at: http://www.sutp.org/documents/Further-Download/giz_embarq_sut-financing_international-review.pdf.

4.4.2 Combining and blending sources of finance

In order to develop a comprehensive, multi-tiered financial strategy for the transport sector, decision-makers need to understand what types of financing are available and how to "package" these sources to sufficiently fund their sustainable transport activities. There are three approaches to creating a "package" of financing sources: combine, blend and leverage.

The term "combined" is a synonym for "packaged" and refers to activities that are co-financed by funding from multiple sources. "Blending" refers to a specific form of packaging, and is the process of combining grants and loans to finance projects, often used as 'blending mechanisms' or 'blending facilities.' The grant component complements the commercial rates of loans, and subsequently reduces the total cost of capital. The blending of finance can serve to make a project financially viable, and ensure a high leverage of grant funds. The concept of leveraging is covered in the next section.

4.4.3 Leveraging public national money and private finance

Domestic public finance can be used to encourage (leverage) private investment. The availability of public finance can reduce the perceived level of risk for the private sector, thereby making it more attractive to private sector investors. The blending of finance, which can increase the affordability of debt instruments, can also, for example, leverage private sector investment, thereby supporting the combination of a larger number of sources of finance.

Private finance is an integral component of financial strategies. In 2011, FDI investments in the transport sector reached USD 42 billion, which is a higher volume than was received from ODA and climate funds combined (ITC, 2013). It is therefore necessary that the public sector recognises the role that it can play in leveraging additional private funding.

☞ For more information about the nature of the framework that can be adopted to increase access to private climate finance for sustainable low-carbon transport, refer to the GIZ Technical Document: Transport Readiness for Climate Finance (2013) available from: http://www.transport2020.org/publicationitem/2052/new-giz-btg-publication-transport-readiness-for-climate-finance.

4.4.4 Institutional framework

In preparation for seeking out additional funding for sustainable low-carbon transport activities, local governments need to identify regulatory and institutional processes, structures and procedures that may affect the coordination of climate finance activities. In order to leverage climate financing, a regulatory and institutional framework that is effective, stable and accountable must exist (PMR, 2011). Additionally, the effective participation and coordination of governmental planning institutions is a critical precondition to prepare for climate finance (ODI, 2012).

The majority of funding from climate finance sources can only be accessed at the national level and then filtered down to lower jurisdictions where projects are implemented. Since local governments often have limited access to these climates funding sources, coordination between the levels of governments is key. This process may be challenging because cities are often not involved in national climate change dialogues or policies. In addition, the political, economic and emissions boundary of a city are difficult to reconcile and city governments have varying levels of autonomy (Lefevre, 2012). However, ensuring coordination between the national government and the local authorities is essential to enforce effectiveness and accountability.

It is also important to implement cross-sectoral coordination because low-carbon development is multi-sectoral. To ensure that the resources and responsibilities to implement a climate-resilient project are properly allocated, it is necessary to collaborate across all sectors of the government (ODI, 2012). Climate financed projects, especially in the transport sector, should also be incorporated into broader low-carbon development strategies. If coordination efforts are lacking across the government sectors, this may lead to the impairment of the effectiveness of the projects due to fragmentation and may lead to duplication of efforts by departments.

5. Summary

Climate change is projected to have major impacts globally, environmentally, socially and economically. The consequences of climate change are predicted to be particularly severe for developing nations, which often already face more extreme climatic conditions and in many cases will not have the means to adapt to the predicted climatic changes.

At present, climate change mitigation may not have a high priority in many developing cities as development problems seem to be much more pressing for many national and municipal authorities. Climate change mitigation in the transport sector may appear to be particularly burdensome as it is closely related with economic activities and personal mobility.

Transport is a main source of GHG emissions and is projected to continue to be a major contributor. Meeting the transport needs of growing populations is getting more and more difficult in many developing cities. Some municipal authorities have started to realise that the reliance on the private motorised vehicles cannot be the solution in the long run. The rate of urbanisation and development of cities means that taking action to design for sustainable transport is both a matter of urgency and a long-term commitment.

However, implementing climate change mitigation should not exclusively be viewed as a burden but it can also be an opportunity to promote sustainable low-carbon urban transport solutions. Sustainable low-carbon urban transport will help reduce GHG emissions but it also has a significant potential to improve the urban living conditions and the competitiveness of cities.

To reduce emissions from the transport sector, decision-makers should first identify and set policy objectives, and then agree on a systematic approach to achieve them. The ***Avoid-Shift-Improve (A-S-I)*** strategy can be used by decision-makers to develop policy objectives aimed at reducing GHG emissions from vehicle travel. This *Sourcebook* module presents a variety of instruments such as land use planning, parking policies, and road pricing that can support these policy objectives.

Figure 33: *Midday in Santiago: Air pollution during a clear day.*
© Jan Schwaab, Santiago, 2004

Table 20: Sustainable transport instrument overview 1 – Level of implementation and responsible/interested stakeholders

Type of instrument		Level of implementation			Responsible/interested stakeholder									
		National	Regional	City	Mayor/Equivalent	Transport Authorities (including public works)	Land use/planning authorities	City Administration (treasury/finance/taxation)	Public relations, Press and Media	Enforcement Authorities (police, others)	Non-Governmental Organisations (NGOs)	Private Sector (Industry/ commercial)	Private sector – Public Transport Operators	Private Sector – Employers
Planning	Land Use Planning		✔	✔	✔		✔						✔	✔
	Public Transport		✔	✔	✔	✔	✔		✔		✔		✔	✔
	Non-Motorised Modes			✔	✔	✔	✔		✔		✔			✔
Regulatory	Physical Restraint Measures			✔	✔	✔	✔		✔	✔			✔	
	Traffic management Measures			✔		✔	✔		✔	✔			✔	
	Regulation of Parking Supply		✔	✔		✔			✔	✔				✔
	Low Emission Zone		✔	✔	✔	✔			✔	✔	✔	✔	✔	
	Speed Restrictions	✔		✔		✔			✔	✔				
Economic Instruments	Road Pricing	✔	✔	✔	✔	✔		✔	✔	✔	✔		✔	
	Fuel Tax Implementation/ Increases	✔						✔		✔				
	Vehicle Taxation	✔						✔		✔				
	Parking Pricing		✔	✔				✔	✔	✔				
Information	Public Awareness Campaigns	✔	✔	✔	✔	✔			✔		✔		✔	✔
	Driver Behaviour Training and Education/Eco-Driving	✔	✔	✔		✔			✔		✔		✔	✔
Technology	Cleaner Production	✔				✔			✔		✔	✔	✔	
	Cleaner Technology	✔				✔			✔		✔	✔	✔	

✔ = indicates level of implementation and responsible/interested stakeholders

Table 21: Sustainable transport instrument overview 2 – Contribution to greenhouse gas reductions, estimated costs, co-benefits and implementation considerations of instruments

Type of instrument		Contribution to reduce greenhouse gas emissions	Potential cost of Implementation	Co-benefits/negative (+ ? –)	Implementation considerations for responsible authorities
Planning	Land Use Planning	##	$	+ Accessibility, social inclusion, air pollution	
	Public Transport	# - ###	$$	+ Accessibility, mobility, economy	Service coverage/frequency, cost
	Non-Motorised Modes	# - ###	$ - $$	+ Safety, accessibility, mobility, social inclusion, economy, air pollution	Safety
Regulatory	Physical Restraint Measures	## - ###	$ - $$$	+ Safety, air pollution, noise ? accessibility, mobility, social inclusion, economy	Traffic displacement, restricted access/mobility, alternative modes provision, enforcement
	Traffic management Measures	## - ###	$ - $$$	+ Safety ? accessibility, mobility, social inclusion, economy, air pollution	Traffic displacement, restricted access/mobility, alternative mode provision, enforcement
	Regulation of Parking Supply	# - ##	$ - $$	+ Air pollution ? accessibility, mobility, social inclusion, economy	Traffic displacement, restricted access/mobility, alternative mode provision, illegal parking/ obstructions, enforcement
	Low Emission Zone	# - ##	$$ - $$$	+ Safety, local air pollution, noise ? accessibility, mobility, social inclusion, economy	Traffic displacement, restricted access/mobility, alternative mode provision, enforcement
	Speed Restrictions	# - ##	$ - $$	+ Safety, air pollution, noise ? accessibility, mobility, social inclusion, economy	Enforcement
Economic Instruments	Road Pricing	# - ##	$$ - $$$	+ Safety ? accessibility, mobility, social inclusion, economy	Traffic displacement, restricted access/mobility, equity impacts, enforcement, cost
	Fuel Tax Implementation/ Increases	#	$$	– Mobility, equity	Level of tax, enforcement
	Vehicle Taxation	#	$$	– Mobility, equity	Level of tax, enforcement
	Parking Pricing	# - ##	$ - $$	+ Safety ? Accessibility, mobility, social inclusion, economy	Traffic displacement, restricted access/mobility, alternative mode provision, illegal parking/ obstructions, enforcement, cost
Information	Public Awareness Campaigns	# - ##	$ - $$	+ Accessibility, mobility, air pollution	
	Driver Behaviour Training and Education/ Eco-Driving	# - ##	$ - $$	+ Safety, air pollution	
Technology	Cleaner Production	## - ###	$$$	+ Air pollution	
	Cleaner Technology	## - ###	$$$	+ Air pollution, noise	

#	= Small contribution	$	= Low cost	+	= positive
##	= Medium contribution	$$	= Medium cost	?	= unclear
###	= High contribution	$$$	= High cost	–	= negative

Table 20 summarises the sustainable transport instruments discussed in this *Sourcebook* module. The table indicates the level at which the instruments should be implemented and the key stakeholders that need to be involved.

Table 21 compiles the potential GHG emission reductions and the cost implications when applying the instruments. The table also presents the co-benefits, potential negative effects and some implementation issues to be considered by the relevant authorities.

It is rare for one instrument to tackle all transport issues or meet all of the policy objectives; therefore, it is important to develop a comprehensive policy strategy that is coherent and integrated and packages various instruments in order to achieve maximum results that promote sustainable transport and reduce GHG emissions. The comprehensive approach that sustainable urban transport policies offer is a way forward to meet the needs for transport and mobility in an environmentally, socially and economically sustainable way.

Decision-makers at the local and national level may have concerns about financing more sustainable low-carbon transport alternatives. However, wider socio-economic benefits of sustainable mobility will outweigh their cost and international climate and development funds may also help initiating this shift. The instruments detailed in this *Sourcebook* can be implemented within a comprehensive framework through a variety of funding opportunities that can offer direct funding and/or be used to leverage additional support.

This *Sourcebook* module presents a variety of financial opportunities available to support the implementation of sustainable low-carbon urban transport instruments. It introduces "non-climate specific" and "climate specific" funding sources that include various individual and collective partners from the public and private sectors at the international and national levels.

Investing in sustainable low-carbon urban transport makes cities more competitive and a desirable place to live, work and visit. A win-win solution is thus possible for the transport sector, which should be backed and promoted by the policy-makers in the developing cities of the world. Sustainable low-carbon urban transport policies will not only improve local transport, quality of life and reduce GHG emissions, they can also support competitiveness and economies.

Figure 34: *The sun setting over Washington, D.C.*
© Armin Wagner, Washington, 2007

Resource materials

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Abbreviations

°C	Degree Celsius
ADB	Asian Development Bank
AFD	*Agence Française de Développement* (French Development Agency)
AfDB	African Development Bank
ASI	Avoid-Shift-Improve
ASIF	Activity-Mode Share-Fuel Intensity-Fuel Type
BaU	Business as Usual
BMU	*Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit* (German Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety)
BRT	Bus Rapid Transit
C40	Communities Climate Leadership
CCF	Climate Change Fund
CDM	Clean Development Mechanism
CEFPF	Clean Energy Financing Partnership Facility
CER	Certified Emission Reductions
CH_4	Methane
CIFs	Climate Investment Funds
cm	Centimetres
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2eq	Carbon dioxide equivalent
COP	Conference of the Parties
CSP	Platform for Climate Smart Planning
CTF	Clean Technology Fund
DEA	Durban Platform for Enhanced Action
EC	European Commission
EKF	Germany's Energy and Climate Fund
ERU	Emissions Reduction Unit
ETS	Emissions Trading System
EU	European Union
EV	Electric Vehicle
FDI	Foreign Direct Investment
FSF	Fast-Start Finance
GBP	Pound sterling (Great Britain)
GCCA	Global Climate Change Alliance
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environment Facility
GGKP	Green Growth Knowledge Platform
GHG	Greenhouse Gas
GIZ	*Deutsche Gesellschaft für Internationale Zusammenarbeit* (German International Cooperation)

GLA	Greater London Authority
$GtCO_2eq$	Gigatonnes of carbon dioxide equivalent
HFCs	Hydro fluorocarbons
ICCTF	Indonesia Climate Change Trust Fund
ICI	International Climate Initiative
IDB	Inter-American Development Bank
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change
ITDP	Institute for Transportation and Development
JC	Joint Committee
JCM	Joint Crediting Mechanism
JI	Joint Implementation
JICA	Japan International Cooperation Agency
JnNURM	Jawaharlal Nehru National Urban Renewal Mission
KfW	*Kreditanstalt für Wiederaufbau* (German Development Bank)
km	Kilometres
LAC	Latin America and the Caribbean
LDCF	Least Developed Countries Fund
LEDS GP	Low-Emissions Development Strategy Global Partnership
LEZ	Low-Emission Zones
LPG	Liquid Petroleum Gas
LUTI	Land-use transport integration
MACC	Marginal Abatement Cost Curve
MDB	Multilateral Development Bank
MEDEC	Low-Carbon Development Scenario Analysis in Mexico
MoUD	Ministry of Urban Development
MRV	Measurement, reporting and verification
N_2O	Nitrous oxide
NAMA	Nationally Appropriate Mitigation Action
NCF	National Climate Funds
NF_3	Nitrogen Fluoride
NGO	Non-governmental organisation
NMT	Non-motorised transport
NO_X	Nitrogen oxides
OECD	Organisation for Economic Co-operation and Development
PFCs	Per fluorocarbons
PIF	Project Identification Form
pkm	Passenger kilometre
PM	Particulate matter
PMR	Partnership for Market Readiness
PoA	Programme of Activities
ppb	Parts per billion
PPIAF	Public-Private Infrastructure Advisory Facility
ppm	Parts per million
PPP	Public Private Partnerships
ppt	Parts per trillion
PREIT	Planning, Regulatory, Economic, Information, Technology
PROTRAM	Federal Mass Transit Program (Mexico)
PT	Public transport
REST-AP	Regional Environmentally Sustainable Transport Action Plan
SCCF	Special Climate Change Fund
SECCI	Sustainable Energy and Climate Change initiative
SF_6	Sulphur hexafluoride
SOx	Sulphur oxide
SUTP	GIZ Sustainable Urban Transport Project
TDM	Transportation Demand Management
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
USD	United States Dollar
USAID	United States Agency for International Development
VER	Voluntary Energy Reduction
WRI	World Resources Institute

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Sector Project ‘Transport Policy Advisory Services’
Dag-Hammarskjöld-Weg 1-5
65760 Eschborn, Germany
Tel. +49 (0) 6196 79-0
Fax +49 (0) 6196 79-1115

transport@giz.de
www.giz.de/transport

Authors
Holger Dalkmann and Charlotte Brannigan (C4S)
Updated module: Benoit Lefevre and Angela Enriquez (WRI)
With contributions from:
P. Sivell, J. Leben, S. Reeves (C4S)
K. Kebeck (Wuppertal Institute)
Daniel Bongardt, Sascha Thielmann and Jonathan Gomez (GIZ)

Manager
Manfred Breithaupt

Editing
Sascha Thielmann
Updated module: Jonathan Gomez

Design and layout
Klaus Neumann, SDS

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Division Water; Energy; Urban development

Addresses of the BMZ offices

BMZ Bonn
Dahlmannstraße 4
53113 Bonn, Germany
Tel. +49 (0) 228 99 535 – 0
Fax +49 (0) 228 99 535 – 3500

BMZ Berlin
Stresemannstraße 94
10963 Berlin, Germany
Tel. +49 (0) 30 18 535 – 0
Fax +49 (0) 30 18 535 – 2501

poststelle@bmz.bund.de
www.bmz.de