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**BEYOND THE FOSSIL CITY:**  
**TOWARDS LOW CARBON TRANSPORT AND GREEN GROWTH**

**(Plenary Session 1 of the Provisional Programme)**

**Final Draft**

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This background paper is prepared by Daniel Bongardt, Manfred Breithaupt and Felix Creutzig, Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, for the 5<sup>th</sup> Regional EST Forum in Asia. The views expressed herein are those of the authors only and do not necessarily reflect the views of the United Nations.

# Beyond the fossil city: Towards low carbon transport and green growth



*Daniel Bongardt, Manfred Breithaupt and Felix Creutzig*  
Eschborn, August 2010

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## **Abstract**

Transport is a fast growing sector. A steadily increasing motorization along with urbanization is a trend that can be observed in most developing countries. This and the oil dependence of the transport sector leads to considerable growth rates of carbon emissions. Action to stop this trend is urgently needed. This paper shows how national and/or urban low-carbon transportation policies could help countries to win the battle and achieve a smart, sustainable economic growth while at the same time stabilizing and later reducing transport emissions. Sustainable Development Policies and Measures in the transport sector include a variety of co-benefits, e.g. reduced air pollution, social equity and economic development. In the context of the global economic crisis such measures promote economic growth, social stability and also can be implemented at reasonable costs.

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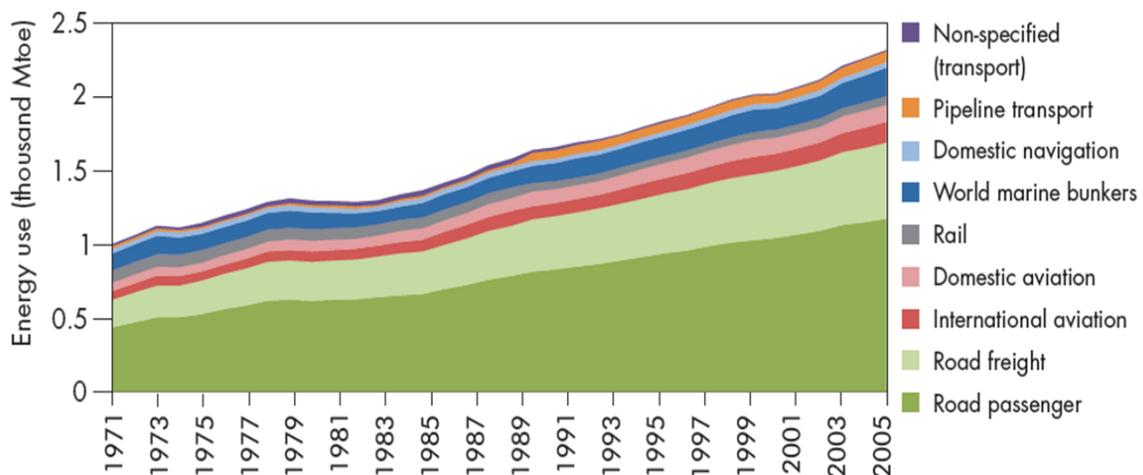
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## 1 The Challenge

While transportation is crucial to the economy and individuals, as a sector it is also a significant source of greenhouse gas (GHG) emissions and can affect human welfare negatively. Transport is currently responsible for 13% of all world greenhouse gas emissions and 23% of global carbon dioxide emissions (CO<sub>2</sub>) from fuel combustion are transport related (International Energy Agency, 2008). Transport related CO<sub>2</sub> emissions are expected to increase by 57% worldwide in the period 2005 – 2030, much more than emissions from any other sector. But there is consensus in science and politics that global GHG emissions must be reduced by more than 80% by 2050 from 1990 levels in order to avoid catastrophic global warming. Contrasting the current growth rate of transport-related emissions with aspired reduction targets, it is clear that the transport sector needs to contribute to mitigation efforts now.

Between 1990 and 2005, transport energy consumption increased by 37%, and was the fastest growing end-use sector. The associated CO<sub>2</sub> emissions rose broadly in line with this increased energy use to reach 5.3 Gt. Within transportation, road transport is by far the largest energy user and accounted for 89% of total transport energy use in 2005 (IEA, 2008). Road transport is also the main contributor to increased transport energy use. While non-road modes increased their energy consumption by 13% between 1990 and 2005, road transport energy use rose by 41%. In Figure 1 the increasing amount of the different transport sub-sectors over the years is presented.

**Figure 1: World Transport Energy Use by Mode, 1971-2006**



Source: (IEA, 2009)

In the USA, a very automobile-dependent world region, the transportation sector directly accounted for about 30 percent of total GHG emissions in 2006, making it the second largest source of GHG emissions, only behind electricity generation (34 percent). Around 60 percent of global road transport emissions currently originate from North America and Western Europe.

In Asian countries GHG emissions from the transport sector constitute a smaller proportion of national total emissions. For example, in China 7% of energy-related CO<sub>2</sub> emissions were from transport in 2007 (IEA 2009). Trends in energy use by transport mode vary significantly amongst countries and regions. On average, the growth in non-OECD countries (+55%) was faster than in OECD countries (+30%). The large increase in non-OECD countries is in part attributable to the rapid economic growth of several major countries, creating

- increased personal disposable incomes,
- higher vehicle ownership and
- increased need for freight transportation.

For instance, China, tripled its energy consumption in the transport sector between 1990 and 2005 and now is just behind the USA and Europe on the third rank in terms of transport related GHG emissions (IEA, 2008). Hence, imminent global warming requires action in developed and developing countries alike. In contrast, in Germany, with very high fuel prices, GHG emissions from transport first stabilized and are now reducing year by year slightly over the last 8 years.

To meet long-term climate targets, developed countries should reduce greenhouse gas emissions by 80 to 95% until 2050 compared to 2000 levels. But also non-OECD countries need to reduce their GHG emissions significantly by 2050. It is also clear that OECD countries have a bigger responsibility and need to support the developing world in this undertaking.

Low-carbon transport is confronted with a number of barriers that need to be encountered by strategic action. These barriers are:

1. **Time-lag between decisions and effects:** Some measures require a long-term approach that only takes effect when continuity in political decision-making is achieved.
2. **Cross-cutting** nature of transport: Many decisions in other sectors influence transport demand. Integrated decision-making is needed.
3. **Fragmented** target group: Everybody and all social groups have mobility needs. The sources of emissions are rather small, so there is a need to bundle measures.

Current models of development promote the automobile as symbol of well-being and societal advance. Unfortunately, this so-called 'American way of life' is doomed to fail in times of increasing resource and oil scarcity. This is especially true for cities that have never evolved around the automobile. In fact, such an automobile-centered development is outdated and can be superseded by a truly modern society that is sustainable in the environmental but also in the economic sense and promotes social stability. At the moment, many industrialized countries struggle to overcome the automobile dependence and face strong difficulties to turn back, while an increasing number of industrialized cities are in the process to break the trend. In light of this experience, it becomes even more important for developing countries to not end up in the same trap but choose a more sustainable path – not only to combat climate change but to develop a reliable and convenient transport system, and to improve the local environment.

## 2 Vision and Opportunities

Low-carbon transportation is not a burden but increases livability and well-being, providing many other advantages. Low-carbon strategies or roadmaps are thus providing an avenue for a modern, sustainable and stable society.

Figure 2: Freiburg, Germany, is an example of a livable city



Photo: Andrea Broaddus, 2007

A low-carbon transportation infrastructure that follows the principle of sustainable development not only mitigates climate change but also realizes the following co-benefits:

- Increases **energy security** as less oil needs to be imported. Resource conflicts can be avoided and transport users won't have to suffer from fuel price shocks;
- reduces traffic congestion, and consequently air pollution and noise are reduced, having a positive impact on the **environment** and **human health**;
- **reduces land demand** by preventing urban sprawl and preferring semi-dense mixed-use neighbourhoods;
- provides visibility and acknowledgement of cities that demonstrate leadership: sustainable and modern low-carbon transportation systems increase the **competiveness and attractiveness** of cities and attract

top companies, highly qualified workers and employees into the country (see Mercer Liveability Index);

- pending on future climate change agreements - cities and countries that achieve mitigation beyond baseline scenarios gain access to emission certificates and carbon related **funding** schemes;

Last but not least, there is a **political co-benefit**: Citizens will recognize that convenient and high quality public transport and non-motorized transport infrastructure will save money and time. In London the popular mayor Ken Livingstone was elected mainly because of his innovative transport policies.

Important abatement policies such as decisions on land-use development do not necessarily require high investments. Technological fuel-based mitigation solutions have been reported to cost between US\$150 to US\$3500/ton CO<sub>2</sub>, whereas modal share improvement produces only emission reduction cost between US\$14 and US\$66/ton CO<sub>2</sub> (Wright and Fulton, 2005). In this regard, low-carbon transport measures and efficient transport services are a considerable opportunity and safe-guard for the future (IEA, 2009).

Elements of a vision for a low carbon transport system are:

- dense but green and mixed used cities that allow white collar jobs, shopping and leisure facilities close to people's living quarters;
- modern, high quality links between the centers and good integration of long-distance hubs with local transportation;
- high quality alternatives to individual car-use, especially efficient public transport and good non-motorized transport infrastructure and its proper integration;
- efficient, inter-modal freight transport and smart urban logistics that also includes clean vehicles;
- advanced technologies such as electric/gasoline hybrid engines, alternative fuels or even electric motorbikes and cars.

There is a high need to manage transport demand in order to make the best and most cost-efficient use out of valuable land and infrastructure. Examples like Zurich, Vienna, London, Paris, New York, Hong Kong, Singapore and many others demonstrate that economic success is directly linked to advanced, sustainable transport systems. Moreover, a higher share of alternative transport modes is directly related to less pollution from cars and less CO<sub>2</sub> emissions. This has a positive impact on air quality and reduces the contribution of transport related emissions to climate change.

In Table 1 the modal share for public transport and non-motorized transport means, as well as the CO<sub>2</sub> emissions per capita per year for different cities, is presented. These figures show how a high share of alternative transport modes is directly related to less CO<sub>2</sub> emissions.

**Table 1: CO<sub>2</sub> emissions from passenger transport vs. modal split in selected cities.**

	% of public transport, walking and cycling	CO <sub>2</sub> emissions (kg per capita per year)
Houston	5%	5690 kg
Montreal	26%	1930 kg
Madrid	49%	1050 kg
London	50%	1050 kg
Paris	54%	950 kg
Berlin	61%	774 kg
Tokyo	68%	818 kg
Hongkong	89%	378 kg

Source: UITP

Instruments and tools are available but political action and good management is required on all levels. Particularly, instead of focusing on specific technological options, a systemic approach can facilitate enduring transport systems and realize several co-benefits.

In fact, many cities demonstrate that a well designed public transport system and non-motorized transport infrastructure are important tools to trigger economic success. In the next chapter, strategic approaches are developed that enable decision-makers to go forward. This includes the development of policy packages and roadmaps for implementing the packages.

**Figure 3: A pedestrian street in Singapore**



Photo: Carlos Pardo, 2008

### 3 Towards Low-Carbon Transport: Avoid/Reduce – Shift – Improve

To achieve significant emission reductions and realize a sustainable and attractive infrastructure, novel and innovative approaches are required. In general, greenhouse gas emissions in the transport sector can be reduced through a number of measures and approaches which will be discussed below.

Figure 4: Low-carbon transport modes in Hangzhou, China



Photo: Karl Fjellstrom, 2006

Ambitious emission reduction targets can best be reached when all factors contribute to mitigation simultaneously. According to current projections, the carbon content will be reduced and energy efficiency will improve only marginally, while travel demand further explodes in developing countries. A low-carbon transportation system needs more than a piecemeal approach and requires improvement in all dimensions – travel demand, mode choice, and technology – simultaneously to quickly gain traction.

Figure 5: Infrastructure for plug-in vehicles in San Francisco



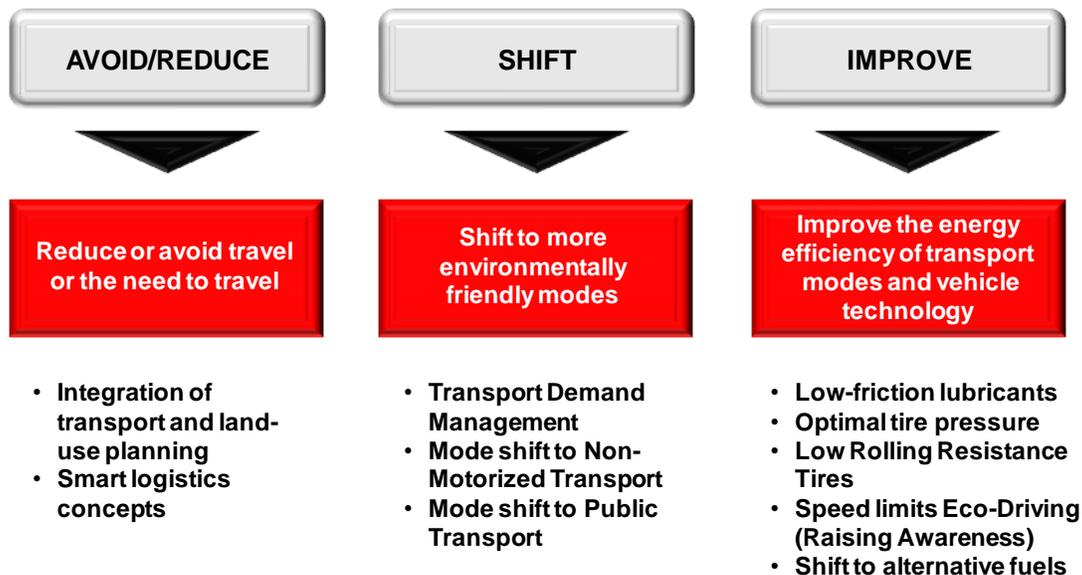
Photo: Felix Kramer, 2009

A main framework for strategic action is the so-called Avoid/Reduce-Shift-Improve approach (GTZ, 2007), where infrastructure is provided in such a way that:

- future travel demand is reduced or avoided,
- travel is shifted to more economic and environmental-friendly modes,
- technological measures improve the vehicle fleet and fuels.

Such a coherent approach has the potential to contribute to emission reductions beyond current expectations. It also would transcend current piecemeal measures such as introducing a few but very expensive hydrogen busses. Instead, sector-wide policies and city-wide schemes can achieve reasonable scales.

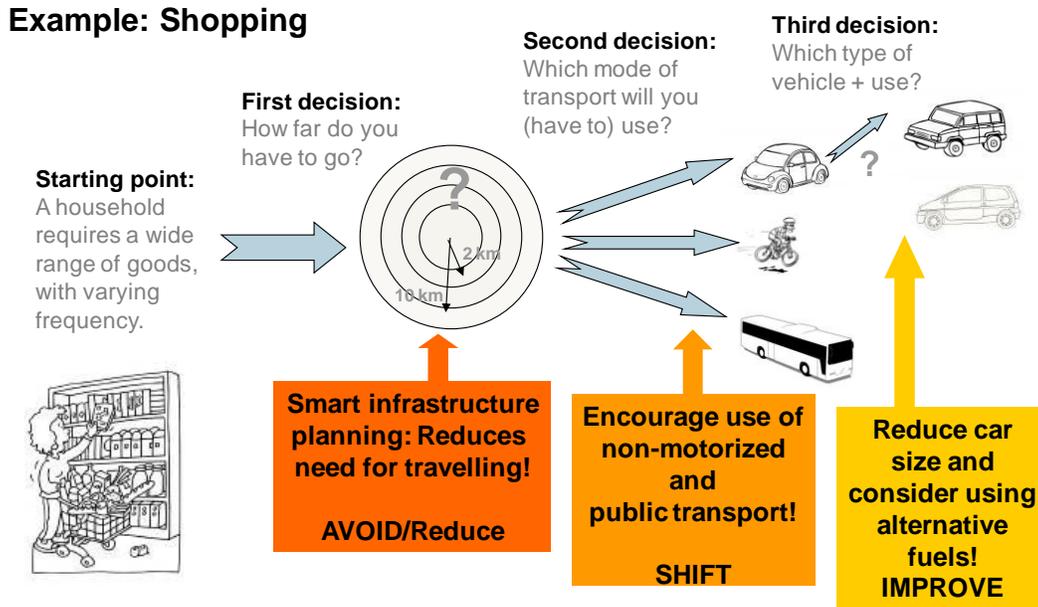
Figure 6: the GTZ approach: Avoid/Reduce-Shift-Improve



Source: GTZ

Avoid/Reduce-Shift-Improve is an important and innovative agenda for OECD and non-OECD countries. Developing countries often have the opportunity to develop sustainable infrastructure in growing cities, maintain high shares of traditional, low-carbon modes, while at the same time “leapfrog” to environmentally-friendly technologies. In contrast to particularly North America, transport infrastructure is often newly constructed and car ownership is in many cases relatively low. By enabling a less car-dependant mobility, developing countries can successfully avoid the high-level of car-dependency and carbon-lock-in syndromes in politics and society.

Figure 7: Traffic generation and carbon emissions: What aspects should we concentrate on?



Source: GTZ

Figure 8: Congestion charging in Singapore influences travel behaviour



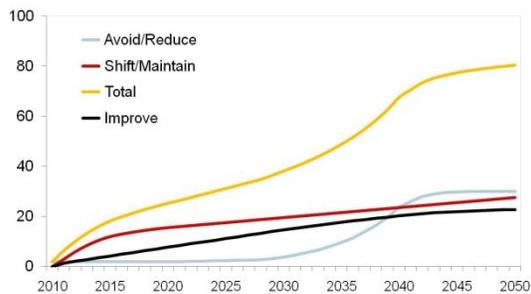
Photo: Carlos Pardo, 2008

For changing the paradigm there are three relevant time-frames.

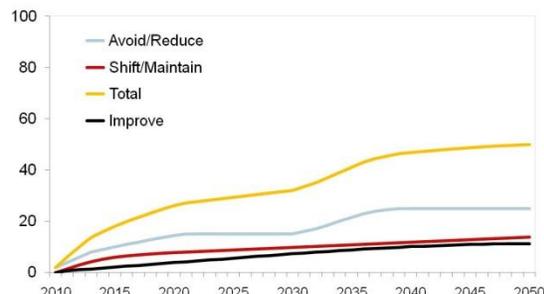
- A short term time-frame is related to immediate behavioral changes. For example, one can economize on the number of trips and do most errands in one round. Such behavioral changes are mostly induced by price signals and informative measures.
- A medium term time-frame addresses vehicle technology. It is determined by the life span of automobiles, the speed of phase-in and the percentage of 'efficient' cars bought in a specific year. Altogether, this time-span is approximately 10-15 years.
- A long time-scale is determined by infrastructure decisions. For example, peripheral land can be developed into low-density suburbia, or clearly structured with pericenters, semi-autonomous service and shopping infrastructures and mass rapid transit system. In suburban areas, inhabitants are highly dependent on cars. Cities can be car-friendly with huge arteries and abundant parking space, or they can be pedestrian and bicycle friendly with walkable neighbourhoods. Mostly, both designs are not compatible with each other. This time-scale is dominated by a) political decisions to promote car-dependent or non-motorized-friendly infrastructures and b) relocation decisions by citizens (both are mutually dependent on each other).

**Figure 9: The potential of emission reduction with the Avoid-Shift-Improve approach**

*How to achieve 80 percent GHG emission reduction by 2050 (developed cities)?*



*How to achieve 50 percent GHG emission reduction by 2050 in developing cities?*



In the long run, infrastructure decisions are particularly important since most expected emissions growth from road transportation in the business-as-usual scenario comes from additional demand created in developing countries. Particularly in these countries many investment decisions on road infrastructure and land-use development are currently taking place. Even with a substantial emphasis on fuel-efficient cars, infrastructure decision can lock China, India and other countries into a fragile situation.

## 4 Policy Packages for Sustainable Development

In many cases, policy packages or sets of measures produce considerable synergies that lead to an overall effect that goes beyond the sum of their singular impacts. This is especially important when it comes to sustainable development in the transport sector. Sustainable transport policies consist not only of a set of measures but also target a coherent set of goals. Climate change is crucial for many Asian cities, as their Himalayan water supply melts away or they face the danger of rising sea-levels, floods or droughts. However, in many cities, climate change is in the short-term not the most relevant issue.

Low-carbon policies must be integrated with goals that are relevant for sustainable development within the city. For some cities, clean air will be the main target. For other cities, congestion relief and more reliable transport, but also higher accessibility for all parts of the population may be crucial. A sustainable transport system may also attract business and tourists that value high life quality. Individual policy instruments were introduced in the “Transport and Climate Change” module (GTZ, 2007) but also in other GTZ modules such as Transport Demand Management.

In the following paragraphs, we discuss policy packages: a set of instruments that evolve synergistically when deployed together on two levels: the national arena and the urban scale. The urban perspective is of particular interest, as many development decisions on infrastructure that create or avoid additional car-travel demand are made in cities. However, there is a need that urban policies are designed in coherence with national policies that (a) influence technology development and diffusion, (b) enable pricing and competitiveness of low-carbon modes and last but not least (c) improve long distance freight and passenger transport. Furthermore, the national level is important to assist local decision-makers through investment programmes or capacity development.

### 4.1 The national policy packages

National governments can implement direct measures and enable local low-carbon policies. The spectrum of possible policies is displayed in Table 1 and structured along three policy packages. They are built on each other and demonstrate a step by step development of a sustainable transport policy. However it must be noted that each single policy needs to evolve over time and should be adapted to the stage of development. E.g. fuel efficiency standards need to get tighter over time, and investment programmes for urban transport needs to be upscaled or adapted to the most recent approaches.

It is not easy to quantify the impact of each of the measures as they are interdependent and different time-frames are involved. In general and as a hint, we assume that by each stage and upgrade of the policy package countries are able to cut carbon emissions by 20-40 percent against *business as usual scenario* within a timeframe of 40 years. This sums up to savings of 50-80 percent until 2050 for those implementing an advanced reduction package.

Table 2: National Level Policies and Packages

Policies	Basic Package (implemented in all countries also in least developed countries)	Advanced (for advanced countries that face rapid development of car-ownership)	Deluxe Package (for most developed countries with high levels of motorization)
<b>1. Removal of fuel subsidies</b> Remove incentives for non-sustainable transport modes			
<b>2. Fuel taxation above European minimum taxation level.</b> Give incentives to travel less, use low carbon modes and purchase fuel efficient vehicles			
<b>3. Low carbon long distance infrastructure</b> Earmark a considerable share of the transport investments in low carbon modes.			
<b>4. Efficiency standards</b> Regulate car producers and correct market failures			
<b>5. Removal of car-oriented subsidies</b> e.g. for business cars in order to remove barriers for sustainable transport modes; replace with job-tickets			
<b>6. Incentive Programme for municipalities</b> to set up TDM, public transport and NMT investments and integrated land-use and transport plans			
<b>7. Vehicle registration tax/ license auctioning</b> e.g. taxing fuel inefficiency or weight			
<b>8. Low-carbon fuel standards</b> Incentivizing low carbon fuels, e.g. electric cars			
<b>9. Research, Development and Demonstration</b> For fuel efficient cars, electric bikes, busses and smart public transit			

While the “Basic Package” should be implemented in all countries - also in “least developed countries” - as soon as possible, the advanced package is an intermediate step towards the deluxe package. As it takes a step by step approach, leaders can already outline the vision of a low or zero carbon city while still being in an initial phase. All packages include co-benefits as described above.

The idea of the **basic package** is to remove the factors that trigger car-use and start the development of low carbon infrastructure so that shifting to the environmentally friendly and sustainable modes and practices is also economically interesting. The earmarking of subsidy savings or taxes for investments in alternative modes makes the package communicable, i.e. enable decision-makers to explain it to the public.

Rapidly developing countries that face a strong increase in car-ownership need to tackle the growing emissions also by involving the vehicle manufactures. In the **advanced package** this feature is added through fuel economy standards. Furthermore, as motorization and urbanization happens simultaneously, cities need support from the national level. An incentive programme for municipalities like the Indian JNNURM helps to face this challenge and enables innovation on local level.

For most developed countries with high levels of motorization **the deluxe package** allows further reduction. This includes high taxation for fuels as well as vehicles and investments in new technology and research. However, countries have to make sure that measures described in the other packages are effectively implemented, as the package builds on the previous steps.

In the following paragraphs, three key measures to reduce carbon emissions are presented in more detail: Fuel prices, fuel economy standards and urban transport policies. For the description of further approaches the Module 5e “Transport and Climate Change” gives further insights.

#### 4.1.1 Fuel Prices

An increase of fuel prices has the most immediate effect on car use. This can be seen e.g. in Indonesia, where even low income cities are characterised by a very low public transport share. In some Indonesian and Malaysian cities public mode share is below 5%. Fuel subsidies are contra productive and should be discontinued. Appropriate fuel pricing is an effective energy conservation and emission reduction strategy. Implementation costs are minimal, since most jurisdictions already collect fuel taxes. The petroleum industry argues that an increase in fuel taxes harms the economy, a claim that cannot be substantiated.

Figure 10: Petrol station in Ho-Chi-Minh-City



Photo: Karl Fjellstrom, 2004

These costs are primarily economic transfers within the economy, since increased costs to motorists are offset by increased revenues or reductions in other taxes. Higher energy taxes reduce the dependency of petroleum-consuming nations on petroleum producers. Higher energy prices motivate businesses to become less transport intensive, more efficient and increase innovation and overall productivity, while low energy prices encourage wasteful use of resources, which is overall harmful to the economy. Some principles of increasing fuel prices are (GTZ, 2009; Durning and Baumann, 1998):

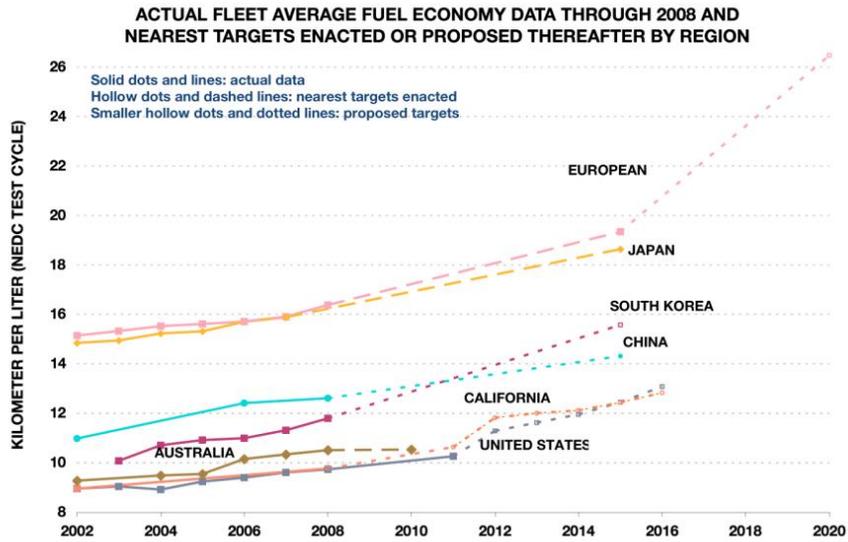
- fuel tax revenues should be used to improve transportation in general, rather than just roads, so that travelers have more fuel efficient accessibility options;
- revenues generated by the new tax should be returned to individuals and businesses through reductions in other taxes. That is, taxes should shift from “goods” to “bads”;
- tax shifts should be gradual and predictable, e.g. 10% annually, so consumers and businesses can take higher energy costs into account when making long-term decisions, such as vehicle purchases and building locations;
- tax reductions and rebates should be structured to favor lower-income workers and other disadvantaged groups;
- taxes should be applied to the full category of harmful goods, with minimum exemptions, in order to make the tax credible;
- crucial is an open and appropriate communication policy to let the public understand the underlying principles and reasoning for such policies.

The first step is to cut subsidies that bring pump fuel prices below crude oil prices. This is the challenge currently facing countries such as Egypt and Yemen. Certain countries can serve as important models for a region. In the past year, Morocco, Tunisia and Ghana have reached reasonable fuel price levels. In the contrary, Indonesia continues to subsidize fuel, with a range of negative effects, including the indirect promotion of individual transport modes, especially of motorbikes, and hence a low public transport mode share.

#### **4.1.2 Fuel economy standards**

Besides price signals, a main instrument to force production of fuel-efficient cars are fuel efficiency or fuel economy standards for car producers. This policy mechanism usually specifies, through a regulatory or political process, the average per-kilometer fuel consumption of new vehicles sold in a given year. Fuel-economy standards are intended to induce innovation in vehicle technologies to curb or reduce oil consumption. Fuel-efficiency standards are meanwhile the most effective climate policy tool in the USA, while the too low fuel taxes are not supporting shifts towards more sustainable transport modes. As car drivers often do not consider fuel consumption when they purchase automobiles, obligatory standards address a crucial market failure. As a disadvantage, they do not influence driving, and may even induce additional driving (the so-called rebound effect) when no price signals are in place.

Figure 11: Energy Efficiency Improvements and Future Targets



Source: ICCT

Governments can also act directly by taking their own measures. For example, they can incentivize public transit in their own ranks by **providing mobility lump sums** for government employees, instead of car benefits. This sets an example for all citizens and can also help capital cities such as Bangkok or Beijing in their drive towards sustainable transport systems. Governments can also choose to purchase highly fuel-efficient duty vehicles.

Figure 12: Energy Efficiency Technologies for Cars



Source: Axel Friedrich

### 4.1.3 Urban transport policies or programmes

A third key measure is **enabling local and urban authorities** to advance low-carbon transportation. This is especially important when it comes to investments in low carbon infrastructure. The challenge facing urban policy-makers is how to enduringly finance a sustainable urban transport system. By providing the necessary financial resources for investment and institutional building, the capacity to raise and manage funding at the local level can be build up and the fragmentation of responsibilities amongst the relevant (transport) authorities can be defeated (see GTZ sourcebook module 1f on Financing Urban Transport).

Under this principle national transportation funds can be dedicated at a much larger scale to public transport, bicycle and pedestrian infrastructure. A sustainable urban transport policy or programme systematically supports cities to invest in low carbon transport systems. Funding is usually related to some conditions, e.g. earmarked for specific measures or the preparation of a comprehensive integrated transport plan. A good example for such initiatives provides India (see box below).

#### Box 1: Jawaharlal Nehru National Urban Renewal Mission (JNNURM) in India

Rapid economic growth, coupled with a fast growing urban population, and urban sprawl has resulted in increased individual housing requirements, and an ever increasing demand for mobility in Indian cities. This has exerted huge pressure on the city's existing resources and made development patterns in the cities unsustainable. One financial instrument to improve the situation and to provide adequate infrastructure to the cities is the National Urban Renewal Mission (NURM). It provides a platform to coordinate significant financial support from the Central Government in urban infrastructure projects to selected cities in India, subject to the cities undertaking a set of institutional, structural, and fiscal reforms, necessary to improve their urban service delivery systems. Towards this, cities identified by the Mission are expected to formulate comprehensive City Development Plans (CDPs) for a period of 20-25 years, with 5 yearly updates, indicating policies, programmes and strategies, and financial plans. Based on the CDPs, more detailed project reports are to be developed with regard to undertakings in the sectors of land use, environment management and urban transport. Once this task is completed, the next steps are to initiate identified projects with funds from Central and State Government.

At inception of the National Urban Renewal Mission in December 2005, the total support of the Government was envisaged at Rs. 50,000 crores (USD 11.1 billion) with matching contribution from states and municipalities to an overall fund of around Rs. 100,000 crores (USD 22 billion). During 2008-09 the commitment of the central assistance was enhanced by Rs. 16,500 crores (USD 3.7 billion) so that a total fund volume of Rs. 116,500 crores (USD 26 billion) was available.

The financial support for 112 transport and transport related projects currently amounts to USD 2 billion and constitutes a share of 23% of all the 478 approved infrastructure projects (see figure below).

Under urban transport, the cities are further expected to draw up Comprehensive Mobility Plans (CMPs) which detail out the city's transport policy objectives and how they will be implemented. Examples of sustainable urban mobility projects supported under the JNNURM ambit are the various Bus Rapid Transit System (BRTS) projects that are being initiated in Indian cities. BRTS proposals are in various stages of appraisal and implementation. BRTSs have been implemented successfully in few Indian cities which include Ahmedabad, Pune, Bhopal or Jaipur. Also, under the JNNURM programme, cities are now eligible to request for grants in order to purchase buses for city bus operation. In this context, a total of 15,260 buses were sanctioned for 61 Mission cities across the country. All these buses are to be modern, low floor and semi low floor with various Intelligent Transport System features as per the Urban Bus Specifications

More information on the JNNURM guidelines can be found at:  
[http://jnnurm.nic.in/nurmudweb/toolkit/guidelines\\_jnnurm-English.pdf](http://jnnurm.nic.in/nurmudweb/toolkit/guidelines_jnnurm-English.pdf)

## 4.2 The low-carbon city

The developing world's urban population will double until 2030 (UN, 2004). Most of the additional travel activity in the next decades, hence, will be produced in the growing cities of the developing world. The inertia of such a trajectory holds danger but also promise: If the current development continues towards automobile dependency and concrete miles maximization, GHG emissions will be fixed for half a century or longer. However, if an alternative low-carbon development gains traction, a fundamental lower emission trajectory can be achieved. As a basic principle on city level, urban development planners should aim at **achieving density**: The aim must be to retain or achieve medium to high urban density profiles. A minimal urban density is precondition for efficient and convenient accessibility by walking and cycling, and for making public transit profitable.

**Figure 13: In Amsterdam, non-motorized transport means have one of the highest modal share among other European cities**



Photo: Manfred Breithaupt, 2009.

In the following three transport-related packages are presented that are – again - linked to the stage of development of a city (basic – advanced – deluxe). Each of the packages includes elements in eight different areas of activity. Ideally, policies shall cover each of the eight areas as managing demand requires an approach that optimizes different parameters of the transport system. Thereby, it follows a **“Push and Pull Approach”** (see for details GTZ's Manual for Transportation Demand Management, 2009). It is fundamental that a set of measures simultaneously:

- a) pushes transport users out of the car or gives incentives to prospective users not to buy a car and, at the same time
- b) pulls them to the low carbon modes public transit and non-motorized transport.

Table 3: Urban transport policies and packages.

Area of Activity	Basic Package Minimum requirements	Advanced Package Standard approaches	Deluxe Package Premium low carbon approaches
<b>1. Make roads people friendly</b>	<ul style="list-style-type: none"> <li>• Provide side walks</li> <li>• Reduce barriers such as bridges, underpasses and fences</li> <li>• Introduce speed limits</li> <li>• Provide bicycle lanes</li> </ul>	<ul style="list-style-type: none"> <li>• Establish pedestrian and bicycle short cuts</li> <li>• Diverse street environment</li> <li>• Trees along roads</li> <li>• Separated networks for bicycles and pedestrians (bicycle avenues)</li> </ul>	<ul style="list-style-type: none"> <li>• Public bicycle scheme</li> <li>• Shared space concepts</li> </ul>
<b>2. Manage parking demand</b>	<ul style="list-style-type: none"> <li>• Prohibit side walk parking</li> </ul>	<ul style="list-style-type: none"> <li>• Replace minimum with maximum requirements for parking places for cars</li> <li>• Provide minimum requirements for parking spaces for bicycles</li> <li>• Pricing for existing parking places</li> </ul>	<ul style="list-style-type: none"> <li>• Reduce/limit number of parking spaces in urban areas</li> <li>• Zero parking (except for special needs) in new developments</li> </ul>
<b>3. Move to high quality public transit</b>	<ul style="list-style-type: none"> <li>• Make public transit clean and convenient</li> <li>• Increase speed through priority signalling</li> </ul>	<ul style="list-style-type: none"> <li>• Integrated ticketing / fares</li> <li>• Information / marketing</li> <li>• Green procurement of vehicles</li> <li>• Bus-only lanes along high-density areas</li> <li>• High quality interchange (Design of stations to have short transfer times)</li> <li>• Level boarding, and off-bus/metro fare collection to speed up transit</li> </ul>	<ul style="list-style-type: none"> <li>• Comprehensive bus rapid transit system</li> <li>• Urban rail network</li> <li>• Full integration of public transport modes and with non-motorised transport</li> <li>• Full integration with land-use</li> </ul>
<b>4. Provide inclusive information</b>	<ul style="list-style-type: none"> <li>• Information campaigns</li> </ul>	<ul style="list-style-type: none"> <li>• Cooperation with companies (e.g. bike parking)</li> <li>• Car-sharing schemes</li> <li>• Bike-sharing schemes</li> <li>• Car free days</li> </ul>	<ul style="list-style-type: none"> <li>• Travel information (Web 2.0)</li> </ul>
<b>5. Reap the benefits of technological advancement</b>	<ul style="list-style-type: none"> <li>• Incentives to promote clean fuels and vehicles</li> </ul>	<ul style="list-style-type: none"> <li>• Use of Intelligent Transport Systems</li> <li>• Green procurement for local fleets (buses, taxis, etc)</li> <li>• Full prioritisation of public transport and non-motorised transport through priority signaling and ITS</li> </ul>	

<b>Area of Activity</b>	<b>Basic Package</b> Minimum requirements	<b>Advanced Package</b> Standard approaches	<b>Deluxe Package</b> Premium low carbon approaches
<b>6. Change the role of cars</b>	<ul style="list-style-type: none"> <li>• Speed limits</li> <li>• Physical car restrictions to slow down speed (e.g. roundabouts, barriers)</li> </ul>	<ul style="list-style-type: none"> <li>• Reduce investments in car oriented roads</li> <li>• Low emission zones</li> <li>• Intelligent Transport Systems (ITS)</li> </ul>	<ul style="list-style-type: none"> <li>• Limitation of access to city centers</li> <li>• Congestion charge</li> <li>• Advanced city toll</li> </ul>
<b>7. Reinvent mixed-used, high density cities</b>	<ul style="list-style-type: none"> <li>• Retain and reinvent dense urban fabric (mixed-use structures)</li> <li>• Forbid large retail and leisure facilities, that are not integrated in the settlement structure</li> <li>• Incentivize mixed-use city quarters (shopping, leisure, work, living)</li> </ul>	<ul style="list-style-type: none"> <li>• Land use regulation (e.g. restriction of greenfield shopping)</li> <li>• Transit-oriented development (e.g. Curitiba developing in linear corridors along BRT)</li> <li>• Green belts or corridors to keep dense areas (Hong Kong)</li> </ul>	<ul style="list-style-type: none"> <li>• Advanced integration of land-use and transport into planning</li> <li>• Accessibility of public transit (maximum walking time to public transport station below 5 minutes)</li> </ul>
<b>8. Create/ Live in urban spaces</b>	<ul style="list-style-type: none"> <li>• Wide side-walks</li> <li>• Pedestrian areas</li> </ul>	<ul style="list-style-type: none"> <li>• Urban greening (shadow trees, lakes and rivers,</li> <li>• Diversity (of buildings, people, infrastructure)</li> <li>• Small public places (with small business and gastronomy)</li> </ul>	<ul style="list-style-type: none"> <li>• Adapted architecture</li> </ul>

Cities can be extremely successful with focusing transit on public modes. Zurich, Vienna, Hong Kong and Singapore all invested heavily in public transit, which led to increasing per capita transit trips. This was accompanied by substantial income increases. In fact, promoting the environmentally friendly modes can increase the attractiveness of a city considerably, and attract both companies and well-qualified employees. Singapore, for example, has made city-wide transit a high priority in land-use planning. In the 70s, Singapore was advised to only upgrade the bus system, but the government nonetheless pushed for a much more expensive rail system. Rail modes are rapid and comfortable but less flexible. Buses and mini-buses add local flexibility to the overall system and have the advantage of more speed and comfort, which makes them more competitive to cars. While many Asian cities from Manila to Urumqi invest heavily in highways and motorized transport, the high density of these cities makes them ideal candidates to build an efficient, economically lucrative public transit system from which environment and society can profit.

The following diagram illustrates how public transport facilities have to be dramatically improved, that is to say, push measures are to be strictly applied in order to discourage car use in inner-cities.

**Figure 14: The push and pull approach**

Measures with push-effects

Area-wide parking management, parking space restrictions in zoning ordinances, car limited zones, permanent or time-of-day car bans, congestion management, speed reductions, road pricing...

Measures with pull-effects

Priority for buses and trams, high service frequency, passenger friendly stops and surroundings, more comfort, park-and-ride, bike-and-ride..., area-wide cycle-networks, attractive pedestrian connections...



Measures with push- and pull-effects

Redistribution of carriageway space to provide cycle lanes, broader sidewalks, planting strips, bus lanes..., redistribution of time-cycles at traffic lights in favour of public transport and non-motorized modes, public-awareness-concepts, citizens' participation and marketing, enforcement and penalizing...

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

Road space in most cases can't be extended in cities, and it also makes no sense, since induced traffic will quickly fill up additional space. Therefore the decision is vital on how to best use existing road space. In some advanced cities road space in some inner city streets is only given to Mass Transit, cycling and walking.

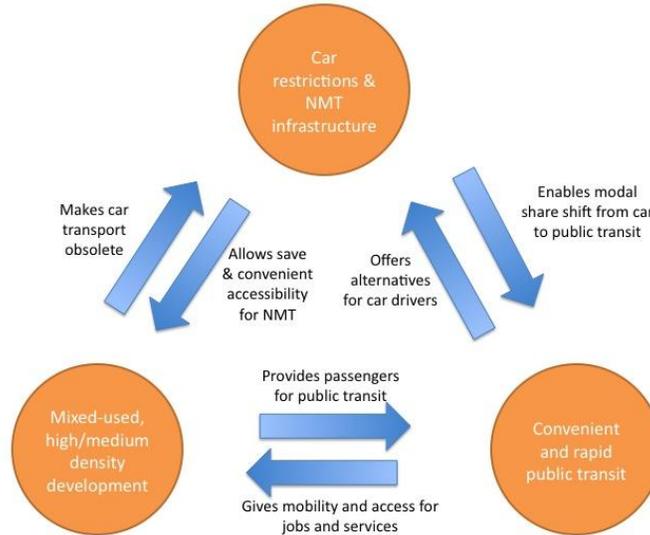
**Figure 15: Car free day in Bogota, Colombia**



Photo: Shreya Gadepalli, 2003

The following figure summarizes the interrelation of activities in urban transport systems: car restriction and NMT, high quality public transit and mixed-used high density urban development. Each element on its own can contribute only little to a sustainable transport path, all together can realize considerable synergies and plant the seeds for a low-carbon future.

**Figure 16: Three elements of low-carbon urban development**



Clearly, it is not enough to just have good ideas. They also must be implemented. Specific integrated planning agencies can foster sustainable transport concepts, whereas others constitute barriers. If institutions are fragmented and work in ignorance of each other and without a coherent perspective, no integrated, high efficient development approach can be achieved. Good examples, can be found e.g. in Singapore, Curitiba, meanwhile Seoul, and in German agglomerations.

And it is possible! Even in previously notorious car based cities such as in Athens a change towards a higher use on non-car based transport was achieved.

**Figure 17: Energy consumption and transport.**

	Modal share of walking, cycling and public transport		Average energy consumption per person (MJ)	
	1995	2001	1995	2001
<b>Athens</b>	34,1	40,9	12.900	12.600
<b>Geneva</b>	44,8	48,8	23.600	19.200
<b>Rome</b>	43,2	43,8	18.200	17.100
<b>Vienna</b>	62	64	10.700	9.050

Source: UITP

**Box 2: Integrated land-use and transportation planning: Bus-centered linear development in Curitiba.**

The most consistent approach, and by now state-of-the art in progressive cities, is to **integrate land-use and transportation planning** to achieve a low-carbon infrastructure reduce travel distance and travel time and increase accessibility to jobs, shops and leisure facilities. The bottom-line is that new mixed-use, high density development must be close to public transit, and vice versa, and that car transport must be relatively costly in terms of money and/or time, to avoid motorization.

Curitiba is the seventh largest city in Brazil with population of approximately 1.8 Mio, and ranks 4<sup>th</sup> in terms of GDP. Curitiba poses a particular example of how a coherent set of policies can transform a city to an impressive and economic successful example of a low-carbon transportation system. In the 1960s the city adopted and started the implementation of a new urban master plan with the prioritization of ecological urban structure.

Curitiba's Master Plan integrated transportation with land use planning: commercial growth was encouraged along the arteries radiating out from the city center - while limiting central area growth. By **developing the city linearly along the arteries**, the downtown ceased to be the primary focus of everyday transport activity. Hence, peak hour commuter congestion was avoided. Also, land within two blocks of the transit arteries is **reserved for high-density development**. New retail growth is channeled to transit stops, and employers offer transportation subsidies for low-skilled and low-paid workers. In contrast, auto-oriented development is not happening, and the downtown center offers only limited parking, thus discouraging car drivers to clog the city center with their vehicles. The last (and perhaps most eye-catching) element of Curitiba's development is a **highly efficient bus rapid transit system along the arteries**, effecting a modal shift from car travel to bus. Compared to other Brazilian cities of comparable size, Curitibaans consume 30% less transport fuel.

## 5 How can a Global Deal support Low-Carbon Transportation?

In December, 2009 more than 180 heads of state met in Copenhagen in order to negotiate a new climate change agreement. Even if no final agreement has been achieved, Copenhagen is a step towards realizing the principles of the so called Bali Action Plan. In 2007, the climate talks in Bali outlined the basic elements of a new treaty. This includes that developing countries start to reduce greenhouse gas emissions and fight climate change. In return industrialized countries support developing countries in achieving a low-carbon development path. While OECD countries commit to strict and ambitious emission reduction targets, the developing world would contribute to the prevention of a dangerous climate change through mitigation actions. This includes implementing sustainable transport policies.

**Figure 18: United Nations Climate Change Conference in Bonn in April 2010**



Photo: Ko Sakamoto

In Copenhagen, industrialized countries (so called Annex 1 countries as they are listed in Annex 1 of the Kyoto Protocol) committed to provide support in terms of capacity building, technology and finance. Just after the conference in Copenhagen, 36 developing countries submitted so called “Nationally Appropriate Mitigation Actions” (NAMAs). These NAMAs are now listed in Annex II to the Copenhagen Accord<sup>1</sup>. Twenty-five of the 36 submissions have made explicit reference to the transport sector, indicating widespread recognition of the role of the sector in climate change mitigation. They also mirror the wider paradigm shift being pursued in the sector, namely to avoid unnecessary journeys, shift travel activity to low carbon modes, and improve the energy

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<sup>1</sup> The Copenhagen Accord (Decision CP -) was developed at the Climate Change Conference in Copenhagen in December 2009. Few countries opposed so the COP only “took note” of the Accord which makes it a non-binding document. It will only gain legitimacy through countries that submit GHG reduction commitments

efficiency of each mode. NAMA actions proposed have, for example, ranged from land-use planning to increasing the energy efficiency of vehicles and fuel and research into the impacts of different strategies.

The main advantage for developing countries in committing to action is *access to support for capacity building, technology transfer and new sources of funding*. During 2010 and the following years the Copenhagen Green Climate Fund or uni-lateral funds will be developed to match actions and funding needs. All the policies described above qualify for NAMAs. However, there is one condition that needs to be fulfilled and that is measuring and reporting greenhouse gas reductions of the activities. Hence, many countries now start developing baselines (do-nothing scenarios) and carbon footprinting of their policies.

NAMAs will add on to existing carbon finance approaches like the Clean Development Mechanism (CDM) and the transport window of the Global Environmental Facility (GEF). NAMAs seem to be especially a good way forward on supporting developing countries in mitigation strategies. For reductions, not a single policy but a set of integrated measures is required to decarbonize transportation. Low carbon transport strategies are well suited and related to sustainable transport policy and worth to be carefully checked and considered by transport ministries in the coming years.

**Box 3: What are Nationally Appropriate Mitigation Actions (NAMAs)?**

Nationally Appropriate Mitigation Actions (NAMAs) are voluntary emission reduction measures by developing countries that are directly reported to the United Nations Framework Convention on Climate Change (UNFCCC). NAMAs will be a practical tool to tackle GHG emissions from the transport sector.

- NAMAs are policies, programmes and projects that are either economy wide measures (e.g. CO<sub>2</sub> taxation) or specific sectoral initiatives (e.g. fuel efficiency standards).
- NAMAs need to be submitted to the UNFCCC by national governments but they can include actions on domestic, regional, or local levels.
- NAMAs are an opportunity to acknowledge developing countries' unilateral contribution to reduce GHG emissions and match these with international funding. NAMAs seeking international support will be recorded in a registry along with relevant technology, finance and capacity building support.

## References

- Button, K. (1990) *Environmental externalities and transport policy*, Oxford Review of Economic Policy vol 6, no 2, pp61-75
- Calthorpe, P (1993) *The next American Metropolis. Ecology, Community and the American Dream*. Princeton Architectural Press. ISBN: 1878271687
- Creutzig, F, He, D (2009) Climate change mitigation and co-benefits of feasible transport demand policies in Beijing, *Transportation Research D* 14: 120-131
- Creutzig, F, Thomas, A, Kammen, D, Deakin, E (2009) Co-Benefits of a City Toll in Chinese Cities: Barriers, Potentials and the Need for Responsible Institutions In *Low Carbon Transport in Asia: Capturing Climate and Development Co-benefits*, edited by E. Zusman, A. Srinivasan, and S. Dhakal (Earthscan, London, 2009)
- Creutzig, F., Kammen, D. (2009) The Post-Copenhagen Roadmap Towards Sustainability: Differentiated Geographic Approaches, *Integrated Over Goals Innovation*, Vol 4 (4): 301-321
- Durning, A, Bauman, Y (1998), *Tax Shift*, Sightline Institute ([www.sightline.org](http://www.sightline.org)); at [www.sightline.org/publications/books/tax-shift/tax](http://www.sightline.org/publications/books/tax-shift/tax).
- GTZ (2009), *International Fuel Prices 2009*, with Comparative Tables for 172 Countries, German Agency for Technical Cooperation ([www.gtz.de/fuelprices](http://www.gtz.de/fuelprices))
- GTZ (2007). Sourcebook module "Transport and Climate Change", <http://www.gtz.de/de/dokumente/en-transport-and-climate-change-2007.pdf>
- IEA (2008) *Worldwide Trends in Energy Use and Efficiency. Key Insights from IEA Indicator Analysis*. [http://www.iea.org/papers/2008/indicators\\_2008.pdf](http://www.iea.org/papers/2008/indicators_2008.pdf)
- IEA (2009a) *Transport, Energy and CO<sub>2</sub>: Moving Toward Sustainability*. ISBN: 9789264073166
- IEA (2009b) *World Energy Outlook 2009*. ISBN: 9789264061309
- Jacobs, J (1961) *The death and life of great American Cities* ISBN: 067974195X
- League of American Bicyclists (2009) *The Economic Benefits of Bicycle Infrastructure Investments*.
- Newbury, D.M. (1990) *Pricing and Congestion: Economic principles relevant to pricing roads*, Oxford Review of Economic Policy, vol 6, no 2, pp22-38
- Pigou, A.C. (1920) *Wealth and Welfare*, MacMillan, London
- Rouwendal, J. and Verhoef, E.T. (2006) *Basic economic principles of road pricing: From theory to application*, *Transport policy*, vol 13, no 2, pp106-114
- Santos, G. and Rojey, L. (2004) *Distributional impact of road pricing: The truth behind the myth*, *Transportation*, vol 31, no1, pp21-42
- Shoup, D (2005) *The High Cost of Free Parking*, American Planning Association, 2005, ISBN: 1884829988
- United Nations Secretariat, Population Division of the Department of Economic and Social Affairs, *World Population Prospects: The 2002 Revision and World Urbanization Prospects: The 2001 Revision* <http://esa.un.org/unpp>. August 2, 2004.
- Victor, D. G. (2009) *Climate accession deals: new strategies for taming growth of greenhouse gases in developing countries*