Prospects for Transport Demand Management in Beijing

Interim project results

On behalf of

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

of the Federal Republic of Germany

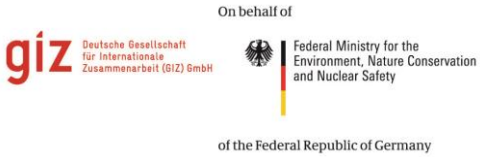
TRC 北京交通发展研究中心 Beijing Transportation Research Center

Prospects for Transport Demand Management in Beijing

Interim project results: 2nd draft report, August 2012

Acknowledgements

The author gratefully acknowledges the support of Dr Yu Liu from BTRC to provide information regarding national TDM policy implementation. The author wishes to thank Mr Carlosfelipe Pardo from Despacio.org and Mr Todd Litman for contributing to the review of this publication. The author also appreciates the support received from GIZ colleagues Mr Manfred Breithaupt, Mrs Andrea Henkel and Mr Armin Wagner, who provided valuable comments. Furthermore, this publication could not have been produced without the help of Mr Tobias Nagy and Mr Andrej Sosedow.



Authors: An Mingying, Daniel Bongardt

Contact: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Sunflower Tower Room 860
37 Maizidian Street, Chaoyang District
100125 Beijing, P.R. China

Beijing Transportation Research Center
9. Liuliqiao Road, Fengtai District,
100073 Beijing

www.tdm-beijing.org

Manager: Daniel Bongardt
Cover photo: Daniel Bongardt
Layout: Andrej Sosedow
Beijing, August 2012

The Project Context

China's economic growth over the past three decades has had some undeniably positive effects on the country's development but it has also led to a massive increase in motor vehicle travel and associated traffic problems, especially in large cities. In Beijing, over five million cars cause severe local air pollution and traffic congestion as well as increasing parking problems and accident costs.

Transportation GHG emissions have become a key challenge for sustainable development in China and globally. Neither roadway expansion nor the development of new car technologies alone can solve these problems; in fact, these strategies often reduce one problem but aggravate others. Transport demand management (TDM) offers truly sustainable solutions which will help in achieving multiple planning objectives.

The aim of this project is to build capacities and competencies to enable Beijing municipal authorities to quantify and model the impact and benefits of various TDM strategies. This will help officials in Beijing and other major urban centers in China identify and implement the most effective and beneficial set of TDM measures.

The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and the Beijing Transportation Research Center (BTRC) are the implementing partners. GIZ is a global service provider in the field of international cooperation and professional training for sustainable development. BTRC's mission is to conduct systematic research on transport development strategies for policies and planning in Beijing and to present recommendations on these measures and action plans to the People's Municipal Government of Beijing.

The project is supported by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and the Beijing Municipal Commission for Transportation (BMCT).

In order to achieve the aims, the project is organized along three work streams

- Work Stream 1: TDM Policies and Measures – BTRC and GIZ cooperate to identify at least three TDM measures for GHG reduction in Beijing and learn from Chinese and international best practice
- Work Stream 2: Emission Scenarios, Modelling and Monitoring – A monitoring system for GHG emissions will be developed
- Work Stream 3: Dissemination – Measures and tools will be discussed with and disseminated to at least 5 other Chinese cities

Table of Contents

1 Background and Aim

This report is a key deliverable in the project work stream 1 (TDM policies and measures) and proposes potential and appropriate TDM polices and measures that reduce GHG emissions and achieve considerable co-benefits towards a sustainable urban transport development. It summarizes key results and recommends focal areas.

In order to learn from other experiences and to identify suitable emission reduction policies and measures, an international review of good practice in TDM policy and GHG emission reduction has been produced. Authors were Frederik Strompen (GIZ, Germany), Todd Litman (VTPI, Canada) and Daniel Bongardt (GIZ, China). Another important input to this analysis was a review of policies and measures taken in Beijing and China, carried out by Dr. Yu Liu from Beijing Transportation Research Center (BTRC). This report summarizes and compares the key results.

This study investigates current transportation problems and challenges in Beijing and identifies recommendations for effective strategies to increase transport system efficiency and reduce GHG emissions. In a later phase of the project (work stream 2, GHG emission scenarios, modelling and monitoring) the potential impacts of selected policies will be analyzed. This research should be transferable to other Chinese cities.

The report is structured as follows: Section 2 analyzes transport challenges in Beijing; Section 3 summarizes the approaches implemented in Beijing, China and international cities to implement TDM measures; Section 4 reviews success factors of good practice; and Section 5 provides recommendations for TDM policies in Beijing.

2 Transport Challenges in Beijing

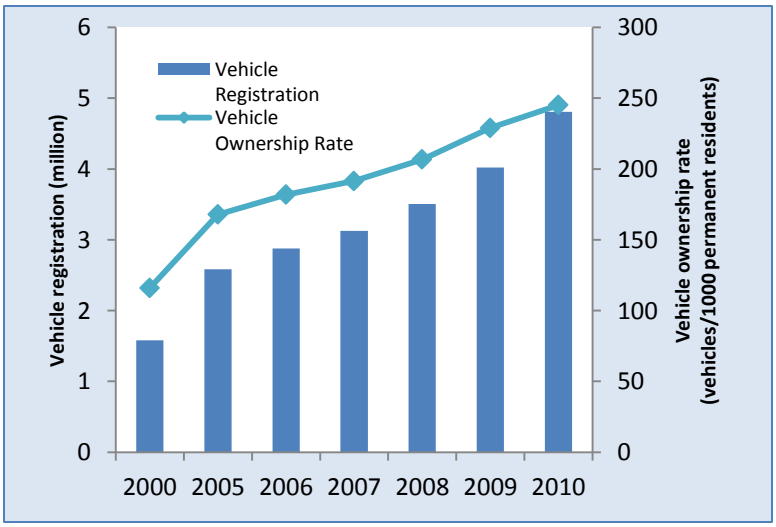


Figure 1: *Vehicle registration and vehicle ownership rate in Beijing*

Beijing is one of the biggest metropolitan regions in the world with approximately 20 million residents in 2010 and more than 5 million motor vehicles in 2012. Because of rapid urbanization and motorization, the city is expanding. The growing number of motor vehicles and traffic demand leads to serious economic, social and environmental problems including traffic and parking congestion, increasing traffic accidents, higher fuel consumption, increasing

GHG emissions, increased user costs and emotional stress. The numerous innovative TDM policies and measures identified in this study can help increase transport system efficiency and reduce these problems. The challenges are summarized in table 1 below. In addition to the key problems of traffic and environment (esp. GHG and air quality), the table also lists challenges related to urban development and other contextual developments.

Table 1: *Traffic challenges in Beijing*

Type	Challenges
Accessibility and transportation	■ Severe traffic and parking congestion ■ Traffic congestion reduces bus service efficiency ■ Reduced walking and cycling efficiency and safety ■ Increased traffic accident costs ■ More dispersed land use development and reduced roadway connectivity reduce accessibility and increase travel distances, increasing transport costs for all system users, particularly for non-drivers. ■ Increased road and parking infrastructure costs ■ Increased costs to consumers to own and operate motor vehicles ■ Increased vehicle fuel consumption increases the economic costs of importing energy.
Health and environment	■ Public health concerns due to air and noise pollution (road related emissions take the largest proportion of total emissions) ■ Bad walking and cycling environment due to air pollution, reduces public fitness and health ■ Rising GHG emissions in the transport sector are a major barrier to become a low carbon city. ■ Increased emotional stress and dissatisfaction due to unpleasant travel conditions and reduced neighbourhood liveability
Urban form	■ Mono-centric urban planning and concentration of jobs lead to longer distances for commuters (and problems both on roads and in public transit during peak hours). ■ Extensive land-use, inadequate zoning and large urban footprint of the city lead to long distance (commuting) trips. ■ High speed of urban development and lack of transit access for new developments make alternative modes less attractive for inhabitants.
Context	■ Barriers to decision-making and data exchange through lack of cooperation between relevant institutes and enterprises ■ Inefficient procedures for enforcement of demand-management measures ■ Limited monitoring of impacts from TDM measures

A key challenge for implementing TDM strategies is the need to improve coordination between the various interest groups, government departments as well as planning and design institutes. Urban planning institutions, property developers, road construction authorities, public transport operating companies and other related organizations have different and often conflicting interests. Better cooperation between these groups can lead to more efficient transport system operation, such as more convenient subway transfer, better bus stop positioning, and improved non-motorised transport (better walking and cycling conditions).

Although many TDM policies have been implemented in Beijing, such as the development of public transport, parking management, and pricing reform, some of these measures are not as effective as expected and need to be improved to some extent. For example, although the official parking charge "standard rates" increased, enforcement is still insufficient. Free parking on pavements and cycle paths or lower parking fees applied by parking management companies is very common.

Picture 1: *Traffic congestion during peak hours in Beijing (P.R. China)*

Photo by Manfred Breithaupt, 2007

Current planning often results in solutions to one problem that exacerbates other transport problems. More integrated solutions can provide multiple benefits. This means, for example, choosing the congestion reduction strategies that also help reduce parking problems, increase safety and reduce air pollution, and choosing the pollution reduction strategies that also reduce traffic and parking congestion.

Picture 2: *Cyclist wearing a mask due to heavy pollution in Beijing*

Photo by Daniel Bongardt, 2007

Policies that are car-oriented and seek short-term economic benefits should be transformed to a more sustainable and human-scaled way of considering the implementation of the policy. It is the responsibility of the city to increase investments in a green transport system, to update regulations and rules, and to protect public interests.

3 Strategies Implemented in Beijing, China and Internationally

There are many effective TDM policies and measures which have proven to be substantial for sustainable transport development. They can be categorized as "push" and "pull" strategies. Public transport improvement and non-motorised transport promotion are examples for *pull* measures (they *pull* into more sustainable transport), while parking management, road/congestion pricing, and vehicle restrictions are examples for *push* measures (they *push* out of cars). In Beijing and many other cities both in China as well as abroad such measures have been applied successfully. In China's capital city work on many measures has been started even before the announcement of the 28 specific measures in 2010, some of which are now reconsidered for being improved or better enforced (marked as "started" in table 2). The most influential policies that have the potential to change travel behaviour and thus reduce congestion and emissions are summarized in the table below.

Pictures 3, 4: *Broadway on Herald Square before (top) and after (bottom) being closed off to vehicles*

Photo by New York City Department of Transport, NYC (USA), 2009 (CC-BY-ND 2.0)

Table 2: *Successful approaches implemented in Beijing, China and international cities covered by the TDM project reports*

TDM *pull* strategies	Beijing	Other Chinese cities	International cities
Public transit extension and improvement	Speed up subway network construction in the central city (started). The total length of the subway will be 660 km by 2015. Structure a rapid-commute bus line network - not scattered isolated corridors (started). Further optimize and adjust bus line network, alignment and interchange facilities (started).	**Guangzhou:** Bus Rapid Transit (BRT) system is successfully implemented and operates along Zhongshan Avenue.	**Bogota:** BRT system TransMilenio (120 km of trunk lines, 1.7 million passengers per day) **Freiburg:** Public transport first. Improved integration and land use management, institutional restructuring and enforcement of policies. **Portland:** Public transport improvements (e.g. MAX Light Rail, Intercity passenger rail, tramway). **Seoul:** Bus Reform: BRT (500 high-quality buses on 107 km of median bus lanes), improved integration of feeder buses with the existing metro system. Stakeholder consultation, performance-based contract design
Non-motorised transport	Long history of cycle-lane development and bicycle promotion (recently losing strength) Public bicycle sharing plan (pilot districts are indentified and already in trial operation)	**Guangzhou** and **Hangzhou** also build up public bicycle sharing plan.	**Berlin:** Bicycle Action Plan: e.g. improved network, orientation, parking, connectivity, integration, safety, public awareness **New York:** Closing off of Broadway at Times Square and Herald Square for vehicles, public bicycle system **Paris:** Complementary vehicle and bicycle sharing (technically convenient, largest network in the world) **Seoul:** Reclaiming of road space (dismantling and demolition of an elevated highway and the uncovering of the historic 5.8 km waterway that ran underneath)
Land use, smart growth, new urbanism	Fully implement transport infrastructure planning (started). Further adjust and optimize the functional layout of the city (started).	**Hong Kong:** Fully implemented transit-oriented development policy with land value instruments	**Curitiba:** Transit-oriented development along BRT lines **Netherlands:** ABC plan. District division according to transport facility accessibility **Yokohama:** Transit-oriented development along subway stations

TDM *push* strategies	Beijing	Other Chinese cities	International cities
Parking management and pricing	Increase driving costs through parking fee reform (started). Progressive parking fees in central districts	**Shanghai:** Enhancement of parking management by technical tools **Shanghai** and **Hangzhou** experience similar parking price reforms as **Beijing**. The parking fee in **Shanghai** is higher than in **Beijing** and **Hangzhou**.	**New York:** Escalating parking fees, peak hour parking, hour-limit parking, new design of on-street parking (small scale 6 months trial) **Rotterdam:** Cash out employee program: Financial incentives to avoid commuting by car in accordance to the distance to work **San Francisco:** Introduction of maximum parking requirements, reform of curbside parking, parking fees in accordance to occupation level **Hamburg** and **Zurich:** Maximum parking space requirements for new residential and commercial developments (abolished the previous minimum parking requirements)
Efficient road pricing	-	-	**London:** Congestion charge on driving in Central London (rebate for residents and some exempted vehicles) **Singapore:** Electronic Road Pricing since the 1970s **Stockholm:** Congestion pricing with exemptions for alternative-fuel vehicles **Trondheim:** City toll (variable fees for peak hour and heavy duty vehicles)
Vehicle restrictions	Implement peak hour driving restrictions in the central city (started). Implementation of vehicle plate lottery system since 2011 to control vehicle number growth	**Shanghai:** Vehicle registration quota **Guangzhou:** Odd-even vehicle driving restriction during Asian Games in 2010 Vehicle quota auction and plate lottery since July 2012	**Berlin** and all other large German cities: Environmental Zones **Milan:** Environmental Zone + congestion charging **Singapore:** Vehicle registration quota
Corporate Mobility Management programmes	Promote commuter shuttle bus plan and school bus plan (started). Build P+R parking lots along subway lines (started). Promote telework, flex hours and staggered working times (started).	-	**BASF** in Ludwigshafen Germany. **METRO Transit Agency** in King County (Seattle Area). **GIZ** in Frankfurt, Germany. Such companies offer linkages to public transit, company tickets, car-pooling, on-site or shuttle bus systems, telecommuting, reduced number of company vehicles and promotion of cycling.

Sustainable urban development requires integrated transport and land use planning, for example, by ensuring that most residential development occurs in neighbourhoods that have good walking conditions, local services, and high-quality public transport. This reduces travel distances and improves transport options, which reduces transport problems. Even though adequate transport demand management policies have been implemented in Beijing, not all of them achieve the expected results. There is still room for improvement. An example is parking management – as described in the following box.

Box 1: Case Studies: Parking Management in Beijing, Shanghai and San Francisco

Parking management in Beijing

Pricing mechanism

Since April 1st, 2011, the standard parking charge in non-residential areas increased significantly. The city will be categorized into three zones according to their level of traffic congestion and parking demand, with higher parking fees in congested areas.

The parking fee in the area of high parking demand is 10 CNY per hour. The time interval of parking fee collection within the 5th ring road has been decreased from 30 to 15 minutes. A progressive charging price is implemented for on-street parking, off-street surface parking, off-street garage parking and underground parking. With respect to residential areas and night parking, the standard charge in principle remains the same as before.

The subsequent effects of the parking policy may not be too strong. 3 months after the implementation, the effectiveness started to decrease. One reason could be that drivers might gradually adapt to the parking price, another one that parking lot managers might not be able to strictly enforce this new pricing scheme.

Parking management in Shanghai

Enhancing parking management by technical instruments

In order to reinforce public parking information management, a new system has been built with service and management functions including a website and a telephone hotline. Real time parking space information will be delivered through this system. It saves time and money for the drivers to find a parking space and helps the management department to collect information and manage parking lot operations. It greatly increased public parking lot efficiency.

Clearer management responsibilities in the adjusted management system

Police bureau and transport management bureau are two administrative departments responsible for road parking management. The responsibility for each department was divided and clarified during the adjustment of the management system. At the same time, the city decentralized some of the parking management responsibility from the city level to the local district level. The city level transport management department is responsible for formulating related regulations and public parking planning. The local district level transport management department is responsible for specific supervision such as parking fee collection, management of parking operation companies and administrative enforcement in their district.

Parking management in San Francisco

The San Francisco Municipal Transportation Agency (SFMTA) has implemented a comprehensive smart parking system to help manage congestion. The primary strategies used to achieve the city's parking management goals include demand-responsive pricing to manage parking towards availability targets, expanded hours of priced parking, enhanced parking regulation enforcement, and new parking information systems. These strategies are supported by new technologies including networked on-street parking sensors and parking meters that support various forms of payment, including coins, smart cards, as well as credit and debit cards.

4 Success Factors to Achieve GHG Emission Reduction through TDM Measures

The international review of successful TDM policies identified various factors that affect the effectiveness of TDM policies, as discussed below and summarized in table 3. These include (a) strong cooperation and dialogue between stakeholders, (b) emphasis on high-quality implementation, (c) developing measures as part of a comprehensive strategy and (d) using innovative technology.

Strong Cooperation and Dialogue between Stakeholders

The inter- and intra-governmental cooperation and coordination between agencies was often mentioned as a crucial aspect in the smooth implementation of projects due to the fact that through cooperation, competitive planning can be avoided. The levels of competitive planning can be diverse. On high-level policy making, cooperation and coordination can be a contradiction between economic and environmental goals while on implementing level it can be a lack of integrated planning of different modes (e.g. subway vs. bus). Efficient procedures for agency cooperation as well as mediation forums can mitigate the risks of adverse planning.

Picture 5: *For the Cheonggyecheon restoration [abbreviated C.R.] project the Seoul Metropolitan Government provided fiscal and human resource capacity, and moreover founded the Citizen's Committee for C.R. as well as incorporated the C.R. Centre.*

Photo by Manfred Breithaupt, 2009

Mediation and general coordination can be a lengthy and costly process. The institutional set-up (contract and organisational design) needs to be suitably designed. E.g. agencies were often merged to one coordinating institution to achieve essential synergy effects. At the same time the rules and procedures for cooperation (e.g. incentive-based contracts between public transport operators and policy making institutions) are crucial in terms of the sustainability of a TDM policy. If revenue from enforcement (e.g. enforcement of parking fees) or fares are channelled back to the agency that provides transport services, there is an apparent incentive for more efficient operations and enforcement.

Cooperation between government agencies is often complicated due to their different responsibilities and interests. However, the city of Shanghai proves that high-quality cooperation and dialogue in Chinese cities is possible. The city has a united commission of construction and transport, which is responsible for drafting the laws, regulations, rules, guidelines and policies and coordinating important projects with respect to urban construction, transport and management. Under such a unified platform, communication and cooperation (e.g. data exchange) among different departments become more efficient and smooth.

Table 3: *Summary of success factors of all international case studies* Source: Frederik Strompen et al. 2012

		Cooper-ation and dialogue		High-quality implementation					Part of comprehensive strategy		
		Inter-governmental cooperation	Institutional set-up	Reliability/comfort	Stakeholder consultation	Linkage to local circumstances	Ex ante data availability	Enforcement	Part of vision or strategic plan	Part of comprehensive TDM strategy	Marketing (small scale best practice)
Public transit service improvements											
Bogota	Bus Rapid Transit			✔	✔					✔	
Seoul	Bus Rapid Transit	✔	✔	✔						✔	
Non-motorised transport											
Berlin	Cycling infrastructure and management	✔		✔							
New York	Human scale road design	✔		✔	✔						
Seoul	Reclaiming of road space	✔			✔					✔	
Parking management and pricing											
Chicago	Long-term lease of curbside parking (privatization)		✔		X			✔		X	
New York	Escalating parking fees, peak hour parking, hour-limit parking, new design of on-street parking	X		✔	✔					✔	
Portland	Freeze of parking space, flexible land use management									✔	
San Francisco	Introduction of maximum parking requirements, reform of curbside parking, parking unbundling	✔	✔	✔	✔		✔		✔	✔	✔
Seoul	CCTV parking supervision and enforcement			✔				✔		✔	
Efficient road pricing											
London	Fee on driving in central London (rebate for residents and some exempted vehicles)				✔	✔	X			✔	
Singapore	Electronic Road Pricing	✔		✔				✔		✔	
Stockholm	Congestion pricing with exemptions for alternative-fuel vehicles				✔					✔	
Vehicle restrictions											
Berlin	Environmental Zone	✔	✔			✔		✔	✔	✔	✔
Milan	Environmental Zone	✔						✔		✔	
Singapore	Vehicle registration quota	✔	✔					✔	✔	✔	✔
Smart growth land use policies											
Curitiba	Transit oriented development	✔	✔	✔					✔	✔	

✔ - Consideration of success factor contributed to effectiveness of TDM measure

X - Non-consideration of success factor contributed to failure or reduced effectiveness of measure

Emphasis on High-Quality Implementation of Policies

It is important to carefully implement TDM policies and programs; otherwise they may fail to achieve their objectives and create distrust of such reforms. Government agencies need suitable human capacity, planning guidelines and quality data to ensure that the transport system is reliable and convenient and to ensure that the public is well integrated in the planning process.

The success and public acceptance of a TDM measure is directly correlated to its convenience and reliability. Relevant stakeholders, including the general public, should be involved in the planning process since their support is crucial for success. A constant flow of information is important to help the public understand the reasons behind the measures.

Push measures require efficient enforcement. Inadequate enforcement can dramatically reduce programme effectiveness. For example, Beijing's vehicle restrictions have performed rather well due to automatic number plate recognition. Also *pull* measures, such as improved bicycle facilities, only work if regulations against illegal car parking on cycle lanes are enforced. Enforcement tends to works best when the enforcing authority benefits from fees.

Picture 6: *Despite advanced parking pricing, enforcement of policies is still limited in Beijing (P.R. China)*

Photo by Daniel Bongardt, 2012

The box below describes the high-quality cooperation and implementation of the Guangzhou BRT system. It is one of the most successful pilot BRT projects in China with comfortable service and faster travel speed than common buses in the same corridor, reflecting leading concepts and technologies.

Box 2: High-Quality Cooperation and Implementation in Chinese Cities: Guangzhou BRT

High-quality cooperation

The planning of the BRT system is regulated by the Public Transport Management Office, while the BRT Management Co. regulates the BRT operations. Bus Rapid Transit Operation and Management Co. Ltd. is the BRT management agency. Unlike most BRT systems in the PRC, which typically have a single operator, the Guangzhou BRT system is operated by seven bus operating companies under three corporate groups. Private bus operators are already allowed to offer public bus services in Guangzhou. This has helped to introduce competition and improve service levels. ITDP provided key technical advice to Guangzhou on the design of the BRT system, started collecting data before the project was built and continues to monitor the project's impacts and also provides technical support to the city government in the development of the project.

High-quality implementation

The Guangzhou BRT system is the first in China to be tightly integrated with the city's existing metro system as well as other non-motorised modes of transport. (ADB: www.adb.org/urbandev, November 2010)

Three BRT stations have connecting tunnels to the Guangzhou metro system, with three more opening when the Guangzhou metro line 5 expands to join up with the eastern end of the BRT corridor. The BRT stations are the first in the PRC to be equipped with bicycle parking and bicycle sharing facilities, and are integrated with the surrounding buildings through connecting bridges from the stations. Other pedestrian-friendly and accessibility facilities are also equipped, including escalators and wheelchair lifts. A ride on the BRT system costs 2 CNY and a smart card which offers discounted fares can be used. Passengers can also transfer for free to other BRT routes in the same direction.

Developing Measures as Part of a Comprehensive Strategy

Positive impacts of TDM measures can be increased with the implementation of comprehensive strategies consisting of *pull* and *push* measures. Both *pull* and *push* measures work together to encourage the mode choice in a positive way. In order to shift from private vehicles to public transport usage, restrictive measures (economic instruments, vehicle restrictions etc.) and a well integrated alternative has to be provided. For short and feeder trips this can be in form of non-motorised transport, for longer trips it can be in the form of public transport. Integrated programmes require strategic planning, which defines long-term goals and objectives, and then identifies specific policies and programs. Integrated programmes tend to be most efficient and acceptable for the public. They should be flexible in the working progress, as they may need to change in response to user feedback or varying conditions. The city of Beijing is a good example in China. The municipal government already issued a comprehensive TDM policy strategy in January 2011 listing 28 specific measures (see annex) structured by land use development, infrastructure construction, public transport improvement, promotion of non-motorised modes, vehicle restrictions, and intelligent transport management. Some of these policies really pay off and receive approval while others still need further improvement due to the gap between the implementation results and expectations. Within the current framework of the comprehensive

TDM strategy, the policies with unexpected effects still need further adaption and follow-up improvements to achieve accurate management and high-quality implementation.

Picture 7: *SF Park phone app showing availability of parking space.*

The comprehensive smart parking system introduced by San Francisco Municipal Transportation Agency (SFMTA) is part of a TDM strategy involving parking space unbundling, maximum parking requirements and high investments in public transit.

With a website, SMS service, mobile phone application and message signs giving real-time parking-related information as well as different payment options it is also an example of using technologies innovatively to meet TDM needs.

Picture by SFMTA, San Francisco, California (USA), 2011

Using Innovative Technology

The last success factor complements the others. In order to explore the full potential of TDM measures, comprehensive and innovative technologies are needed. Electronic toll collection, enforcement through video and licence plate recognition, convenient ticketing and pricing mechanisms, real-time passenger information etc. help to achieve high-quality implementation. New technologies that allow electronic exchange of data and visual presentation of effects through GIS maps are important for cooperation between different groups and organizations. Beijing is generally a forerunner in China with respect to the testing and running of innovations and may further explore the potential of information technologies. However, the application of new technology is costly and needs support from the local government to cover most of the operating costs. London's congestion charging, for example, has to spend 50% of its revenue on operation costs since the technology employed is very expensive.

5 Recommendations for Beijing Transport Demand Management

In order to summarize the strategies implemented in Beijing and successful factors to achieve GHG emission reduction through TDM measures, this chapter will provide recommendations for Beijing for planning a strategy and specific TDM policies.

The existing TDM policy package implemented in Beijing is part of a comprehensive strategy consisting of *pull* and *push* measures (see annex). However, some of them are not well enforced and still need new elements to improve the entire strategy. For example, congestion charging is a further option for the existing parking pricing mechanism. A low emission zone is another alternative for policy makers and may be combined with congestion charging to some extent. Parking management enforcement should be implemented in a more efficient way with high quality. Public transport improvement, together with improvements of non-motorised transport, should provide a multi-mode choice.

The success factors are effective in various ways for the activities of the TDM project, including study tours to European cities, pilot areas to evaluate TDM policies, integrated *pull* and *push* measures and testing innovative technologies.

5.1 Pricing – A Missing Element

So far, only a few pricing reforms have been implemented in Beijing, and they have not been considered very effective. This may result from inadequate enforcement (for example, if motorists can avoid paying parking fees), relatively low fuel prices in China (mid-level), relatively high incomes of vehicle owners in Beijing, and fears that high road user fees are unfair to poor people. This suggests that there is potential for much more implementation of transportation pricing reforms.

Picture 8: *Sophisticated parking meter in Ann Arbor, Michigan (USA)*

Photo by Dwight Burdette, 2010 (CC-BY 3.0)

Building upon the Existing: Effective Parking Pricing

Although a new parking charge standard was implemented in 2011, enforcement was not as strict as expected during the policy implementation. Learning from the good practices and experiences from Japan, UK, the Netherlands and other countries on parking management, it is recommended to decentralize and localize parking management responsibilities according to parking zoning. The whole city or the central city is

divided into several parking zones, and each zone has its own parking management operator to determine specific parking measures and charges. The revenue generated from parking fees should be kept at the local level as earmarking to support sustainable transport and other public facilities or public services. For example, in the London Royal Borough of Kensington and Chelsea, 12% of the parking revenue is used to fund Freedom Pass - a program that gives free transit tickets to the elderly (60+) and disabled.

Hamburg, Paris, Zurich, Hong Kong, and many European cities implement maximum parking space requirements for new residential and commercial developments (abolishing the previous minimum parking space requirements). The rule is, if we provide less parking, then fewer vehicles come into those districts. An excellent example is Hong Kong.

A Future Option: Congestion Charging

Congestion charging is widely implemented with successful effects in a few European cities, like London (UK) and Stockholm (Sweden). Singapore is the first and the only Asian city which successfully conducts congestion charging since the seventies of the twentieth century. Congestion charging is worthy to explore as an economic tool in Beijing's central city. Congestion charging is especially useful to shift commuters to public transport. However, congestion charging is costly to implement and may have undesirable, unintended consequences, and so requires careful planning. In this case, a feasibility study before the implementation of congestion charging can be employed to analyse whether or not the majority of the public supports a particular proposal. Information and campaigns about the purpose of the policy as well as on the use of the revenues (e.g. to improve NMT or public transport) can help to increase awareness and acceptance of the public. The charging form, pricing, fee collection locations and other technical issues also require multi-department coordination and cooperation.

Box 3: Beneficial Impacts on GHG Emissions by Implementing TDM Policies

The review of international good practice shows that comprehensive application of an appropriate set of TDM instruments, such as parking management, congestion charging and a low emission zone all contribute a lot to GHG emission reduction. For example, in London CO_2 emissions were reduced by 19% after congestion charging was implemented, Stockholm was able to reduce its CO_2 emissions by 18% after congestion charging was applied, and in Berlin PM_{10} emissions were reduced by 10% through the creation of a low emission zone. Milan set up a low emission zone based on congestion charging, which is a TDM policy package. After the implementation, travel volume decreased by 21%. It is reasonable to assume that a TDM policy package in Beijing can significantly contribute to GHG emission reduction and substantially improve the living environment.

Besides congestion mitigation and air quality improvement, GHG emission reduction has very important social co-benefits. The measures can restructure the transport modal split and make non-motorised transport more attractive, which will greatly raise the living quality in terms of air quality and noise exposure. Fossil resources become more and more scarce, and thus the reduction of transport related energy consumption plays an important role in sustainable development. The challenges that are connected with this task are even greater for developing countries. GHG emission reduction will reduce the **heat island effect** and indirectly improve air quality and reduce energy consumption. The improvement of air quality also contributes to public health and saves potential medical costs.

5.2 Further Develop Regulation

Regulation is a powerful and effective tool in Beijing. Good experiences with number plate bans, vehicle registration lottery and parking management are very promising. Managing car use especially relies on effective rules – and their enforcement. Using technology to further improve enforcement may be needed. Institutional issues may also be considered. E.g. enforcement is especially accepted if the enforcing authorities directly benefit from fees and charges.

Reinforcing Parking Management

In addition to parking pricing, appropriate parking management is needed. According to statistics from Beijing Transport Management Authority, there is considerable scarcity of parking throughout the city. However, it is possible that the parking problem is not a problem of scarcity but more a problem of allocation. It is important to collect information on parking supply, pricing and demand, and to develop integrated parking management programs that include efficient pricing, regulation, enforcement and user information for each district. The most convenient parking spaces should be managed to favour short-term users, such as delivery vehicles and customers, over long-term users such as commuters and residents, through limits on parking duration and higher prices. In order to increase the effectiveness of parking management measures, private parking operators need to be included in the parking regulation. Another missing element may be to limit the number of parking spaces for new developments (maximum instead of minimum parking standards) in order to make commuters shift to public transit and ensure a high probability of getting parking spaces.

Adding an Element: Low Emission Zone

Recently, environmental issues receive more and more attention. As one of four municipalities in China, Beijing will proclaim a new environmental air quality standard in 2012, including limitations for PM 2.5. In order to comply with the new standard, Beijing is considering the implementation of a low emission zone. Due to the uniform EU environment standard, low emission zone policies are widely used in European countries, for example in Berlin (Germany) and in Milan (Italy). However, such approaches mainly intend to eliminate the high-polluting vehicles form the city centres, as limitations to enter the zone are linked with the

Box 4: Towards a Low Emission Zone

As the environmental standard in China gradually integrates with the EU standard, most of the requirements are prepared to implement a low emission zone. Vehicles with emissions higher than Euro III are forbidden to drive within the 5th ring road in Beijing. In order to build up a low emission zone, the first step is to identify a restricted area, the second step is to classify vehicles based on the emission standard, and finally high emission vehicles have to be banned from driving into the restricted area at a certain time of day. The implementation of this policy requires the involvement of the transport management department as well as the cooperation of the environment protection department. More specific emission standards should be added into the current environmental standards, in order to classify different vehicles for low emission zones.

emission standard and not the fuel consumption. While Euro 1-3 vehicles are still responsible for a considerable share of emission of pollutants like PM 2.5 or NO_x, the effect to reduce GHG emissions is very limited. In order to be also effective to alleviate congestion and reduce GHG emissions, such a low emission zone may be combined with a congestion charge.

5.3 Optimize Public Transit through Better Integration

The subway is the backbone of Beijing's transport system. It may be further extended and improved where needed and complemented by some commuter rails. However, the subway system needs a large amount of government financial investment and policy support, especially in the early stage to construct but also to maintain infrastructure and ensure good operation. In order to make the best use out of the system and make it as profitable as possible, more transit-oriented development should be envisaged. Along subway lines new mixed use towns like in Hong Kong may help to reduce travel distances and get people to choose public transport. Due to its rapid construction, Beijing subway system lacks in many cases:

- Easy access through short distances of subway stations to shopping, offices and housing (walking accessibility)
- Rapid transfer between lines
- Good link to the bus system

Picture 9: *Tung Chung Station on Tung Chung MTR Line in Hong Kong (P.R. China)*

Photo by Hokachung, 2009 (CC-BY 3.0)

The bus system should be improved to help transfer passengers to subway stations. The city of Seoul's bus improvements provide a good example of integrated bus and subway network planning. Seoul is building BRT lines on top of the subways to serve shorter trips and reduce subway congestion. Considering quick land use development, passenger growth and financial investment, it is recommended to build dedicated bus lanes and BRT lines in long distance transport corridors. This can be done quickly by converting existing general traffic lanes to bus lanes and building improved bus stops.

Picture 10: *Bus Rapid Transit service in Beijing (P.R. China)*

Photo by Daniel Bongardt, 2012

In order to take full advantage of the subway as mass transit, it is necessary to shorten the entire trip link travel time and facilitate bus transfers through a bus signal priority system, prepaid bus fares, electronic fare payment systems, faster loading and unloading, better bus and train station designs, improved walking and cycling access to bus and train stations, and improved user information. The bus planning institute, management and operation companies should take the

Box 5: Cycling Revival and Walking Improvement

Cycling was once a popular travelling tool in 1980s and early 1990s. The cycle lanes were well designed and usually physically separated by green belts. However, the rapid urbanization and motorization breaks the balance of bicycles and cars. The cycle lanes were gradually encroached by motor lanes and separated cycle lanes were replaced by mixed lanes.

Now it is time to draw people back from cars to bicycles to escape from the traffic congestion and parking headache. The first prerequisite is reallocating the road space and returning the wide and safety protected cycling lanes to cyclists. Besides, landscape design along the roads is also crucial to provide a more comfortable environment for cycling. The Public Bicycle Sharing Plan is in trial operation in Chaoyang and Dongcheng districts since June 2012. Most of these rental spots are located near subway stations or in inner central districts, which encourages bicycles for short distance trips.

http://www.china.org.cn/environment/2012-06/20/content_25694034.htm

Walking and cycling are efficient and affordable transport modes in a low carbon transport system. Many urban trips rely entirely on walking or cycling and most public transport and automobile trips involve walking links. Pedestrian transit improvements are often an important way to encourage public transit travel and to support more efficient parking. In the "last one kilometre" campaign, barriers and illegal parking are moved from cycling and pedestrian lanes to provide a more comfortable environment for the short distance trips around subway stations and bus stops.

responsibility to push the integration of planning, design and implementation.

5.4 Considering Success Factors for the TDM Project

Having been the kingdom of bicycles but turning into the capital of cars, Beijing can now transform into a low carbon transport city. In order to develop a pragmatic approach to improve the TDM implementation in Beijing, the joint project between GIZ and BTRC provides a good opportunity to support decision-making by suggesting feasible TDM measures for Beijing. The project may focus in its efforts to provide international experiences and quantify emissions in the following three areas:

1. Parking management and pricing (institutional reform, parking zoning, enforcement, minimum/maximum parking requirements, etc.)
2. Congestion charging and low emission zones
3. Public transit integration and improvements (bus priority and esp. improving the physical integration between the bus and the subway network, as ticket fare integration has been achieved)

A further option is to work on the policies to promote non-motorised modes. Based on the extensive cycling infrastructure major upgrades could be achieved in the coming years.

For all options, the identified success factors could be considered when developing policy suggestions:

Strong Cooperation and Dialogue between Stakeholders

Exchange of information and transparent processes for mutual agreement on policies is necessary. The project will bring in international experts that also report about cooperation mechanisms. In some cases recommendations for institutional reform regarding responsibilities of and cooperation mechanisms between urban transport players may be developed, too. This is especially the case in pilot areas, in which cooperation may be increased at a micro scale. For the overall city, the project can only target procedures for cooperation or the institutional arrangements in Beijing indirectly – or if especially requested from the Chinese counterparts.

Emphasis on High-Quality Implementation of Policies

When starting policy implementation, the project team may support BMCT through carrying out feasibility studies and providing implementation concepts. In order to ensure the highest quality of the implementation, a pilot area may be best suited to demonstrate and test. It is necessary to identify such an area early in order to learn from experiences. Once the pilot area is determined, high-quality implementation and accurate management may be monitored. This way, the policy sensitivity can be pre-tested for further adaption and improvement. Additionally, demonstration may help to improve the public acceptance of the measure.

Developing Measures as Part of a Comprehensive Strategy

Simply implementing a single TDM measure may not be successful. Combining *push* and *pull* strategies may also be applied in pilot areas, e.g. combining parking management with cycling infrastructure improvements. On a city-scale, such policies that lack effectiveness shall be gradually adapted and improved and missing elements may be added.

Using Innovative Technology

Innovative technology may be tested in the three TDM policies that the project is focussing on. Beijing is well prepared to identify and apply the relevant technologies and build the necessary capacities to apply and implement them. However, such investments need to be decided on and taken by the city government.

Picture 11: *Effective street design providing ample space for different modes of transport and plants in Beijing (P.R. China)*

Photo by Daniel Bongardt, 2011

References

1. Beijing Transport Research Center. *Beijing Transport Annual Report 2011*. http://www.bjtrc.org.cn/JGJS.aspx?id=5.2&Menu=GZCG
2. Tencent News. *Vehicle Registration Surpass 5 Million.* http://news.qq.com/a/20120217/000624.htm?qq=0&ADUIN=187276547&ADSESSION=1329444528&ADTAG=CLIENT.QQ.3493_.0
3. Huang, Yan (2004). *Urban Spatial Patterns and Infrastructure in Beijing.* http://www.lincolninst.edu/pubs/969_Urban-Spatial-Patterns-and-Infrastructure-in-Beijing
4. Beijing Traffic Management Bureau. *Special Subject on Comprehensive Congestion Migration Measures in Beijing. Historical Vehicle Population data.* http://www.bjjtgl.gov.cn/zhuanti/20101223news/index.html
5. People Daily. *Flexible Work Hours for Institutional Organizations in Beijing.* http://politics.people.com.cn/GB/14562/11333149.html
6. Beijing Car Quota Control and Management Information System. http://www.bjhjyd.gov.cn/
7. Net Ease Auto. *Area-differential Parking Measure to gather public support.* http://auto.163.com/10/1213/07/6NP31ATV00084JTJ.html
8. People Daily. *Beijing vehicle restrictions have noticeable results, car owners support* http://english.peopledaily.com.cn/90001/90776/90882/6629339.html
9. Beijing Broadcast. *Effects of Area-differential Parking Measure are Obvious.* http://news.rbc.cn/bjxw/201110/t20111024_2351406.htm
10. People Daily. *Results on Traffic Congestion Migration Survey by Beijing Municipal Commission of Transport* http://auto.people.com.cn/GB/15116188.html
11. China Transport News. *28 congestion mitigation measures implemented in Beijing since 2011.* http://www.zgjtb.com/content/2010-12/19/content_178537.htm
12. CCTV.com. *Beijing releases new measures to ease traffic congestion.* http://english.cntv.cn/program/china24/20101224/102302.shtml
13. China.org.cn. *Public bike sharing in Beijing.* http://www.china.org.cn/environment/2012-06/20/content_25694034.htm
14. GIZ (2012). *Transport Demand Management in Beijing: Work In Progress* http://www.tdm-beijing.org/files/Work-in-Progress-TDM-Beijing-brochure.pdf
15. Andrea Broaddus, Todd Litman and Gopinath Menon (2009). *Training Document On Transportation Demand Management, Sustainable Urban Transport Project* http://www.sutp.org/index.php/en-dn-th2
16. Frederik Strompen, Daniel Bongardt, Todd Litman, 2012. *Reducing Carbon Emission through Transport Demand Management Strategies.*

17. Todd Litman (2003). *Mobility Management Module* of the Sustainable Transport Sourcebook
http://www.vtpi.org/gtz_module.pdf

18. ADB (2009). *Changing Course: A New Paradigm for Sustainable Urban Transport, Asian Development Bank*
http://www.adb.org/Documents/Books/Paradigm-Sustainable-Urban-Transport/new-paradigm-transport.pdf

19. ADB (2010). *Reducing Carbon Emissions from Transport Projects, Asian Development Bank*
http://www.asiandevbank.org/Documents/Evaluation/Knowledge-Briefs/REG/EKB-REG-2010-16.pdf and www.adb.org/evaluation/reports/ekb-carbon-emissions-transport.asp

20. Daniel Bongardt, Dominik Schmid, Cornie Huizenga and Todd Litman (2011), *Sustainable Transport Evaluation: Developing Practical Tools for Evaluation in the Context of the CSD Process, Commission on Sustainable Development, United Nations Department Of Economic And Social Affairs*
http://www.un.org/esa/dsd/resources/res_pdfs/csd-19/Background%20Paper%2010%20-%20transport.pdf

21. Felix Creutzig and Dongquan He (2009). *Climate Change Mitigation And Co-Benefits Of Feasible Transport Demand Policies In Beijing, Transportation Research D, Vol. 14, pp. 120-131*
http://www.user.tu-berlin.de/creutzig/trd.pdf

22. Paul Barter (2010). *Parking Policy in Asian Cities, Asian Development Bank*
http://beta.adb.org/publications/parking-policy-asian-cities.

23. GIZ (2011). *Changing Course in Urban Transport- An Illustrated Guide, Sustainable Urban Transport Project (www.sutp.org) Asia and GIZ*
http://www.sutp.org/index.php?option=com_content&task=view&id=2825

24. International Conference on Parking Reforms for a Livable City, Centre for Science and Environment (www.cseindia.org), 17 August 2011, New Delhi http://www.cseindia.org/node/2911. Presentations:
    - Paul Barter: Promising Parking Policies Worldwide: Lessons for India?
    - Michael Kodransky: Europe's Parking U-Turn

25. Chhavi Dhinghi (2011). *Measuring Public Transport Performance- Lessons For Developing Cities: Sustainable Transport Sourcebook, Sustainable Urban Transport Project (www.sutp.org) Asia and GIZ*
http://www.sutp.org/index.php?option=com_content&task=view&id=2826

26. Chang Deok Kang and Robert Cervero (2008). *From Elevated Freeway to Linear Park: Land Price Impacts of Seoul, Korea's CGC Project, UCB-ITS-VWP-2008-7, Volvo Center for Future Urban Transport, University of California Berkeley*
http://repositories.cdlib.org/cgi/viewcontent.cgi?article=1019&context=its/future_urban_transport

27. Santhosh Kodukula (2011). *Raising Automobile Dependency: How to Break the Trend?, GIZ Sustainable Urban Transport Project*
http://www.sutp.org/dn.php?file=TD-RAD-EN.pdf

28. KOTI (2010 and 2011). *Toward an Integrated Green Transportation System in Korea, Korea Transport Institute*
http://english.koti.re.kr

29. James Leather, Herbert Fabian, Sudhir Gota and Alvin Mejia (2011). *Walkability and Pedestrian Facilities in Asian Cities: State and Issues, Sustainable Development Working Paper, Asian Development Bank (www.adb.org)*
http://cleanairinitiative.org/portal/sites/default/files/documents/ADB-WP17-Walkability-Pedestrian-Facilities-Asian-Cities.pdf

30. John Pucher and Ralph Buehler (2009). *Sustainable Transport that Works: Lessons from Germany, World Transport Policy and Practice, Vol. 15, No. 1, May, pp. 13-46*
http://www.eco-logica.co.uk/pdf/wtpp15.1.pdf

Annex: 28 Specific Measures

Categories	Contents of the 28 Specific Measures
Improve urban planning, mix the functions and population of the central city	1. Further adjust and optimize city function layout 2. Optimize guidance in the transport system in order to provide better service 3. Fully implement an infrastructure planning policy
Speed up transport infrastructure construction, increase the transport system capacity	4. Promote overall primary road network construction 5. Accelerate the construction of a central city road micro-circulation system 6. Build more than 50,000 public parking spaces in the central city 7. Build more than 200,000 basic parking spaces depending on local conditions 8. Construct a national highway network and municipal primary road network
Put more effort on public transport priority, encourage public transport modal choice	9. Speed up subway network construction in the central city 10. Reform the existing subway safety operating service facility 11. Structure a rapid-commute bus line network 12. Further optimize and adjust the bus line network 13. Speed up the comprehensive passenger transport hub and bus terminal construction
Improve non-motorised transport, park and ride facilities, promote green transport modes	14. Build up a public bicycle sharing system, including 1,000 public bicycle sharing spots, accommodating more than 50,000 bicycles 15. Develop a school bus service system and promote commuter buses for companies 16. Build up P+R parking lots accommodating more than 30,000 parking spaces along the subway lines 17. Promote modern transport concepts and public transport-related activities 18. Promote telework and flex work hours
Further improve vehicle management, give incentives for suitable usage of cars	19. Control the growth of car registrations, ease the vehicle rapid growth trend 20. Maintain the implementation and improvement of peak hour driving restrictions in the central city 21. Increase the cost of driving through parking fees and thus reduce traffic volume in the central city
Improve the scientific and modern traffic and transport management level	22. Continue the implemented congestion-ease project, increase road capacity 23. Construct a new Intelligent Transport Management System 24. Enforce transport management 25. Enforce parking management 26. Create traffic information publications, warnings, forecasting systems, improve emergency management 27. Further improve the transport management system, clarify responsibility 28. Incorporate congestion-ease as part of the supervision and performance assessment

Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Sunflower Tower Room 860
37 Maizidian Street, Chaoyang District
100125 Beijing, P.R. China

Beijing Transportation Research Center

9 Liuliqiao Road, Fengtai District
100073 Beijing, P.R. China