Sustainable Urban Mobility: The Example of Istanbul
A Short Survey
Case Studies in Sustainable Urban Transport #3
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The series ‘Case Studies in Sustainable Urban Transport’ contain examples of best practice in the development of sustainable transport in cities. This paper does not represent an example of this in a strict sense (except for the implementation of the BRT system). However, it does identify the current transport problems Istanbul faces and it gives a clear overview of the sustainable transport strategies that are available to the city. For this reason, the paper has been included in these series.
# CONTENTS

1. Introduction .............................................................................................................. 1  
   1.1 Scope of the survey .............................................................................................. 1  
   1.2 Geography and demography .............................................................................. 2  

2. Transport Conditions in Istanbul ........................................................................... 4  
   2.1 Road network infrastructure and cars ................................................................. 4  
   2.2 Public transport infrastructure .......................................................................... 5  
   2.3 Non-motorised transport ..................................................................................... 7  
   2.4 Summary .............................................................................................................. 8  

3. Transport Demand Management (TDM) ................................................................. 9  
   3.1 Measures to improve the transport services in Istanbul ..................................... 9  
      3.1.1 Bus transport ............................................................................................... 9  
      3.1.2 Paratransit ................................................................................................... 9  
      3.1.3 Bus rapid transit ......................................................................................... 9  
      3.1.4 Sea transport ............................................................................................... 10  
      3.1.5 Light rail transit, metro and rail ................................................................... 10  
   3.2 Focus on non-motorised transport ...................................................................... 10  
   3.3 Freight and commercial transport ..................................................................... 11  
   3.4 Organisational measures and public relations ................................................. 11  
   3.5 TDM measures – Overview of recommended actions ..................................... 11  

4. Intervention for sustainable transport: a public transport plan ............................... 16  
   4.1 System-wide measures ..................................................................................... 16  
   4.2 BRT related measures ...................................................................................... 17  
   4.3 Perspective for Istanbul’s MRT system ............................................................... 17  
   4.4 ITS measures ................................................................................................... 19  
   4.5 Fare structure and tariffs ................................................................................... 19  
   4.6 Expected impacts .............................................................................................. 20  

5. Additional measures: improvement of finances and economic instruments .......... 21  
   5.1 Economic and legal measures .......................................................................... 21  
   5.2 Institutional framework and cooperation with the private sector ....................... 21  
   5.3 Impacts on transport activities, environment and finances ................................ 23  

6. References .................................................................................................................. 25
1. Introduction

1.1 Scope of the survey

To describe transport issues of Europe’s largest city and find ways for mobility in Istanbul compatible with both eco-societal and environmental demands requires taking a look at Istanbul’s geopolitical and historical structure as well as its dynamic economic development.

Istanbul is a booming city facing immense challenges in trying to accommodate additional 84,000 cars every year (Urban Age, 2011a). The increase in motor vehicles is faster than population growth.

Despite measures aimed at restricting car use, new infrastructure to a great extent favours the private car. The city struggles with air pollution, congestion and damage to its natural and cultural heritage.

Since developments in the transport sector are influenced by a number of factors ranging from economic conditions over urban development to social practices, no universal solution exists.

This case study is intended to support, update and contribute to existing plans and approaches, such as the ones by the Istanbul Metropolitan Municipality (IMM).

Its main objective is to explore information and knowledge about urban mobility trends in connection with the expansion of urban areas, so as to call attention of decision-makers and other stakeholders on impacts in terms of sustainable development. The goal is to identify the main transport problems of Istanbul, outline a suitable transport system, appropriate and integrated urban transport planning and implementation strategies, structural measures, technical features, economic instruments as well as institutional framework towards sustainability in Istanbul’s urban transport.

The following main achievements related to a balanced mobility in Istanbul can be noted:

- The state tax policy supports smart growth by setting relatively high fuel prices.
- After a short planning and construction period, a BRT system (Metrobüs) was put into operation in Istanbul in 2007 and enjoys great attractiveness.
- The Municipality implemented a user-friendly and widely accepted fare system in all municipal means of public transport, based on an easy-to-use smart ticket (Akbil).

Further steps towards balanced mobility in Istanbul are proposed:

- Polycentric development of Istanbul to be continued and promoted, no more settling of industries in the Marmara region as the saturation level has been reached.
- Parties responsible to consider transport, urban planning, business, public services, energy and goods supply as part of the same integrated system, alternatives and easy connections to be offered to all Istanbulites.
- Rediscover Istanbul as a seaport and waterfront town and boost sea traffic to a real MRT system.
- Make the poor a priority: urban mobility systems must ensure that goods, services and job opportunities are open to all: affordable fares and accessibility to all Istanbulites.
- Go beyond the car: Istanbul shall be designed for people, not cars –including added value to public finance!
- Change people’s behaviour: beyond better infrastructure and technologies, Istanbul needs to apply to social norms that motivate for low-carbon lifestyles.
1.2 Geography and demography

Istanbul is situated in the north-western part of Turkey, where the Black Sea is connected to the Marmara, Aegean, and Mediterranean Sea by the 31 km long Bosporus strait. It divides the metropolis of Istanbul into an Asian (Anatolia) and a European part (Thrace). Today, Istanbul is Turkey’s and Europe’s largest city and one of the largest cities of the world with around 14 million inhabitants (18% of Turkey). Consisting of 39 boroughs, Istanbul extends for over 100 km, covers an area of some 5 300 km² (0.67% of Turkey) and, with that, it has one of the largest urban footprints in the world.

The boroughs are subdivided in some 1 000 quarters and villages with their own elected head officers or mayors. The average population density has increased from some 1 000 people per km² in the 1980s to 2 400 people per km² today, varying considerably up to 20 000 persons per km² in central areas with peaks of 40 000 up to 70 000 inhabitants per km² in totally urbanised districts on the European side. For 2023, an increase to 3 400 people per km² is projected, as shown in Figure 1.

![Figure 1: Istanbul’s population density in 2007 and 2023.](source: Gerçek, H. and Demir, O. (2008))
The rural province of Tekirdağ neighbours Istanbul in the west. Eastwards the industrialised province of İzmit/Kocaeli links the Istanbul and Marmara region with the Anatolian mainland. Due to unemployment in the southeast of Turkey, many people from that region migrate to Istanbul, where they establish themselves predominantly in the outskirts of the city. Two thirds of all Istanbulites live in the European section. The population has more than tripled since 1980 with a higher rate on the Anatolian side. Settlements have concentrated at the shore of the Sea of Marmara but are going beyond municipal limits and dispersing into the northern forested areas towards the Black sea.

As a result of rapid and extensive growth, the macroform of the city has changed from a duplex centred (Eminönü – Beyoğlu) to a multi-centred one with a number of sub-centres such as Bakırköy, Bağcılar, Büyükçekmece in the European side and Kadıköy, Üsküdar, Kozyatağı or Kartal in the Anatolian side. The map in Figure 2 charts the city’s growth. New settlements away from the original city centre have developed as car-dominated residential and mixed use areas with industrial and business parks. Whereas Ankara (4.5 million inhabitants) is capital as well as political core of the Republic of Turkey, Istanbul is the country’s undisputed cultural, economic, and financial centre, generating 21.2 % of its GNP.

Figure 2
Istanbul’s growth and age of buildings.
Source: Urban Age (2011b)
2. Transport Conditions in Istanbul

2.1 Road network infrastructure and cars

Two six to eight-lane beltways (the TEM and E-5 Highways) surround the city on a length of 130 km and accommodate the interregional motor traffic. They connect the two international airports, the three main ports, and most important business districts and provide access to the sub centres. The European and Asian sides of Istanbul are connected by two highway bridges. 420 000 vehicles cross the Bosporus each day. The Bosporus bridges are toll roads.

Almost the whole highway network, especially the arterial roads and the main trunks including the two bridges with their beltways, are overloaded in the morning and evening peak hours and increasingly even during the rest of the day. Though car ownership is at low level yet (one third of household have a car), and though Turkey’s fuel prices are one of the highest worldwide whilst taking only rank 62 of income level (UNDP, 2010), Istanbul faces severe congestion problems. In peak hours, average speed slows down to 8–10 km/h. Most commuters spend more than 2 hours daily in traffic.

Main roads (motorways and state roads) are generally in good conditions whilst provincial and local (secondary) roads lack maintenance and have to cope with heavy loads and seasonal weather effects.

The increasing inner urban traffic does not match with the Ottoman structure of the city and its self-contained neighbourhoods. The buildings of such urban quarter (Mahalle) are as a rule arranged concentrically around a mosque. Few public access roads (Tarik-i ämm) and narrow private lanes (Tarik-i hâss), often cul-de-sacs dominate. Through roads generally lack, links between different Mahalle are rare. Since the 1950s, boulevards and avenues for the car and bus traffic were constructed at the cost of historical structures. Proposals with divided public opinion are at an advanced stage to construct a 3rd bridge north of the city, some 150 km of new urban road tunnels, and a road tunnel under the Bosporus nearby the historical city centre south of the Golden Horn. Personal motorisation is still fairly low (139 cars per 1 000 inhabitants in 2009, which is about one third of the western industrialised countries), though increasing significantly by 20% in the last decade. The number of registered automobiles in Istanbul

Figure 3
Istanbul main road traffic information system.
Source: IBB (2011)
Sustainable Urban Mobility: The Example of Istanbul

has though multiplied tenfold since 1980 and more than doubled in the last 10 years. As per end of 2010, 1.8 million cars and 175 000 motorcycles were registered in Istanbul. Whereas today two third of all households have no car, it is predicted that in 2025, two third will have one. The Istanbul Metropolitan Municipality runs an online ITS system informing on the traffic situation and congestions, which is shown in Figure 3. Data of traffic sensors at the principal and other main roads are real-time published by a traffic control centre via Internet.

2.2 Public transport infrastructure

The public transportation system has difficulties to keep pace with the rapid growth and changing urban structure. Bus fleets owned by the municipality (İETT) and by a nationwide operating private organisation (ÖHO) together with private minibuses form the main body of the public transport network. Some 600 main bus routes of both large-scale entities are operated by coordinated schedules; several hundred of paratransit routes—shared taxi (Dolmuş) and private minibuses—exist. They play a key role in the commuting patterns of Istanbul’s residents, comprising the highest share: 40.8% of all daily motorised journeys. The Dolmuş is a special service in Turkey, a collective taxi with fixed routes but free stops. It can be considered as informal service. The fee in Dolmuş (8 passenger capacity) and minibuses (12–20 passengers) depend on the distance travelled and is paid to the driver only in cash. Prices are set by the municipality. The owners are small-scale firms or individuals forming a well organised interest group.

Buses, minibuses and Dolmuş altogether provide service for approximately 6 million passengers daily on a network of more than 6 000 kilometres with the Dolmuş and minibuses predominantly but not always acting as feeder systems to the main bus lines. Average age of the vehicle fleet is estimated at least 12 years at a prevailing low level regarding pollutant emission, noise, comfort or accessibility for handicapped persons, especially regarding Dolmuş and minibuses.

The main coach terminal Esenler in the European district of Bayrampaşa is one of the biggest in Europe with 15 000 travels per day and a capacity of 600 000 passengers.

A BRT line (Metrobüs) implemented in 2007/08, which recently obtained the Sustainable Transport Award, operates on a distance of 41 km across the first Bosporus bridge and links the western suburbs on European side with the busy district of Kadıköy at the entrance of the Bosphorus on the Asian side.
The ridership is more than 600,000 trips per day and 30,000 PPHPD with an average speed of 30–40 km/h and a frequency of up to 120 buses per hour. Before, the trip duration on the longest relation covered nowadays by the Metrobü is 180 minutes at an average fee of TRL 4.50 (USD 2.90). Metrobü provides a ride without transfer in 60 minutes for TRL 1.95 (USD 1.25), which means a 56% price reduction in a third of the time (Urban Age, 2011b).

A variety of waterborne lines are run by the municipality, private, and semiprivate agencies and operators; ferryboats, seabuses and water taxis link both sides of the Bosporus strait as well as the centres along the coast off the Marmara Sea, with 300,000 daily passengers.

Istanbul’s urban metro and light rail network, operated by Istanbul Ulaşım, has currently a system length of 76 km and comprises one metro line, DC (Direct Current) driven by a third rail, with 12 stations, and 3 AC (Alternating Current) driven light metro lines. One more line is under construction, two more and extensions to the existing lines are planned or under way to expand the metro and LRT network to some 230 km by 2015. In addition, two funicular lines and two historical tramway lines provide service in steep central areas. One modern tram line of 14 km length is in operation. The daily passenger rate of all urban rail traffic is about 700,000 passengers. The heavy rail and suburban fully electrified rail system has a total length of 163 km, of which most provides a low level of service for 750,000 passengers per day. Two terminal stations accommodating the suburban and long distance lines on both European and Asian side are operated by Turkish State Railways (TCDD) and are linked by a railroad ferry transporting freight trains only.

The development of the rail network is impeded by the hilly topography and the rapid urban sprawl.

The Marmaray Project (Ray’ is Turkish for ‘Rail) includes a Bosporus crossing through an immersed tunnel and the upgrade of the existing suburban train lines to create a 76 km high-capacity line along the Marmara sea shore with 4 new underground stations, 37 other aboveground stations to be rebuilt or re-furbished, and a third parallel track, to increase capacity up to 75,000 passengers per hour in each direction. After completion, the usage of rail transportation in Istanbul is predicted to rise from 3.6% to 27.7%. The project is currently 4 years behind schedule, largely due to the discovery of archaeological findings.

Railway Lines within the city are planned, constructed or upgraded by the Ministry of Transportation’s General Directorate DLH, while municipal entities manage the construction of metro lines and run the public transport of the city.

Istanbul’s modal split has changed in favour of the car in the last decades; its share has risen from 20% in 1987 to 30% in 2009, buses dropped from two thirds down to a quarter. Rail and sea transport range at a constant low level between 2% and 5%. An overview is given in Figure 6. As it can be seen, company and school buses increased their share to more than 20% in recent years. This service has become a significant means of transport in Turkey provided to employees.

Figure 5
Situation before and after the implementation of the BRT system (Metrobü). Source: IBB (2006, 2010)
and pupils, however making flexible working hours difficult. Empty and parallel trips are inherent in this concept.

In all PT means, payments are done by either cash, by smartcards or by smart tickets. The easy-to-use smart ticket called ‘Akbil’ is a plastic key with a refillable battery, valid on all buses, ships, sea buses, metro and tunnel systems and provides discounts from 10–25%. Contactless smartcards are available with discounts for subscribers, students, retired, or handicapped people. A ‘Citizen Card’ is being developed with the aim of handling more applications as car parking, e-health or event ticketing.

### 2.3 Non-motorised transport

The share of walk trips has decreased in the last decades from almost half of the total trip rate to less than one third in the 1990s. During the last ten years, it has slightly increased but it lies with 16% still below the rate of other metropolitan cities (Gerçek, H. and Demir, O., 2008). Public space for pedestrians is reduced to gain space for the increasing motorised traffic. However, the district municipalities put efforts in allocating pedestrian and/or car free zones in inner urban areas.

Cycling is exercised if at all in sport and leisure areas as at the seafronts. As part of the urban traffic, cycling is practically nonexistent (0.05% of all trips). This is due to the hilly topography, the absence of cycle paths in urban areas, the image of the bike as a means of transport for the poor, and the car drivers’ unawareness of cyclists and along with this the inherent safety problems.
2.4 Summary

The major issue of Istanbul’s traffic situation is congestion. It is the problem that concerns people most. The city is generating enormous business activities (12% growth of the Turkish GDP in the 1st quarter of 2010) associated with increasing traffic volumes of inter-regional and intra-regional demands. Though CO₂ emissions will reduce on a ‘per passenger-km’ basis in the coming years due to improved technologies, the total emissions are expected to increase by 170% due to the estimated increase in VKT (Gerçek, H. and Demir, O., 2008). This results from the continued inflow of new residents and the increase in car ownership. For the poor this will result in both more deprivation of affordable transport and more exposure to air pollution if no measures are taken.
3. Transport Demand Management (TDM)

The low mobility rates in Istanbul – 1.74 trips per day and person (versus 3.40 trips per day and person in Germany) (Gercek, H. and Demir, O., 2008; INFAS, 2011; MiD, 2011) – reflect the fact that urban travel demand is suppressed due to severe traffic congestion, insufficient capacity of the infrastructure network, and long travel times on Istanbul’s road network. The TDM policies to be outlined below refer to the situation described in the introductory section. It aims to improve indicators for sustainability of transport, such as: energy consumption, GHG emissions, traffic noise, land take, traffic accidents and fatalities, accessibility of basic facilities and transport services, transport prices, motorised traffic prices, charges and taxes.

Ways shall be found to reduce transport demand through suitable approaches of town planning rather than tackling it simply by new transport options. The effectiveness of the sum of measures is considered to be higher than the single measures as together they will achieve more than any on its own; for example public transport improvements and controls on parking will be better able together to influence demand for car use. Likewise, one policy instrument can be used to overcome the barriers to introducing another: improving bus services make congestion charging more palatable, while congestion charging provides the finance for the improved services. The TDM is further needed to tune the variety of solutions and reduce interferences or parallel planning. An adjusted package of ‘small’ and local measures is regarded as more efficient than prestigious but isolated ‘flagship’ projects. Studies make it clear that where and how investments are made in transport infrastructure make a difference: people drive less in areas with greater transport options and where it is easier to walk (Deal, B. et al., 2009). Investments that reduce the demand for travel by car benefit the environment as well as the economy.

3.1 Measures to improve the transport services in Istanbul

3.1.1 Bus transport

As it is demonstrated through studies (GIZ, 2011), buses provide a more efficient occupancy of the scarce road space than cars could ever do; user capacity (users/hour/3.4 m lane) is 2.5 to 7 times better and space demand (m² per user) of buses is 20 times better than those of cars. The number and length of bus lanes in Istanbul is behind other cities. All existing multilane roads should be thus assessed with the aim to designate further bus lanes. Divided busways should be arranged wherever trouble free bus circulation cannot be ensured due to unauthorised use of bus lanes by cars. Signal prioritisation should be given to PT; buses and Dolmuş should be privileged at toll stations by re-served lanes to further enhance the attraction of PT. The outlined improvements to bus transport are also a step towards reducing GHG and increasing overall accessibility for socially deprived population groups.

3.1.2 Paratransit

Safety standards and comfort of minibuses and Dolmuş are to be raised comparable to those of formal means of transport. The vehicles should undergo regular technical and environmental checks.

3.1.3 Bus rapid transit

Per passenger, a Metrobüs consumes between 0.3 and 0.4 litres of fuel per 100 kilometres, and thereby makes a significant contribution to the reduction of CO₂ emissions. By virtue of its cost-effectiveness, high passenger capacity, low infrastructure costs and time savings, it is an ideal component for innovative transport systems.
The acceptance of Istanbul’s Metrobus has exceeded all expectations and thus extensions should be made. Existing projects should be accelerated and remaining obstacles and shortcomings in the operating procedures are to be removed at short notice in order to keep the system’s efficiency and acceptance.

3.1.4 Sea transport

Istanbul’s ferries –Vapur– are a characterising feature of the city and an identifier for its people. It should be valued as such; its decline towards a shadowy existence should be averted by all means. Unused capacities and latent demands in ferry services should be identified by appropriate studies; the system should be optimised accordingly in order to increase its low share of modal split. Low frequented or abandoned jetties can even be found in dense city areas (as Kadıköy-Moda, Kalamış, Çengelköy or Kabataş) and should be evaluated for re-launch or reactivation.

Fast ferries or Sea Buses (Deniz Otobüsleri), including high-speed catamaran ferries, provide commute services and have been operating with great success.

New or refurbished fleets with lateral-thrust units for speedy berthing, easy-embarking facilities and carbon filters indicate fields of action with immediate positive results.

A more developed and efficient coastal service may provide added value to the predominant shore-to-shore service and alleviate the collapsing land transport.

3.1.5 Light rail transit, metro and rail

State of the art signalling and continuous train control systems should be provided or retrofitted to increase capacity and operating grade (especially but not limited to the Şişhane – Taksim section of the M2 Şişhane – Hacı Osman Metro line).

New rail projects should be re-assessed if useful seeing the risks encountered with past and ongoing rail constructions: archaeological findings, adverse topography and series of contingencies, construction stoppages and delays, especially with underground projects obstruct in time completion. Due to the fact that construction cost and times for completion are far more advantageous with at-grade and off-track projects, such systems should be favoured where and whenever possible.

The Marmaray Project struggles with serious technical, legal, logistical, conceptual and organisational challenges; changes in urban planning and the dynamic development along the line impede the works. A project of that scale accommodating both long distance train operations and commuter rail with two minutes headways on three tracks calls for close control, professional guidance, utmost quality, commitment and integrity, full support of all stakeholders acting in concert, and clear employer’s directives throughout entire consultancy, design and implementation stages.

3.2 Focus on non-motorised transport

The outlined TDM concept requires not only dedicating the limited public space of Istanbul to more efficient means of transport than the car but also to favour eco-friendly mobility by safe walkways and bicycle lanes.

Fostering NMT also means reducing speed and traffic volume by calming and constructive measures to make additional streets and public areas more attractive to pedestrians and cyclists.

Reducing the offer of available parking space and restricting car access at certain zones and/or times is another solution already successfully practiced in different areas throughout the city. Experiences should be disseminated among the district administrations.
A bicycle network should be designed to connect the few existing isolated lanes and to provide an alternative to the car for medium distances. Mental and physical barriers against NMT should be torn down by appropriate campaigns backed by health organisations, employers, and personalities of public life, especially to raise the acceptance and awareness of cycling in Istanbul.

3.3 Freight and commercial transport

Conditions for eco-friendly freight transport to Istanbul and throughout the city shall be pursued: efficient distribution centres for goods are to be established or upgraded. They shall allow rail and/or ship access, particularly for heavy goods. The distribution of cargo goods to retailers and/or end users by trucks as well as empty trips can be reduced to a minimum by a coordinated management system. Side effect: cost savings can be expected for all involved parties and stakeholders (infrastructure providers, consumers, operators, suppliers, manufacturers).

Traditional freight transportation as well as separated waste collection and removal by hand truck, trolley and wheelbarrows, especially but not limited to the Bazaar quarters should be maintained and adequately rewarded; collecting waste including sorting, separation and disposal is the work of the poorest Istanbulites.

3.4 Organisational measures and public relations

IBB’s Department of Transportation should streamline the various entities being involved in transport and infrastructure planning including those beyond territorial borders as well as to commit the different stakeholders to a common guideline for the course of actions. The intended policies as well as updates on projects and measures have to be addressed to the public and be responsive in order to gain broad support.

3.5 TDM measures – Overview of recommended actions

Table 1 provides an overview of possible TDM measures.
<table>
<thead>
<tr>
<th>TDM Measure</th>
<th>Objective and degree of mitigation</th>
<th>Way of implementation</th>
<th>Institutional and legal framework</th>
<th>Sources of finance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polycentrism;</td>
<td>Keeping and supporting Istanbul's historical self-contained structures;</td>
<td>Adequate legal and strategic framework, combining responsibilities and competencies, allowing to co-operate across territorial borders and tune programs if needed;</td>
<td>National level;</td>
<td>Targeting and regrouping of public revenues;</td>
</tr>
<tr>
<td>Decentralisation;</td>
<td>Force employment nodes merging in metropolitan Istanbul;</td>
<td>Reduce financial speculation especially for unplanned land by means of public control;</td>
<td>IBB - Urban planning and transport institutions;</td>
<td></td>
</tr>
<tr>
<td>Inward urban development;</td>
<td>Regenerate or relieve saturated or congested urban areas on one hand and develop urban settlements in suburban areas;</td>
<td>Implement existing integrated Land-Use Transport Plans based on the FSM model (JICA, IMM, 2007);</td>
<td>Transport Companies and suppliers;</td>
<td></td>
</tr>
<tr>
<td>Conversion and compaction;</td>
<td>Raising accessibility;</td>
<td>Qualified, consistent and transparent urban planning with accompanying public participation and sustainable land use patterns with early provision of PT and infrastructure;</td>
<td>Land owners;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Allow short ways;</td>
<td>Supply of jobs, education and daily needs in the vicinity by mixed structures;</td>
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<td></td>
<td>Reduce urban sprawl, land take and gentrification;</td>
<td>Promote and implement 'Shared Spaces' as urban design concept and remove the traditional segregation of motor vehicles, pedestrians and other road users;</td>
<td></td>
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<tr>
<td></td>
<td>Balancing suppressed and induced traffics;</td>
<td>Establish and promote model quarters and exemplar neighbourhoods;</td>
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<td></td>
<td>Partaking of the poor;</td>
<td>Reusing empty houses and empty lots;</td>
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<td></td>
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<td></td>
<td>Preserve green areas;</td>
<td>Encouraging vertical instead of horizontal constructions;</td>
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<td></td>
<td>Reduce traffic noise;</td>
<td>Central locations along settlement belts, promoted development around the main terminals of the PT;</td>
<td></td>
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<td></td>
<td>Reduce commuting;</td>
<td>No permission to closed communities or dormitory suburbs;</td>
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<td></td>
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<tr>
<td>Develop rural areas in Turkey;</td>
<td>Stop rural depopulation and regulate attraction of Istanbul;</td>
<td>Settling of – trendsetting - industries (not automotive but renewable and energy efficient technologies) in Eastern and Central Turkey and discontinue industrialisation in the Marmara region;</td>
<td>National government;</td>
<td></td>
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<td></td>
<td>Encourage people to stay in their ancestral areas by local job programmes;</td>
<td></td>
<td>Technical Universities;</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Shifting and allocation of funds to less developed regions in Turkey;</td>
<td></td>
</tr>
<tr>
<td>TDM Measure</td>
<td>Objective and degree of mitigation</td>
<td>Way of implementation</td>
<td>Institutional and legal framework</td>
<td>Sources of finance</td>
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<tr>
<td>Economic countermeasures (disincentives) towards car domination;</td>
<td>■ Internalise external car costs; ■ Reduce congestions; ■ Improve air quality; ■ Foster low carbon transport; ■ Lower resource consumption, pollutions and energy consumption; ■ Reduce noise;</td>
<td>■ Congestion and single user charges, peak-hour charges; ■ Taxes, fuel prices, tolls, ‘Pay-as-you-drive’ and ‘Polluter-pays’ Principles; ■ Earmarking fees on car purchase and other incurred costs for PT projects; ■ Use sustainability criteria when allocating public funds to projects;</td>
<td>National government;</td>
<td>Taxation; Revised fiscal policies;</td>
</tr>
<tr>
<td>Structural measures;</td>
<td>■ Reduce congestions; ■ Reduce GHG emissions; ■ Preserve historical structures and comply with UNESCO requirements for World Heritages;</td>
<td>■ Provide HOV lanes on highways; ■ Park&amp;Ride at interchange stations in the outskirts; ■ Upgrade and extension of existing parking management areas; ■ Road pricing scheme for the historical peninsula – the features of a cordon ring or area licensing are regarded as appropriate to reduce emissions and traffic jams in the old city centre comprising the former Eminönü district (in earlier times Byzantium), now a neighbourhood of Fatih district. The Theodosian Wall bordering old Constantinople of medieval times and today marking out Fatih district is deemed to be suitable to function as a second outer cordon.</td>
<td>IBB with national bodies as KGM; NGOs;</td>
<td>Self financing and partly revenue generating;</td>
</tr>
<tr>
<td>Review of projects (as 3rd Bosporus bridge, Bosporus road tunnel, Marmaray, Metro projects);</td>
<td>■ Avoid induced traffic; ■ Mitigate additional GHG emissions; ■ Promote PT; ■ Raise efficiency; consistency, safe costs, and accelerate works or project implementation; ■ Preserve historical and support self-containing structures; ■ Preserve natural heritages, green areas and wetlands, stop land fragmentation;</td>
<td>■ Carry out project audits on efficiency, organisation and use indicators for sustainability; ■ Commissioning expert reviews and reports;</td>
<td>National government (Ministry of Transportation); IBB;</td>
<td>Public funds; Application for EU loans;</td>
</tr>
<tr>
<td>TDM Measure</td>
<td>Objective and degree of mitigation</td>
<td>Way of implementation</td>
<td>Institutional and legal framework</td>
<td>Sources of finance</td>
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<tr>
<td>Change Istanbul’s modal split towards PT;</td>
<td>Entire city accessible through the use of PT; Affordable mobility for all; Reduction of private car use;</td>
<td>Harmonise and upgrade the existing network through adjusted scheduling, efficient transfer stations and interchanges; Accelerate buses through ITS systems as signal prioritisation, and by buslanes/busways; Affordable fare system, subsidised by revenues from re-internalised cost of individual motor car traffic; Remove shortcomings in passenger and online information for easy-to-use schedules and trip planning; Park&amp;Ride and Bike&amp;Ride facilities at the outskirts;</td>
<td>IBB with municipal and regional Transport Institutions;</td>
<td>Fares; Public funds; PPP;</td>
</tr>
<tr>
<td>Expand and optimise Metrobüs BRT system;</td>
<td>Use and further raise attraction for a competitive, comfortable and efficient PT;</td>
<td>Further develop existing system; Remove inconsistencies in fare collection and embarking/ alighting procedures;</td>
<td>IBB with IETT;</td>
<td>Fare collection; Public and supranational funds;</td>
</tr>
<tr>
<td>Increase share of sea traffic;</td>
<td>Alleviate land transport; Activating unused capacities;</td>
<td>Identify unused capacities and latent demands; Upgrade the existing system technically, revitalise abandoned routes and jetties and promote it;</td>
<td>IBB with İDO and Şehir Hatlan companies;</td>
<td>Public funds;</td>
</tr>
<tr>
<td>Freight transport coordination;</td>
<td>Reduce empty trips and coordinate supplies; Maintain and promote traditional and sustainable goods transportation practices and methods (by hand);</td>
<td>Include all suppliers into an overall urban logistical and distribution management system (ITS); Strengthening rail and water-bound transportation of goods; Rewarding system for hand carriers, – beneficial to unskilled and poor people, which generally fulfil this work; Relevant agreements among involved parties and Introducing organisational guidelines for presence times and work times; Transition to flexible and varying school times; Establish attendance check systems for employees if deemed necessary;</td>
<td>IBB with suppliers, industry, trade, commercial and sales organisations, carriers and agencies;</td>
<td>Self financing: System will result in cost reductions;</td>
</tr>
<tr>
<td>Flex time and telework models;</td>
<td>Disentangle peak-hour congestions; Reduce traffic volumes;</td>
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<tr>
<td>Traffic calming measures;</td>
<td>Reduce accidents, fatalities and injuries, of comfort and sojourn; Allow more safety in public areas;</td>
<td>Speed reductions; Access limitations for individual cars (resident parking only, time constraints, area restrictions);</td>
<td>IBB with Planning Directorate, urban planning institutions, municipalities and heads of Mahalle;</td>
<td>Public funds;</td>
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### Sustainable Urban Mobility: The Example of Istanbul

<table>
<thead>
<tr>
<th>TDM Measure</th>
<th>Objective and degree of mitigation</th>
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<th>Institutional and legal framework</th>
<th>Sources of finance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrianisation; Enhance NMT (walking and cycling);</td>
<td>Improve local conditions; Contribution to the citizens’ health and fitness; Enhance air quality; Make walking more attractive;</td>
<td>Remove obstacles and optimise arrangements of installations, pavements and kerbs; Widening walkways, eliminate undersized and dead end walkways; Raise pedestrians’ safety by separate walkways and secure overpasses; Establish more pedestrian ones, especially in urban subcentres (as Kartal, Pendik, Nişantaşı, Fatih, Küçükçekmece); Establish a bicycle network; Build Bike stations, promote Bike&amp;Ride and hire systems; E-mobility for promoting cycling in view of the hilly topography; Promote car free days on a voluntary base to motivate people not to use their car and make a collective experience of moving around without their car;</td>
<td>IBB with urban planning institutions, municipalities and heads of Mahalle, health care organisations, celebrities;</td>
<td>Public and semi-private funds;</td>
</tr>
<tr>
<td>Change in behaviours, questioning and toning down the prestige of mobility;</td>
<td>Reduction of need for travel and questioning of mobility as an overall goal and guiding principle for sustainability, smart growth/de-growth;</td>
<td>Publicity campaigns questioning car use and promoting PT; Application for Istanbul as European Green Capital; Launching information on goals, projects, measures, benefits and activities via internet;</td>
<td>Nationwide, supranational; IBB with Istanbul’s Twin Cities and other members of C40 Cities (C40, 2011);</td>
<td>Public funds; Fundraising; Earmarking public revenues for PT and eco-friendly projects;</td>
</tr>
</tbody>
</table>

Source: Hennig, M. (2011)
4. Intervention for sustainable transport: a public transport plan

The system shall include all parts of Istanbul’s population and be socially equitable. More sustainable urban transportation in Istanbul is highly dependent on efforts for gaining control over traffic in city periphery areas and suburban connections and areas that are currently poorly serviced if at all. It is also true that in unplanned areas, where social facilities and PT are missing or poor, residential land price is lower than in planned areas. There is a direct relationship between the diversity of transportation modes and the accessibility level, which results in higher residential land prices. Policies must consider this and provide affordable housing including infrastructure.

80% of roadway space in Istanbul is occupied by 14% of the population – the motorists. The remaining 86% must move within the remaining 20% of space that is dedicated to public transport. This inequity calls for review and appropriate allocation of the scarce space.

Bearing all this in mind and based on the TDM Plan developed above, a Public Transport plan for Istanbul shall comprise the following features:

4.1 System-wide measures

The entire urban area should be analysed in terms of accessibility for PT. The distances to the next bus or Dolmuş stop should be less than 600 m or 10 min of walking for all residents. The line network should be reassessed by a detailed survey and adjusted accordingly.

The dynamic demographic development requires permanent monitoring of operations and reliability, short review cycles of the network; transportation forecasting and modelling – for example by the FSM (1 trip generation, 2 trip distribution, 3 mode choice, 4 route assignment) – should be carried out on a regular basis. Notwithstanding, the results should be verified and checked if in line with the overall goal for sustainability to avoid induced trips and to better meet the demands, improve journey speed and service quality.

Passenger friendly schedules, information systems, convenient transfer stations and stops are to be provided. The partly unsatisfactory situation should be analysed and upgraded; relations, locations, capacities and dimensions of bus stops and stations are to be reviewed to make sure that they match with relevant safety standards. Frequently, bus stops are situated at highway junctions requiring the passengers to cross the lanes or provoking shortcuts up and down the embankments.

Regarding vehicle fleet, over-aged buses are to be replaced by low emission, air-conditioned, clean and convenient low-floor vehicles to raise riding comfort and attraction and improve air quality. Forward looking technologies as compressed natural gas, electric or hybrid vehicles should be pursued.

The campaigns of free trips on public transport arranged on some national holidays to attract more people should be repeated and intensified.

Despite severe traffic congestion, car travel is still faster than PT in Istanbul. That is because most of the buses are caught up in the traffic jams. Buses are to be accelerated through more buslanes, segregated busways and signal prioritisation (ITS) as pointed out above.

The fare system should be kept simple and affordable; as a general rule travel expenditure should not exceed 10% of the household income. Subsidies should be used by earmarking revenues from car users.

Park&Ride and Bike&Ride facilities are to be provided at stations in the suburbs to encourage use of PT. Taking bicycles on MRT vehicles should be assessed; considerations are already in progress with TCDD and Ulaşım and should be pursued.
4.2 BRT related measures

Istanbul’s Metrobüs currently carries almost 600,000 passengers a day over 40.4 kilometres of bus ways separated from the motorway at a speed of 40 km/h. This has reduced in-vehicle travel time by about 50%, provided price reduction, increased use of PT and decreased the emissions from road traffic.

Remaining inconsistencies in fare collection and embarking/alighting procedures (transfers sometimes are without, sometimes with extra charges; sometimes payments to be done in the bus, sometimes at the station turnstile; some stations with separate boarding and alighting areas, some not and all of it subject to changes throughout the day) should be redressed (consequent pre-board fare collection, ticketing and verification in order to achieve uninterrupted speedy boarding and alighting).

The success of the BRT is beyond question: it was accepted immediately, it is cost-effective and should thus be expanded as it has reached its initial capacity limits. To avoid that it will be affected by its own success, upgrade, expansion and integration into the entire PT system should be accelerated. The envisaged extension of the Metrobüs system to additional relations (Beylikdüzü – Avci, 2011, Kozyatağı – Seynantepe, Altunizade – Sultanbeyli, Kucukcekmece – Yenikapi, Kahataş – Levent, Aksaray – Bagcılar, Edirnekapi – Vezneciler) should be expedited.

All multi-lane roads in dense corridors should be evaluated in terms of their fitness for the Metrobüs and benefits which can be expected from its implementation. Moderate planning and construction time, high capacity and competitive speed are the features in favour of the Metrobüs and give reason for expanding it as alternative to more cost-intensive rail bound systems and underground constructions along with their inherent soil and ground uncertainties.

4.3 Perspective for Istanbul’s MRT system

The outline in Figure 8 shows the MRT lines (BRT, LRT, metro and suburban railway) being under operation (white) and under construction (grey); existing or planned interchange facilities are indicated as well. Additional lines are proposed as BRT corridors along existing multilane roads (shown as dashed). They shall shape a combined radial-tangential system supporting the polycentric structure of Istanbul, relieving the historical city centres and mitigate further urban sprawl.

By expanding the network, additional and user-friendly interchanges are foreseen and should be provided for wherever lines converge. Parallel services should be carefully assessed whether passenger flows are diverted, the services are complementary and do not frustrate each other (IBB, 2011). This will in particular apply for:


The same is with the:

- Aksaray – Bagcılar Metrobus line and the existing LRT line M1/M1A (Aksaray – Kartal – Esenler – Bagcılar) currently being extended on the European side; and

- Anadoluray (the new Metro line M4 Kadiköy – Kartal being opened to service in 2012) and Marmaray on the Asian side.
In addition to the outlined measures concerning land transit, parts of both car traffic and mass transport should be shifted to maritime traffic through enhancing and promoting the seaborne services and increase its share to modal split. The new ferryboats purchased and brought into service in 2009 are a good start towards this goal. The existing predominant shore-to-shore links should be complemented by efficient coastal lines calling at Istanbul’s subcentres along the Marmara Sea as well as up and down the Bosphorus shores (blue lines). Suitable interchanges between land and sea transport are to be integrated as it is nowadays the case in Kabataş and Sirkeci/Eminönü/Karaköy or it will be in the future in Üsküdar-Şemsipasha. The jetties and waterfront areas in the neighbourhoods/districts of Beykoz, İstinye/Sariyer, Ortaköy, Beşiktaş, Beylerbeyi, Yeşilköy, Zeytinburnu, Bakırköy, Avşarlar, Harem, Kadıköy/Haydarpaşa, Bostancı, Maltepe, Kartal, Pendik and Tuzla are regarded to become central sea/land hubs. These interchange locations are indicated in the sketch of Figure 8 by blue dots.

Compared with other cities, the density of the outlined MRT system (approximately 350 km) remains behind other rail networks (for example Berlin rail bound public transportation network length: 500 km for 3.5 million inhabitants, or Zurich metropolitan area: 500 tram km for 1.9 million inhabitants). However the length and density of rail networks in a city does not necessarily indicate the PT transport quality of a city, the same service quality features can be achieved with prioritised bus systems.
**Box 1: Example of investment costs**

Empirical values provide 1–5 million USD/km of construction cost for BRT. Assumed that additional 200 km are being constructed in accordance with the proposal in Figure 8,

\[
5 \text{ million USD/km} \times 200 \text{ km} = \text{USD 1 billion}
\]

of investments will be necessary. A time horizon for completion of these investments until 2015 is deemed realistic.

Extrapolating today’s traveller figures to the future BRT network of some 250 km and assuming a conservative estimate of 10 000 passengers per km and day,

\[
250 \text{ km} \times 10 000 \text{ passengers} = 2 500 000 \text{ trips per day}
\]

can be expected.

A trip price of 2 TRL (USD 1.30) will result in daily revenues of

\[
2 \text{ TRL (USD 1.30)} \times 2 500 000 \text{ trips per day} = 5 \text{ m TRL/day} \approx 3.9 \text{ m USD/day}.
\]

Taking into account operating costs amounting to 60%, the BRT expansion entails a payback period of less than 22 months:

\[
1 \text{ billion USD} \div 3.9 \text{ m USD/day} \times 40\% = 641 \text{ days} \approx 21.4 \text{ months}.
\]

After this period, the BRT system can be expected to be self-sustaining and yield net profits to the operating company and/or the owner.

Rail bound and underground systems with $\geq 40$ m USD/km (Marmaray: tentatively 45 m USD/km) lead to lower cost efficiency and longer payback periods, although they will be financially rewarding and provide assets to the operator, too. Seen the fast return on investment, the above rough calculation illustrates that financing is not at all the determining factor. The expected revenue is rather an encouraging parameter to accelerate evolving the BRT projects. In return, waiting with or procrastinating PT infrastructure is missing the chance for additional revenue to the IMM. In addition, public finance further economise due to decreasing accident rates and the related costs.

### 4.4 ITS measures

Through state of the art signalling and control technology (ITS), the headways particularly of Istanbul’s rail bound systems are to be optimised in order that the available line capacities are fully utilised.

The smart ticketing features are of high value for PT and help to secure its success. Intended add-ons to the Akbil as e-ticketing will further enhance the popularity of this ITS. However, an easy handling must be kept and full applicability to all users including those not using Internet must be ensured. As an accompanying measure, every citizen should be provided with a free Akbil (nowadays a deposit of 6 TRL is to be paid).

Travellers’ information systems are in use and should be improved and upgraded in an economically reasonable and moderate frame. Simple but efficient panels and screens are regarded as sufficient; an oversupply of electronic devices in vehicles, at stations and bus stops will inflate fares and should be kept at a moderate level.

### 4.5 Fare structure and tariffs

Regarding fare structure, the existing system of scaled prices depending on the distance travelled should be kept. To the general rule that expenses for transportation should not exceed 10% of the household income, which is about USD 10 000 in Istanbul (it should be added that 15% of the population lives below the poverty threshold of USD 1.25 per day). To render affordable services for those groups subsidies have to be provided similar to the existing
discounts for students, handicapped and retired persons. In return, the discounts allowed to teachers, professors or other beneficiaries should be re-assessed whether dispensable.

It should be considered to include the minibuses and Dolmuş into the fare structure and make the Akbil valid in these vehicles as well. This requires negotiations with the operators’ associations.

The transportation market in Istanbul should be continued to be supervised by municipal and state authorities and managed by ‘controlled competition’. Safety standards, network modelling and fares should be ensured by a regulating authority to ensure a city-wide consistent system.

4.6 Expected impacts

From the proposed interventions the main goals of shorter distances and travel times within the emerging spatial structure are being expected to be achieved.

Mobility and transportation are key components of urban life in Istanbul as in cities all over the world. Businesses desire mobility because it is vital for their operation and functioning. The number of negative impacts caused by the need and want of to ‘be on the move’ such as air pollution, congestion, noise, greenhouse gas emissions, disruption of neighbourhoods, accidents can be mitigated by an efficient PT system. The tension between the human desire for mobility and the concern about the negative impacts of the physical realisation of this desire in the form of transportation shall be relieved by the outlined approach of shaping Istanbul’s transportation systems through supplying a maximum level of mobility while generating only a minimum of negative impacts. Istanbul must acknowledge the fact that mobility needs to be rethought and that measures need to be implemented for achieving urban transport systems that satisfy the claim for sustainability.
5. Additional measures: improvement of finances and economic instruments

The above chosen interventions must be accompanied by a number of additional economic measures that secure sustainability. The assumed goal conflict with economic development and its tendency toward short-term profit is to be made compatible. The calculation in Box 1 shows that efficient PT systems can make a contribution to the financial situation to the operating municipality whilst they improve and satisfy the basic need for mobility of all citizens. Seeing that, the mentioned goal conflict appears to be less significant if existing at all.

5.1 Economic and legal measures

In order to accompany the outlined concept and to reduce fuel-based road traffic and its externalities, the policies for private vehicle taxes and sales charges have to be kept up and –along with the ongoing economic growth of the country– fuel taxes should be further increased as an accompanying measure. The same is with the road pricing fares on a local level in Istanbul. Public means of transport should benefit from exemptions, at least significant reductions in fuel taxes and tolls.

In addition to the bridge tolls and motorway pricing a city toll for urban districts as Fatih are to be considered. A cordon ring surrounded by the E-5 highway is suited for pricing individual traffic in an even greater inner urban area.

At the national level, tax differentiations for low emission technologies should be pursued and implemented. Fixed costs, such as insurance and registration fees, should be converted into variable costs.

All revenues should be earmarked and support PT investments and create a basis for a self-financing of the transport sector. Box 1 reveals that financial benefits can be expected from BRT operations.

Tax mechanisms aimed at evening out inequalities in the metropolitan region include redistributive transfers and devices for the distribution of tax income.

The control of property assets by city councils is considered essential to project realisation as private land requires long negotiation and expropriation processes.

5.2 Institutional framework and cooperation with the private sector

Concerning the institutional framework, IBB have earlier subdivided the management and operations of the particular PT sectors into individual municipal undertakings (IETT, IDO, Şehir Hatları, Ulaşım). These divisions work and are administrated like companies, nonetheless they remain within the ownership of the metropolitan municipality.

The coordination and integration of other and private operators (taxis, Dolmuş, minibuses or ferry companies) into the overall system is administered by the municipality as well.

The dynamic development of the city calls for unifying all agencies, institutions and providers under a single authority.

An established single interface is to manage planning, financing and compensating the private sector.

More benefits of competition and better performance are often expected to be attained by awarding suitable contracts to independent operating companies. A private company may be more flexible to changed demands or new technologies. A private company concentrates on its core business and may run the system in a customer-friendly and effective manner.
‘Public-Private Partnerships’ (PPP) are considered as a contractual agreement and frequently applied between public and private partners that stipulate the results to be achieved in order to improve the delivery of public services. This agreement establishes a real allocation of responsibilities, investments, risks and benefits so as to provide mutual benefits that promote the achievement of results.

According to the OECD, the decision to opt for a public or private service provision should be taken after objectively evaluating what would best serve the public interest. Factors to take into account include the current service supply level and the state of facilities. It is also important to consider financial accessibility for families and business, network coverage, operational efficacy and long-term facility maintenance, as well as social and environmental viability.

In this way, the respect for a series of principles in relation with other factors will make it possible to extract advantages from PPP projects.

PPP can make it possible to broaden the public financial capacity to carry out more infrastructure projects in a shorter time, to speed up the realization of the intended BRT or other projects, to share risks with the private sector to different degrees, to alleviate the public sector load and to achieve margins for public financial manoeuvres for services that only the public sector can offer (as social, health care or educational facilities).

PPP are not a panacea for the problem of financing. They should be adapted to each project and context. The fundamental element in a PPP is to properly assess the part of the risk the private sector will assume. The greater the risk transferred, the higher the public cost.

A PPP gives satisfactory results only if there is true agreement between a common vision and a balanced distribution of responsibilities with regards to development, management, maintenance and financing. Contracts have to be clear and transparent, prepared by specialists and examinable by the interested public. Budgets and timelines are to be respected and controlled by independent bodies to provide security to all partners.

Furthermore, a PPP requires true political leadership. All inter-governmental discussions must be carried out beforehand. Maintenance costs must be included when assessing project costs. Technical monitoring is to be established as well as mechanisms for conflict resolution, legal regulations referring to the financing and distribution of income and mechanisms for communication between parties.

The major disadvantage or risk of PPP projects is the lack of control over genuine public duties. Supply of mobility can be regarded as a primary need of the public, similar to the provision of water and electricity; a PPP bears the risk that the system is deprived of public control. It is in the nature of things that a private investor intends to maximise its revenues and profits. Cost savings in safety or quality, rise of fares can be the consequence to realise these goals. Thus, the initial advantages and incentives can be lost; the idea backfires and turns towards its undesired affects.

Financial risks (revenues from ticket sales, imponderabilities in construction, inflation or currency risks) have to be shared adequately between the partners. The undeclared motto of PPP (Privatising profits, socialising losses) should by all means be avoided by sound agreements. The revenues of tolls or fares should not be estimated too optimistically beforehand. The credibility of bidders should be checked carefully. Safety and quality standards should be clearly negotiated beforehand. The supervision of the private partner should be established within the ruling authority. The citizenship should be involved in the decision finding and making process, for example by a referendum, as the importance of the PPP project may go beyond the authorisation given to the ruling party by one election period. Relations or dependencies between the private partner and representatives on the side of the decision makers should be forbidden and rigorously prosecuted in case they occur.
5.3 Impacts on transport activities, environment and finances

The praise of the car as an indicator for freedom and welfare together with car production as an alleged key industry for economical growth and ‘development’ has been questioned and must be further discussed at a national and even international level.

The impact of transport on the environment is significant. Regarding pollutant emissions in Istanbul, Figure 9 shows the actual level of emissions (million tonnes/year) in 2006 (blue), the projected level of emissions for 2015 based on the pollution increase and new public transport projects (red) and the project level of emissions assuming a 25% reduction due to technological improvements and the availability of cleaner fuel (green).

Istanbul should take advantage of its membership and roll within the ‘Large Cities Climate Leadership Group’—also known as the C40 Cities—, and of ICLEI (Local Governments for Sustainability) —a worldwide movement of local governments—to promote the related political discourse.

This shall lead to fostering forward-looking industries and to a turn away from industries causing incalculable external costs to the public and to future generations.

The societal dimension of transportation, i.e. the degree by which transportation influences the evolvement of social structures and practices and is in turn influenced by the way people live and travel, is often neglected. This fuels social exclusion and the deterioration of living conditions for a large number of Istanbul’s inhabitants.

Istanbul and its people have the capacity, the disposition and the potential to swing up from victims of excessive traffic to shapers of a liveable urbanity. The city is dynamic, vibrant and smart enough to take the leadership within an international context in achieving the aim of mobility-balance brought to a metropolis. It can be trend-setting for cities all over the world if the necessary steps are taken and can become the Capital of Balanced Mobility.

The following guidelines shall conclude and summarise this survey on Istanbul’s mobility:

1. Mobility and Social Cohesion, i.e. the importance of mobility for ensuring for all citizens equal access to and participation in social life; establishing transport systems adapted to the people with the most needs, such as children, the elderly, the job-seekers and the handicapped; paying particular attention to gender issues; developing and implementing
measures that guarantee equal access to public transport and that increase traffic safety through the use of suitable technology and organisation.

2. Financing of Urban Mobility: mechanisms to fund infrastructures and public transport systems; to promote the exploration and use of innovating funding systems for all types of transport; to follow the principles of efficiency, transparency and modal integration, to prioritise the interest of trans-port users, and analyze the economic and social impact of public transport and its specific value for the functioning of Istanbul.

3. Urban Commercial and Freight Transport, i.e. the need to organise inner city distribution of goods and services in such a way that it benefits the economy, local businesses and citizens without impeding the urban environment, air quality or the conditions and quality of urban public space.
6. References


