INTRODUCTION

This booklet resumes FISCUS handbook which aims to provide practical guidelines on the evaluation of the real costs of urban mobility and on the most appropriate ways to finance it, tackling a set of issues with increasing importance in the political agenda of urban transport.

The handbook is mostly directed to decision-makers on urban transport policy, urban planners, managers of operating companies and last but not least to the citizens, who often see their money being used to finance urban public transport, and are thus entitled to know how the system works from the economic and financial viewpoint.

One of the missions of this handbook is to facilitate the understanding of cost and financing related issues, and also to indicate possible ways for assembly of solutions that will fit each local reality. The handbook does not provide a universal recipe to solve the financial problems of urban mobility. However, it does provide effective tools to understand and manage these problems.

FISCUS has opted for a review and estimation of all costs of urban mobility in the sense of *total resource costs,* that is, anything that consumes any resources of real or potential value, but disregarding issues that merely constitute transfers of money or of any type of rights. By adopting this position, the issue of internal versus external costs loses relevance for the total bill, although it is of course not forgotten, in particular when, on the other side of the coin (i.e. financing) the issue of "who pays or suffers what" is addressed.

Current use of the word "Financing" entails a double meaning: getting resources to pay for the creation and functioning of the systems; and anticipating the availability of those resources, namely by recourse to "other people's money". FISCUS concentrates on the former (who pays for what?), although we also dedicate some attention to the latter (who puts up the money?) such is the current and likely future relevance of this type of instruments to get new projects under way. To some extent we may identify the first meaning of the term "financing" with "structural support" and the second with "leveraging instruments".

In this context, this handbook aims, with the help of examples that illustrate typical situations in the urban areas[1], to help decision-makers in formulating and answering questions such as:
What are the transport' costs in my city?
Who should bear what part of the costs mobility in my city?
How can an efficient pricing policy contribute to a sustainable urban mobility policy?
Up to which extent can policy initiatives enhance managing the financing of mobility?
Up to which extent can costs be managed through a coherent system design?

In answering these questions and raising a number of related issues, this handbook will also give a contributing step towards a future harmonisation of procedures regarding cost evaluation, pricing and financing at the European level, so as to ensure comparability between transport systems, efficiency and fair competition between operators and modes.

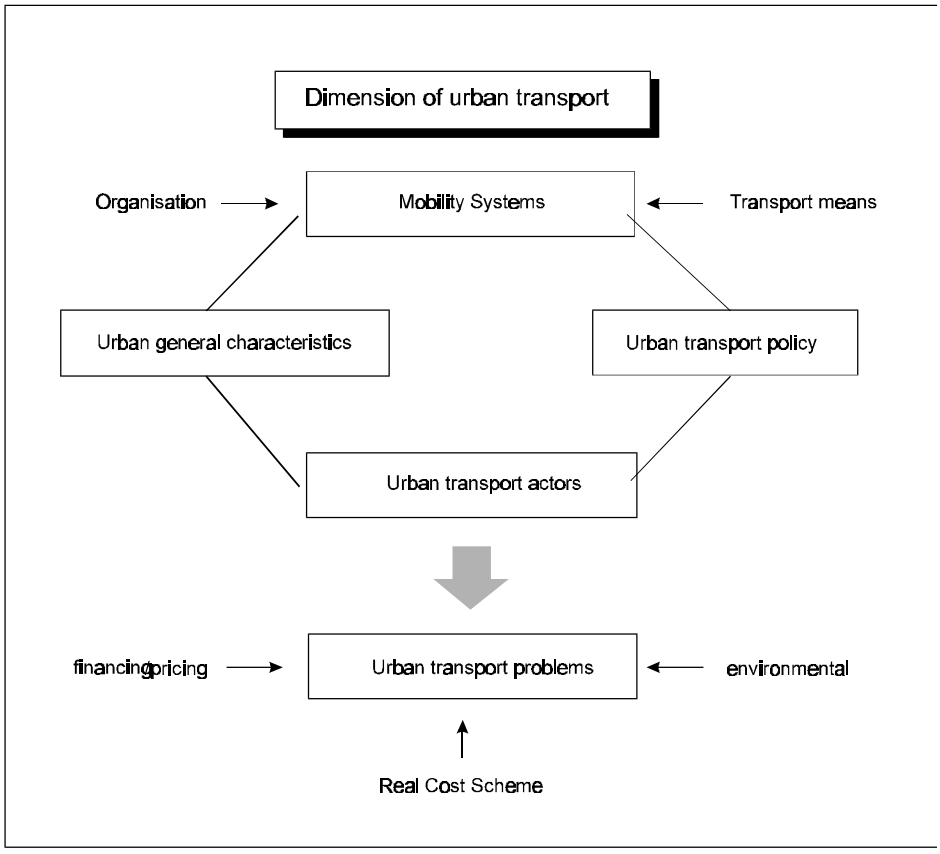
Since the objective of the handbook is to provide insights with practical applicability, mainly directed towards political decision makers and managers of urban mobility systems at both strategic and operational, it can be used in the long-term transport/mobility planning and also as a useful reference in daily traffic planning and evaluation. The handbook is mainly addressed to an audience of politicians and non transport

[1] A booklet resuming the main findings of FISCUS research will be produced for wider dissemination.

specialists with an interest in the area, reason why an easy reading format was adopted and, as much as possible, a non-technical language. Notwithstanding, a glossary is provided to facilitate the understanding of some concepts, words and specific expressions to this context or those have particular meanings within it.

URBAN TRANSPORT DIMENSIONS

A Real Cost Scheme and associated financing schemes, which were the main objective of this research, are expected to represent the state and the future of urban transport policy in monetary terms, focusing on the economic scope. In this perspective, policy evaluation systems and recommendations for urban transport must consider the different dimensions of urban transport and its function in general urban policy. It is the aim of this handbook to present specific tools in order to have an unbiased picture of the problems and the structure of urban transport policy. Being a European handbook, there is in addition the demand to consider the similarities and differences of urban areas in Europe. As certainly self-evident from the great diversity of existing situations, it is not possible to provide recommendations on a very specific level. This chapter therefore wants to provide an overview of the different dimensions in order to guide the reader more consciously through the analysis and recommendations presented in the following chapters. The figure below gives an overview of the most important dimensions to consider:



Aspects influencing the specific urban transport problems and their possible solutions- FISCUS Handbook

Due to the complex dimensions and the number of influencing factors, this handbook does not address specific comprehensive urban clusters, what is in line with our aim of producing a general consistent approach of practical added value for all cities, although without pointing out any "best" or even "ideal" type of urban organisation. The recommendations given in this handbook distinguish between several urban issues in a problem-oriented way. The most important are:

- The recommendations in the Real Cost Scheme in chapter 3 are differentiated according to the availability of data and the foreseen accurateness of the results. Two different (light-full) estimation levels are addressed.
- The recommendations for improved financing schemes consider mainly the size of the city and their financial position based on the institutional set-up (level of privatisation, importance of upper state level). Thus a differentiated view by city authorities is necessary.

EVALUATING THE REAL COSTS OF URBAN TRANSPORT

It is well known that transport - like other economic activities - is imposing a variety of effects on different parts of society. While some of these effects are carried by the transport users themselves, others are borne by parts of society, which might be not directly involved in transport. If we express all these effects by monetary units we talk of the "real costs" of transport. The knowledge of transport-related costs in a specific urban environment provides the basis to judge or - if necessary - to refine current pricing or financing mechanisms of individual and public transport and to analyse the development of the financial and social situation between modes and over time.

The social costs arising from urban traffic are manifold, and such are their properties. Besides the private costs of operating individual and public transport, the costs transport users impose on each other (congestion), on different state levels (provision of transport infrastructure), on society (accidents, noise) and on the environment need to be taken into consideration. Each of those cost categories can be characterised by:

1. The most important determinants of the costs;
2. The relevant final payers carrying these costs;
3. The mechanism and degree of cost coverage.

The table below gives a brief overview of the most relevant cost categories and their properties.

Cost Category	Main Determinants	Most Relevant Final Payers	Degree of Externality
Costs due to infrastructure supply	Size, technology and age of transport networks, share of heavy traffic, maintenance policy.	Different state levels and private investors	Partly covered by user charges and partly earmarked vehicle-related taxes.
Costs related to vehicle operation	Density of P.T. provision Composition of vehicle fleet and traffic management sophistication, maintenance policy.	User in individual public transport frequently with strong contribution from taxpayer in public transport.	Totally internal in individual transport, partly covered by fares in public transport.
Costs of traffic congestion	Infrastructure capacity, traffic demand structure, traffic management.	Transport users occupying the same infrastructure.	Internal to the transport sector. Covered by user charges or via other users' time losses.
Costs of traffic accidents	Driver's behaviour, safety measures, traffic control.	Municipality, health system, economy and victims.	Partly covered by liability insurance payments.
Costs due to emissions into the air	Vehicle technology, energy mix, share of heavy traffic.	Health system, land owners and affected inhabitants.	Possibly covered by emission-related fuel or vehicle taxes
Costs due to traffic noise	Traffic volume and mix, settlement structure and land use.	Land owners and directly affected inhabitants.	Usually totally external.
Other transport-related effects	Traffic network, environmental structure, energy mix, etc.	General society, depending on effect	Usually totally external.

Possible approaches for the estimation of social costs of transport - FISCUS Handbook

A detailed description of the composition of these cost categories, with in-depth discussion of their properties, and details on the techniques of quantifying them can be found in the complete version of the handbook.

THE REAL COST SCHEME - RCS

This section provides technical guidance on how to evaluate real costs. A stepwise approach consisting of 9 working steps is presented in order to list data requirements and necessary actions in a systematic way. Depending on the availability of data, of sophisticated traffic simulation models or of other resources, for most of these working steps a detailed and a cut-down procedure has been worked out. The table below provides an overview of the 9 working steps, the data requirements under varying levels of resource availability and the principles for allocating total costs to different modes of transport.

Step	Data Requirements for Determining Total Costs		Cost Allocation
	Minimal	Optimal	
Step 1: General Data	• Number of vehicles, average annual mileage, speed, occupancy, time costs, etc. of all modes involved in urban transport		-
Step 2: Infrastructure	• By type of asset: average unit value, age and life expectancy • Average running costs and overhead rate	• Detailed inventory of infrastructure assets by unit value, designed life span, age, annual running costs and administration requirements	PCU-km / Axle-load-km
Step 3a: Vehicle-associated costs	• By type of vehicle: average unit value, age and life span • Average rates for running costs and administration	• Detailed statistics on vehicle fleets in individual and public transport • Accounts of running expenses, administration and time consumption	Directly evaluated by mode
Step 3b: User contributions	• Average kilometric or annual rates of taxes, charges, fees, fares and insurance payments	• Statistics on tax returns, charge and fare collection and liability payments	Data is collected by user group
Step 4: Congestion	• Average speed reduction and share of traffic affected by congestion	• Speed-flow curves and traffic counts for highly occupied roads at several hours of the day	PCU-km
Step 5: Emissions into the air	• Emission factors per vehicle type and cost values per ton of pollutant from external studies	• Population and real estate exposed to pollutants and respective exposure-response functions per pollutant • Damage cost values	Vehicle-km by emission classes
Step 6: Accidents	• Average accident, injury and fatality rates per vehicle type and respective cost values from external studies	• Police reports, accounts of health and liability insurance companies; local cost functions	Direct / Kinetic-energy-km
Step 7: Noise	• Estimate of affected population by area and exposure level; national cost functions	• Emission-dispersion-models • Local cost functions	Vehicle-km by emission classes
Step 8: Other externalities	• Information on bio-topes separated or destroyed • Obstacles for pedestrians and additional space required for bicyclists	• Application of replacement and abatement approaches, valuation of additional time costs	Direct / PCU-km
Step 9: Social Cost accounts	• General data (step 1) • Resource costs and transfer payments step 2 to 8		

Working steps to evaluate real costs - FISCUS Handbook

STEP 1. COLLECTION OF GENERAL DATA

1.1 Transport Modes and types of vehicles used:
a) Individual road transport (obligatory): Private Cars / Motorcycles / Vans / Lorries
b) Collective transport: Bus (fuel powered) / trolley bus / tramway / light rail / rail / metro / ferry

1.2 Characteristics of urban traffic (for each type of vehicle identified in 1.1)
a) Vehicle fleet: Units operating in the urban area (including commuters to/from suburban areas)
b) Average annual mileage performed by vehicles in urban area [in km per year]
c) Average occupancy / load rate per vehicle [in passengers / tons per vehicle]
d) Average travel speed in off-peak per mode, including waiting times in public transport [in kph]
e) Average value of (no congested) travel time by mode [in EURO / h]
f) Passenger car units of each vehicle type (contribution to traffic loads compared to passenger cars)

STEP 2. CALCULATE THE REAL COSTS OF TRAFFIC INFRASTRUCTURE

2.1 Update or create an inventory of assets including road, rail and ferry structures, surfaces and associated elements.
2.2 For each element of the inventory, determine age, average life span and production costs (historical or future).
2.3 Choose a depreciation variant (linear or proportional) and determine annual depreciation costs.
2.4 Determine an appropriate interest rate of capital and determine capital costs.
2.5 By analysis of accounts identify operating, maintenance and administrative costs.
2.6 Allocate the costs to means of transport (fixed costs by PCU-kilometres, variable costs by the 4th-power-rule).
2.7 Calculate the marginal costs based on maintenance costs and allocate it according to the 4th-power-rule.

STEP 3. COLLECT AND ESTIMATE THE VEHICLE-ASSOCIATED DATA AND CALCULATE THE REAL VEHICLE-ASSOCIATED COSTS

3.1. Collect and estimate the vehicle-related parameters such as:
- unit cost of purchase
- design life
- average vehicle age
- cleaning and servicing need
- tyre renewal need
- fuel price
- driver wages etc.

3.2. Calculate the vehicle-associated resource costs
3.3. Calculate the vehicle-associated transfer payments
3.4. Determine the marginal costs taking into account the local features and the study objectives
3.5.

STEP 4. ESTIMATE THE REAL COSTS DUE TO CONGESTION

Full approach:
4.1. Find out whether congestion is considered a problem in the city. If no, proceed to step 5.
4a.2. Determine the congested routes, their optimal and real flow rates, modal split and suitable speed-flow functions.
4a.3. Calculate the additional time costs and their payers.
4a.4. Calculate the additional operating costs and their payers.
4a.5. Allocate the congestion cost to transport modes on the basis of Passenger-Car-Units.
4a.6. Calculate the pricing-relevant marginal external costs on the basis of local speed-flow relationship

Cut-down approach:
4.1. Find out whether congestion is considered a problem in the city. If no, proceed to step 5.
4b.2. Assume optimised inner-urban traffic and measure the average waiting times at the outer urban cordon.
4b.3. Estimate the additional time costs.
4b.4. Marginal costs: see 4a.6.

STEP 5. ESTIMATE THE COSTS DUE TO TRAFFIC ACCIDENTS

5.1 Determine the unit costs for various damages to human health and property

Full approach:
5a.2 Determine the annual number of traffic accidents and victims by severity out of local statistics.
5a.3 Adjust the local statistics with underreporting factors.
5a.4. Estimate the total accident costs.
5a.5 Allocate the costs arising from inter-modal accidents to traffic modes by the kinetic energy approach.

Cut-down approach:
5b.2. Estimate the number of accidents by applying risk rates to the annual mileage per vehicle category.
5b.3. Determine the total costs by vehicle type
5b4: Determine marginal costs = average costs per pkm / tkm / vkm for each vehicle type

STEP 6. ESTIMATE THE REAL COSTS DUE TO EMISSIONS INTO THE AIR

Full approach:

6a.1. Collect and/or estimate the data needed: emission factors or electricity consumption for vehicles and specific emissions of the electricity
6a.2. Estimate the local and regional pollutant concentrations caused by local combustion-engine based traffic.
6a.3. Estimate the local and regional, population and material exposed to the concentrations in 6a.2.
6a.4. Using exposure-response functions, define the impact categories which the emissions cause and define the unit costs of for those impacts.
6a.5. Calculate the health impacts using exposure-response functions and unit costs from step 6.4.
6a.6. Calculate the material impacts similarly.
6a.7. Redo the steps 6a.2. - 6a.6. for electric traffic using appropriate data, e.g. data on emissions from energy production and population and stock exposed in the country as a whole.
6a.8. Allocate the costs to transport modes and derive the marginal costs.

Cut-down approach:

6b.1. Collect and/or estimate the data needed: emission factors or electricity consumption for vehicle: specific emissions of the electricity; local population density within 35 km from the source ; region type (up to a few thousand kilometres)
6b.2. Estimate the costs for combustion-engine based emissions using benefit transfer.
6b.3. Estimate the costs for electric vehicle based emissions using benefit transfer.
6b.4. Allocate the costs to transport modes and derive the marginal cost.

STEP 7. ESTIMATE THE COSTS DUE TO TRAFFIC NOISE

Alternative1: Cut-down approach

7a.1. Use of an existing traffic noise inventory or collection of data on noise levels in several key areas of the system. The greater the number of the measurement points, the higher the reliability of the results. Main parameters are:
- situation of the measurement point (area type, special features)
- average day- and night-time noise levels
- estimated contribution of traffic to the noise level by eliminating background noise levels

Alternative 2: Sophisticated approach

7b.1. Rough approach: estimate the noise levels using noise dispersion models, based on traffic levels by time of day under consideration of the surrounding environment and population density.
7.2. Compare the measured noise levels to the target levels and derive the noise exposure.
7.3. Estimate the population in different kinds of areas (residential, commercial, industrial etc.) that is exposed to the following noise above the target levels: 0-5 dB, 5-10 dB, 10 or more dB.
7.4. Estimate the unit costs for noise exposures above the target levels, and the consequent total cost.
7.5. Allocate the total cost on the basis of noise-equivalent-rated traffic performance to transport means.
7.6.

STEP 8. ESTIMATE THE REST OF THE POSSIBLY RELEVANT TRAFFIC-RELATED COSTS

8.1. Make a relevance analysis for the remaining cost categories such as:
- loss of existing biotopes
- deterioration of historic buildings
- indirect emissions and risks of energy production etc.

8.2. Determine the quantitative data set for the relevant cost categories and estimate the cost.
8.3. Allocate the cost to the transport modes using a suitable driver, such as traffic performance.

A rough but comprehensive computation example of the real costs of urban transport and their allocation of actor groups is presented in the handbook

THE USE OF THE RCS

The Real Cost Scheme provides periodic information on the state of cost of the urban transport system. It can be used for different purposes:

- **Monitoring transport costs**: Annual total and average costs and as well cost coverage can be used as an important statistical information on the relevance of different cost elements by means of transport, their development over time and their deficits with regard to cost coverage.
- **Evaluation of future developments and projects:** The Real Cost Scheme provides a very sound basis for the comparison of policy scenarios based on Cost-Benefit-Analysis. Different policy options (e.g. infrastructure projects, other policy instruments) can be compared by their impacts on the cost situation by means of transport. Thus the Real Cost Scheme is an important tool in order to implement least cost strategies in the transport sector.
- **Transport Pricing:** Although the Real Cost Scheme is providing information on the full costs of transport, marginal costs can be derived in order to have a sound basis for transport pricing. In many cases, variable average cost figures (such as accidents, air pollution, climate change) are a satisfactory proxy for pricing purposes. With regard to noise, average noise costs, although different from marginal costs, can be used as well. One important difference is congestion, where external marginal costs differ considerably from average costs. However the Real Cost Scheme presents both outputs.

Cost coverage indicators provide a tool to refine the current transport-pricing situation for the various transport modes. While figures of total cost coverage give evidence to the question of fairness in the distribution of financial burdens among actor groups is, variable cost coverage ratios indicate the sustainability and adequacy of pricing systems. A basic rule to be considered in terms of designing a pricing regime is that variable resource costs should be covered by variable user contributions in order to make the underlying social costs visible . Cost coverage ratio may also be computed for a selected set of social cost categories (e.g. infrastructure or P.T. operation costs), in this case it must be made sure that the considered transfer payments have any relation to the resource costs.

For a worked example demonstrating how the real cost scheme might be applied and how the results might be presented the interested reader is referred to the annex of the FISCUS handbook. Different pricing principles as well as financing needs and strategies to which the real cost scheme can provide valuable input information are also described

PRICING AND FINANCING OF URBAN MOBILITY

Pricing and financing are closely linked, as pricing represents one of the most important methods of raising finance. But pricing has another equally important role. It is a key mechanism for influencing the volume of traffic using each method of transport, in order to achieve other important aims such as economic efficiency and environmental sustainability. There is good evidence that existing pricing mechanisms and levels are contributing towards the problems of congestion and environmental pollution in urban areas by failing to provide appropriate signals to influence behaviour. In the first part of this chapter, alternative approaches to transport pricing will be considered.

Following this, we look at financing issues. It is perceived that in many urban areas, existing financing mechanisms, which typically rely solely on a combination of user charges and public budgets, are not providing sufficient funding for their transport systems. Thus there is a need for new funding mechanisms and packages of mechanisms. We examine in turn further user contributions, public budgets, value capture, cross funding and private finance. The task of financing an urban transport system may be divided into two main elements – namely, financing the ongoing costs of the system, including servicing any debt, and the provision of capital for investment. Whilst some financing mechanisms, such as general taxation, may to some extent be used for both purposes, others – such as private finance – may only be used for the latter. In practice, it is almost inevitable that a variety of financing mechanisms will be used in any one city. Thus, as well as examining individual pricing mechanisms, we also put forward alternative packages of measures for consideration, and provide advice on the circumstances in which each package may be appropriate.

Fair and efficient pricing in an urban area

User contributions, in the form of prices, charges or fees, represent one of the most important ways of financing urban transport systems. They can be set according to either a cost-orientated approach or a demand-orientated approach. In the first approach, prices should reflect the (additional or full) costs incurred by the use of the transport system, while the second one seeks to reflect the benefits derived from that use (according to the users' willingness to pay).
One of the cost-orientated approaches is the social marginal cost pricing principle. According to economic theory, an efficient urban transport system would imply prices set according to the additional cost that extra use of the system -an extra journey- would generate, including both the operating costs and the costs associated with all types of external effects (pollution, congestion, accidents and noise). In other words, transport prices should reflect the marginal social cost. This means that, in considering whether to make a particular journey, or what means of transport to use, transport users will compare the benefits of the trip with what the trip will cost, and the cost to them will reflect the cost to society as a whole.

What fair pricing for urban transport implies is, however, much more difficult to describe since the concept of fairness is controversial. Fairness can be defined and interpreted in different ways. The first one refers to an equal treatment of the different transport modes. Under this view, by applying similar and transparent pricing principles to all transport modes, a fair treatment is guaranteed. In this respect, social marginal cost pricing contributes not only to efficiency, but also to fairness by making the prices of the different modes reflect their own social costs.

Fairness can also be interpreted as social equity. From this point of view, the distributional impacts (how costs and benefits from the different measures are distributed among the different income groups) of the different pricing principles should be considered. Thus, fair pricing can also be interpreted as pricing which does not have negative distributional impacts or regressive effects, i.e. lower income groups paying relatively more than higher income groups. In this respect, efficient prices might not contribute to a fair pricing of the transport system since the social marginal cost principle does not allow for differences in income levels. Therefore, there can be a trade off between allocative efficiency and

equity, and efficient pricing may need to be accompanied with some kind of compensation measures in order to generate a fair and efficient transport system. Equity concerns can be most efficiently addressed with direct income transfers or tax reductions. For instance, additional user charges in the form of urban road pricing could be used to reduce fixed taxes on motoring, such as vehicle excise duty, on those vehicles which have electronic road pricing devices fitted. This would help those poorer members of society who are in a position where they need to own a car. Alternatively, or as well, the charges may be used to reduce public transport fares. Ideally, such compensation measures would be targeted specifically at poorer groups, but that may be difficult to achieve in practice.

In the current situation, users normally pay for public transport use via single journey tickets or travel cards, and for private transport through annual vehicle charges and fuel tax. Often there will also be parking charges, and in a very small number of cities also some supplementary charge, such as the ring tolls for entering Oslo, Bergen and Trondheim.

In general, the reality shows that both public and private transport charges are not reflecting marginal social costs. Given the time pattern of travelling (high traffic during the peak hours and lower traffic during off-peak hours), a proper implementation of the marginal social cost approach would require a set of differentiated prices with higher prices implemented during the peak periods and lower during the off-peak ones.

The move to an efficient price system does not guarantee, however, that sufficient resources will be raised for all and future financial needs. It is likely that the implementation of marginal social cost pricing for roads in high congested cities would lead to a surplus that can be used to recover possible deficits in the public transport (through cross-funding) and/or finance future infrastructure investments. Otherwise, the finance of new investments should rest not only on appropriate charges for infrastructure use, as mentioned above, but also on other types of financing mechanisms, like value capture.

Box 1 - EFFICIENT PRICING - the example of Stockholm

Current pricing policies lead to under-pricing of private transport, particularly in the peak, and also often off peak public transport. This may be illustrated by the case study of Stockholm, in which it is found that private motoring does not pay for the congestion and pollution it creates particularly in the peak. Whilst peak public transport users who buy single tickets do more than cover both extra operating costs and the congestion and pollution they cause, this is far from true for the majority, who buy heavily discounted season tickets. By contrast, in the off peak, the public transport system could take a lot more passengers at virtually no additional cost.

(Example from Stockholm case study)

Charge per journey (SW K)	**Existing**	**Proposed**
Road pricing for car (in addition to current fuel tax)		
Peak	0	4.52
Off-peak	0	1.63
Public Transport (single fares)		
Peak	15.44	12.39
Off-peak	16.99	0
Public Transport (Travel card)		
Peak	8.99	14.51
Off-peak	0	0

- **Measures to reflect social marginal social costs in prices**

In the handbook it has been pointed out that the current transport prices in urban areas are far from reflecting social costs. In order to move towards a fairer and more efficient urban transport system, a system of differentiated prices should be introduced to reflect differences in costs according to time (and location) and duration of journeys. The full introduction of such a system would require the implementation of electronic road pricing. This type of pricing equipment has significant advantages in terms of flexibility and non-interference with the traffic flow. However, they still rely on expensive and unproven technology, which imposes practical feasibility constraints on their use in terms of costs and reliability. As a consequence, there is a trade off between efficiency and practical feasibility that should be taken into consideration.

The full adoption of prices based on social marginal costs by means of electronic road pricing will also face problems of acceptability by some transport users. It is considered that the main opposition to such systems will come from poorer private road users, road freight operators and local commercial interests. The first two will experience an increase in their transport costs leading to a reduction of available budget for the first, and an increase in production costs for the second. Commercial interests may experience a loss of clients when alternative similar sites are available and cheaper in terms of mobility costs. All these oppositions can, however, be mitigated by accompanying measures. Use of the revenues raised to improve public transport, facilities for walking and cycling and the city environment, provided that the money is spent wisely, may also offset some of the immediately perceived disadvantages.

Because of the above mentioned problems in terms of costs and risk of unreliability, only in dense urban areas where a highly differentiated price system is required, is electronic road pricing likely currently to be appropriate and justified. It should then be implemented only in large cities with high externality problems. For small/medium cities and large cities with no important externality problems, the use of sophisticated pricing equipment will probably not be justified in the short/medium term. Therefore, other kind of measures should be adopted in those cases.

Box 2 - ROAD PRICING

Road pricing is increasingly seen as a major part of the answer to both the problem of efficient pricing and the problem of financing urban transport systems. It is slowly being implemented across the world as shown below.

Singapore implemented road pricing, in the form of an 'Area Licensing Scheme' in 1975 and in 1998 an electronic system was implemented so that motorists could pay electronically for the use of a major expressway in the city. The new system is based on a relatively simple dashboard-mounted stored value card, detected by card-readers mounted on overhead gantries along the strategic roads. The card-reader is activated by a microwave signal and the toll is deducted. A key feature of the new system is that the prices may be adjusted according to time of day and traffic volume. However, care should be taken in comparing Singapore to European cities as it is accustomed to a lot of government control and people are worried less about privacy than the extra charges they will have to pay to use the highways.

Trondheim in Norway, a city of 140,000 population, implemented the World's first fully automatic toll ring in 1991. The pricing scheme is based on a cordon, which surrounds the city and has 12 entry points. At each entry point there is a paying station where road users have to pay a toll rate of 8 NOK with a reduction in off peak hours of 30% of the price. Tolls have been used both to raise funds for investing in the improvement of mobility and to influence the times that people travel and the routes/modes that they choose in order to reduce congestion. Since implementation, the city has experienced a 10 percent drop in rush-hour traffic and opposition to it has declined from 70 percent to fewer than 50 percent.

Simpler systems, based on pre-purchased data cards or chips, are operated on New York and New Jersey roads in the United States, and on toll roads leading into Oslo, where vehicles have a data chip to put in the windshield and there are cameras to record violations.

Finally, regarding the acceptability of these measures, the same kind of opposition can be expected whenever their implementation associates additional costs to transport use. The greater the cost increase, the greater the opposition will be.

For small/medium cities, measures towards more efficient pricing might just require a system of differentiation in levels of fares between peak and off-peak. This relatively simple pricing system poses no significant technical problems, although a practical problem still exists in dealing with the problem of artificial peaking of trips at the start of the cheaper period. Nevertheless, some cities, including Leeds, have long had successful differentiation of bus and train fares between peak and off peak.

In terms of the effects on stakeholders, the introduction of efficient prices might have the opposition of the poorer public transport users especially when a high price increase, mainly for the peak hours, is proposed. As in the case of road transport, the key to overcoming this opposition is a careful design of accompanying measures and a sensible use of the revenue accruing from higher transport prices.

- **Financing needs and ways of meeting them**

The first and most obvious way of meeting the financing needs associated with the provision of transport services is to charge users for the use of those transport services. However, it is widely accepted that, efficient user prices will not necessarily yield sufficient revenue to meet all financing needs. Evidence from the FATIMA (1997) research project suggests that, if efficient prices for transport services were levied, those efficient prices would, in certain situations, cover financing costs. The percentage of costs covered by efficient prices varies for a number of reasons, including:

- the city size;
- the scale and characteristics of the local public transport network; and
- the levels of traffic congestion and other external costs.

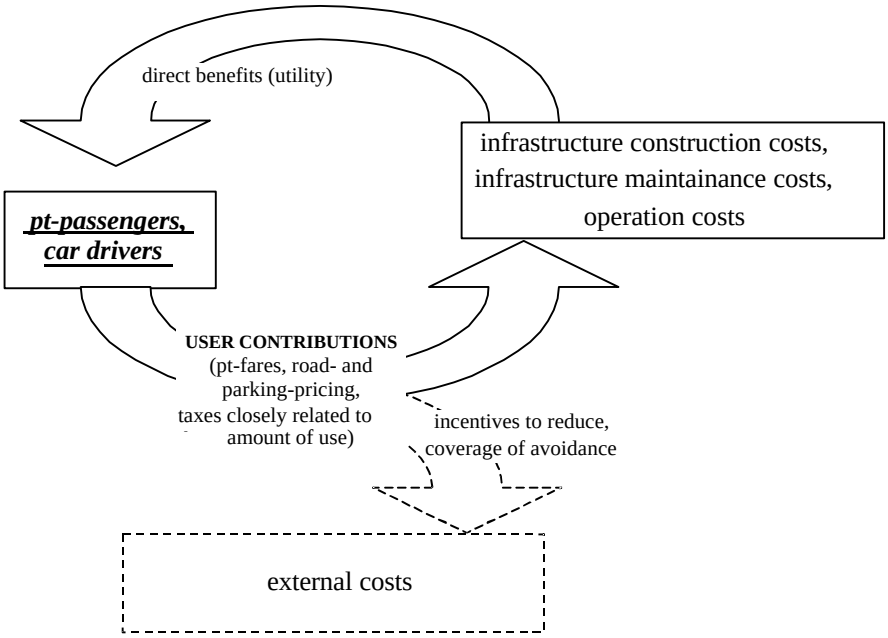
Therefore, efficient prices will, in certain circumstances, fully meet the financing needs associated with the provision of transport services[2]. At least in these sorts of circumstances, the first recommendation is that efficient pricing principles, where prices are set to equate with social marginal cost, are used to calculate prices for the use of:

- Roads services - through road pricing;
- parking services - through parking pricing; and
- public transport services - through public transport fares.

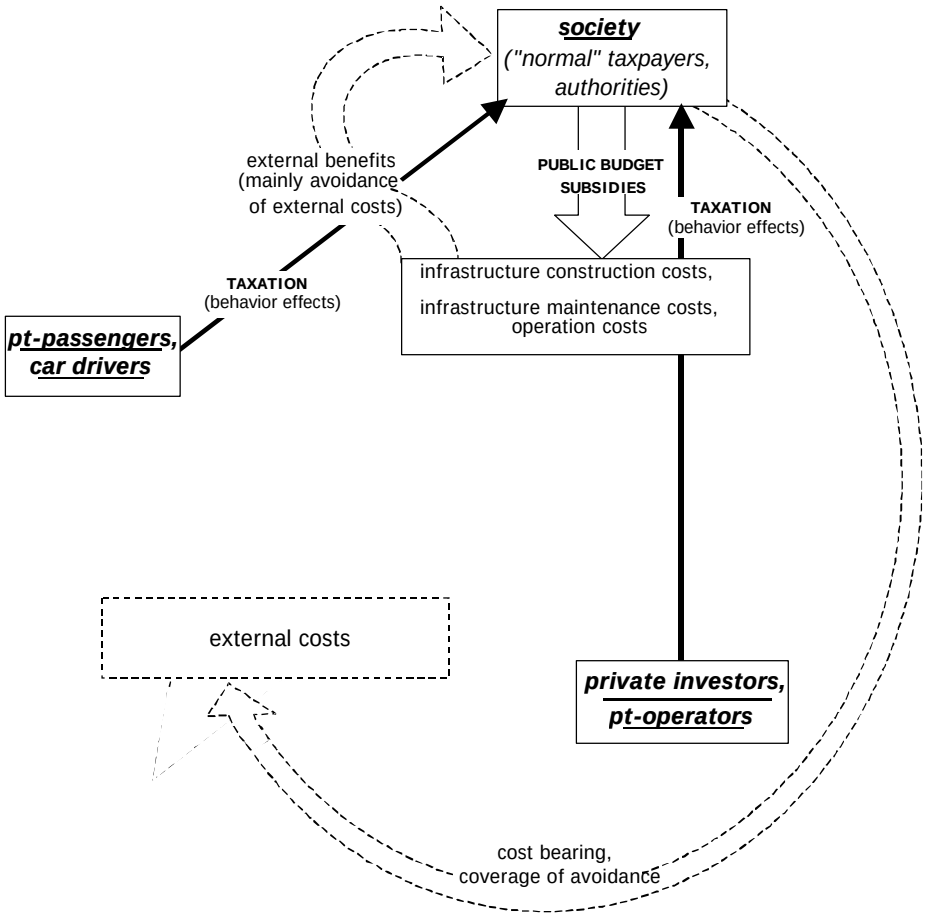
Even in this situation, however, there may be needs for capital finance to pay for new projects, even if ultimately user contributions will suffice to service this capital.

However, there may be barriers, related to feasibility or acceptability, which prevent efficient prices from being charged; in this situation some kind of second best set of prices must be devised. When devising this set of prices, cost recovery is often one of the objectives considered. The FISCUS handbook highlight different ways in which the financing needs, resulting from the failure of efficient prices to cover financial costs or the inability to implement efficient prices, may be met. The following figures are conceptual representations of the theoretical development made in the handbook.

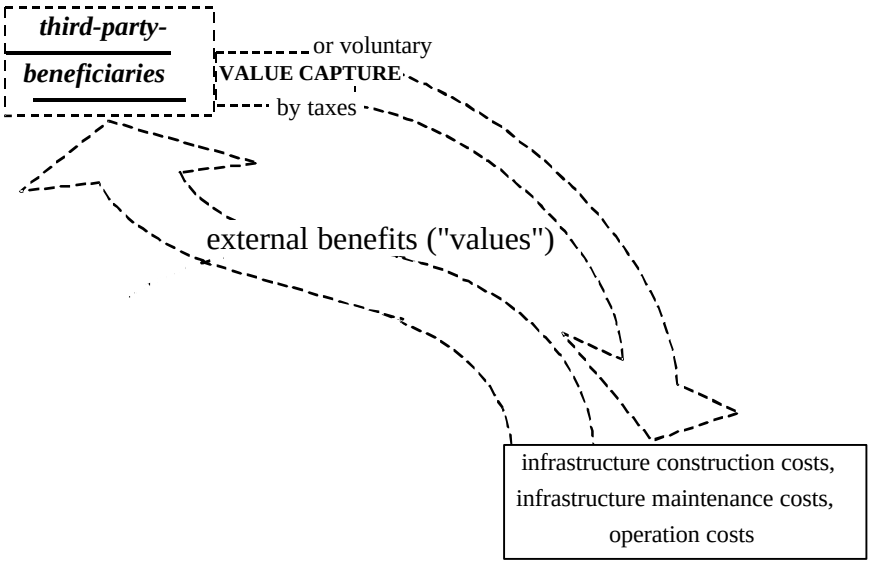
[2] This does not allow for the fact that part of the charge might arguably be used to provide compensation to victims of accidents or pollution. However, the major sauce of revenue is congestion charges.



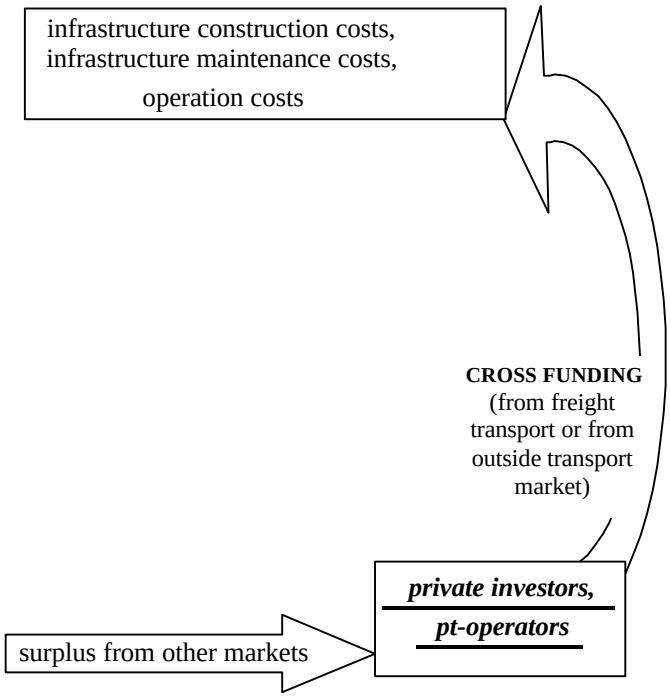
Financing by User Contributions (conceptual) – FISCUS Handbook



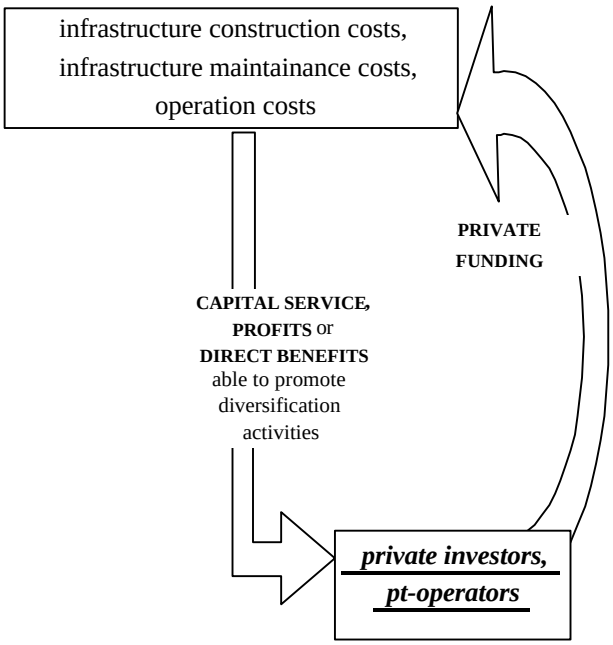
Financing by public budget (conceptual) - FISCUS Handbook



Financing by value capture (conceptual) – FISCUS Handbook



Financing by cross funding (conceptual) – FISCUS Handbook



Private financing (conceptual) – FISCUS Handbook

- **Financing packages**

There are three main reasons that explain why packages of measures may be more appropriate for financing urban transport systems than individual financing mechanisms.

First, it is of general acceptance that urban transport systems cannot be financed from a single source. In the presence of decreasing costs, user contributions set according to the social marginal cost principle might not cover total costs from some services.

Deficits from the transport sector are generally covered by subsidies from the general budget. However, this financing source is now being questioned given the current pressure to reduce public expenditure and the existence of other sectors also demanding public support. The profits from transport and non-transport activities/services can also be used to cover (public) transport deficits.

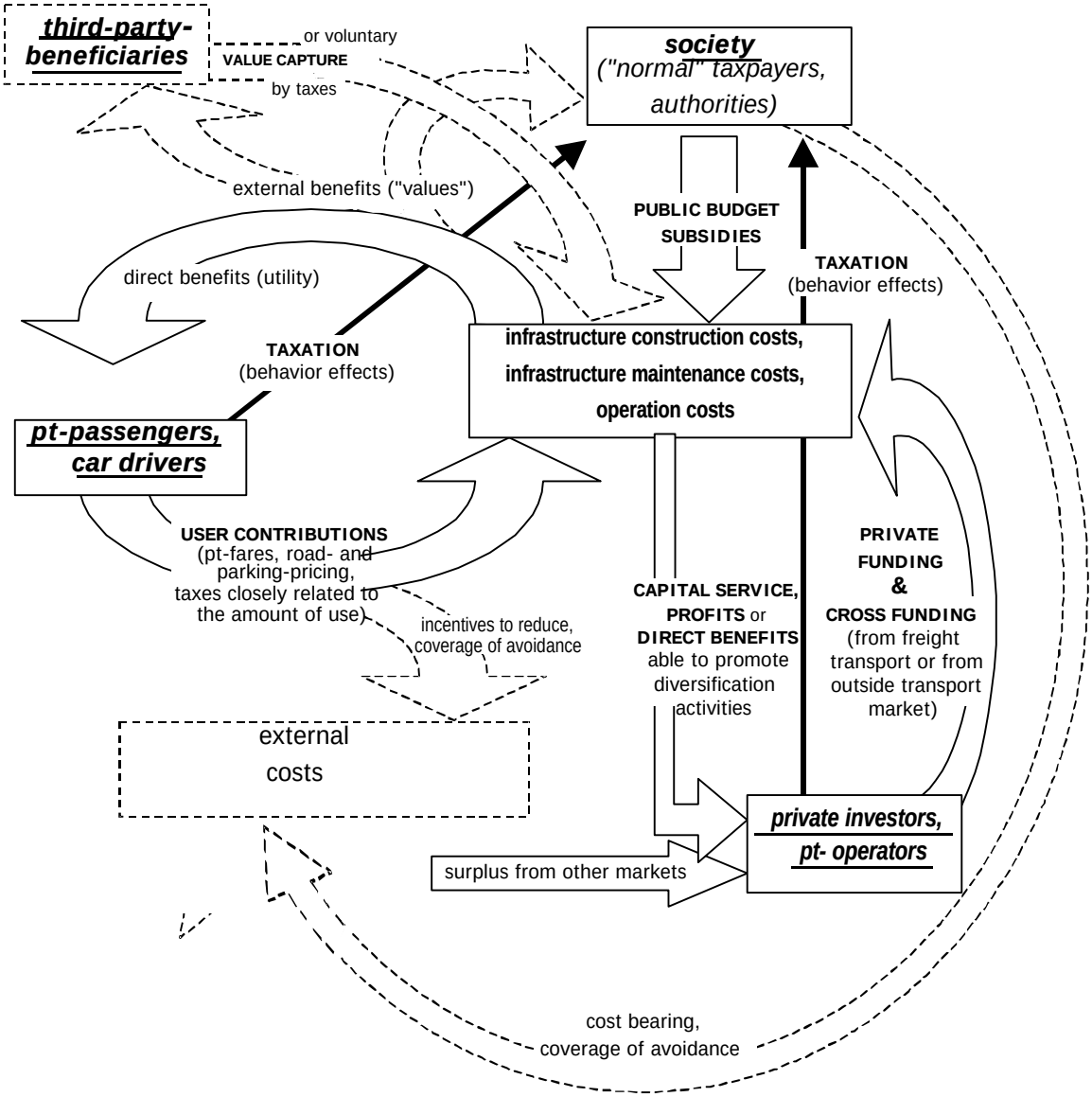
Cross-funding within the transport sector is mainly justified when there are high external costs in some markets and economies of scales in others.

Finally, value capture is seen as a funding source that may contribute to covering operating costs and, especially, financing investment, in a fair way since it is paid by beneficiaries of the system.

When the resources required to finance new investments are added to the operating costs of current transport infrastructures and facilities, the role of single sources in financing urban transport systems is even lower. Private finance constitutes a major and growing additional source of funding for investment, but it cannot usually be used to cover operating costs; on the contrary it creates a need for a method of funding to service the capital in question.

And thirdly, the previous section has also illustrated how the different financing mechanisms trade off between efficiency, acceptability and practical feasibility. The use of a combination of different mechanisms might offset the disadvantages of one instrument with the advantages of another.

Clearly, a large number of alternative funding packages may be put together, and what is seen as most suitable will vary very much with the situation in the city in question. The FISCUS Handbook provides a number of examples that should be taken as illustrations rather than a definitive list. They have been chosen rather to illustrate the range of options available, and therefore tend to be rather concentrated at the extremes of what is available.



Financing alternatives in Urban Transport - FISCUS Handbook

A move to a more efficient pricing structure will both serve to reduce the problems of congestion and environmental externalities, and very often help to solve the financing problems of transport in urban areas. Indeed the evidence suggests that in many larger cities such charges will cover all operating and capital servicing costs, although there may still be a need for public or private capital for investment projects.

There will be many cases where efficient pricing leaves a need for more funding, however. In this case a wide variety of mechanisms is available and should be examined. In most cases a mix of measures will be needed. In this chapter we have examined both the individual mechanisms and some examples of packages, as well as giving some advice on when each mechanisms or package is most likely to be appropriate.

In general, a combination of efficient pricing, with the use of public budgets to meet any remaining financing needs, has many attractions, but

may not be financially sustainable and provide adequate resources for investment. In these circumstances, we would recommend exploring a mix of private sector funding, perhaps through franchising, and simple approaches to value capture to service the debt. But there are many options available and each city must select what best suits its situation.

CONCLUDING REMARKS AND AFTERTHOUGHTS

As stated in the beginning of this handbook, FISCUS is a research project looking at both the total and marginal costs and the financing solutions for urban mobility. Although it may seem that the costing side is purely technical and the policy dimension is on the financing side alone, it became clear during the research that no strong inter relation exists between the Real Cost Scheme and the financing schemes (RCS).

Financial packages cannot be derived from an RCS, however the RCS provides important information to enable the right decision with regard to the cost situation revealing that there is also a strong element of political decisions affecting the costs side.

In fact, not only are many of the cost items heavily influenced by policy decisions (on land use, on design of the transport systems), but also there is no such thing as "objective" or "technical" social cost calculation since several value judgements have to be made by the system, person or organisation performing the calculation. In addition, the uncertainties contained in the results are often large.

Hence the future challenge of social cost calculation and urban transport policy is:

- to identify the distributional and environmental impacts to be taken into account;
- to link the actors causing the impacts to the actors paying them;
- to measure these impacts and express them in monetary terms; and
- to make the fundamentals of decision-making more transparent - not just to find *the* values for social and environmental impacts.

The following table summarises variables affecting the real cost of the urban transport system that can be influenced by politicians and decision-makers and gives examples of how those variables can be influenced.

Many of the influencing factors have more to do with long term decisions, especially those in the area of allocation of urban space for various types of use, and in particular for the different transport modes.

Main variables in the urban transport policy	**Can be influenced, e.g., through:**
Number of vehicles	- urban and regional planning - vehicle taxation - road and rail infrastructure supply and financial policy - tolls - promotion of car sharing and car pooling
Specific traffic performance per vehicle (km/year)	- urban planning / regional planning - fuel taxation - public transport service level - pedestrian and bicycle lanes and service level - tolls, parking space and fees

Average travelling speed per transport mode	- urban planning - road capacity planning - public transport service level - traffic priorities for public transport (special road lanes etc.) - Speed control measures/Telematics
Passengers per vehicle	- Public transport service level - Differentiated road tolling - Car sharing and car pooling in commuter traffic - Information campaigns
Future infrastructure investments	- Infrastructure supply/financial policy - Local policy statements - Infrastructure planning and evaluation instruments
Average vehicle age	- Public transport investment policy - Vehicle taxation and fees
Fuel consumption per vehicle (litre/vkm)	- Public transport operator's vehicle selection - Eco-driving campaigns - Traffic calming and speed control measures - Fuel tax - Vehicle taxation
Fuel price (ECU/litre)	- Fuel taxation
Number of congested roads and severity of congestion	- Urban planning - Infrastructure provision and capacity planning - Tolls - Telematic/traffic control instruments - Public transport service level etc.
Emission factors (PM, SO_2, NO_x, CO_2, VOC) of combustion-engine based vehicles (g/vkm)	- Public transport operator's vehicle selection - Vehicle taxation - Eco driving campaigns - Traffic calming measures - Fuel taxation
Electricity consumption per vehicle (kWh/vkm)	- Public transport operator's vehicle selection - Vehicle taxation - Energy taxation
Specific emissions (g/kWh) and risks of electricity production	- Public transport operator's power producer selection (deregulated markets) - Local power production strategy (all markets)

Variables affecting the real cost of urban transport system - FISCUS Handbook

In preparing this handbook, we are aware that no scheme for allocation of costs and assembly of financing instruments, can be classified as "best for Europe", and thus this has not been our objective. Instead, this handbook aims to provide:

- a consistent approach to the whole costing and financing of problem of mobility in urban areas;
- a series of procedures for estimation of the most relevant items of urban mobility costs, clearly indicating what are the features of the urban landscape and background that more strongly contribute to the increase or decrease of each of those cost items;
- a list of archetypal financing solutions (schemes), indicating the merits and risks of each of them, as well as a small collection of packages of such schemes, which can be considered as an example of rather "pure" forms, not claiming to be ready for adoption in real situations – where several type of constraints will always be present – but allowing easy perception of the type of solutions that have to be sought in a wide range of real situations:
- synthetic inputs of possible ways to make the policy approach to the issue of total coverage of mobility costs at the urban level, trying to identify the main "solution building path" in connection with the political priorities that might be defined by the respective authorities.

A move to a more efficient pricing structure will serve both to reduce the problems of congestion and environmental externalities, and very often help to solve the financing problems of transport in urban areas. Indeed evidence suggests that in many larger cities such charges will cover all operating and capital servicing costs, although there may still be a need for public or private capital for investment projects.

However, there will always be many cases where efficient pricing leaves a need for more funding. In this case a wide variety of mechanisms is available and should be examined. In most cases a mix of measures will be needed. In this handbook we have examined both the individual mechanisms and some examples of packages, as well as given some advice on when each mechanisms or package is most likely to be appropriate.

In general, a combination of efficient pricing, with the use of public budgets to meet any remaining financing needs, has many attractions, but may not be financially sustainable and provide adequate resources for investment. In these circumstances, we would recommend exploring a mix of private sector funding, perhaps through franchising, and simple approaches of value capture to service the debt. But there are many options available and each city must select what best suits its situation.

Finally, it is worth to highlight that pricing and financing policies imply the use of different mechanisms at the same time, that is single measures are never fully effective if applied in an isolated way. The risks involved in the implementation of each measure, their synergetic potential, as well as the assurance that the different measures involved in one policy package do not produce contradictory effects, are important issues that have to be included in the concerns of the decision-makers when choosing the most appropriate policies for their local context.

If we want to know the full costs of urban mobility, it is not acceptable to develop solutions of financial support of those costs that simply say "apply prices equal to marginal social costs" ignoring the consequences (or even the dimensions) of incomplete coverage of those costs. In the end, all costs are always covered, and it is not appropriate to defend a policy that deliberately ignores who those payers might be. Prices should be defined considering the marginal social costs of the systems at their current level of operation, but not necessarily so as to be equal to those marginal costs. In parallel to those marginal social costs other issues have also to be considered, and the definition of prices (as well as the possible contributions of non-users in order to ensure full cost coverage) has to be made with this wider view, keeping in mind that some pricing issues cannot be solved on urban scale alone.

The key conclusion is that, all mobility costs being always paid by someone, a systematic approach to these issues is strongly recommended, not only to ensure higher transparency in the estimation of magnitude and allocation of responsibility for the various cost items, allowing more justice in the allocation of these costs across society, but also the regular and sustainable performance of our mobility system with good overall quality levels.

The research presented here should contribute towards making such a systematic approach more widely accepted and practised.