

# **Identifying implementation paths for marginal cost pricing in urban transport and on interurban roads**

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## **ABSTRACT**

The goals of this paper are twofold. First, to provide an overview of barriers to marginal cost based road pricing in urban transport and on interurban roads. Second, to identify most likely implementation paths for marginal cost pricing given the identified barriers. A key feature of the paper is to distinguish between barriers and constraints to pricing. The constraints refer to second-best constraints or limitations on the pricing system and the measures used. The barriers instead represent factors or societal phenomena that are underlying reasons for these constraints to be true – they generate the constraints.

*This essay was prepared for the fourth seminar of the IMPRINT-EUROPE Thematic Network  
“Implementing Pricing Policies in Transport: Phasing and Packaging”  
Brussels, 13th - 14th May 2003*

## 1 Introduction

Road pricing as a policy to alleviate congestion, environmental and other problems related to urban and interurban road transportation has received much attention during the last decade. However, despite the relatively great benefits of road pricing that economists and other analysts have shown, and despite the efforts of the EU/EC to get road pricing implemented, it is not implemented in a broad scale. It is still widely considered to be a radical and controversial policy. This is due to many factors, including that the public and politicians do not seem to be convinced of the benefits (either to the society or to them personally). On the other hand, there are long-lasting disputes also among academics, especially around the application of the concept of marginal cost pricing.

Barriers to road pricing both in urban transport context and on interurban roads have been investigated and discussed in many research projects and papers. See IMPRINT Deliverables 1 and 2 and the numerous references therein. These reports also review the status of current policies, relevant technologies, legislation, institutions etc both on the European and national level as well as provide summary information of the numerous demonstrations and experiments in relation to these issues that have been carried out or are ongoing. The IMPRINT Deliverables, based on the recent White paper (CEC, 2001) and other relevant policy documents and research reports, also provide detailed summary descriptions of the current situation on the European and national levels regarding both policies and industry developments. Quinet (2001) shows how different pricing doctrines have prevailed in different countries in Europe. Nash and Matthews (2001) and Nash and Niskanen (2003) are relevant summary articles.

This paper provides a comprehensive review of the barriers and constraints to marginal cost based road pricing. The main contribution is to concentrate on the link barriers – constraints – implementation paths. The paper is based on MC-ICAM Deliverable 4. A new aspect is an important conceptual distinction made between barriers and constraints. In our view, this distinction provides an extremely valuable tool for analytic treatment of the relevant issues, thus facilitating the formulation of theoretically sound policy conclusions as well as integration of the issues in real-world modelling work.

With our goal of providing a systematic overview of relevant issues, much of the paper necessarily remains on a rather general level. (More detailed examples and applications of the ideas discussed here are presented in MC-ICAM Deliverable 4.) The goal is to highlight the whole range of questions that need to be asked and allowed when considering implementation of marginal cost based road pricing. Because these are the areas where possible problems most likely will arise. Though not reflected in the structure of the paper, we mostly consider pricing issues in urban road and interurban road transport separately. There are many reasons for a separate treatment. The barriers and constraints, the very topic of this paper, are often different. The policies in the two areas have typically been different (focusing in urban transport on private car and interurban road on freight transport) and have been implemented by different authorities (levels of government). Also existing analyses – both theoretical or conceptual and those using real-world simulation models – have mostly dealt with these two topics separately. While doing this, we however are aware of many interactions between the two areas and take them into account where relevant.

## **2 Theoretical framework**

### **2.1 Goals of road pricing**

The following three broad goals of road pricing are typically mentioned:

- to collect revenue
- to reduce road traffic and its nuisances (induced externalities like congestion, environmental damages, noise etc)
- to promote efficiency

The interpretation of the first two goals is quite obvious. Putting measurement problems aside, these two goals are rather concrete and easy for a policymaker to understand and apply. In particular, the collected revenues can be earmarked (hypothecated) or can provide for general fiscal taxation. And the goal of traffic reduction can be related to the broader goal of promoting modal shift.

But the third goal, promoting efficiency, is more problematic, and leaves room for interpretations. The term efficiency here refers to efficient resource allocation. To the extent that efficiency improvement is achieved through reduced traffic or modal shift or reduced external costs, there is overlap with the goal of reducing traffic and its nuisances; the difference can be seen such that promoting efficiency is the main or broader goal whereas reducing traffic and its nuisances is a goal derived from that. In practice promoting efficiency as a goal means that the policies are justified on a more general level (in the sense of welfare economics and cost-benefit analysis). However, even though efficiency is a clear and unambiguous concept in a static world (Pareto efficiency and the like), it is not necessarily so in a dynamic world and with uncertainty. One important issue is efficiency in the short term vs in the long term. These may not automatically coincide. Another important question: How does efficiency as a goal relate to the goal of sustainable transport? Finally, whilst not a primary policy goal in the context of road pricing, equity concerns are an important side condition.

### **2.2 Approaches to road pricing**

As for approaches to road pricing, two long-standing issues – also academic disputes – and dividing lines have been:

- short-run or long-run marginal cost pricing?
- marginal cost based or accounts based approach to road pricing?

Though these questions are now better understood than earlier (the emerging trend being integration rather than further contrasting of the different views), there still seem to be some unresolved issues also on the theoretical level. However, we believe that these issues, as important as they are also for the design of practical pricing policies, are not generally considered to be a real reason or barrier for not implementing road pricing in practice. Of course, their existence has made the attempts to market and implement road pricing as an application of marginal cost pricing more difficult.

The pricing instruments relevant for marginal cost based road pricing include: link based tolls, area based charges, cordon tolls, electronic kilometre based charges, vehicle taxation, fuel taxation, parking pricing, and public transport fares. De Palma, Lindsey et al (2002) (MC-ICAM task 4.1 report) provide a good overview of them and their theoretical properties, whilst focusing on urban road transport. Project DESIRE (see also IMPRINT Deliverable 2 and references therein) has identified and analysed the relevant measures in a more detailed level appropriate to interurban road.

### **2.3 Behavioural dimensions and externalities**

A critical prerequisite for marginal cost pricing in practice are sound estimates of relevant marginal costs. Besides reliable estimates, it is useful for the policymaker also to have understanding of the mechanisms behind the generation of these costs (evidently this can also help in producing reliable estimates). This requires identification of the different types of activities (cost drivers) and decision-making points in which the users of transport infrastructure are involved. These activities may be called dimensions of behaviour (behavioural dimensions).

Logically, there are various critical decision-making points that clear and reliable information on charging needs to incorporate: from long-run decisions about residence and location of firms, employment and car ownership, through short-run (day-to-day) decisions about mode, travel time, destination etc, to instant decisions about exact departure time and route. We have to ask: which of these dimensions are the most important in determining the various elements of external costs; and which are most appropriate for levying charges to result in the desired behavioural response.

An important characteristic of urban road transport is that the public are the key users of the transport system, rather than commercial users. A related feature is that the people's movements often are for their essential regular (even daily) activities. Commuting and shopping trips account for a high proportion of urban trips. An important feature of interurban road transport is the commercial freight transport i.e. heavy goods vehicles (HGVs) as a key user group. Another important difference that matters to the design of interurban road pricing systems vs urban systems is that the distribution of travel by trip purpose is different.

Behavioural dimensions and externalities and how appropriate road pricing instruments can allow for them were discussed on Project AFFORD relating to urban transport and in Verhoef (2001).

### **2.4 Barriers vs constraints**

The types of barriers and second-best constraints that may impede the implementation of marginal-cost pricing have been earlier visited in a number of European research projects such as AFFORD and PRIMA. The results have been reported e.g. in Glazer et al (2001), Harsman (2001), Herry (2001) and Milne et al (2000).

Project MC-ICAM has made an important conceptual distinction between barriers and constraints. The constraints refer to second-best constraints or limitations on the pricing system and the measures used. The barriers instead represent factors or societal phenomena that are underlying reasons for these constraints to be true, they generate the

constraints. The constraints thus are implied limitations on the pricing system. As contrasted to barriers that may be rather general and in some cases rather abstract (as discussed below), the constraints should be able to formalise and operationalise the underlying barriers for the purposes of theoretical and simulation modelling analysis. Another key principle is that a given barrier may give rise to – or contribute to – more than just one constraint, or conversely different barriers may lead to similar constraints.

The relevant second-best constraints to be considered when implementing marginal cost based pricing in practice are related to:

- coverage or scope of the pricing system
- composition and level of pricing measures
- degree of differentiation of pricing measures
- rules and principles governing revenue use
- use of supplementary non-price measures

The constraints on the *coverage or scope of the pricing system* mean limitations on the number of market segments that can be priced i.e. features such as: geographical or spatial coverage, modal coverage, user groups covered, externalities covered. The constraints on the *composition and level of pricing measures* mean limitations on features such as: the types and combinations of prices or charges or taxes used, maximum tolls or price caps, minimum total revenues, budget constraints, etc. The constraints on the *degree of differentiation of pricing measures* can mean limitations on differentiation of prices over relevant sub-markets: in space (geographically, over links and nodes in networks), over time (peak/off-peak), and by person or vehicle characteristics. The constraints on the *rules and principles governing revenue use* mean limitations on the allocation of revenues generated – for instance, between ear-marking (hypothecation) or circulating the revenues through the general state budget. One could think of revenues that are constrained to be used in the same mode, in another mode, in transport in general, in the same jurisdiction, to the disproportionate benefit of certain (income etc) groups, etc. Finally, the constraints on the *use of supplementary non-price measures* mean limitations on measures such as investment, non-price regulation, information provision, etc.

The relevant barriers can be categorised into three broad groups as follows:

- technological and practical barriers
- legal and institutional barriers
- acceptability related barriers

It is important to see that the barriers and constraints as defined here appear in different dimensions. Barriers categorisation identifies (distinguishes between) different background factors or conditions that may affect the implementation of pricing or the pricing system. Constraints categorisation identifies different aspects of the pricing system itself: those aspects that limit the policymaker's ability or freedom to optimally determine or choose those aspects. These ideas are illustrated in tabular forms in section 3.3 (relating to technological / practical aspects and section 4.5 (relating to legal / institutional aspects.)

### 3 Technological and practical issues relevant to designing implementation paths

#### 3.1 Technology

For urban private road transport the existing technologically oriented research and demonstrations and experiments carried out during the last few years in a number of European cities indicate that GPS-based electronic road pricing could guarantee an efficient solution for a fee collection system, allowing for charging an individual vehicle user for a specific trip at a specific place and time. (PROGRESS, CUPID) However, although the technology to permit fully differentiated pricing, to track patterns of movement in ways that allow user-specific externality-based congestion and other charges to be implemented in principle exists, it is not widely tested and therefore is likely to be considered too risky to justify full-scale implementation in the short term (at least). This can be a principal barrier to urban road pricing in the short term.

Parking pricing is often seen as a substitute to urban road pricing – although an imperfect one – to reduce congestion. On the other hand, there is also a strong theoretical (and practical) case for their joint use – as complements like in park and ride. Obviously there is a need for integrating parking pricing into the road pricing system also in terms of technology (i.e. not just economically). This most likely means integrated GPS-based technological solutions.

In urban public transport, the smart card technology (electronic stored value fare payment) has in a short time dramatically changed the prospects and the whole picture, similarly as the appearance of GPS-based ERP has changed the prospects regarding road pricing. This technology will permit complex pricing structures as a practical solution; it is generally seen as a practical means of allowing differentiation of fares, whilst satisfying the criteria of simplicity and transparency. The technology is already in use on some public transport systems, and the rapid growth of applications seems guaranteed. Similarly to parking pricing above, an integrated technological solution should comprise also public transport fares.

As for interurban road transport, the same technological developments (GPS-based ERP or electronic fee collection EFC) apply as for urban road transport pricing. However, here a new issue or problem arises: interoperability. That is, a precondition for an efficient European-wide transport pricing system is that the charge collecting systems implemented in different countries are technically interoperable. The subsystems introduced in different local and national territories need to be compatible so that vehicles – particularly heavy goods vehicles (HGVs) – could rely on a single technology when travelling long distances across Europe. The pricing system should be able to manage vehicles with foreign registration, should include allocation of the traffic and thus the revenue to several administrative units (countries or municipalities), and should not significantly disturb physical transport operations. (DESIRE)

Ultimately what matters is the cost of technology, rather than the existence of the technology in itself. Whilst sophisticated systems, such as GSP-based electronic road pricing, are better able to implement marginal-cost pricing along most dimensions of behaviour, they are more expensive. On the other hand, the overall costs of setting up and operating a road pricing system depend not only on the technology but also the

complexity of implementation and operation overall – including means of enforcement, existing legal powers for implementation, and how well the system is marketed to the public. (These other aspects will be discussed in the next subsections.)

In summary, the following barriers to marginal cost pricing can be identified:

- Technology (GSP-based ERP) for road pricing though in principle exists, is not widely tested and is likely to be considered too risky and expensive to justify full-scale implementation in the short term
- Existing technology for road pricing does not allow full price differentiation over time and vehicles and spatially
- Interoperability problem in interurban road transport (HGVs in cross-border transport)

### **3.2 Practical preconditions**

A major practical problem for urban road pricing is that the spatial structure of urban road networks can be extremely complex. This can cause serious practical implementation problems. It may not be a coincidence that the only (before London) operating systems – i.e. those in Norway and in Singapore – exhibit a notably simpler geography than European cities typically. Obviously the geography, population density and other physical features may affect the design of marginal cost based pricing policies and may in some cases act as barrier to their implementation. In interurban road transport the implementation is easier to the extent that networks are simpler than urban road networks. Therefore, the links to be priced can be rather easily isolated.

Another type of important practical precondition is availability of reliable cost and other relevant data and transferability of marginal cost and other estimates including potential impacts of the pricing system when implemented. Whilst there is a relatively well-developed level of understanding regarding the impacts of price levels on the use private car and public transport, via research into fares elasticities, the impacts this then might have on land-use and wider economic objectives are relatively unknown. Uncertainty about these aspects amongst political decision-makers may act as a barrier.

In summary, the following key barriers exists:

- Spatial structure of urban road networks usually extremely complex
- Availability of reliable cost and other data and transferability of marginal cost and other estimates still a problem

### **3.3 Summary: technological and practical barriers & constraints**

The above subsections 3.1 and 3.2 reviewed the technological and practical issues that may affect the implementation of marginal cost pricing. The aim was to provide an overall picture of the issues rather than going into detailed analysis. There is much previous and ongoing other work – research projects and demonstrations – that have investigated and tested these issues in detail. In particular, see Projects PROGRESS and CUPID for urban transport and DESIRE on interurban transport. See also Dix (2002), Kendzia (2001), Ricci and Fagiani (2002), Teule (2002), Tomassini (2002), Viegas

(2002), and IMPRINT Deliverables 1 and 2 which draw the different experiences together.

The technological and practical barriers identified above are important factors to be taken into account. And they likely are to be serious barriers to the application of marginal cost based road pricing in its full scale and with full differentiation in the short term. But in the medium term and for sure in the long term full-scale applications should be possible. Whilst stating that, we however do not believe that these kind of barriers alone can be a credible explanation for road pricing to be currently so rare. The introduction of the technology could always have been done in steps – first in a smaller scale in the short run and then gradually extending the scope and degree of differentiation in the medium and long term.

The discussion above focused on key barriers, and their identification, but did not mention constraints practically at all. As explained in section 2.4 above, this paper (and MC-ICAM in general) makes an important distinction between barriers and constraints. Table 3.3 illustrates the links between the barriers summarised above and the types of second-best constraints they imply.

Table 3.3: Technological and practical barriers vs implied second-best constraints

Implied second-best constraints on Underlying technological and practical barriers	Coverage or scope of the pricing system	Composition and level of pricing	Degree of differentiation of pricing measures	Rules and principles governing revenue use	Use of supplementary non-price measures
1. Technology (GSP based ERP) for road pricing though it in principle exist, is not tested in a broader scale and is likely to be too risky and expensive to justify full-scale implementation in the short term	Not all links tolled Only central areas tolled in urban transport Only main links tolled in interurban transport Constraints on which externalities can be charged for	Fixed charges still important	-	-	-
2. Existing technology for road pricing does not allow full price differentiation over time and vehicles and spatially	-	-	Flat tolls over time and space Undifferentiated tolls over user groups	-	-
3. Interoperability problems in interurban road transport (HGVs in cross-border transport)	Only main links tolled in interurban transport European wide kilometre charge delayed	-	-	-	-
4. Spatial structure of urban road networks can be extremely complex	Only central areas tolled in urban transport	-	-	-	Fixed capacities Given network configurations
5. Availability of reliable cost and other data and transferability of marginal cost and other estimate is still a problem.	Not all links tolled Only central areas tolled in urban transport Only main links tolled in interurban transport Constraints on which externalities can be charged for	Simple charging systems	Flat tolls over time and space Undifferentiated tolls over user groups	-	-

## **4 Legal and institutional issues**

### **4.1 Policy framework and supportive legislation on European level**

The adopted European approaches to urban transport and interurban road transport policy are very different. For urban transport pricing, according to the subsidiarity principle, the responsibility lies mainly with local and national authorities. The principle provides a policy framework for national authorities to pursue policies they see most appropriate without the need to take into account the EU's plans. But it can also be seen as a barrier to an effective, co-ordinated implementation of European transport pricing policy. However, the EU has consistently encouraged interested cities to liaise and co-ordinate with each other, through discussion and debate amongst policymakers, with the goal to develop and disseminate best practice throughout Europe. EUROPRICE and PROGRESS initiatives are examples of this. (CUPID)

As for interurban road transport, the EU has actively taken its key policy maker's role. However, the EU's efforts to promote interurban road user charges have been more or less dispersed, mostly focusing on individual issues. Also, the existing legislation is insufficient and has contradicting elements. Clearly there is a lack of common European strategy and framework. However, the Commission's new framework directive on infrastructure charging and the methodology paper are expected to provide an appropriate policy framework for reform, but how far they will go and into which direction and how prescriptive they will be is still open.

The main barrier to interurban road pricing is that the current EU legislation is not adequate to permit universal marginal social cost based kilometre charges since it limits such charges to main roads; moreover, they have to be related to infrastructure costs alone, i.e. excluding other externalities. Besides this, the so-called Eurovignette directive focuses on setting maximum levels for road user charges rather than giving clear instructions for how tariffs should be calculated (which costs should be included etc). According to other relevant directives, the actual fuel taxes are set by national authorities, and, consequently, the motivations for setting them at a higher or lower level can vary greatly across countries. (DESIRE)

In summary, the following barriers to marginal cost pricing can be identified:

- Subsidiarity principle in urban transport
- Lack of a common European strategy or framework for interurban road
- Lack of European laws (insufficient or contradicting legislation) to permit kilometre-based charging on interurban road freight

### **4.2 Policy objectives and supportive legislation at national level**

The major goal of marginal cost pricing, as advocated by economists, is to promote efficiency. However, in urban transport the responsible local governments typically want and need to justify their policies in terms of practical and often detailed local specific arguments – rather than in terms of more general arguments referring to efficiency benefits at a more aggregate level emphasised in the context of marginal social cost pricing.

Reflecting this seeming dilemma, policymakers still very much remain unconvinced that marginal cost-based pricing approaches are both feasible and desirable in practice. For instance, AFFORD concluded that the majority of policymakers involved in urban transport pricing are not, primarily, motivated by a commitment to marginal cost-based pricing approaches and are in many cases sceptical of the applicability of the detailed economic theory to the real-world urban environments. Rather, in their view, managing the urban transport system (incl. pricing) is a practical function which operates in parallel (and, often, subordinate) to managing the local and/or regional economy with the aim to provide for the general economic, social, environmental, health and educational needs of the resident population. The emphasis of urban transport policy has very much been on providing a service that facilitates other important lifestyle activities, and with an inevitable competitive angle with respect to neighbouring localities/regions. This has tended to encourage policies promoting maximum mobility in pursuit of short-term economic growth and perceived social welfare.

Overall, the traditional practical pricing and decision-making culture and the prevailing legal and institutional frameworks in urban road transport have evolved, primarily, to cater for other political and economic concerns than efficiency, the key objective behind marginal cost pricing. As a result, marginal cost pricing principles have, to date, played little part in determining the prevailing pricing approaches for urban areas.

Also public transport fares are often a highly political issue. There is a political desire to promote public transport use as an alternative to car use and to use fares as an instrument of social policy with the goals such as increasing usage or equity. These factors lead to pressures for fares that are simple and transparent and relatively low, and militate against the introduction of differentiated fares regimes, for example with high peak fares. Also, deregulation and privatisation of public transport service production have in some countries been set as a primary goal and approach. These developments – behind which there may often be broader political reasons or aspirations and which for sure may be useful policies for fighting inefficiencies elsewhere – appear to make implementation of marginal cost pricing more difficult both by increasing the difficulties of co-ordination (section 4.3 below) and due to the now relevant full cost recovery target. However, although it is likely that subsidies would be needed (with some potential re-targeting), in many cases this would be nothing new as public transport tends to receive large subsidies already.

As for interurban road pricing the policy is typically determined at the national level, and the motivations may range from fiscal taxation needs to environmental or energy policy concerns and the freight transport sector's internal competition problems.

Effective implementation of integrated transport pricing systems and policies requires an appropriate legal framework on the national level. To facilitate the implementation the legal framework should contain laws governing the structures and relationships of institutions responsible for, or with a stake in, transport pricing. And it should contain laws supporting specific marginal cost based pricing measures. The former type of laws would mainly support road pricing as a policy approach; the latter type would facilitate sufficient price differentiation (over vehicles, over time and spatially).

In different countries throughout Europe, there is a general lack of national legislation that would aim to facilitate and support the implementation of marginal cost based road pricing in urban (incl. the pricing of private parking facilities) and interurban road. In

some cases there is not even legislation that would make road pricing, i.e. direct charging of road users, legally permissible. In some other cases the legislation may be insufficient to facilitate the necessary differentiation (over time, spatially). Evidently the current very different status of legislation in different European countries reflects the fact that there have been widely differing and often contradicting objectives affecting the way road user charging and vehicle and fuel taxation have been organised.

In summary, the key barriers to marginal cost pricing include:

- Predominance of other goals in national/regional/local transport policymaking (the user/polluter pays principle often ignored)
- Lack of laws (insufficient supportive legislation) to permit or facilitate road pricing
- Lack of laws to enable price differentiation

#### **4.3 Co-ordination/co-operation and organisational structures within government and industry**

The implementation of marginal cost based pricing – as a central element of an integrated multi-modal pricing system – requires co-ordination and co-operation by multiple organisations, both government organisations and non-government stakeholder groups. However, authorities and operators responsible for the formulation and implementation of pricing schemes and necessary supportive measures often show a lack of co-ordination and communication. Effective co-ordination and co-operation is not automatically guaranteed because of the disaggregated nature of national (and local/regional) transport planning systems, and because of the multi-level structure of the government decision-making process. There may be lack of co-ordination between different parts of government on the same level, or between different layers of government (local, regional and national). For instance, issues of policy competition can impair the possibilities for implementation.

These issues may again be particularly important in regard to urban transport policy where many important decisions are largely taken by locally accountable politicians rather than by national government. This may mean neighbouring cities or urban areas competing, or a situation between a city and distinct local areas that may not correspond well to a city's sphere of influence. Besides neighbouring communities competing between each other rather than co-operating, this may mean lack of co-ordination between those responsible for urban roads and those for interurban roads, those responsible for urban roads and those for urban public transport.

In particular, the lack of co-ordination between cities and urban areas may lead to 'strategic waiting'. Between cities (regions / countries) there may be a first-mover disadvantage (uncertain technologies / behavioural responses etc) when implementing advanced road pricing, although there may also be a 'lagger disadvantage' in the longer run (not very innovative). As discussed by AFFORD, these strategic games may act as a barrier and prevent early implementation. Also, the problem may not just be the lack of co-ordination between relevant government organisations, but rather an active pursuit for competition between them.

Another issue is co-ordination between government and non-government institutions – particularly in regard to parking and public transport systems where they are privately owned or run, and the local public authority has only limited powers to control charges.

One reason for the lack of co-operation and co-ordination may be inappropriate organisational structures. It may be that key responsibilities are not allocated optimally from the point of view of introducing an integrated transport pricing system and marginal cost based pricing as its core part in particular – though the allocation may be optimal from some other viewpoints. It may be that wrong organisations, or levels of government, have been assigned (as a result of historical development with no particular purpose, or with the aim to support some other purposes), wrong tasks or responsibilities. In principle, the main responsibility for reforming pricing may be by an organisation the representatives of which do not see this to be in their own interest.

A general feature in transportation is that responsibilities and powers tend to be shared between different administrative levels and are not always treated in a comparable manner in different parts (e.g. competing modes) of the transport sector. For example, whilst responsibility and power in the railway sector is, usually, primarily at the national level, that for roads tends to be divided between national and local levels depending on road type. In particular, in road transport, the implementation of an integrated transport pricing policy may be impaired by the fact that management of urban and interurban road modes is in the hands of separate public agencies.

Organisational structures can also greatly vary between different countries. In particular, in relation to urban transport and urban transport pricing, an important question concerns the number of administrative levels: the number of administrative levels that need to be involved in formulating and implementing pricing policy will evidently affect the logistical complexity of achieving policy goals. That is, the greater the number of administrative levels the greater the legal and institutional complexity – and associated barriers – may prove to be. Indeed, it may be no coincidence that the longest-standing example of a successful urban road pricing system is in Singapore, a single city state with, in effect, a single administrative level for deciding and implementing transport policy.

As regards public transport, where services are franchised, government's ability to influence fares may be limited to when franchises are being re-negotiated or re-let (i.e. every 5, 10 or 15 years or however long franchises are). And where services are deregulated, governments' ability to influence fares may be even more limited. Also, the separation of decision-making on public transport fares and other road transport pricing could be viewed as a barrier in that there is a failure to integrate pricing decisions: prices for one mode end up having to be set, in part at least, to compensate for pricing policies on other modes. At the extreme, if pricing decisions are made entirely separately, they may provide travellers with conflicting incentives.

In recent years the role of the private sector in funding, producing and operating transport infrastructure and in providing public transport services has been growing. The private sector's involvement in public transport and parking in an urban context, and Public-Private-Partnership (PPP) in an interurban road context evidently has implications for pricing in the direction that revenue collection and revenue maximisation get relatively more weight, thus reducing the attractiveness of marginal cost pricing.

In summary, the key barriers include:

- Lack of co-operation between neighbouring cities and communities (e.g. ‘strategic wait’), and between government and private institutions
- Lack of co-ordination between local and national government bodies with different objectives and responsibilities
- Management of modes (urban and interurban roads) in the hands of separate public agencies, which may work against integrated multi-modal urban pricing policy
- Number of administrative levels involved in formulation and implementing pricing policy
- Supply and operation of private non-residential parking and public transport services outside direct government control
- Public-Private-Partnership (PPP) for producing and running infrastructure in an interurban road context

#### **4.4 Legislation and policies in other areas and sectors**

Legislation and policies in other areas and sectors that in the first place focus on other issues and perspectives may have considerable impact on road transport pricing. They may impose clear constraints on transport related policymaking; and they may affect the policy objectives assumed in the transport sector. In particular, urban transport policies may to a great extent be directed to promote more general (rather than transport specific) goals: fiscal policies, economic vitality of a city, competition between communities to attract business and taxpayers, social and equity related goals, etc.

Therefore, whilst there is a lack of laws that would facilitate or support the implementation of marginal cost based road pricing (section 4.2), at the same time there are important laws in many countries that can hamper or even prevent direct charges for road use. Such laws may be related to fiscal taxation, or they may be concerned with certain basic national constitutional rights or guarantees, such as freedom of access or movement, privacy needs and civil liberties (possible misuse of electronic information as evidence etc). Such laws can conflict with the need for marginal cost pricing to differentiate prices according to types of users (vehicles) and in space and time. Laws related to fiscal taxation may explicitly state that road user charges or taxes must not vary over time. And civil liberties legislation can constrain those forms of road pricing that need tracking of the location of individual vehicles.

Prevailing political and financial relationships between local and national governments may make fundamental decisions about charging and revenue use more to do with politics than economics. In particular, fiscal laws may contradict introduction of marginal cost pricing also to the extent that earmarking is a necessary (acceptability) condition. This means that marginal cost pricing principles are easily over-ruled in decision-making, particularly where one level of government is likely to lose out financially in relation to another.

In summary, the key barriers include:

- Laws to prevent direct charges for road use with reference to freedom of access and movement
- Civil liberties (possible misuse of electronic information as evidence etc) and privacy needs
- Contradictory legislation and policies related to fiscal taxation

#### **4.5 Stakeholder and interest groups**

Important actors to be taken into account when formulating and implementing road pricing policies are non-governmental organisations with a stake in urban transport. Some of these may favour marginal cost based road pricing (e.g. environmental groups, but these can also oppose), other may strongly oppose (e.g. industry groups), and thus barriers may be caused by their strategic opposition.

In particular, in relation to urban transport pricing, non-governmental interest groups with a perceived stake in the system to oppose marginal cost based pricing policies may be much more common than similar organisations acting for their support. A strong theoretical argument supporting this view is based on the obvious asymmetry between winners and losers due to marginal cost-based pricing policies: typically, the intensity of welfare changes for the losers is notably bigger than for the winners, suggesting that potential losers create organisations to oppose the policies more likely than potential gainers to support them. An additional and related observation strengthening this conclusion is that the benefits are often indirect, whereas the costs are mostly direct. A well-known fact is that direct impacts of policies matter much more than indirect impacts, if only because the direct impacts accrue immediately but the realisation of indirect impacts takes time.

Also, the organisations representing the losers have an incentive to exaggerate expected losses and/or neglect possible gains, in order to try and realise a share in the revenue allocation as large as possible, should implementation materialise. In other words, due to a strategic behaviour the resistance may seem even greater than it actually is. The failure to even attempt to influence the pricing scheme as much as possible in the institution's population is unattractive when the organisation's representatives are judged by the extent to which they serve their population.

Related to the discussion on the non-optimal organisational structures above (section 4.3), it can be in the interests of government workers or interest groups to continue existing policies they are used to. They either may not understand the new policies they should be responsible for or they may be afraid of likely organisational rearrangements and even for losing their jobs. Therefore, a particularly important question concerns the link or interaction between legal and institutional issues (barriers) on the one hand and acceptability related issues (barriers) on the other hand. AFFORD concluded that politicians, planners and managers in the urban transportation sector tend to think of core issues and barriers in terms of socio-political acceptability rather than in terms of legal and institutional feasibility. This was interpreted to reflect the fact that most legal and institutional barriers could potentially be removed at national level if only sufficient socio-political acceptability (i.e. political will) existed. These observations lead to emphasise the potential interdependence between the low socio-political acceptability and the legal and institutional status quo. That is, while in many cases changing the

legal and institutional structures first might be the key to gaining the required socio-political acceptability, such a change does not appear likely without gaining the required acceptance first. The existing studies have not sufficiently addressed this important issue.

In summary, the following key barriers to marginal cost pricing can be identified:

- Opposition by non-governmental stakeholder/interest groups
- Interdependence between the low socio-political acceptability and the legal and institutional status quo

#### **4.6 Summary: legal and institutional barriers & constraints**

Subsections 4.1-4.5 above have discussed the whole range of legal and institutional issues that may affect the implementation of marginal cost based pricing in different circumstances. The aim was to provide a comprehensive picture of the issues; this necessarily leads to a rather general treatment. Distilling theoretically sound conclusions is also impeded by the problem that legal and institutional issues have not previously been investigated systematically in a transport pricing policy context. There is a very limited availability of relevant work to provide reference information and facilitate the analysis at anything other than a general level.

The existing previous work can be characterised by the following dichotomy. On the one hand, there is some work that have considered legal and institutional issues on a general and conceptual level (Stough and Rietveld 1997, Rietveld 2002). The empirical work, on the other hand, has addressed a range of transport pricing issues at varying levels of detail, but has not explicitly addressed them in the context of marginal cost pricing. The empirical literature mostly consists of largely pragmatic accounts of detailed legal and institutional issues related to specific policy measures, undertaken as part of real-world feasibility studies and demonstration projects.

The discussion above has shown that there are a great number of legal and institutional factors or barriers affecting marginal cost pricing implementation at the European, national and local/regional level. Clearly all the identified legal and institutional barriers are important factors to be taken into account. However, similarly to technological and practical barriers (section 3 above), these type of barriers alone can be no credible reason for road pricing to be so rare. Legislation and institutional structures can always be changed, and in many cases in a relatively short time (as is often seen), if only political will existed. Indeed, the real issue or barrier in most cases appears to be the lack of political will. One potentially important factor affecting here was highlighted above (in section 4.5): the potential interdependence between the low socio-political acceptability and the legal and institutional status quo. This leads to the view that it is the acceptability related barriers or reasons that explain why road pricing and marginal cost pricing in particular are so rare, both in urban and interurban road transport.

The discussion in subsections 4.1-4.5 focused on key barriers, and their identification, but did not mention constraints practically at all. As explained in section 2.4, this paper (and MC-ICAM in general) makes an important distinction between barriers and constraints. Table 4.6 illustrates the links between the legal and institutional barriers summarised above and the types of second-best constraints they imply.

Table 4.6: Legal and institutional barriers vs implied second-best constraints

Implied second-best constraints on	Coverage or scope of the pricing system	Composition and level of pricing measures	Degree of differentiation of pricing measures	Rules and principles governing revenue use	Use of supplementary non-price measures
Underlying legal and institutional barriers					
1. Subsidiarity principle in urban transport	Not all links tolled Only central urban areas tolled	-	-	-	-
2. Lack of a common European strategy or framework for interurban roads	No uniform pricing throughout all Europe	Pricing schemes non-harmonised	-	-	-
3. Lack of European laws (insufficient or contradicting legislation) to permit kilometre-based charging on interurban road freight	Only main links tolled in interurban transport Not all user groups tolled Constraints on which externalities can be charged for	Specific price caps	Flat tolls over time and space	-	-
4. Predominance of other national transport policy goals ('user/polluter pays principle' often ignored)	No road charging	Fixed charges popular	Flat tolls over time and space Undifferentiated tolls over user groups	Revenues to state budget	-
5. Lack of national laws to permit or facilitate road pricing	No road charging	-	-	-	-
6. Lack of national laws to enable price differentiation	-	-	Flat tolls over time and space Undifferentiated tolls over user groups	-	-
7. Lack of co-operation between neighbouring cities and communities (e.g. 'strategic wait'), and between government and private institutions	Not all links and not all urban areas tolled Only central urban areas tolled	No integrated pricing system possible	-	Revenues hypothecated	Impossibility of setting local technology standards in combination with non-differentiated taxes
8. Lack of co-operation between local/regional and national bodies with different objectives and responsibilities	Not all links and not all urban area tolled Only central urban areas tolled	Charges to be revenue neutral: need to lower fuel taxes and vehicle excises to compensate	-	Revenues hypothecated	-

9. Management of modes (urban and interurban roads) in the hands of separate public agencies	-	-	-	Revenues hypothecated	-
10. Number of administrative levels involved in formulating and implementing pricing policy	No road charging	-	-	-	-
11. Supply and operation of private non-residential parking and public transport services outside direct government control	-	No pricing of privately provided parking  Public transport charges based on commercial not marginal social cost principles	-	Revenues hypothecated	-
12. Public-Private-Partnership (PPP) for producing and running infrastructure in an interurban road context	-	Road charges based on commercial not marginal social cost principles	-	Revenues hypothecated	-
13. Laws to prevent direct charges for road use with reference to freedom of access and movement	Not all links tolled  Only central areas tolled in urban transport	Traditional fixed charges possible, not new variable charges	-	-	-
14. Civil liberties and privacy needs	Not all links tolled  Only central areas tolled in urban transport	Traditional fixed charges possible, not new variable charges	Undifferentiated tolls over user groups	-	-
15. Laws and policies related to fiscal taxation	-	Fiscal taxes	Flat tolls over time and space	Revenues to the state budget  No revenue hypothecation	-
16. Opposition by non-governmental stakeholder/interest groups	Constraints on which externalities can be charged for  Need for pilot / demonstration schemes	Specific price caps	-	Need for revenue hypothecation	Capacities may need to be expanded
17. Interdependence between the low socio-political acceptability and the legal and institutional status quo	No road charging	-	-	-	-

## **5 Implementation paths**

As discussed in the earlier sections, the three type of barriers identified – technological / practical, legal / institutional, and acceptability related – imply constraints on what is possible for government to implement in the short, medium or long term. In many cases the barriers may be expected be eased over time – because of developments or advances in technology and changes in legislation and institutional structures. Passage of time and new information and experiences may also facilitate changes in the public and political acceptability. This leads to the idea of a gradual or phased approach to the implementation of marginal cost pricing.

This final section discusses directions for potential implementation paths for marginal cost based pricing, given the identified barriers / constraints and their likely development over time. (The acceptability barriers and constraints, though discussed in MC-ICAM Deliverable 4, were not considered here.) We consider separately the most likely progress in the following five key policy areas:

- urban road pricing
- urban parking charging
- urban public transport pricing
- interurban road pricing
- fuel taxation and vehicle licences

### **5.1 Urban road pricing**

For urban road pricing, in the short term, area-based charges (incl. cordon tolls) should be implemented in central i.e. the most congested urban areas and on weekdays. Simple technology should be used whilst ensuring that it is compatible with whatever plans there may be for more sophisticated technology in the future. In the medium term, distance-based electronic road pricing (ERP), which would be GPS-based, should replace area-based charges. Pricing may still need to be restricted to central areas and weekdays, both for technological / practical and acceptability reasons. Initially, ERP may need to be introduced anonymous i.e. same prices should be charged for all vehicles. However, the levels of charges should gradually move towards pricing relevant marginal social costs. And in the long term would be implemented full distance-based pricing with charges differentiated according to full marginal social cost based differentiation and on all urban links and at all times.

### **5.2 Urban parking charging**

In urban parking charging, in the short term, publicly controlled parking fees should vary by location and time, and should be increased where necessary to cover relevant induced costs. Legislation to facilitate public control of private parking should be pursued. In the medium term, publicly controlled parking fees should be further differentiated by location and time. Public control and greater differentiation of private parking fees (and other factors) should be increased where possible. In the long term, publicly controlled parking fees would be fully disaggregated by location and time, and

similarly for private parking where possible. Parking charging technology will most likely ultimately be integrated with the GPS-based ERP system.

### **5.3 Urban public transport pricing**

In urban public transport pricing, in the short term, public transport fare structures and subsidies should be adjusted on second-best principles to be in line with area-based charges for cars. A key technology facilitating the application of effective pricing is smart card technology. The medium term could see further adjustment in public transport fares and subsidies as distance-based ERP is phased in. Smart card technology may be integrated with concurrent road pricing system. In the long-term public transport fares and subsidies will become fully adjusted and smart card technology will be integrated with concurrent GPS-based ERP road pricing system. Also information systems to indicate fare structures for passengers will be developed.

### **5.4 Interurban road transport**

For interurban roads, in the short term, the main thing is the introduction of distance-based kilometre charges for heavy goods vehicles (HGVs). Initially this applies to certain countries using currently the Eurovignette system; for these countries the introduction of kilometre-based charging system would replace the Eurovignette. Some countries already have made, or are making, progress here, and other countries are interested in following on a longer timescale. Two important preconditions to facilitate the implementation in the short term are: a reform of EU legislation so that to permit a full marginal social cost pricing scheme; and development of European wide standards to ensure inter-operability across national borders. Naturally, further development and testing of the technology itself is needed too.

The kilometre-based charges will also allow for certain induced environmental costs, and not just infrastructure costs (as is the case with Eurovignette). Furthermore, to secure acceptability but also for technological reasons, the kilometre-based charges may need to possess in the short term two features or limitations: no differentiation within country by time or space, and revenue neutrality (compensating reductions in other taxes). However, though revenue neutrality may be relevant (to overcome acceptability problems) in the short term, it certainly should not matter in the medium let alone long term. In the medium term, distance-based charges for HGVs should be extended to all Europe. The most likely technology again (as with urban road pricing) is GPS-based ERP or EFC (electronic fee collection) system, which now needs to be standardised throughout Europe. (DESIRE has considered most likely paths for the existing technological solutions, which prevail in different parts of Europe, to converge within the next 10 years. See Viegas (2002).) The ERP charges should be gradually moved towards pricing relevant marginal social costs, and, ultimately in the long term, full GPS-based ERP should be phased in on all European interurban links for HGVs, for passenger transport and for private vehicles. That is, charges should ultimately be set according to full marginal social cost based differentiation. Here the system's extension should be facilitated by the experience of the technologies that has been build up from applying the system for HGVs in the short and medium term.

In the short term, throughout Europe, the kilometre-based pricing scheme should be complemented by a system of road tolls which, using simple technology, could be introduced on certain roads with especially serious environmental, congestion, financing etc problems so that to warrant separate consideration. Over time, from the medium to long term, such toll roads should become more common and they should become more differentiated by time of day (and vehicle characteristics too). Ultimately these charges can be absorbed by the full ERP system.

#### **4.5 Fuel taxation and vehicle licences**

Fuel taxation and vehicle licence policies are different from mode specific charges (road user charges, parking fees and public transport fares) discussed above, as they directly and equally affect both urban and interurban road transport modes. Therefore, interdependencies between these two modes are an important issue to be taken into account.

In the short term, if revenue neutrality of the introduction of kilometre-based charges for HGVs is any acceptability issue, fuel taxes and/or vehicle licenses (excise duties) may need to be reduced for compensation. As distance-based ERP will be extended in the medium and long term also to cover private vehicles and passenger (in interurban road) transport, fuel taxes and vehicle licences may be further reduced. The situation depends both on the starting level of fuel taxes and vehicle licences (which vary greatly between different countries) and on the ability of fuel taxes vs ERP to allow for and affect the key behavioural dimensions (cf section 2).

#### **5.6 Summary table**

Table 5.6 presents an overall implementation path for urban transport and interurban road transport. The table summarises the discussion in subsections 5.1-5.5 above, and it suggests directions for practical implementation paths for urban roads (road user charging and parking charging), urban public transport and interurban roads. It presents directions for potential implementation paths for marginal cost based pricing, given the identified barriers / constraints and their likely development over time. It shows the most likely progress in the five key policy areas – urban road pricing, urban parking charging, urban public transport pricing, interurban road pricing, and fuel taxation and vehicle licences – whilst distinguishing between the short (-3 years), medium (3-10 years) and long (10- years) term.

In the table we have sought to define an overall implementation path that makes the fastest possible progress towards marginal social cost pricing given the constraints, and within which second-best optimal prices (pricing instruments and their levels) may be set. Of course, there are many uncertainties, and it may not prove possible to implement all the elements included in this overall path, and certainly not to do so everywhere. But we regard this path as a sensible basis for further analysis.

Table 5.6: Directions for potential implementation paths for urban transport and interurban road transport

Policy area	Short term (-3 years)	Medium term (3-10 years)	Long term ( 10- years)
Urban road pricing	Area-based charges (incl. cordon tolls) in central urban areas and on weekdays. Simple technology used but ensured that it is compatible with plans for more sophisticated technology in the future.	Distance-based electronic road pricing (ERP) replaces area-based charges. Pricing still restricted to central area and weekdays. ERP non-differentiated (i.e. same for all vehicles) and GPS-based. Charges gradually moving towards pricing relevant marginal social costs.	Distance- and GPS-based ERP on all urban links and at all times. Ultimately charges according to full marginal social cost based differentiation.
Urban parking charging	Publicly controlled parking fees by location and time, and increased where necessary to cover induced costs.	Publicly controlled parking fees more disaggregated by location and time. Increased public control of private parking (fees and other conditions).	Publicly controlled parking fees fully disaggregated by location and time. Same for private parking when possible. Parking charging technology ultimately integrated with the GPS-based ERP system.
Urban public transport pricing	Public transport fare structures and subsidies adjusted according to second-best principles to be in line with area-based charges for cars. Application of smart card technology.	Further adjustment in public transport fares and in public transport subsidies as distance-based ERP phased in. Smart card technology integrated with (technologically) concurrent road pricing system.	Public transport fares and subsidies fully adjusted (levels) and smart card technology integrated with concurrent GPS-based ERP road pricing system. Information systems indicating fare structures for passengers.
Interurban road pricing	Distance-based kilometre charges for heavy goods vehicles (HGV's) in certain countries. In some cases this may need to be compensated by reductions in other taxes. No differentiation within country by time or space. In other countries, the current system (Eurovignette or no road charging) continues. Tolls on certain roads with specific congestion or financing problems.	Distance-based charges for HGVs throughout Europe (Euro legislation). Most likely through technologically standard (throughout Europe) GPS-based ERP system. Tolls on specific roads more common and differentiated by time of day. Charges gradually moving towards pricing relevant marginal social costs.	Full GPS-based ERP phased in: distance-based road pricing on all European interurban links for HGVs, road public transport and private vehicles. Charges ultimately according to full marginal social cost based differentiation.
Fuel taxation & vehicle licences	Fuel tax and vehicle license reductions may be needed to compensate for introduction of kilometre charges.	Fuel taxes gradually reduced, as distance-based ERP phased in. Vehicle licenses gradually reduced, as ERP phased in.	Fuel taxes reduced to cover CO <sub>2</sub> emissions costs only. Vehicle licenses further reduced, in some cases (but not in all) ultimately to zero.

## **6 Overall conclusions**

This paper has provided an overview of barriers to marginal cost based road pricing in urban transport and on interurban roads and has identified most likely implementation paths for marginal cost pricing given the identified barriers. A key feature of the paper has been to distinguish between barriers and constraints to pricing.

The paper has considered in detail technological and practical barriers, and legal and institutional barriers. It has not discussed much acceptability related barriers, not because they are not that important (they are!), but because of practical reasons (there is another paper on acceptability at this seminar).

This paper has focused on features that are more or less common to different countries and parts of Europe rather than on differentiating factors. It is clear that when formulating detailed optimal road transport pricing policies in practice, and their implementation strategies, on the European and national (also local/regional) level or scale, the existing large inter-country variations in the current road transport pricing or taxation systems and policies are an important starting point. Large variations also exist in relation to technological / practical aspects and legal / institutional aspects discussed here. However, only after understanding and agreeing on the optimal and most likely common developments and policies on an aggregate level, we can formulate more detailed policy suggestions for the different countries and parts of Europe allowing for local or country specific differences and features – yet making sure the suggestions are consistent with proposals made, and the developments foreseen, on a more general level (and elsewhere).

Another precondition for effective and realistic policies and implementation strategies regarding road transport pricing is that it must not be considered as an isolated issue but as part of a broader transport, economic and social system. (E.g. AFFORD and Goodwin (2001).) The discussion here, however, has concentrated on modal (road) level issues.

As stated in the beginning, the progress in the implementation of road pricing and marginal cost based pricing in particular has been very slow. Marginal cost pricing is still widely considered a radical and controversial policy, and such it no doubt is. One reason may be existing political structures – the inherent structural workings of a representative democracy. The political need for favourable and comparatively quick results may militate against radical approaches or policies like marginal cost pricing which also involve lengthy implementation paths.

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