

# SIXTH FRAMEWORK PROGRAMME



Project contract no. 006293

## IMPRINT-NET Implementing pricing reforms in Transport - Networking COORDINATION ACTION

*Thematic Priority 1.6.2 "Sustainable Surface Transport"  
Objective 3.4.1 "Research to support the European Transport Policy"*

### DELIVERABLE 1

## Pricing for (sustainable) transport policies – A state of the art

*Due date of delivery: November 2005  
Actual submission date: December 2005  
Revised version submitted: March 2006*

**Start date of project:** 1<sup>st</sup> of July 2005

**Duration:** 36 months

Lead authors for this deliverable: **Andrea Ricci, Patrizia Fagiani (ISIS), Chris Nash, Bryan Matthews, Batool Menaz, Dan Johnson and Phil Wheat, (ITS), Arnaud Burgess, Wieger Savenije, Robert De Jong (TNO), Katalin Tánczos, Ferenc Meszaros (BUTE), Jens Schade (TUD). With contributions from Phil Smith (EUROCONTROL) and Karsten Sten-Pedersen and Thomas Oodgard (COWI)**

Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)		
Dissemination Level		
<b>PU</b>	Public	<b>x</b>
<b>PP</b>	Restricted to other programme participants (including the Commission Services)	
<b>RE</b>	Restricted to a group specified by the consortium (including the Commission Services)	
<b>CO</b>	Confidential, only for members of the consortium (including the Commission Services)	

## TABLE OF CONTENTS

<b>EXECUTIVE SUMMARY</b> .....	<b>3</b>
<b>1. BACKGROUND AND OBJECTIVES OF THE DELIVERABLE</b> .....	<b>6</b>
<b>2. POLICY BACKGROUND</b> .....	<b>7</b>
2.1 LATEST EU POLICY DEVELOPMENTS.....	7
2.2 LATEST MS POLICY DEVELOPMENTS .....	9
2.2.1 <i>Policy developments in EU-15</i> .....	9
2.2.2 <i>Policy developments in new Member States</i> .....	11
<b>3. REVIEW OF RECENT RESEARCH AND EXPERIENCES</b> .....	<b>15</b>
3.1 COST VALUATION .....	15
3.1.1 <i>Overall summary of state of the art</i> .....	15
3.1.2 <i>Infrastructure costs</i> .....	24
3.1.3 <i>Scarcity costs in the rail and air sectors</i> .....	30
3.2 TARIFF SETTING .....	37
3.2.1 <i>Charging for the use of roads</i> .....	40
3.2.2 <i>Charging for use of rail infrastructure</i> .....	45
3.2.3 <i>Charging for the use of inland waterways and maritime transport infrastructure</i> .....	55
3.2.4 <i>Charging for the use of air transport infrastructure</i> .....	64
3.3 IMPACT ASSESSMENT .....	73
3.3.1 <i>Impact categories</i> .....	73
3.3.2 <i>Interurban road pricing: evidence from modelling</i> .....	75
3.3.3 <i>Interurban road pricing: evidence from practical experience</i> .....	82
3.3.4 <i>Inland waterways and maritime transport</i> .....	84
3.4 REVENUE USE .....	87
3.4.1 <i>Overall summary of state of the art</i> .....	87
3.4.2 <i>Various approaches to the problem of pricing and investments for a transport infrastructure</i> ...	88
3.4.3 <i>Evidence from research about the impacts of alternative uses of revenues</i> .....	90
3.4.4 <i>Current practice of revenue recycling schemes</i> .....	95
3.5 ACCEPTABILITY .....	98
3.5.1 <i>Road</i> .....	99
3.5.2 <i>Rail</i> .....	101
3.5.3 <i>Air</i> .....	102
3.5.4 <i>Water</i> .....	103
<b>4. MAIN TOPICS FOR DISCUSSION IN THE EXPERT GROUPS</b> .....	<b>105</b>
4.1 INTERURBAN ROAD TRANSPORT .....	105
4.2 RAIL .....	106
4.3 INLAND WATERWAYS AND MARITIME TRANSPORT .....	108
4.3.1 <i>Introduction</i> .....	108
4.3.2 <i>Maritime transport</i> .....	109
4.3.3 <i>Inland waterways</i> .....	111
4.4 AIR TRANSPORT .....	112
4.5 REVENUE USE .....	114
<b>5. REFERENCES</b> .....	<b>116</b>

## Executive summary

In the EU consensus has been widely achieved on the need to introduce or/and reinforce the principle and the practice of cost-based transport charges. Pricing of transport infrastructure use has been identified since the Green Paper of 1995 on fair and efficient pricing (EC, 1995) as a pillar of the strategy towards a more sustainable transport system. Much has since then happened over a relatively short period of time, and visible progress has been made both in the scientific area and in the policy making realm. This report provides an updated summary of the current state of play and identifies the main issues still open for debate, thus setting the scene for the IMPRINT-NET Expert Groups to further develop the discussion and seek consensus at the EU level.

On the **policy making** side, the Green Paper has been followed by the White Paper of 1998 on the fair payment for infrastructure use (EC, 1998) and the White Paper of 2001 on the European Transport Policy till 2010 (EC, 2001a). Since the publication of the 1998 White Paper, the EC started to implement these principles at a modal level through legislation. The process has been slow, and the few directives issued find difficulties in being translated into national laws by Member States mostly because at the national level the principle of social marginal cost pricing is not smoothly accepted (Laird et al., 2004).

Pricing reforms are still hindered by the existence of specific, critical gaps in the available body of knowledge, and by the insufficient level of consensus currently achieved within the transport community of stakeholders.

The state of advancement of research and policy making on the issue of a more fair and efficient pricing system is uneven between modes: this implies that a differentiated approach has to be taken for rail/road and air/maritime. In particular, for road and rail transport there is a need to move the focus from the first stages of an implementation pathway (i.e. establishing a theoretical framework, improving valuation methodologies for impacts, costs, effects) to the more mature stages of designing and implementing policies, and assessing the impacts. Consensus achieved around the former IMPRINT-EUROPE has to be consolidated (and remaining uncertainties accounted for) and information about the latter has to be exchanged and elaborated. For air and waterborne transport, notably owing to their structural complexity, there is instead the need of furthering the discussion around the theoretical framework, the implementation pathways etc., since the state of the art for these two modes is lagging somewhat behind.

The **valuation of social external costs** is a fundamental input to the process of price setting. Extensive research has been carried out in this area - both at European and national level - showing that methodologies and tools are available to calculate external cost values with acceptable accuracy levels, although the maturity of the methodologies still varies between modes and cost categories. Infrastructure costs and scarcity costs are still under-researched areas on which research efforts are lately converging.

Effectiveness, feasibility and cost-effectiveness are the critical features when it comes to **tariff setting**. In the road sector, kilometre-based charges are considered to be the most effective tool to allow for both charging as close as possible to the point of use and for differentiation of charges. Such a system enables rational decisions to be taken by individuals and firms, informed by price signals of the full costs of their travel demands, to determine traffic levels and trends in transport demand. In Europe, outstanding experiences have been carried out in Switzerland (heavy vehicles fee), in Germany (heavy goods vehicles fee) and in Austria. Other Member States have toll motorways, set largely on cost recovery principles. At the present time, European Legislation (the 1999 Eurovignette Directive) still requires that

time or distance based supplementary charges are confined to motorways and to the average cost of providing and maintaining the infrastructure. Although proposals exist to amend this to allow for charges on all roads, and for greater differentiation according to external costs, the amendment would still tie the average level of charge to average infrastructure cost (i.e. excluding externalities). Agreement on this compromise measure has just been reached. In the rail sector, a variety of approaches exists on charging for congestion and scarcity in rail track access in Europe. For historical and legal reasons, until now specific charges related to external costs have not been imposed on inland shipping and maritime transport (with the exception of Sweden for maritime transport).

In **new Member States**, radical changes happened in the transport sector in the past fifteen years, both in terms of organisations and institutions. The reforms had positive impacts on technical modernisation and infrastructure development, with however negative drawbacks such as a lack of transparency of roles and responsibilities on the decision level and changes in the balance between modes leading to a dominating role of road transport. Environmental concerns are gradually entering the decision making process, although with different paces in the various countries, according to specific national conditions.

Only recently research turned its attention to **assessing the impacts** of the introduction of marginal social cost based charges in the transport sector and in the wider economic system. Among these studies, this report concentrates on the EU funded projects IASON, MC-ICAM and SPECTRUM and on a study carried out by ECMT (ECMT, 2003).

Practical experience suggests that heavy goods vehicle charging can have significant effects on the types of vehicles selected and the way they are used. There is however no real evidence of the impact of charges on mode split, although in the case of the longest lived of these systems, the Swiss, that is not surprising since the impact of charges was offset by permitting heavier vehicles. The modelling exercises suggest that efficient pricing would have a significant, though small impact on mode split. The overall welfare impacts are found to be highly positive in all studies.

Research on the impacts of transport pricing reforms based on social marginal cost has produced abundant evidence consistently indicating that the implementation of reforms will generate effects unevenly distributed across modes and countries. The EC is turning a growing attention to the issue of the **use of revenues**, i.e. how the government that receives the money should best transfer back the benefits to the community: both research and experience show that alternative ways of spending revenues are likely to have significant effects on the efficiency of the scheme itself, on income distribution (between groups, between regions, etc.) and on public acceptance. The debate on the use of revenues assumes relevance in a context where the EU and Member States are facing both pressing infrastructure investment financial requirements (see e.g. TEN-T and TEN-E) and stringent budget constraints. The findings of the REVENUE interurban case studies are highly case-specific: it clearly appears that to draw more general conclusions, a stronger body of comparable case studies is needed. The applicability of the results to policy formulation and implementation is limited by the fact that they are derived from theoretical models whose assumptions are not necessarily holding in the real world.

In addition to the expected impacts on national budgets both in terms of structure of taxes and of level of budget, implementing pricing reforms and deciding on the utilisation of possible revenues (as well as on how to cover possible deficits) raises fundamental institutional questions as to who bears these responsibilities, and how coordination could best be ensured should these responsibilities not reside with the same institutions. The impacts on the efficiency of decentralising investment decision making to lower levels of government, agencies and private firms are a key issue here.

Plans to apply the pricing principles to the transport sector have typically faced serious doubts and strong opposition. The arguments against generalised transport charging range from technological and institutional problems to political and acceptability related problems. Evidence from recent studies and experiments suggests that acceptability is not static and is largely dependent on several factors. In general, **acceptability** should be further investigated by questioning "*acceptability of what, through whom and under which conditions and circumstances*". Along these lines, this report provides a summary of the main acceptability implications by mode of transport.

# 1. Background and objectives of the Deliverable

Pricing of transport infrastructure use has been identified by the 2001 White Paper as one of the pillars of the Common Transport Policy, notably on the grounds that it can contribute decisively to all dimensions of sustainability, by:

- ⇒ generating welfare gains through a more efficient use of the European transport networks (optimal use of capacity);
- ⇒ orienting travel demand towards more sustainable choices (of mode, time of travel, etc), in order to reduce environmental damages and, more generally, the costs imposed by the transport sector on society as a whole;
- ⇒ mobilising the financial resources required to sustain economic growth (e.g. to develop the TEN-T).

Devising and implementing pricing reforms that will actually deliver these benefits requires the improvement and enhancement of the currently available body of scientific and practical knowledge (economic theory, costs and impact evaluation, acceptability constraints, etc.). It further requires that this knowledge is effectively passed on to the policy makers to allow them translate it into the formulation and implementation of the advocated policies: the economic theory that drives the formulation of pricing reforms is complex, and must be put forward to policy makers and citizens in such a way that it is clearly understood and perceived as convincing.

Over the past decade, a large number of transport pricing research projects have been developed, mostly within the EU RTD Framework Programmes. Starting with the definition of pricing principles (TRENEN) and the estimation of costs (QUITS, PETS, EXTERNE-Transport), research then moved on to analyse methodological and practical issues associated to the implementation of pricing policies, including (i) the identification of policy packages and the assessment of phased approaches favouring the introduction of pricing reforms (AFFORD, MC-ICAM), (ii) the appraisal of acceptability barriers (PATS, PRIMA), (iii) the development and evaluation of real life demonstrators (PROGRESS, CUPID, DESIRE), and the identification of optimal approaches to revenue usage (REVENUE). UNITE and RECORDIT provided major contributions to the development of a comprehensive body of knowledge supporting the formulation of pricing policies, notably through the design and pilot development of integrated transport accounts and through the substantial enhancement of the reference datasets in the area of marginal costs of transport infrastructure use.

The project GRACE builds upon the research carried out in UNITE, and aims at providing new evidence on the costs of transport infrastructure use for all modes of transport (wear and tear, congestion, accidents and environmental), as well as impacts of charging these costs to users. Understanding of how these costs vary with circumstances will be improved, and the role of transport accounts in helping to measure and monitor them further explored. Modelling of the consequences of charging users these costs will concentrate on regional and equity issues as well as economic efficiency.

Ever since the 1995 Green Paper (EC, 1995), EU policy orientations have played a major role in steering pricing research: the 1998 White Paper (EC, 1998) and the reports of the High Level Group on infrastructure charging (HLG, 1999a to 1999g) made a clear case for the adoption of marginal social costs as the basic principle driving pricing reforms, while the 2001 White Paper (EC, 2001a) looked at pricing instruments in the broader context of the Common Transport Policy, highlighting the important role that pricing reforms can play on the road to safer and more sustainable mobility. The link with sectoral and macroeconomic

performances, and with financial constraints, transpires even more explicitly in the recent proposal for a Directive (EC, 2003) aimed at the revision of the Eurovignette, where the potential contribution of transport pricing to the funding of the TEN-T is forcefully put forward, with tariff setting explicitly geared to the latter. Other important directives have also been proposed or adopted (the Railway package, the Interoperability Directive) that bear immediate relevance to the progress of pricing research.

Much has therefore happened over a relatively short period of time, and visible progress has been made both in the scientific area and in the policy making realm. However, pricing reforms are still hindered by the existence of specific, critical gaps in the available body of knowledge, and by the insufficient level of consensus currently achieved within the transport community of stakeholders.

Before IMPRINT-NET, the CAPRI Concerted Action in the 4<sup>th</sup> Framework Programme RTD (CAPRI, 2001) and the IMPRINT-EUROPE Thematic Network in the 5<sup>th</sup> Framework Programme RTD have provided concrete contributions to the dissemination of research results and to the improvement of communication within the community of transport stakeholders.

The state of advancement of research and policy making on the issue of a more fair and efficient pricing system is uneven between modes: this implies that a differentiated approach has to be taken for rail/road and air/maritime. In particular, for road and rail transport there is a need of moving the focus from the first stages of an implementation pathway (i.e. establishing a theoretical framework, improving valuation methodologies for impacts, costs, effects) to the more mature stages of designing and implementing a policy, and assessing the impacts. Consensus achieved around the former IMPRINT-EUROPE has to be consolidated (and remaining uncertainties accounted for) and information about the latter has to be exchanged and elaborated. For air and waterborne transport, notably owing to their structural complexity, there is instead the need of furthering the discussion around the theoretical framework, the implementation pathways etc., since the state of the art for these two modes is lagging somewhat behind.

## **2. Policy background**

### **2.1 Latest EU policy developments**

The key messages of the EC infrastructure charging policy emerge from the latest policy documents, as well as from the directives and proposals for directives issued with the aim of implementing them. The framework stems from the Green Paper of 1995 on fair and efficient pricing (EC, 1995), the White Paper of 1998 on the fair payment for infrastructure use (EC, 1998) and the White Paper of 2001 on the European Transport Policy till 2010 (EC, 2001a).

The EC policy is based on the “user pays” concept. In a European Union where pricing practices are to a great extent not related to the cost of use and vary from country to country in terms of structure, level and objectives, the EC promotes a radical change: prices should vary according to the levels of environmental, safety and congestion burdens imposed and of infrastructure damage caused. The transport user has to bear these costs, which would otherwise (and unfairly) be borne by the society as a whole.

The new charging regimes must provide the necessary incentives to promote a more efficient use of infrastructure, to reduce congestion and pollution, to re-balance the modal split and to decouple transport growth from economic growth. Pricing must also ensure an adequate level

of revenue raising, both in connection with EU and Member States infrastructure investment policies and with the role of public-private partnership in infrastructure managing.

The 1998 White Paper identifies *marginal social costs* (including external costs) as the fair and efficient pricing principle. It is however recognised, also in the following policy papers, that in some cases it may be appropriate to depart from marginal social costs, when cost recovery requirements are stringent. Pricing reforms must ensure that no discrimination between operators and between modes happens: “Whether for airports, ports, roads, railways or waterways, the price for using infrastructure should vary in the same manner according to category of infrastructure used, time of day, distance, size and weight of vehicle, and any other factor that affects congestion and damages the infrastructure or the environment.” (EC, 2001a).

Since the publication of the 1998 White Paper, the EC started a legislative process to implement these principles at a modal level through legislation. The process has been slow, and the few directives issued find difficulties in being translated into national laws by Member States because at a national level the principle of social marginal cost pricing is not smoothly accepted (Laird et al., 2004).

On road transport, two directives have been issued in relation to charging and to promoting competition in the road freight sector (heavy goods vehicles), that is the Eurovignette directive (1999/62/EC) and a proposal for amending this directive issued by the European Commission in 2003 (EC, 2003). The Eurovignette as modified in 1999, which applies to vehicles weighing 12 or more tonnes, is limited to motorways, based on duration of use and related to infrastructure costs and not also to external costs. The 2003 proposal extends the coverage to the TEN network and to other roads to which traffic might divert and to heavy goods vehicles (HGV) weighing over 3.5 tonnes. Differentiation factors should be distance travelled, location, infrastructure type and speed, the vehicle type (axle weight, engine type, energy source, emission standards), time of day and specific routes (EC, 2003). The proposal also extends the cost basis including some categories of external costs, namely the infrastructure and the uncovered accident costs (i.e. external cost of accidents minus insurance premiums). Earmarking of revenues to the transport sector is explicitly required. A compromise version of this proposal has been argued between the Council of Ministers and the European parliament.

The rail sector underwent a complex reform process towards the liberalisation of the sector, opening access to international traffic, the integration of the system at a EU level and the introduction of criteria for the efficient management of infrastructure, started in 1991 with Directive 91/440, through the Directives issued in 2001 (Directive 2001/12, Directive 2001/13, Directive 2001/14, Directive 2001/16) and the recent Second Railway Package (2004). Directive 2001/14, in accordance with the general principles, applies to the entire network and sets the framework conditions for capacity allocation and management, as well as the tariff structure for the use of the network. According to the directive, “charges for the minimum access package and track access to service facilities shall be set at the cost that is directly incurred as a result of operating the train service”. This charge can be modified to reflect scarcity and environmental concerns. A Member State *may* impose mark-ups with the aim of obtaining full recovery of the costs incurred by the infrastructure manager, provided that market conditions are suitable to this, that competitiveness in particular of international rail freight is guaranteed and on an efficient, transparent and non-discriminatory basis.

In the air transport sector, a proposal for a directive on airport charges dating back to 1997 has been abandoned. The proposal suggested mandatory cost-related charging schemes and environmental based differentiation of charges. A proposal for a directive on noise charging at airports issued in 2001 is also still dormant.

In a recent Commission Staff working document on Airport capacity, efficiency and safety in Europe (EC, 2005), which is still in the stakeholders consultation phase, the EC seems to favour the issue of a proposal for a directive (possibly in the framework of a more general communication on Infrastructure Pricing) focusing on airport charges. Charging policy, according to this document, could play a role at various levels, such as:

- ⇒ encouraging the shift towards rail alternatives for short haul, for instance by allowing airport operators to apply higher charges to short haul flights, when competitive rail link alternatives exist;
- ⇒ including environmental concerns allowing for the differentiation of airport charges according to environmental performance;
- ⇒ contributing to the financing of large scale airport extension and refurbishment projects through a specific user charge (applicable to aviation users of the airport);
- ⇒ moving traffic towards secondary airports to alleviate congestion allowing for the modulation of airport charges; secondary airports may benefit from the introduction of congestion charges at bottlenecks of the system.

## 2.2 Latest MS policy developments

### 2.2.1 Policy developments in EU-15

The implementation of EU transport policy at a national level has been a slow process, with different paces according to modes.

In the **road sector**, HGV kilometre based charging proposals have already been implemented in Switzerland (a non-EU state), which introduced in 2001 a Heavy Vehicle Fee on the entire Swiss public road network, applying to both Swiss and foreign vehicles weighing over 3.5 tonnes.

The German HGV charge has been introduced at the beginning of 2005, applying to all lorries exceeding 12 tonnes gross weight. The tax is calculated based on the vehicle's environmental status (engine emission levels) and the number of axles.

The Austrian charge came into force on January 2004. It covers the whole network of Austrian motorways and expressways and applies to all vehicles exceeding 3.5 tonnes. It is based on the distance travelled and the number of axles. Chapter 3.2.1 describes more extensively these experiences.

In the **rail sector**, the directives on infrastructure charging had a different pace of implementation. Table 2.1, drawn from the final report of the ERAIL project (ERAILE, 2005), gives an overview of the state of the art of the implementation of EU railways the EU-15.

**Table 2.1 Assessment of individual countries' implementation of the EU railways directives**

Country	Features
Austria	⇒ Railway Infrastructure Package has been transposed. However, entry barriers to Austrian market remain, e.g. in terms of extensive safety regulatory procedures. Limited competition in freight with passenger services being almost exclusively provided by ÖBB.

Country	Features
Belgium	⇒ Until recently limited reform in Belgium. In 2005 creation of new organisation for infrastructure (Infrabel). Limited market opening despite formal transposition of the Railway Infrastructure Package.
Denmark	⇒ Substantial reforms have been undertaken. Railway Infrastructure Package has been transposed together with the 2001 Interoperability Directive. Reforms of public institutions. Full separation of infrastructure and operations. Market entry for both passenger and freight operations. In the case of passenger through tender of contracts for regional services.
Finland	⇒ Finland has transposed the Railway Infrastructure Package. However, VR Group Ltd. is still the only licensed railway undertaking.
France	⇒ Despite the transposition of the Railway Infrastructure Package barriers to access to the French market remain high such that SNCF is largely in a monopoly position
Germany	⇒ Substantial reforms for the German railway market with open access for freight and long-distance passenger operations, along with possibility for controlled competition in the short distance passenger market. DB AG a holding company with separate divisions for infrastructure and transport operations. Potential problem of dominant position of DB AG. Germany has not yet notified the EU about transposition of Railway Infrastructure Package.
Greece	⇒ Reform of the Greek railway market has been limited. The market is dominated by OSE where only separation of accounts has been adopted. In March 2005 a communication by Greece of the implementation measures for the Railway Infrastructure Package Directives.
Ireland	⇒ Ireland has recently transposed the Railway Infrastructure Package (some derogations apply) and the Interoperability Directive for conventional trains. However, in practice market opening has not resulted in new entry and Irish Rail retains a monopoly; special characteristics of Irish Rail Market (island location, small network, technical circumstances). Only limited separation between infrastructure and operations.
Italy	⇒ In recent years progress towards market opening, though certain entry barriers remain, e.g. safety certification and rolling stock approval. Infrastructure manager (RFI) though part of the holding Ferrovie dello Stato (FS). Transposition of the Railway Infrastructure.
Luxembourg	⇒ Luxembourg has satisfied certain minimum requirements regarding market opening and as a result CFL is still in a dominant position. Further legal steps against Luxembourg were announced in March 2005 for failure to communicate national implementation measures for the Railway Infrastructure Package Directives.
The Netherlands	⇒ The Netherlands has adopted a number of railway reforms since the mid-90's. Most elements of the Railway Infrastructure Package have been established though without full implementation in place. In December 2004 a court case against the Netherlands was launched for incomplete transposition. The Commission asks the Netherlands to fully implement legislation opening international rail freight. Subsequently, in April 2005 the Netherlands provided information to the Commission about the implementation measures for the three Directives in the package.
Portugal	⇒ Recently, substantial reform regarding market opening. Problems though regarding transparency for approval of rolling stock. Separation of operations and infrastructure management. Portugal has transposed the Railway Infrastructure Package
Spain	⇒ RENFE retains a monopoly in the Spanish railway market. Organisational separation of infrastructure and operations was finally implemented in 2005 with

Country	Features
Sweden	<p>the creation of an infrastructure manager. The Railway Infrastructure Package has now been transposed but at present there is a court case against Spain under way for non-compliance of national measures.</p> <p>⇒ Sweden was one of the first countries to initiate the liberalisation of railways. Full separation between infrastructure and operations. In 2004, the Railway Infrastructure Package Directives were transposed.</p>
United Kingdom	<p>⇒ Great Britain has been one of leading reformers of railways in Europe regarding market opening, competition and separation of infrastructure and operations. Many of the elements of the Railway Infrastructure Package are in practice implemented, but formal transposition is presently lacking.</p> <p>[Northern Ireland]: different framework from rest of Great Britain with one single integrated railway company in public ownership.</p>

Source: adapted from ERAIL (2005)

## 2.2.2 Policy developments in new Member States

### 2.2.2.1 Short historic overview of transition period

The process of integration with the EU and introduction of the *acquis communautaire* involved a variety of dimensions in the former socialist countries: economy, regulation, legislation, political systems and institutions. In the CEEC the first phase of transition started by 1990 and practically consisted in reforms leading to economic stabilisation, liberalisation, partial institutional reforms and privatisations. After this first phase, in several countries (mainly Slovakia, Poland, Hungary) a second generation of reforms were initiated, aimed at re-tailoring the welfare system, privatising network industries, reforming the pension system to address the inter-generational implicit debt, as well as administrative reform. However, the implementation of structural reforms underwent a slow down and were not completed (e.g. privatisation in the transport sector). The main reasons are the political risks and their unpopular attributions.

Hungary was among the countries having a primary role during transition as front runner in structural reforms. The Hungarian case is here described in terms of its recent policy, institutional and legislative developments.

Transport networks are the property of the Hungarian state. The construction, operation, and maintenance of facilities are government functions regulated by law, and overwhelmingly financed from central and local budgets. Before the start up of the transition process in 1989, the government applied the “leftover principle” (from the state budget, after allocating the needed sources for management tasks, the remained sources were allocated for improvement and development tasks), which was insufficient to finance infrastructure developments required by a continuously growing demand. In order to fit all criteria of the sustainable transport system, it was/is necessary to invite private capital into financing the transport sector. For this reason several laws and regulations were introduced related to transport sector creating the possibility for involving private capital into transport infrastructure development. Hungary had a pioneer role in this context in CEEC, and after a couple of years the country could implement two concessions for motorway projects. Despite problems which happened at a later stage in the implementation of the projects, the motorways were constructed and opened for the public. The government is gradually assuming a new role: from “owner” to “regulator”. This process started with the privatisation of several entitlements and

management functions formerly attributed to the government. In the last few years even more fields of transport sector were affected by the privatisation process. After joining the European Union, transport markets are partly liberalised and opened to foreign operators from other Member States: this exposes national players in the transport market to a growing competition. In this situation, the role of the government as a regulator in order to create a proper legal framework assumes a fundamental importance.

One of the outstanding reforms in the transport sector at the outset of transition was the creation of a ministry with competencies on transport: until the first free elections in 1990 after the communist era, transport-related issues were assigned to various ministries. From that moment on, transport issues were dealt with by the Ministry for Transport, Communication and Water Management (KHVM). In 1998 the structure was modified into the Ministry for Transport and Water Management (KöViM). In 2002 a further institutional change created the Ministry for Economy and Transport (GKM) which has remained as such so far.

During the first years of the transition period, the ministry had the role of establishing the proper legal environment for later privatizations and public-private co-operation objectives, and for the establishment of new institutions, organisations and companies. At more mature stages of transition, when the most important laws were already been prepared and approved by the Parliament, it started its role of regulator. Tánczos et al. (1998) highlighted that the role of decision makers in ensuring supply or in control over quantities decreased substantially, while it strengthened in the area of control and management of competition and in the area of emerging environmental and social interests.

### ***2.2.2.2 Aims of transport policy***

The transport policy setting in various new Member States and the changes of the Polish transport policy has been extensively dealt with in Bak (2003). Strong political and social barriers have been found in this analysis concerning acceptance of charging reforms as well as insufficient assistance from the EU on how to implement them. The barriers identified can be summarised as follows:

- ⇒ lack of information – insufficient data collection on costs;
- ⇒ remaining mentality and social acceptance;
- ⇒ transitional ideological chaos, as in transport policies as well;
- ⇒ financial resources – high costs of implementing and applying the new concepts.

In CEEC the finalisation of structural reform and achievement of desired gains is progressed due to the expected completion of the transition process, the higher rate of GDP growth compared to the EU average level and successful adaptation and implementation of existing experiences from the EU (transfer of knowledge). Realising some practical economic benefits from the EU integration process can speed-up the transition process and abolish existing barriers to implementation of new policies. Guidelines can be also proper tools for improving the effectiveness of changes.

The national transport policies of CEEC are in harmony with the Common Transportation Policy of the European Union, but they have special objectives. For instance the transport sector in Hungary is lagging behind EU-15: the density of motorways is one-third of EU-15 average, the passenger car fleet is one-half and the backlog in the quality of the services is also considerable. Against this background, the aim of the Hungarian Transport Policy (2004) is the creation of an economically efficient, up-to-date, safe transportation system that meets

the demands of the society and less harms the environment, and certainly falling into the line with the EU-15. Priorities of this strategy are recovering infrastructural gap, conservation of the environmental, economical and social equilibrium, influencing the joint effects of the increasing mobility demand, quality level and traffic safety. With regards to tariff setting one of the main strategic directions is creating the conditions of the efficient operation and maintenance of transport system with the aid of regulated competition. Different ways have to be chosen in setting tariff systems in different areas of transport (e.g. public transport, interurban transport).

**2.2.2.3 Methods and barriers for implementation and application**

Political consensus is a critical factor for successfully implementing the transport policy measures. However, the structural and regulatory changes in the transport sector still encounter sometimes constraints and shortcomings. Uncertainty at the decision making level is therefore still a feature in some new Member States, when transparency in rights and attribution of responsibilities is not ensured.

The case of the Hungarian ministry for transport can be seen as a paradigm of how institutional settings and administrative procedures can hinder an effective implementation of transport policies.

A feature of Hungarian administration is the lack of continuity of concepts and objectives between one government to another. The structural change of the Hungarian transport ministry was undertaken without a preliminary study of the reallocation of tasks and responsibilities. The organisational and operational procedures of the ministry primarily in the economic-financial and regulatory areas changed 11 times in the latest 15 years: this implied discontinuity of the work, difficult communication between the organisational units and co-ordination and imposed an extra burden to the administration.

Despite all this, the increased efficiency at ministerial level is tangible: in the last years the workload per capita tripled, and external experts have been more and more involved into the regulatory process. Their involvement has been related to operational tasks, while the strategic decision making remained in the hands of the ministry.

By the end of 2002 the ministry had a state share of EUR 79 million. The ministry had a share of EUR 16 million in 27 companies funded by it and another EUR 63 million in 31 public companies. The professional background for ensuring the representation of the proprietary rights and recording the assets in the form of shares was insured.

In case of the road sector the national decision-makers have considerable independency compared to the rail sector. Namely, there are strict EU railway regulations which had to be adopted by the member states in the framework of market liberalisation.

Table 2.2 below summarises the state of the implementation of the EU directives in the new Member States.

**Table 2.2 Assessment of individual countries’ implementation of the EU railways directives**

Country	Features
Cyprus	⇒ -

Country	Features
Czech Republic	⇒ Significant reform effort to adopt legislation to the Railway <i>acquis</i> . Railway Infrastructure Package has been transposed. New entrants have emerged on the railway market, mainly freight operators, though limited market share compared to incumbent.
Estonia	⇒ Railway network consists of two part networks in private ownership, both companies also provide transport services with only separate accounting. Some entry barriers for other railway undertakings. Implementation measures for the Railway Infrastructure Package were communicated to the Commission in November 2004.
Hungary	⇒ Limited competition in the Hungarian railway market. The market is dominated by two railway undertakings operating services on separate networks. Implementation measures for the Railway Infrastructure Package were communicated to the Commission in November 2004.
Latvia	⇒ Restructuring of the railway sector in progress and market entry is starting. Implementation measures for the Railway Infrastructure Package were communicated to the Commission in November 2004.
Lithuania	⇒ Significant development of railway sector underway. No separation of infrastructure and operations (apart from accounting). No competition in the market as yet. Implementation measures for the Railway Infrastructure Package were communicated to the Commission in November 2004.
Malta	⇒ -
Poland	⇒ Significant reform of the railway system in Poland. A number of external railway undertakings operate in the market. Implementation measures for the Railway Infrastructure Package were communicated to the Commission in November 2004.
Slovakia	⇒ Significant restructuring of railway system. However, certain constraints regarding access and licensing conditions. In practice no competition in the market. Implementation measures for the Railway Infrastructure Package were communicated to the Commission in April 2005.
Slovenia	⇒ Some steps towards liberalisation. Limited competition in the market. Implementation measures for the Railway Infrastructure Package were communicated to the Commission in November 2004.

Source: adapted from ERAIL (2005)

#### 2.2.2.4 Lessons from existing knowledge

In the past years the transition and integration process in the new Member States has speeded up considerably. In the transport sector, this led to increasing road traffic volumes, but in parallel a deterioration of traffic conditions and growing needs of financial resources. The implementation of the *acquis communautaire* in countries significantly differing from EU-15 drove several changes in the national transport policies.

A wide analysis of the transport policies in the new Member States is carried out in the SPECTRUM project (Timms et al., 2005), and is briefly summarised here.

Radical changes happened in the transport sector in the past fifteen years in the CEEC and Baltic States, in terms of organisations and institutions. The reform process in the transport sector focused on the liberalisation of the transport market. The reforms had positive impacts on technical modernisation and infrastructure development, although having negative drawbacks such as lack of transparency of roles and responsibilities on the decision level and

changes in the balance between modes leading to a dominating role of road transport. Environmental concerns are gradually entering the decision making process, although with different paces in the various countries according to specific national conditions. In the rail sector, liberalisation is still an ongoing process: legal aspects are often a barrier difficult to overcome to the application of efficient solutions. In addition, the financial, technological, social aspects of reforms are at the stake, and the planned rail regulations will have to cope with all these aspects. The dimension of the EU financial contributions in the next years will be a critical factor in the effectiveness and speed of this process.

Apart from few countries, strong constraints are imposed on new Member States by the perspective of fulfilling the Maastricht criteria. This latter factor and the experiences of structural reform in the transport sector highlight the primary role of trans-governmental strategic planning in the transport sector, which is an asset to be reinforced in the practices of new Member States.

The degree of transferability of policy instruments from EU-15 to New Member States and candidate countries is affected by the specific economic condition of the countries. Transferability was very low in the first years of transformation, when economic reforms were concentrated on eliminating the high inflation, changing the ownership structure (privatisation) as well as defeating economic recession. The scenario of new Member States and candidate countries, after about 15 years since the starting of the transformation process, is still varying sensibly from country to country. This has to be taken into account, and implies that transport policy must be planned in a country-specific way.

### **3. Review of recent research and experiences**

#### **3.1 Cost valuation**

In the EU consensus has been widely achieved on the need to introduce or/and reinforce the principle and the practice of cost-based charges. Short run marginal social costs are generally considered as the most appropriate starting point in the process of price setting and social external cost valuation is a fundamental input to such a process. Extensive research has been carried out in this area - both at European and national level - showing that methodologies and tools are available to calculate external cost values with acceptable accuracy levels, although the maturity of the methodologies still varies between modes and cost categories.

An overview of the state of the art of research in the field of the assessment of the main social costs categories related to the use of transport infrastructure is provided in this chapter. After an overall summary of the state of the art (Chapter 3.1.1), emphasis is given to research on infrastructure costs and scarcity costs, in consideration of the methodological questions still open concerning their appropriate evaluation. Accordingly, Chapters 3.1.2 and 3.1.3 focus specifically on these issues.

##### ***3.1.1 Overall summary of state of the art***

The strong orientation of the EU policy towards the adoption of the principle of marginal social costs for pricing reforms has played a major role in orienting research on external costs of transport. Previous estimates were often based on a top-down approach, which resulted in average costs value being used when allocating total external costs to the different modes and

vehicle categories. In order to estimate marginal costs, research has then turned to test and implement bottom-up methods, in particular econometric methods and engineering methods.

Econometric methods derive cost functions and then marginal cost estimates on the basis of detailed cost databases. As an alternative, engineering methods can be implemented as the starting point for economic valuation: ‘physical functions’ are derived from detailed databases of physical data, and an economic evaluation of cost functions and marginal costs follows. This is the approach followed to calculate for instance marginal accident costs. This is also the basic principle underlying methods - such as the Impact Pathway Approach (IPA) – currently used to evaluate environmental costs.

Both methods are demanding in terms of data, as they require extremely disaggregated databases: since detailed databases of physical data are more often available than economic data, engineering approaches are often preferred.

The recent study carried out by ECORYS and Mettle about charging and pricing in the area of inland waterways (ECORYS and Mettle, 2005) adopts a *cost-allocation* approach, considering that both the econometric and the engineering approaches entails severe problems of data availability in their application to inland waterways. Although this method also has drawbacks (thorough analysis of the available data, need for continuous interaction with the organisation providing data and a certain degree of arbitrariness in certain passages of the allocation process), the authors maintain that that the methodological approach of cost-allocation to determine the marginal costs of inland waterways could potentially be generalised to the whole sector. A necessary pre-requisite is, however, the introduction of a common cost accounting method (including methods, allocation to inland shipping vs. for example flood protection, water management etc., fixed vs. variable costs, etc.).

In addition to econometric and planning models, Lindberg (2003) also quotes planning models such as Highway Development and Management System (HDM)<sup>1</sup>. These models are used in a number of Central Eastern European countries as a decision support system for policy makers, allowing forecasts of the economic, technical, social and environmental outcomes of possible investment decisions concerning the road sector. These models could also be used to derive marginal costs, although attention has to be paid to the choice of variables and proxies and to the interpretation of results (see Thomas, 2003, for more details on this issue).

The most recent studies providing estimates of marginal costs for various modes of transport are summarised below:

**“Charging and pricing in the area of inland waterways. Practical guideline for realistic transport pricing”. ECORYS and Mettle (2005).**

This study identifies the different elements that should be incorporated in a social marginal cost pricing scheme, namely infrastructure costs, safety and accident costs, congestion costs and environmental costs. It provides a methodological framework (on the basis of a cost-allocation method) for the estimation of these cost categories and applies it to a number of inland waterways case studies.

**“UNITE –Unification of Accounts and Marginal Costs for Transport Efficiency” (2004).** Lead Partner: ITS, Leeds, UK.

---

<sup>1</sup> HDM models are part of an international project started in 1993 and aimed at developing new road investment analysis tools. ISOHDM (International Study of Highway Development and Management Tools) is sponsored by the World Bank, the UK Department for International Development, the Asian Development Bank, the Swedish National Road Administration, and other sponsoring organisations, including PIARC member governments.

This project is part of the 5<sup>th</sup> Framework Project. Its main goal are to provide a comprehensive set of marginal cost estimates relevant to transport contexts around Europe and deliver a framework for integration of accounts and marginal costs, consistent with public finance economics and the role of transport charging in the European economy.

**“External Costs of Transport. Update Study”** INFRAS-IWW (2004).

Update of the previous study aimed at improving the empirical evidence on external costs of transport, based on state of the art methodologies. This study takes into account the results of the UNITE project.

**“TIPMAC - Transport Infrastructure and Policy: a macroeconomic analysis for the EU”** (2001-2003).

This EU funded project analysed the role of transport in macroeconomic development and employment, combining transport and macroeconomic modelling to quantify the indirect macroeconomic impacts of transport infrastructure investment (TEN-T) and transport pricing policies (e.g. marginal social cost pricing) in the EU. The models used are the SCENES transport network model which was linked to the E3ME macroeconomic model. The other used the ASTRA model to study similar scenarios. Within the project, a survey of available estimates of marginal costs has been carried out.

**“RECORDIT - Real Cost Reduction of Door-to-door Intermodal Transport – Deliverable 4”** (2001).

It provides a good assessment of the external costs on selected European corridors. The costs covered by the study are the external costs of rail and road along the corridors concerning the goods transportation. The studies compare the “inter-modal” and the “all road” solutions so that the corresponding set of values is available for both road and rail.

**“A study on the cost of transport in the European Union in order to estimate and assess the marginal costs of the use of transport”**. TRL, IWW, UFSIA, PTV AG, NEA (2001).

The study, commissioned by the EC DG-TREN, covers all the cost items, and provides ranges of estimates applicable to all modes of transport. Values are calculated for the whole European Union. It must be remarked the complete literature review reported in Volume 1 (Draft Final Report – July 2001).

**“External Costs of Transport”**. INFRAS-IWW (2000).

This study was carried for the International Union of Railways (UIC). It reports a full data set of average costs for all the European countries. The marginal costs are calculated separately and are not as much detailed as the average ones.

**“Revenues from Efficient Pricing: Evidence from the Member States”**. Edited by Dr. Rana Roy. London (2000)

This study, commissioned by UIC, CER and DG-TREN, seeks to estimate the flow of revenues that would follow from the efficient pricing of transport infrastructure in three EU Members States Germany, United Kingdom, France. Basically, it simulates with the aim of the TRENEN model, two scenarios: the 'actual' one and the optimal one, in which transport prices internalise the marginal external cost. This is carried out in different area types: agglomeration (e.g. London), other urban areas and non-urban areas.

**“ExternE – Externalities of Energy, Vol. 7: Methodology 1998 update”**. European Commission (1999).

This study provides marginal costs for air pollution coming from road traffic in six different Member State. The “Impact Path-way” methodology that analyses the sequence of events which links a 'burden' (e.g., the emission of pollutants) to a 'link' (e.g., impact on human health), is able to provide very detailed and site-specific marginal costs for air pollution impacts. ExternE findings are used in several studies, that want to estimate the marginal costs of air pollution from transport.

*Source: based on Maffii and Martino (2003)*

The following chapters have been prepared drawing mainly from Lindberg (2003), complemented by additional sources.

### Air pollution costs

Marginal environmental costs of transport vary considerably with (i) the technology of a vehicle, train, ship or aircraft and (ii) site (or route) characteristics. This makes a detailed bottom-up calculation the only option to assess costs with a reasonable degree of confidence.

Currently the most common approach to the calculation of environmental costs is the Impact Pathway Approach (IPA), originally developed in the ExternE project series [see e.g. European Commission (1999a), Friedrich and Bickel (2001)]. The IPA adopts the principle of estimating costs starting from the chain of events (physical changes) induced by the transport activity: the emission of a burden, its diffusion and chemical conversion in the environment, its impacts on the various receptors (humans, crops etc.). The impact is then ‘monetised’, i.e. valued in monetary terms. In other words, information is generated on three levels: i) the increase in burden, ii) the associated impact and iii) the monetary valuation of this impact. Within the UNITE project (see e.g. Bickel et al., 2003) the IPA has been extended to the quantification of noise impacts and applied to a number of case studies in Finland, Germany, Italy, and the Netherlands.

Table 3.1 and Table 3.2 illustrate the estimates of marginal costs obtained in the UNITE case studies. A full description of the studies, including considerations about comparability and generalisation of these results, is available in Bickel et al. (2003).

**Table 3.1 Overview of damage costs due to air pollution from road vehicle exhaust emissions in Eurocent/v-km**

		Car Petrol EURO2	Car Diesel EURO2	HGV Diesel EURO2
<b>Urban case studies</b>	Helsinki	0.12	n.a.	n.a.
	Stuttgart	0.25	1.45	17.52
	Berlin	0.15	0.73	10.19
	Florence <sup>a)</sup>	0.01 <sup>a)</sup>	0.26 <sup>a)</sup>	4.69 <sup>a)</sup>
<b>Interurban case studies</b>	Helsinki – Turku	n.a.	n.a.	2.09
	Basel – Karlsruhe	0.37	0.63	6.91
	Strasbourg – Neubrandenburg (outside built-up areas)	0.12	0.26	3.89
	Strasbourg – Neubrandenburg (within built-up areas)	0.11	0.38	7.46
	Milano - Chiasso	0.25 <sup>b)</sup>	1.91 <sup>b)</sup>	6.72 <sup>b)</sup>
	Bologna - Brennero	0.20 <sup>b)</sup>	0.73 <sup>b)</sup>	5.07 <sup>b)</sup>
<sup>a)</sup> Restricted comparability to other results, because estimate is based on a different methodological approach; only human health impacts on the local scale due to CO, Benzene and PM <sub>10</sub> considered (NO <sub>2</sub> , SO <sub>2</sub> , Ozone, NMVOC not included).				
<sup>b)</sup> Emission standard not specified				

Source: Bickel et al. (2003)

**Table 3.2 Comparison of damage costs due to PM<sub>2.5</sub> emissions of urban case studies**

Location	Population density (inh./km <sup>2</sup> )	Costs due to damages on the local scale in EUR/tonne of PM <sub>2.5</sub>	Costs due to damages on the regional scale in EUR/tonne of PM <sub>2.5</sub>
Helsinki	2,800	95,000	2,800

Location	Population density (inh./km <sup>2</sup> )	Costs due to damages on the local scale in EUR/tonne of PM <sub>2.5</sub>	Costs due to damages on the regional scale in EUR/tonne of PM <sub>2.5</sub>
Stuttgart	2,800	200,000	26,800
Berlin	3,800	90,000	17,500
Florence <sup>a)</sup>	4,100	50,000 <sup>a) b)</sup>	n.a.
<sup>a)</sup> Restricted comparability to other results, because estimate is based on a different methodological approach;			
<sup>b)</sup> EUR/t of PM <sub>10</sub> ; n.a. = not available			

Source: Bickel et al. (2003)

Other studies (e.g. WHO, 1999 and McCubbin and Delucchi, 1996) have also looked at the chain of environmental pollutant concentrations, human health impacts and monetary valuation. But in contrast to ExternE or UNITE, the pathway analysed did not include detailed modelling of vehicle emissions at specific locations, as the share of the transport sector was allocated "top-down".

Conclusions from UNITE (Bickel et al., 2003) underline that besides exhaust emissions, emissions due to fuel/electricity production processes are relevant and gain in importance with stricter emission standards for road vehicles. This process can in fact cause considerable environmental burdens depending on the energy mix being used for electricity generation. The impact pathway approach for air pollution has been applied to all modes e.g. in the projects ExternE (see e.g. Friedrich and Bickel, 2001), UNITE (see e.g. Bickel et al., 2003), and RECORDIT (see e.g. Schmid et al., 2001).

Emissions from shipping activities have also been measured in a series of studies commissioned by DG Environment [among others, Lloyd's Register (1999) and Entec UK Ltd (2002)].

For what concerns inland waterways, a recent study commissioned by the EC (ECORYS and Mettle, 2005) carries out estimations of marginal air pollution costs (as well as other cost categories) for a series of case studies. The methodology applied for the calculation of the *environmental costs*, including *noise*, is the impact pathway approach (see Friedrich and Bickel, 2001).

DG Environment has recently promoted in the framework of the CAFE Programme (Clean Air for Europe) the update of estimates of marginal external costs of air pollution in Europe (Holland et al., 2005). The study provides estimates of the damage caused to people and crops by the exposure to pollutants in various situations. Estimates are disaggregated by pollutant (NO<sub>x</sub>, SO<sub>2</sub>, PM<sub>2.5</sub>, VOCs and NH<sub>3</sub>), by country (EU25 excluding Cyprus), by different sea areas in Europe (North Sea, Baltic Sea, Atlantic, and Mediterranean) and by urban and rural environment. The study is based on the IPA methodology and source-receptor relationship are based on the work of Simpson and Wind (2005). The detailed results of the analysis can be found in Holland et al (2005).

In addition to EU funded research, various Member States have carried out estimations of marginal costs. Among them, the Swedish Institute for Transport and Communication (SIKA) publishes annually estimates of marginal costs for the freight transport market. A study by Nerhagen and Johansson compares SIKA estimates (calculated on the basis of the ASEK

method2) with ExternE estimates, revealing that major differences in the assessment of external environmental costs still exist (Nerhagen, 2003). Values can thus vary by as much as a factor 10, particularly for what concerns local effects, mainly owing to different approaches to exposure modelling. Further research has to be developed in this area.

### *Global warming*

The effects of climate change due to CO<sub>2</sub> emissions are one of the most important categories of fossil fuel emission related damages, but also amongst the most uncertain and controversial. The impacts of incremental climate change due to emissions from the European transport sector are global in nature, and they are expected to extend over many generations and a very wide range of resources and human activities. In general, the quantification of the effects of climate change is still affected by a considerable degree of uncertainty.

The most commonly used cost calculation method consists of multiplying the amount of CO<sub>2</sub> emitted by a cost factor. The level of the cost factor heavily depends on the objectives of the climate change policy and on strategies planned for their achievement.

INFRAS/IWW (2004) provides an overview of the shadow values found in literature for the costing of one tonne of CO<sub>2</sub> emitted (Table 3.3).

**Table 3.3 Overview of shadow values for CO<sub>2</sub> emissions for the transport sector for avoidance costs**

Study	Value
<b>Fahl</b>	
<i>Shadow value</i>	EUR 19 per tonne of CO <sub>2</sub> emitted (avoidance costs). This is equivalent to ca. 4.5 Eurocent per litre gasoline and ca. 5.2 Eurocent per litre diesel (Friedrich and Bickel, 2001)
<i>Scenario</i>	Meeting the Kyoto targets in Germany (Fahl et al. 1999)
<i>Source</i>	Fahl et al. (1999)
<b>Duerinck</b>	
<i>Shadow value</i>	EUR 25 per tonne of CO <sub>2</sub> emitted (avoidance cost). This value lies within a range of values of EUR 5 to EUR 38 per tonne of CO <sub>2</sub> avoided presented by Capros and Mantzos (2000). This is equivalent to ca. 4.6 Eurocent per litre gasoline and ca. 5.1 Eurocent per litre diesel (Friedrich and Bickel, 2001)
<i>Scenario</i>	Meeting the Kyoto targets in Belgium
<i>Source</i>	Duerinck et al. (1999)
<b>INFRAS/IWW</b>	
<i>Shadow value</i>	EUR 135 per tonne of CO <sub>2</sub> emitted, with a range of 70 up to EUR 200 calculated over a range of marginal abatement costs from different studies.
<i>Scenario</i>	Reduction target 50% in 2030 compared to 1990 (recommended by IPCC), which are more stringent reductions than the Kyoto aims are to reach sustainability.
<i>Source</i>	INFRAS/IWW (2000)
<b>Capros and Mantzos</b>	

<sup>2</sup> ASEK (*Arbetsgruppen för samhällsekonomiska kalkyler*) is a working group of Swedish representatives of all transport administrations. The group is in charge of taking decisions about practices and parameters to be used in the evaluation of investments.

Study	Value
<i>Shadow value</i>	EUR 38 per tonne of CO <sub>2</sub> emitted (1990 prices), without international emission trading.
<i>Scenario</i>	Meeting the Kyoto targets in EU.
<i>Source</i>	Capros and Mantzos (2000)
<b>Criqui and Viguier</b>	
<i>Shadow value</i>	US\$ 37 per tonne of CO <sub>2</sub> emitted. With international emission trading this amount could be reduced to ca. US\$ 14 per tonne of CO <sub>2</sub> .
<i>Scenario</i>	Meeting the Kyoto targets in EU.
<i>Source</i>	Criqui and Viguier 2000
<b>Commissariat Général du Plan (France)</b>	
<i>Shadow value</i>	EUR 27 per tonne of CO <sub>2</sub> emitted (avoidance costs)
<i>Scenario</i>	Meeting the Kyoto targets in France, by using clean development measures and emission trading. A shadow of EUR 41 per tonne of CO <sub>2</sub> emitted, when the Kyoto targets have to be met within the European Communities.
<i>Source</i>	Boiteux and Baumstark (2001)
<b>Krom et al. (ETSAP study)</b>	
<i>Shadow value</i>	The study shows for different countries shadow values: Belgium: 80 \$ per tonne of CO <sub>2</sub> Netherlands: 25 \$ per tonne of CO <sub>2</sub> Sweden: 170 \$ per tonne of CO <sub>2</sub> Switzerland: 160 \$ per tonne of CO <sub>2</sub>
<i>Scenario</i>	Prices 1996, abatement costs for reduction commitments in the Kyoto protocol
<i>Source</i>	ETSAP (1996)

*Source: INFRAS/IWW (2004)*

Valuation based on the damage cost approach (see for instance the ExternE project, Friedrich and Bickel, 2001), would result in substantially lower costs.

Due to the enormous uncertainties involved in the estimation process, such values have to be used very cautiously.

In the aviation sector, the Intergovernmental Panel on Climate Change reports provide a comprehensive assessment of the effects of aviation on the global atmosphere (see for instance IPCC 1999). All the aircrafts emissions into the atmosphere (gases and particles) are considered and their impact on chemical properties of the atmosphere, the formation of contrails and the radiative properties of the atmosphere (leading to climate change), and on the ozone layer (leading to changes in ultraviolet radiation reaching the Earth) are considered.

Carbon dioxide emissions (CO<sub>2</sub>), as well as water vapour (H<sub>2</sub>O), are generally easier to calculate as they are directly proportional to the amount of fuel burned. However, especially for gases with a long residence time in the atmosphere, economic valuation remains the subject of controversy in relation to the choice of the most appropriate discount rate. The evaluation of impacts on climate change of the emissions of nitrogen oxide (NO<sub>x</sub>) is more complex and uncertain, since it is indirect and passes through the impacts on ozone and methane<sup>3</sup>.

<sup>3</sup> The impact of NO<sub>x</sub> on ozone and methane goes in the opposite direction, but the variation of ozone on average does not compensate for that on methane, therefore the likely outcome of an increase of NO<sub>x</sub> is an increase in global warming.

The presence of condensation trails may also - according to IPPC - have an impact on climate change. However, owing to the high degree of uncertainty associated to their evaluation, these are usually not included in the valuation of impacts on climate change.

Evaluations of the emissions of en-route navigation and their impact on climate change can also be found in Dings et al. (2002) and in EUROCONTROL (Chesneau et al., 2003 and Fuller et al., 2004). In particular, the studies by EUROCONTROL focus on the appraisal of the *internal* (airline direct operating costs) and *external* (climate change) costs related to the "inefficiency" of ATM flight, measured as the difference between actual routes and theoretical optimal routes in terms of distance flown, duration of flight and fuel burned.

### *Congestion costs*

There is general consensus about the methodology to be used to estimate marginal congestion costs or benefits. Three basic steps are usually undertaken, each of which is associated to specific data requirements:

- ⇒ Determination of a volume-time relationship. This relationship is given by engineering speed-flow curves in inter-urban road transport, by model outputs in urban road transport and by regression analysis in rail and air transport.
- ⇒ The unit costs of time and other operating costs.
- ⇒ The price elasticity of demand: this is needed to determine the optimal level of congestion charge, as the imposition of a charge itself induces changes on the volume of traffic and on the level of congestion.

For road transport, extensive research on the required relationships exists; the main outstanding problem is that different models use different speed-flow relationships and therefore yield different results. Latest research increasingly recurs to detailed transportation modelling able to capture in a more refined way the possible directions of users' reactions (Lindberg, 2003). Among the more recent studies on this issue: UNITE project (Doll, 2002), the INFRAS/IWW study (INFRAS/IWW, 2004) and RECORDIT (2003).

For what concerns inland waterways, a recent study commissioned by the EC (ECORYS and Mettle, 2005) carries out estimations of marginal congestion costs (as well as other cost categories) for a series of case studies. The *congestion costs* are difficult to determine. They have rarely been estimated and in general are expected to be rather small, except in cases where a waterway has several locks and/or bridges. This study applies a 'waiting-time lock model' (previously developed by ECORYS) applied to two consecutive years in order to calculate an approximation of the marginal congestion costs.

### *Accident costs*

The methodology for the estimation of traffic accident costs is well established and includes the estimation of the risk of accidents and of both the material (including property damage, administrative costs, medical and hospital costs, net lost production and congestion caused) and non material (emotional and social costs of casualties resulting from transport accidents) costs (HLG 1999a, b).

Non-market estimation techniques such as Contingent Valuation Methods (CVM) are the most commonly used methods to assess the risk value: they allow to elicit the willingness to pay (WTP) of the users for a small reduction of risk (and hence the value of statistical life). Although the application of this method is the best available technique to date, Lindberg

reminds that specific methodological questions are still open concerning their use (Lindberg, 2003, quoting Beattie 1998 and Carthy, 1999).

The possibility to estimate the link between accident risk and traffic volume (risk elasticity) is limited by the poor availability of information on exposure to risk (e.g. distance travelled). Most studies carried out in this area suggest a decreasing trend of accident risk with respect to traffic volume (Lindberg, 2003)<sup>4</sup>.

Reference literature in this field includes the reports of the High Level Group on Infrastructure Charging (HLG, 1999a), the UNITE reports dealing with marginal accident costs (Bossche et al., 2000 and Lindberg, 2002) and the most recent update of the INFRAS-IWW study on the external costs of transport (INFRAS/IWW, 2004). Several national studies are also completed or undergoing.

The recent study about charging and pricing inland waterways transport (ECORYS and Mettle, 2005) calculates *safety and accident costs* on the basis of a risk elasticity approach. The main problem encountered is the one of data availability: data on the number and severity of accidents are not available on a detailed level for all countries, and where available are often not completely accurate. The available information shows that for most accidents the major cost drivers are damages to the infrastructure, vessel and perhaps cargo, but not to human health. An additional difficulty is that the percentage of these costs that are covered by the insurance premiums is not known. The study concludes that, however, safety and accident costs in inland waterways seem of minor importance with respect to the total transport performance,

#### *Noise costs*

The physical modelling of the noise phenomenon poses a number of challenges. In fact noise is a very local and short term phenomenon, and noise perception depends logarithmically on the existing noise level, while the willingness to pay for noise abatement increases exponentially with that same value of noise exposure. As a result, the marginal noise cost function may be decreasing or increasing depending on the noise levels considered acceptable (see on this argument the High Level Group report on calculating transport environmental costs, EC 1999b). The Impact Pathway Approach is the most common methodology used to estimate noise costs: exposure is first estimated (on the basis of spatially related data concerning the transport activities and population distribution), impact is then calculated through sound emission and propagation models, which also take into account existing background noise levels from other sources. Monetisation of costs through contingent valuation techniques to evaluate the costs of noise impacts is mainstreaming in EU research. Hedonic prices are also used, e.g. based on the preferences revealed by the real estate market, and yield cost values generally comparable to those obtained by direct CVM studies. The most critical issue concerning noise costs estimation remains the availability of data on exposure.

---

<sup>4</sup> Lindberg argues that possible reasons for the declining of risk with the increase in traffic volume are i) that an increased traffic volume implies reduced speeds, and as a consequence increased safety and ii) increased traffic volumes can induce risk-reducing behaviours of unprotected users such as using other routes or using cars instead of non-motorised modes (e.g. bicycles) (Lindberg 2003).

### 3.1.2 Infrastructure costs

At the margin, higher use of transport infrastructure results in an increase in wear and tear damage which implies associated costs of extra maintenance work and a bringing forward in time of renewal activity<sup>5</sup>. Results of studies for road and rail using both approaches are presented and key differences identified. This summary draws heavily on Link and Nilsson (2005), which provides additional details on the studies considered. There is a lack of evidence for air, maritime and inland waterway, although informed judgement is that wear and tear costs for these modes are close to zero.

Estimation of marginal costs can be characterised into two groups: top-down approaches and bottom-up approaches (Link and Nilsson, 2005). Top down approaches use data on costs of maintaining and/or renewing the infrastructure and estimate what proportion of these cost are variable with traffic. Two methods of doing this have been implemented in Europe: estimation of an infrastructure cost function using econometric techniques and cost allocation methods which allocate constituent parts of total cost to activities and then use engineering judgement to determine the variability of this cost to traffic. The econometric approach produces very disaggregate measures of marginal cost; it however requires data of sufficient quantity and quality to produce reliable estimates. The cost allocation method gives a measure of average variable cost which may differ from true marginal costs, and relies heavily on the judgement of engineers. However the approach is more easily undertaken and so is seen as a pragmatic alternative to estimating a cost function through econometric methods.

Bottom-up approaches rely on engineering models and judgement to determine the likely wear and tear impact of running an extra vehicle on each different component of the infrastructure network. Crucially, from the perspective of an economist, a cost is then assigned to the resulting added wear and tear and this is the marginal cost. In principle this method would give a true measure of marginal wear and tear cost, as unlike top-down approaches, these are based on the need for maintenance and renewal activity rather than actual historical activity which maybe distorted by e.g. budgetary constraints. However in practice the models can rely on many tenuous assumptions and may not cover all aspects of wear and tear costs [see for example ORR (2000) for a criticism of the bottom-up model proposed by Railtrack in the 2000 access charges review]. For these reasons, in railway transport, bottom-up approaches are usually only used to allocate variable costs from the top-down models between vehicle types in a more disaggregate way than implied by the top-down models [see for example Booz, Allen and Hamilton (2000) for experience in UK railways].

Much less work has been done for air and water transport. The UNITE project included an Inland Water Way case study of the lower and middle stretches of the Rhine (Donselaar and Carmigchelt, 2001), an airport case study focusing on Helsinki-Vantaa (Himanen et al., 2002), and two sea ports case studies – one focusing on Swedish ports in the Baltic (Jansson and Ericsson, 2002) and the other focusing on Mediterranean ports (Tsamboulas et al, 2001). From these, it appears that marginal infrastructure costs are very low, but further work is needed to confirm this. This statement could be somewhat different in case of major infrastructural interventions in inland waterways transport (e.g. building of locks in the Rhine): in such a situation some of the labour and energy costs would certainly be variable. For what concerns nodes (airports and ports), estimates of marginal operating costs are also needed: an estimation through a regression approach has been used but data requirements are heavy. On the basis of these studies, it seems that marginal operating cost should be considered very low.

---

<sup>5</sup> The converse is true of lower use.

The recent ECORYS and Mettle study about charging and pricing in the area of inland waterways (ECORYS and Mettle, 2005) confirms that in the case of inland waterways the *real current marginal infrastructure* costs are hard to determine: an indication is obtained by calculating the average user-dependent costs. These costs are determined by dividing the total (freight) user dependent costs by the total number of (freight) vessel kilometres:

*average (freight) user-dependent costs = total (freight) user dependent costs / total (freight) number of vessel kilometres*

**Errore. L'origine riferimento non è stata trovata.** gives an overview of the range of the average user-dependent costs per freight vessel-kilometre. The range has been estimated on the basis of the results of the various cases within the ECORYS-Mettle study.

**Table 3.4 Average user-dependent costs for freight vessels per waterway**

Waterways	CEMT	Lower	Upper
Amsterdam-Rhine Channel (NL)	Vlb (6400-12000)	€ 1,14	€ 1,15
Prinses Margriet Channel (NL)	Va (1500-3000)	€ 0,27	€ 0,45
Van Starckenborgh Channel (NL)	Va (1500-3000)	€ 0,67	€ 0,91
Basin Rhone-Saone (F)	1500 up to 6000 tons	€ 0,06	€ 0,50
Danube – Austria (A)	Vla-c (3200-18000)	€ 0,14	€ 0,18
Main-Danube Channel (D)	Vb (3200-6000)	€ 2,45	€ 3,31

Source: ECORYS and Mettle (2005)

It is clear that more theoretical, engineering-based and empirical knowledge is necessary in this field. Currently, additional case study work is being carried out within the FP6 funded research project GRACE.

### Results of marginal wear and tear costs of infrastructure for Rail

The results of econometric studies in Europe are shown in Table 3.5. The elasticity of cost with respect to traffic density is the ratio of marginal cost to average cost and can be interpreted as the cost recovery ratio from implementation of pure marginal cost pricing. For example, in Austria charging a price of EUR 0.55 per gross t-km would yield a cost recovery of 27% (of maintenance costs only).

The differences in estimates for both elasticities and marginal costs between countries can be explained in several ways (Thomas, 2002). Firstly, marginal costs may differ because of physical differences in networks e.g. because of differences in terrain. That is, there are different fixed factors in railway networks between countries that mean the cost of a unit of maintenance and also physical damage a given gross t-km has on the network differs between countries.

Secondly, marginal costs may also differ because different cost elements are considered in different studies. When Tervonen and Idstrom analyse maintenance and renewal costs, they find both a higher elasticity and marginal cost than when only maintenance costs are considered. That is, renewals expenditure seems to vary more with traffic and this, coupled with the increased cost base, results in a greater marginal cost. However there is a more subtle issue of definition of maintenance and renewal between countries. Activities that are considered maintenance in one country maybe considered renewal in others and consequently

the cost bases are not comparable. In addition the definition of renewal and enhancement may differ depending on the renewal strategy adopted by the infrastructure manager<sup>6</sup>.

Thirdly, econometric studies use past data on costs. These may reflect budgetary constraints as well as underlying ‘need’. In addition renewal expenditure tends to be lumpy, which makes statistical analysis using only a few years of renewals data difficult.

In addition to Thomas’ arguments, there are statistical issues that may result in differences between estimates of marginal cost. These result from differences in the availability of data. For example different studies had different fixed input variables (e.g. maximum permitted line speed and proportion of track switches and crossing) included within the cost function. This could mean that each study is estimating an elasticity of cost with respect to traffic that controls for different variables.

**Table 3.5 Results of econometric cost function estimation of marginal infrastructure wear and tear costs**

Study	Country	Elasticity of cost with respect to traffic density	Marginal Cost (EUR per thousand gross t-km) <sup>1</sup>
<b>Maintenance cost only</b>			
Johansson and Nilsson (2004)	Sweden	0.169	0.127
Johansson and Nilsson (2004)	Finland	0.167	0.239
Tervonen and Idstrom (2004)	Finland	0.133-0.175	0.179-0.246
Munduch et al. (2002)	Austria	0.27	0.55
Gaudry and Quinet (2003)	France	0.37	Not reported
<b>Maintenance and Renewals</b>			
Tervonen and Idstrom (2004)	Finland	0.267-0.291	0.77-0.87

Finally, Johansson and Nilsson and Gaudry and Quinet adopted models that could analyse the behaviour of marginal cost as traffic density increases. Johansson and Nilsson conclude that the ratio of marginal cost to average cost falls (and then becomes roughly constant) as traffic increases, that is the cost recovery ratio falls, while Gaudry and Quinet show the opposite.

One of the most established top-down accounting models is that used by the UK Office of Rail Regulation (ORR) for assessing the variable access charge the infrastructure manager is allowed to charge. Cost variability proportions are determined by activity category and those used in the 2000 review are shown in

Table 3.6. These proportions are then applied to the total cost by cost category. Overall 20% of maintenance and renewal expenditure was deemed to be variable with traffic. Provided the assumption of average variable cost equal to marginal cost is reasonable, the results are in line with those from the econometric studies.

The sum of all variable costs is then allocated to different vehicle types by use of bottom-up methods. That is, cost is allocated to vehicles depending on the damage the vehicle does to the network relative to other vehicles.

---

<sup>6</sup> Thomas (2002) gives an example the if a modern equivalent asset renewal approach is followed then ‘renewal’ may result in enhanced outputs.

The studies reviewed seem to indicate that marginal costs are between 10-40% of average costs, however marginal costs vary considerably depending on, amongst others, the cost base adopted, as well as the physical characteristics of the network. Therefore it may be preferable that in the absence of being able to undertake a cost study in a country, the results from the studies should be transferred via the elasticity estimates provided (Link et al., 2002).

**Table 3.6 Cost variability with traffic by asset type used in the UK ORR’s 2000 access charging review**

Asset	% variable with traffic
Track	
Maintenance	30
Renewals	
Rail	95
Sleepers	25
Ballast	30
Switches and Crossings	25
Structures	10
Signals	
Maintenance	5
Renewals	0
Electrification	
Maintenance	
AC	10
DC	10
Renewals	
AC	35
DC	41

Source: Booz, Allen and Hamilton (2000)

**Results of marginal wear and tear costs of infrastructure for Roads**

As with rail studies, there is no consensus as to whether marginal cost is increasing or decreasing with traffic. The Swiss study indicates a decreasing marginal cost relationship with traffic while the Austrian, German and Swedish studies indicate the opposite.

Given the wide range of estimates of marginal costs and elasticities, generalisation of these results to other countries is difficult. These studies represent the first steps in this field (Link et al., 2002) and more research is clearly required before reliable generalisation can be made.

Table 3.7 shows the implied marginal infrastructure wear and tear cost from econometric studies in Europe for roads. They show considerable variation in estimates of marginal cost. The same differences in studies/countries identified above in the rail analysis can be applied to road to explain the differences in marginal costs. However, it is peculiar that the Austrian and Switzerland study yield such differing estimates as both consider (roughly) the same cost base and the two countries are both mountainous (Link et al., 2002).

The difference between cost elasticities between studies is greater for road than for rail. For example the elasticity for maintenance and renewals/upgrades for Switzerland is approximately 0.8 (and even higher for Austria), for Sweden the renewals cost elasticity is on average 0.4 (ranging from 0.1. to 0.8 depending on axle load) and for Germany, again for renewals only, the average is 0.87 (ranging from 0.05 to 1.17).

As with rail studies, there is no consensus as to whether marginal cost is increasing or decreasing with traffic. The Swiss study indicates a decreasing marginal cost relationship with traffic while the Austrian, German and Swedish studies indicate the opposite.

Given the wide range of estimates of marginal costs and elasticities, generalisation of these results to other countries is difficult. These studies represent the first steps in this field (Link et al., 2002) and more research is clearly required before reliable generalisation can be made.

**Table 3.7 Results of marginal infrastructure wear and tear cost estimation for road (Eurocents/v-km)**

Study Type	Country	Study	Costs considered	Elasticities	Mean	Trucks	Passenger cars
<b>Econometric</b>	Germany	Link 2006	Renewal	0.05-1.17 (Mean 0.87)		0.08-1.87	
	Austria	Herry and Sedlacek 2002	Maintenance and renewals	1.046	0.16	2.17	0.07
	Switzerland	Schreyer et al. 2002	Maintenance, renewals and upgrades	0.8	0.67-1.15	3.62-5.17	0.42-0.50
<b>Bottom-up</b>	Sweden	Lindberg 2002	Renewals	0.1-0.8		0.77-1.86	

Source: Link et al. (2002). Updated using Link (2006). Elasticity for Austria taken from Herry and Sedleck (2002)

Across Europe there have been several cost allocation studies that have been used expenditure on road to different vehicle types. Table 3.8 shows the methods used in cost allocation vary considerably between European studies. DIW et al. (1998) applied the methodologies of Austria, Denmark, Switzerland, Germany, UK, Finland and Netherlands to data from Austria, Germany and Switzerland.

**Table 3.8 Overview on road cost allocation methods used in different European studies**

Country	Method used
Austria	⇒ Regression analysis Adaptation of the German method
Denmark	⇒ Differentiation of capital and running costs into: Fixed costs, V-km dependent costs Space dependent costs Weight dependent costs Use of specific weight and space factors by type of vehicle
France	⇒ Differentiation between fixed and variable expenditures Use of different allocation factors such as: - v-km - weight v-km - standard axle v-km
Germany	⇒ Differentiation between marginal costs and capacity costs Allocation of: 1. Marginal costs by AASHO-Road factors*v-km

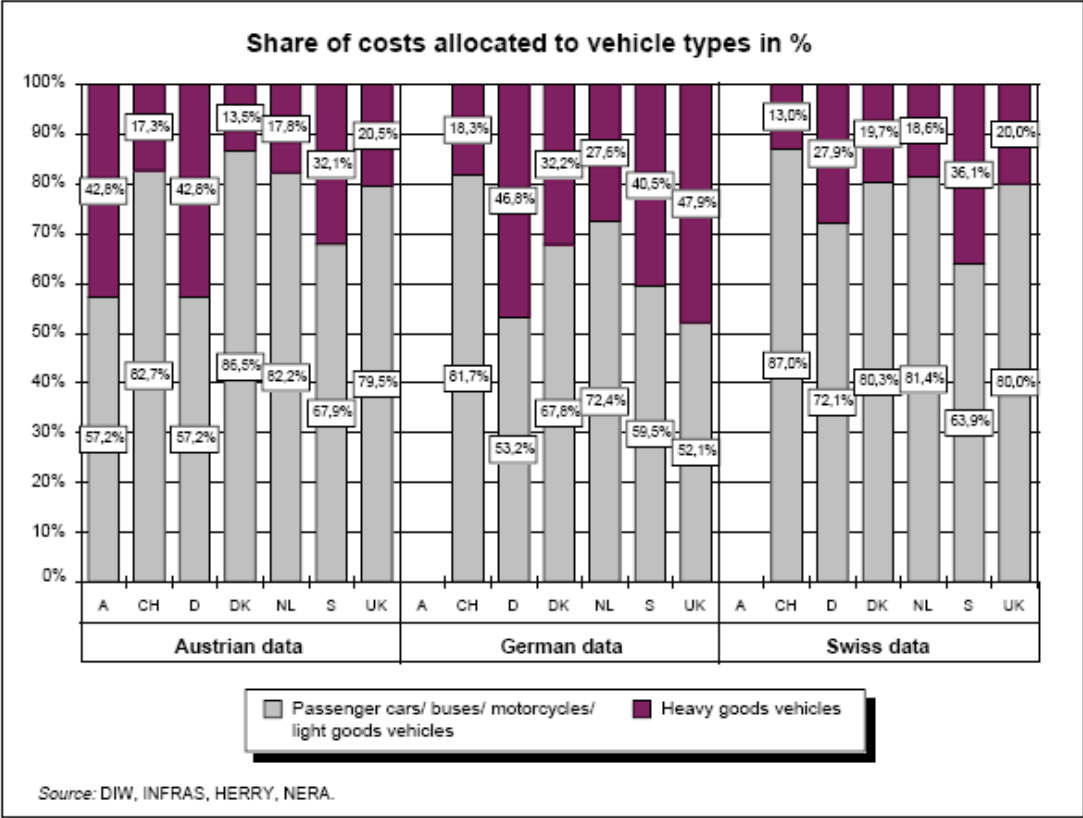
Country	Method used
Italy	<p>⇒ 2. Capacity costs by (speed-dependent) equivalent factors*v-km</p> <p>Differentiation between marginal and capacity expenditures, allocated by:</p> <ul style="list-style-type: none"> <li>- v-km</li> <li>- weight v-km</li> <li>- standard axle v-km</li> </ul>
Netherlands	<p>⇒ Differentiation of investment expenditures and running expenditures into different sub-categories allocated by:</p> <ul style="list-style-type: none"> <li>- v-km</li> <li>- PCU-km</li> <li>- axle load-km</li> </ul>
Finland	<p>⇒ Differentiation between fixed and variable expenditures allocated by:</p> <ul style="list-style-type: none"> <li>- v-km</li> <li>- weight-factors</li> </ul>
Sweden	<p>⇒ Differentiation of fixed and variable expenditures into</p> <ul style="list-style-type: none"> <li>- v-km dependent expenditures</li> <li>- space- and speed-dependent expenditures (allocated by PCU-km)</li> <li>- weight-dependent expenditures (allocated by AASHO-factor-km)</li> </ul>
Switzerland	<p>⇒ Allocation of:</p> <ol style="list-style-type: none"> <li>1. Weight dependent costs of new investment (estimated by percentages per road type) by weight-factors</li> <li>2. Weight dependent costs for pavement and investive maintenance by axle-load/v-km</li> <li>3. Capacity costs: 80% by vehicle-length *v-km 20% by v-km</li> <li>4. Current costs by v-km</li> </ol>
United Kingdom	<p>⇒ Allocation of:</p> <ol style="list-style-type: none"> <li>1. Capital expenditure: 15% by max. GVW-km, 85% by PCU-km.</li> <li>2. Maintenance expenditure further differentiated by types of expenditures and different allocation factors applied</li> <li>3. Policing and traffic wardens by v-km.</li> </ol>

Source: Link et al. 1999

The results which are shown in

Figure 3.1 show that the cost allocation between HGVs and other vehicles differs considerably depending on the methodology imposed. Note that this methodology allocates both fixed and variable costs to traffic. The proportion of cost determined as variable, however also differs across studies. This is due to a lack of agreement as to the cost drivers for each cost category.

**Figure 3.1 Share of costs allocated to vehicle types by applying different methodologies to different data sets**



Source: DIW et al. (1998)

**3.1.3 Scarcity costs in the rail and air sectors**

**3.1.3.1 Rail transport**

One of the most difficult issues to deal with in rail infrastructure charging is that of scarce capacity. Ideally charges would give train operators appropriate incentives to expand services only where the value of the service is at least as high as the costs it causes, and where capacity is scarce to ensure that it is used to provide the services of greatest value. This issue has become of great importance given the growth of traffic and the high costs of expansion and the consequent need to make the most effective use possible of what capacity is available (Bowker, 2002).

Congestion arises from delays due to trains running close to each other. In a planned system such as a railway the timetable is designed to prevent this from happening, but it remains the case that at high levels of utilization, the presence of an additional train on the tracks may lead to additional delays to other trains by reducing the ability of the system to recover from delays.

Congestion charges should be distinguished from the costs of delays imposed by the infrastructure manager or by one train operator on another. Where these are charged for, they are part of a separate performance regime. Such regimes already exist in Great Britain and Finland, and other countries are examining them.

A capacity charge based on the cost of congestion has already been introduced in Britain (Gibson, 2002). But congestion is only the appropriate capacity cost where the train in question constitutes an additional train to what would otherwise have been run; where the train in question runs instead of some other train the appropriate capacity cost is the opportunity cost of trains forced off the system by lack of capacity.

Scarcity costs arise where the presence of a train prevents another train from operating, or requires it to take an inferior path, while congestion costs only arise when a train actually operates; scarcity costs are incurred whenever a path is reserved for its use and reflect the characteristics of the foregone service. Quinet (2003) claims that scarcity has not received the attention it has deserved. Whilst it has been mentioned in EU directives, there has been no detailed algorithm presented. Instead, countries have simply established priority rules typically with the following hierarchy: International and intercity passengers, local passenger services, and finally goods trains.

### **Identifying Scarce Capacity**

The following description is taken from Nash and Sansom (1999).

The carrying capacity of a railway link is the maximum number of physical transport units which can use the link, and can be expressed as a function of the number of tracks in a section, average train speeds, geometry, signalling and safety systems, section lengths, length of trains, etc. (Rothengatter et al., 1996). Moreover, all these factors will vary for individual segments of the route and the services operating will vary by time of day, requiring calculations to be done in fairly fine detail.

Nash and Sansom continue:

“However, over and above all these factors, the mix of train speeds and the precise order in which trains are run is crucial. For instance, on a predominantly high speed line an additional slow freight train may remove the paths of several high speed passenger trains; on a heavy freight route the reverse may be true. Capacity is also maximised by grouping trains of like speeds, so that a 'flight' of fast passenger trains is followed by a 'flight' of slow freights and vice versa. However, this conflicts with providing a good service of well spaced trains at regular intervals for the public. More complicated still is the interaction of trains on different routes or between different origins and destinations; as with roads, junctions and other bottlenecks (e.g. speed restrictions) are key factors determining capacity.”

The result of all these considerations is that it is impossible to come to a ready definition of the capacity of a rail route corresponding to that for roads. More seriously, the impact of an additional train of a particular type on the paths available to other trains will differ enormously according to the precise mix of traffic on the line. At the same time, the value of a slot to other commercial operators or to government bodies providing social services will also differ enormously in time and space. It does not therefore seem possible to come to a general methodology to estimate scarcity values for rail slots in a variety of typical circumstances, in the way in which we have for road congestion.

The ECIS Bottleneck Study (Rothengatter et al. 1996) aims to improve the understanding of infrastructure bottlenecks particularly in rail and road sectors. The report highlights two types of bottlenecks pertinent to rail. Firstly, capacity bottlenecks where there is a lack of track capacity, and secondly, quality, or level of service bottlenecks due to low train speeds. The report finds that physical track capacity in Europe does not seem to be the main problem. Where it does exist, the most serious constraints were observed in the UK, northern Italy, Southern France, Randstad, Rhein-Main area and eastern Germany. Instead the study suggests

that 'the decline of the railway sector over the past 40 years can to a large extent be explained by insufficient quality. One important element here is the low average train speeds compared to road and air travel.

The ECIS report suggests that the best ways of improving bottlenecks in rail involve the improvement of network management, e.g. better separation of fast and slow trains and more sophisticated train control systems. Investment in a number of physical extensions of congested links, upgrading and better rolling stock do however need to be undertaken to cater for any extra demand arising in freight or passenger services and new high-speed links are required for high-potential corridors between cities.

An outcome of the first periodic review of access charges in the UK (ORR, 2000) was a definition of capacity utilisation. It takes the actual timetable being operated over a period and 'squeezes' the timetable the trains together, accounting for infrastructure/ signalling capability until they are at the minimum possible operational headway apart, whilst maintaining the original ordering of the trains. Capacity utilisation is defined as the time taken to operate this 'squeezed' timetable as a proportion of time taken to operate the actual timetable (Gibson et al., 2002).

### **Marginal Cost Pricing and Scarcity**

The following analysis is based on Rees (1976).

Marginal cost pricing requires that price over a particular period be equal to the marginal cost of varying output within that period. In the case of rail, marginal cost pricing needs to be considered in the context of fixed capacity, i.e. the inflexibility of rail infrastructure to respond to changes in demand for use of tracks, signalling etc. Where demand exceeds capacity this excess demand must be rationed in some way. Marginal cost pricing rules can still be defined and implemented.

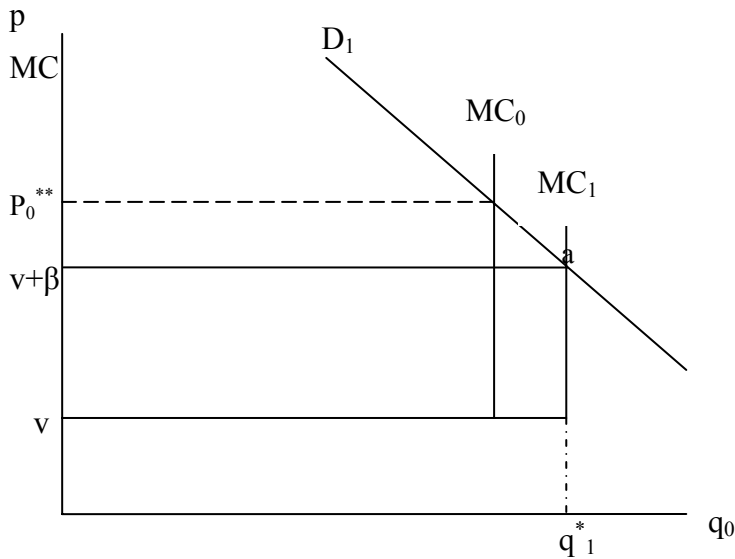
The analysis can be looked at in terms of two periods, period 0 and period 1 or, the short run and the long run for which investments in capacity can be implemented (see

Figure 3.2).

In year 0, the enterprise, or infrastructure manager, must choose a price and output pair and make an investment plan for year 1, which is derived from the output and price pair planned for year 1. In year 0 output variations can only be made within the limitations of fixed capacity, whereas in year 1 output is fully flexible in line with capacity investment made in year 0.

The pricing decision is illustrated in the diagram below. In the diagram,  $v$  represents the incremental cost of output when capacity is fixed, or the running costs,  $\beta$  represents the capacity cost of each unit of output, or capital charges. Where there is fixed capacity, the rule marginal cost pricing rule states that price should be equated to  $v$ , the marginal cost, unless there is excess demand at this price, in which case price should be raised to a level to choke off the excess demand to capacity output.

**Figure 3.2 Pricing decision**



Suppose in year 0, demand is given by  $D_1$ , and the marginal cost is given by  $MC_0$ . Note the vertical section of the curve  $MC_0$  shows the point at which capacity is fully utilised. Output cannot be increased beyond this point in year 0 i.e. the short-run. If price is used to ration the available output, it will have to rise to  $P_0^{**}$  generating a profit as this exceeds the running cost and capital charges,  $v+\beta$ .

If we now assume that  $D_1$  is also the expected demand level in year 1 (and future years), price is now set at the intersection of the new marginal cost curve,  $MC_1$  with the demand curve  $D_1$  at price  $v+\beta$  and quantity  $q_1^*$ .

If actual demand is less than  $D_1$  then price will be below  $v+\beta$ , and losses made, or if demand is greater than  $D_1$ , price will have to be above  $v+\beta$  and profits will be made. Correct estimation of demand will lead to a break-even situation.

### **Valuing and Charging for Scarcity**

Quinet (2003) highlights that, as regards charging for infrastructure, rail differs from road traffic by the nature of congestion, externalities and the oligopsonistic structure of infrastructure supply. Charging for scarce capacity requires estimation of the opportunity cost of a slot. The most attractive solution to this problem in theory is to 'auction' scarce slots. There are many practical difficulties however, including the complicated ways in which slots can be put together to produce a variety of types of service, and the fact that the value of a particular slot for a particular use depends on how other slots are being used (in terms of the operation of complementary or competing trains). It is also the case that the willingness to pay for the slot by the train operating company will only reflect its social value to (the company) if appropriate subsidy regimes are in place to reflect the user and non user benefits of the service. In practice it is therefore usually accepted that any degree of price rationing of scarce slots will have to be on the basis of administered prices rather than bid prices, although some countries, including Britain, allow for a degree of 'secondary trading' in which slots change hands between operators at enhanced prices (strictly, this must take place through Network Rail, so it is not secondary trading in the sense forbidden by EC Directive 2001/14). Nilsson (2002) provides a more detailed consideration of auctioning.

When considering services other than those of the prime user of the route, it will often be sensible to measure opportunity cost in terms of the value of an additional standard path to the prime user. The prime user is usually a passenger operator, and existing passenger demand forecasting models may be used to forecast the impact on demand and revenue of the allocation of the additional slot. In addition it is necessary to forecast user benefits not captured as revenue, and non user benefits.

The opportunity cost of a slot for this type of service can be estimated as the sum of:

- ⇒ the additional amount of traffic attracted to rail by the presence of this train multiplied by the price it pays
- ⇒ the consumers surplus to rail users as a result of the additional quality and capacity provided by the train
- ⇒ the savings of external costs to road users and the public at large from the train attracting passengers from road
- ⇒ less the train operating, infrastructure and external cost savings from failing to run this train

Nash et al. (2003) illustrate this approach with a worked example for the British Transpennine Route, and Johnson and Nash (2005) use PRAISE to estimate the value of slots on the East Coast Mainline using this approach.

Quinet (2003) suggests that central planning combined with auctioning is the best way to deal with scarcity. He notes that the opportunity cost of a slot can only be known if the value of slots to different operators is found and the optimal assignment made. Thus in the short run at least pricing cannot determine the allocation. Auctioning may be of value in determining the value of slots to different operators. Pure auctioning of paths would require bids from each path allocation combination, and the chosen allocations will be based on those which yield the highest values, with each participant paying the difference between their valuation and the second best. For this process to be undertaken properly, all stakeholders including final consumers, neighbours of infrastructure, operators and users of other modes, as well as the train operators, should be considered. The transactions costs of such a process would undoubtedly be high.

Auctions would however reveal the values of items on which the regulator has an information asymmetry, for example operator profits. Examples of how such auctioning could be carried out are outlined in the work of Nilsson (2002) and Brewer and Plott (1996). Based on experiments where subjects are given values for paths and participate in auctions to reveal their profits, through an iterative process:

- ⇒ Bidders announce the values for their desired paths.
- ⇒ Based on these valuations, the planner optimises total surplus and publishes these results.
- ⇒ Bidders update their bids, and a new optimisation is carried out until no bidder wishes to change their bid.

The central planner can then build on this information. The true social value of paths must consider environmental effects, and consumer surplus. Whilst the former is easily dealt with through an appropriate tax/ subsidy regime, the estimation of consumer surplus is more complicated.

An alternative to auctioning is to simply impose a price and see what happens to demand, and then iterate until demand equals capacity. The risk is, however, that serious distortions may

occur whilst the price is adjusting, and that strategic game playing may occur to force the price down by withholding demand, where competition is not strong.

A third approach, recommended by NERA (1998), is to identify sections of infrastructure where capacity is constrained and to charge the long run average incremental cost of expanding capacity. However, this is a very difficult concept to measure (the cost of expanding capacity varies enormously according to the exact proposal considered, and it is not easy to relate this to the number of paths created, since they depend on the precise number and order of trains run). It may be argued, however, that more appropriate incentives are given to infrastructure managers if they are allowed to charge the costs of investment they actually undertake, rather than for the scarcity resulting from a lack of investment, at least if they are commercially oriented. For short run marginal cost pricing encourages them to restrict capacity in order to keep price high; whereas a system where a capacity charge reflected actual expenditure on expanding capacity would overcome this problem. EC Directive 2001/14 which governs rail infrastructure charges, seeks to get round this by requiring infrastructure managers to undertake studies to determine the cost of expanding capacity, and to test whether this is justified on cost-benefit grounds, where scarcity charges are levied.

Given the difficulties with all these approaches, it may be thought that the best way of handling the issue is to permit direct negotiation between operators and the infrastructure manager over the price and allocation of slots, including investment in new or upgraded capacity. However, British experience of this approach is that it is complex, time consuming and will not necessarily lead to an optimal outcome given the number of parties involved and the scope for free-riding.

The most comprehensive recent study of different approaches to scarcity costs in European airports was that undertaken by NERA on behalf of DG TREN (NERA, 2004b). This study did not specifically seek to measure the scarcity costs, but examined the potential impacts and feasibility of 5 different variations of market mechanism. They find that market mechanisms per se have the potential to increase passenger numbers by as much as 7%, but that implementation difficulties would probably limit gains to something less than this figure. Table 3.9 provides a summary of the study's findings in relation to the different market mechanisms examined.

**Table 3.9 Summary of main properties of market mechanisms**

	Secondary Trading	Higher Posted Prices	Higher Posted Prices & Secondary Trading	Auction of Slots & Secondary Trading	Auction of 10% of Slots & Secondary Trading
<b><i>Approximate Estimate of Impact on Passengers</i></b>					
Low Case	2.2%	3.8%	4.1%	2.4%	0.4%
Central Case	4.0%	4.3%	5.0%	4.2%	4.1%
High Case	4.8%	5.2%	5.8%	5.0%	4.6%
<b><i>Implementation Costs</i></b>					
	Very low	Low	Moderate	Moderate	Very High
<b><i>Other Factors</i></b>					
- potential for instability in airline	Very low	Low	Low	Low	High

	Secondary Trading	Higher Posted Prices	Higher Posted Prices & Secondary Trading	Auction of Slots & Secondary Trading	Auction of 10% of Slots & Secondary Trading
schedules					
- likelihood of increased concentration at hub airports	Moderately High	Moderately High	Moderately High	High	Very High
- consistency with existing scheduling procedures	Good	Moderately good	Moderately Good	Moderately Good	Poor
- risk of international disputes, challenges & retaliation	Low	High	High	Low	Very High

*Source: NERA (2004b)*

### 3.1.3.2 Air transport

Similar problems of scarce capacity also arise in the air sector at congested airports. The current system for allocating slots at most airports is based mainly on historic precedence and administrative procedures and is, in the context of increasingly scarce capacity at airports, widely viewed to be economically inefficient. With existing users being given priority to use the same slots in the next season, it does not include an explicit mechanism for ensuring that slots are allocated to those who attach the highest value to them and, hence, does not adequately reflect the scarce nature of airport slots. Historic precedence does nothing to encourage competition from new entrants and, even though a slot pool is created for this purpose, it is argued that the slot pool contains slots of a low commercial value, and insufficient slots to allow a new entrant to create a service or route that could compete with incumbent airlines. It is, therefore, highly unlikely that the system results in slots being held by the most efficient user or those users who place the greatest value on the slots. It has, however, survived many years of concerted criticism. Proponents point to its success in maintaining stability within a complex and turbulent industry, whilst airline competition and new market entry has been provided for via competing airports.

A number of alternative systems that could be used to allocate slots based on a reflection of their value as a scarce resource have been proposed. Slots could be priced to better reflect their value and opportunity cost, auctioned in a way that allocates them to the optimum bidder who can best utilise the resource, or traded on a secondary market following either an administrative or market-based primary allocation. Alternatively, some combination of administrative and pricing mechanisms might be used. Yet few of these alternatives have been tested in real-world conditions, despite research and investigation into the subject dating back over 30 years (Carlin and Park, 1970; Yance, 1970).

Differentiation of slot prices may be a good way to reallocate the demand for slots from peak to off-peak periods, hence reducing scarcity at peak periods. It would, in all likelihood, lead to some prioritisation amongst different air services, but an optimal allocation of slots would require prices to be estimated with a high degree of accuracy. In actuality, it would be difficult to calculate what prices to charge. One proposal is for the airport authority to

attempt to calculate directly the opportunity cost involved, though the scale and complexity of this calculation may be overwhelming. Alternatively, a process of iteration towards equilibrating prices may be a pragmatic means of arriving at appropriate price levels, but the time it might take to arrive at these prices, and the implied distortions along the way, are causes for serious concern.

There is a sizeable body of literature relating to the use of auctions for allocating slots. (e.g., Nilsson, DotEcon, NERA, Grether). There are many different types of auctions to choose amongst. Nilsson argues that the sealed bid, one price auction - a sealed process where the highest bid is accepted at the lowest bid price - is the most efficient method of allocation as it allowed bidders to reveal their true valuation of the slots, and did not destroy their profits as the lowest bid determined the price. However bidders may inflate bids in order to win the auction, knowing that they will not have to pay that value. There is considerable concern regarding the practicability of designing an auction for airport slots, given the different complexities that most agree would have to be allowed for. Probably as a result of this concern, there is no actual experience of auctions in this setting, though a number of experiments have been undertaken (Nilsson, 2002).

The use to which the revenue generated from differential pricing and/or auctions would be put to, is a very important issue. This depends on who receives the funds, which in turn depends on who is adjudged to 'own' the slots – governments, airports or airlines. Using the price mechanism as a means of rationing demand would involve the transfer of economic rent from the airlines to the airports (or, in the case of a tax, to the government). In an environment where many airlines are already less profitable than airports, a further transfer in this direction is likely to be strongly resisted.

There is a strong case for a secondary market in slot allocation. After the primary allocation of slots via administrative forms such as grandfathering, slots could then be redistributed among airlines in a secondary market through barter trade or monetary trading, as has been the case at four of the busiest US airports. This may ensure that all slots are efficiently allocated to the appropriate users, however the market needs to be regulated to ensure against market concentration concerns.

## **3.2 Tariff setting**

Current infrastructure charges often poorly reflect marginal social cost. Sometimes infrastructure use is completely free. Sometimes it is charged for in a fixed charge unrelated to use, or in a variable charge which is not differentiated in time and space.

Pricing policy can have different aims:

- ⇒ To finance infrastructure expenditure.
- ⇒ To reach environmental or societal objectives.
- ⇒ To increase economic efficiency.

Examples of the first type of pricing are toll-highways. Example of the second type are congestion charges. The third type might be the internalization of external costs in a kilometre charge. Infrastructure and environment are scarce goods. They have to be used efficiently. Charging the user with scarcity and possible damages (the societal costs) will result in an efficient use of these scarce goods.

The costs of scarce goods that currently have no price, like the environment, may be passed on to the consumer in several ways. Examples are taxes, levies, and auctioned emission

trading. When the costs of scarcity and damages are passed on to the user of infrastructure, a transport company or shipper can make an informed choice between different modes of transport. This leads to fair competition within and between modes of transport and to a more efficient use of infrastructure and the environment.

In comparison with other instruments, based on command and control, cost charging has the advantage that it maintains or enhances freedom of choice. Therefore, optimisation, innovation and diffusion are encouraged, without passing on the external costs to the rest of the society.

When designing policy instruments, policy makers have to assess possible options on three aspects:

- ⇒ Will the instrument work?
- ⇒ Can it be implemented?
- ⇒ How much will it cost?

The first question relates to the effectiveness of the instrument, the second to the feasibility, and the third to the cost-effectiveness. Particularly for the EC also the criteria of subsidiarity play a role. All these criteria are briefly discussed below. It is evident that some of the criteria conflict with one another and do not always point in the same direction with regard to the choice of policy instruments. Choices must be made and trade-offs assessed.

### ***Effectiveness***

It is clear that any policy instrument should achieve its intended objectives. The effectiveness of a policy instrument depends, among others, on its transparency, its side-effects and the possibilities for enforcement. Policy instruments that are intended to change the behaviour of either citizens or companies, like pricing policies, should be transparent in order to be effective. If they are not understood and accepted, they will fail to incite citizens or companies to change their behaviour. So simple instruments should be preferred to complex ones.

The effectiveness of policies can be hampered by negative side-effects, or enhanced by positive ones. While many side-effects will become clear in ex-ante evaluations, some are the result of intricate societal processes and may only become clear after a policy instrument has been implemented. So both in ex-ante and in ex-post evaluations, attention should be devoted to positive and negative side-effects.

Policies that are not enforced, or that cannot be enforced, will not be effective. So, for example, emission charges are only effective if it is possible to identify the source of the emissions unequivocally. If not, other policies should be adopted to reduce emissions.

### ***Feasibility***

Whether or not a particular instrument can be used in practice, depends on legal considerations and on the perception of the fairness of the instrument. To start with the latter, in environmental policy, equity principles such as the User Pays and the Polluter Pays are widely accepted. Instruments based on these principles will often be considered as fair. In some cases, however, additional policy measures are needed to correct unintended and undesired distributional effects of environmental policy.

Policy instruments have to be either acceptable under current law or based on a new law. With respect to inland shipping in the Rhine estuary, the Mannheim Convention is of most relevance.

### *Cost-effectiveness*

Cost-effectiveness, the cost per unit of effect, is another key criterion. The most cost-effective instrument is an instrument that achieves a predefined target at least cost. Administrative and transaction costs are also important here.

A further important issue is the question of the level of government that should implement the policy. Each level of government should deal with those issues with which it is most qualified to deal. A 'higher' level of government should be involved only if it is better suited to solving the problems than lower-level authorities. This is one of the basic principles of the policy of the Commission. Subsidiarity affects the effectiveness, the feasibility and the cost-effectiveness of policy instruments. When policies are implemented at a level that is too low, the effectiveness of the policy may be reduced since actors affected by the policy may escape its consequences. For example, if high emission charges would be introduced in one mode of transport, but not in others, a modal shift will decrease the reduction in emissions. Similarly, if an emission charge is introduced in one waterway, but not in another, traffic may be diverted to the second waterway, again decreasing the effect of the charge. When the effectiveness decreases, so will the cost-effectiveness.

The introduction of a policy instrument that can be easily evaded may encounter more resistance than an instrument that is applied to all members of the targeted group. This affects the feasibility of a policy. This is in fact the reason that this study focuses on European market based instruments rather than on national instruments. Subsidiarity relates not only to the Commission versus national governments, but applies also to the role of local and regional authorities.

Tariff setting deserves specific attention in new Member States, where the transition to the market economy has lately prompted major policy changes. A comprehensive overview of the evolution of transport policy in former socialist countries is provided in Bak (2003). The tariff setting was determined by the state administration. Objectives of the tariff policy in transport sector were supporting financial resources for the state budget, having an impact on the localisation of the production, stimulating export (getting convertible currency for the country), supporting anti-import production as a sort of market protection, improving the balance of payments, and co-ordinating transport tariffs with the general policy of the country.

In these countries the shortcomings inherited from the old tariff system have to be removed, and the regulatory reform (decision making and legislation, budgetary) finalised: the lack of good practical examples, the incompatibility of the old and new regulations and social acceptability problems are key barriers to be addressed (Tánczos et al. 2004). The main constraints identified are confusion in the attribution of power across state institutions, blocking efficient decision making in new economic conditions, limitation of enterprises' decision making in new pricing systems. The suggested approaches and expected outcomes of tariff setting at the EU level can generate practical contradictions at the lower levels of administration. The recent national transport policies are aligned with EU objectives and attempt to transpose the latter at the national and local levels with particular attention to environment protection, the calculation of the external costs of transport, and the possible instruments of internalisation. The effects of former policy approaches are still perceptible i.e. revenue-generating potential can still prevail over other transport pricing policy objectives. Three major factors are identified that influence the setting of pricing policies: the political factor, the economic factor and the state of EU integration processes.

Tariff setting follows similar patterns across new Member States, although some countries (e.g. Hungary) have accrued more experience in this field. The experience of new Member States on the setting of tariffs will be dealt with in the following modal chapters.

### ***3.2.1 Charging for the use of roads***

ECMT (2003) emphasises that it is vital that pricing reforms charge closely to the point of use of the infrastructure. They insist that such a system enables rational decisions to be undertaken by individuals and firms, informed by price signals of the full costs of their travel demands, to determine traffic levels and trends in transport demand. Traditional systems of charging for the use of roads through annual vehicle charges and fuel tax do not achieve this. The goal is best achieved by kilometre based charges, as implemented for heavy goods vehicles in various European countries as explained below, but ideally differentiated by vehicle type, location and time.

#### ***3.2.1.1 Swiss charge***

The Swiss Heavy Vehicle Fee (HVF) came into operation on January 1 2001. The charge was levied on the entire Swiss public road network, applying to both Swiss and foreign vehicles alike, weighing over 3.5 tonnes.

The charge level of the fee was calculated in three steps. The first step was to calculate the uncovered costs of heavy traffic. This included uncovered road costs and external costs caused by heavy vehicles. Damages caused by congestion or the greenhouse effect were not considered. The external costs were found from studies and were divided into three areas that could be given monetary values; air pollution, noise and accidents. The second step involved calculating total transport performance (in t-km). The corresponding performance for each weight category was calculated and these figures were then multiplied by the average admissible weight in each category. The third step fixed the rate which involved dividing the uncovered costs (as calculated in the first step) by the total transport performance in t-km (as calculated in the second step) (Balmer, 2003).

The implementation of the fee has two dimensions, political and technical.

In regard to the technical side, the fee varies according to three factors: distance (kilometres travelled on Swiss territory), weight (admissible weight of vehicle and trailer) and the emissions of the vehicle. Therefore the HVF is calculated by:

$$\text{Rate} \times \text{Distance travelled in Switzerland} \times \text{Weight of vehicle and trailer} \times \text{Emissions}$$

Two systems were developed; one for domestic and one for foreign vehicles, in order to gather the relevant data. Each domestic vehicle has to be fitted with an on board unit (OBU) which is connected with a tachygraph, that enables the OBU to register the kilometres driven. The installation of an OBU is not mandatory for foreign vehicles, but is available on request. For an unequipped vehicle, the fee is registered by using an identification card at the special terminals for HVF clearance.

Balmer states that three reasons that have been decisive for the political implementation of the HVF are: Firstly, before the final implementation project started, it was criticized heavily. The political deal of introducing the HVF to outbalance the negative effects of the higher weight limit led the project to be on safe political grounds again. Secondly, the way the revenue of a pricing project is used is important, as learned from the EU project PRIMA (Pricing Measures

Acceptance). The project showed that acceptance was good when the revenue was reinvested in transport infrastructure in road and public transport. A large majority of people agreed that up to 2/3 of the revenue from the HVF should be used for projects in public transport. This decision fits well with the strategy of shifting goods from road to rail and helps finance the new railway lines. The remaining 1/3 goes to the cantons where it is used mainly for road purposes. And finally, one of the strongest arguments in favour of the HVF was its link to the polluter pays principle.

### **3.2.1.2 German charge**

The German heavy goods vehicle (HGV) charge was introduced in January 1 2005, applying to all lorries exceeding 12 tonnes gross weight. The tax is calculated based on the vehicle's environmental status (engine emission levels) and the number of axles.

Rothengatter (2002) explains that the objectives of the study into the HGV charge were to derive fair and efficient user charges for the different vehicle categories using the federal roads and to ensure that charges for infrastructure costs recovered all costs including capital costs and took into account future re-investment cycles, new investment and current expenditures. It was necessary that all users should bear exactly the costs that they were responsible for.

European law (Directive 1999/62/EC) required that the toll rate had to be based on actual infrastructure costs, stating that the weighted average tolls shall be related to the costs of constructing, operating and developing the infrastructure network concerned. External costs were not included. The vehicle category charge had to be based on the category's average infrastructure cost. It was possible to differentiate the charge by the time of day (peak/off-peak) and by environmental performance (emission category). The German government decided to only differentiate according to environmental performance.

By introducing the HGV toll system, the German government believes there will be more rigorous application of the 'user pays principle' to domestic and foreign users. HGVs are responsible for much of the costs of construction, maintenance and operation of motorways, and a distance-based toll will allow HGVs to make a contribution towards infrastructure costs. It was suggested that more efficient use would be made of transport infrastructure capacity due to the tolls.

The German government decided to allow a private sector operator to run the system of upgrading, maintenance, operation and financing, in order to ensure cost effectiveness and consumer friendly behaviour, which will be higher than with a public organisation. The idea was to have a combination of tolling and public-private-partnership models and the operator has to pre-finance the system. This allows the private operator to receive a share of the tolls collected on a stretch of motorway. There was additional relief for public budgets by switching from tax funded to user funded infrastructure.

The German system mainly relies on satellite tracking to determine the distance trucks travel on the autobahn network. In mid 2005, around 70% of the trucks on the network were fitted OBUs which use GPS satellite signals and other positioning sensors, to track vehicle movement, calculate the toll charge and communicate information to Toll Collect agency. Toll revenue is then collected at the end of each month by direct debit from registered accounts, credit cards or fuel cards. For vehicles without OBUs, payments can be made for particular trips in advance either online or at 3500 toll-station terminals.

The first results of the implementation of this scheme show that there has been no traceable increase of transport charges and no significant impact on the structure of the trucking

industry. However, the early results do show some improvement in haulage load per vehicle and the number of empty trips has decreased by 6%.

### **3.2.1.3 Austrian charge**

The Austrian charge came into force on January 1 2004. It applies to all vehicles exceeding 3.5 tonnes, using the Austrian motorways and expressways. It is based on the distance travelled and the number of axles. The main motivation for the charge is to attribute costs more fairly according to use.

The Austrian system uses a Dedicated Short Range Communication (DSRC) which is the main type of microwave system used for road tolling. DSRC is used based on 400 road side beacons distributed across Austria's 2000 km autobahn network. Onboard devices (Go-Boxes) are used to communicate with these beacons and track truck movements across the network and calculate the toll level. Tolls are either paid via a centrally registered account or pre-pay by topping toll credit in advance through the internet or sale points. Go-Boxes must be fitted on all vehicles with a gross weight of over 3.5 tonnes travelling on the Austrian motorways (McKinnon, 2005).

### **3.2.1.4 CEEC charges**

The new Member States of the EU have to wrestle with increasing traffic volumes, parallel deteriorating traffic conditions and growing needs for financial sources in the road sector. The importance of the pricing policy is illustrated by the sheer volume of revenues from road users. However, the circumstances in Central and Eastern European Countries (CEEC)<sup>7</sup> are significantly differing from those in the Baltic states<sup>8</sup>, and even more in the former EU-15. While in the CEEC region the transit traffic is a significant factor, it has only a marginal role in the Baltic states, stressing the importance of infrastructure charges for the CEEC.

Motorway charging has generally found a high public resistance in new Member States due to historical reasons: road charging is a quite new institution, the public has a lower income level compared to the old Member States, and generally the other costs related to motorised mobility (fuel, insurance, registration, maintenance) are considered high enough with respect to the current GDP per capita. The "neighbour-effects" of motorway charges (i.e. traffic diversion to secondary roads and rise of externalities) can become substantial, therefore they are not extensively applied as a traffic demand management tool, rather in a limited way in order to collect revenues for operating and maintaining the infrastructure. Users often feel they are "double taxed" when charges are added on top of taxes. This low acceptability is also endangered by the fact that, as shown by quality of service indicators, the "value for money" in terms of quality is very poor.

The case of the first concession and charged motorway in Hungary proves that making users pay for the full actual costs of using transport infrastructure in new Member States is unfeasible. One of the well known reasons of project's failure was in fact the extremely high toll rates compared to the purchasing power of the existing demand at that time. In the long run, the strengthening of the economies, the rising purchasing power of the users and of commercial companies will enable the progressive introduction of the "user pay" principle, so that fares and charges can gradually approach actual transport costs. Until this becomes

---

<sup>7</sup> Central and Eastern European Countries (CEEC) include Poland, Czech Republic, Slovakia, Hungary, Slovenia.

<sup>8</sup> Baltic States include Estonia, Latvia, Lithuania.

reality, state participation to financing infrastructure requirements will remain fundamental. This situation is common to other CEECs, such as Poland and Czech Republic.

Reforms in the legal and institutional background are a crucial pre-requisite for the introduction of charges in the new Member States. For example in **Hungary**, there were a few attempts to introduce a motorway charging system, but this plan has been hindered by low public acceptance and by missing supplementary funds.

The Law on Concessions (Act XVI of 1991) and the Law on Concessions (Act XXXIX of 1992) created a legal background for implementing the institution of concession in Hungary. After a restructuring of the transport sector in 1996, public road management companies at a county level got the responsibility for managing the national public road network. The involvement of private capital into the management of road public network put the introduction of road infrastructure charges on top of the policy agenda, as a mean to allow cost recovery without recurring to public subsidies.

The Law on Road Transport of 1998 authorises the minister of transport to set motorway charges (the latest modification of regulation on motorway charges is the Decree 125/2004 issued by the Ministry of Economy and Transport). The decree defines the user categories, a flat-rate for different types of vignettes, the sections of the motorway network which are free of charge and the penalties. The infrastructure charges shall gradually meet the actual costs of maintenance, operation, and renovation with additional state subsidies in compliance with the current legislation of the ministry of transport in Hungary and with the principles of fairness, equity and efficiency. The current flat-rate charges should, according to the plans, develop in the long term into a mileage based electronic toll collection system.

The “Eurovignette” directive, which is in place for freight transport in various EU countries, is not in force in new Member States yet.

### Current practice

In most of the CEECs a flat-rate vignette system has been introduced on the motorway network.

In **Slovakia** the system also extends to several sections of the national road network.

In the case of **Poland**, HGVs and buses are subject to the payment of the vignette system on the national road network, while there are only 4 sections of charged motorways.

The structure of the existing flat-rate vignette system in **Hungary** is relatively cheap and acceptable for frequent users, but it causes social stress due to its unfair and unequal attribution (favouring regular users and heavy good vehicles with respect to casual users and passenger cars, which produce less external costs but specifically need to pay more). Motorway vignette prices in **Hungary** in 2005 are detailed in Table 3.10.

**Table 3.10 Vignette prices for 2005 in Hungary (Prices in EUR, including VAT)**

Validity Category	1-day	4-day	10-day	31-day	Annual
<b>D1</b>	—	4.52/ 5.90*	9.29	15.75	141.33
<b>D2</b>	—	—	25.44	46.44	407.83

Validity Category	1-day	4-day	10-day	31-day	Annual
D3	—	—	39,57	67.43	605.69
D4	8.08	—	50.47	86.01	767.21

Source: State Motorway Management Company, using 247.65 HUF / EUR average conversion rate of National Bank of Hungary from January to November 2005

\*The 4-day vignette costs EUR 4.52 when purchased between May 1 and September 30, and EUR 5.90 when purchased at other times of the year.

Vehicle categories:

- D1: Motorcycles and motor vehicles with a maximum total weight of 3.5 tons, including any trailers.
- D2: Motor vehicles or long vehicles (motor vehicle with trailer) with a maximum total weight over 3.5 tons but not exceeding 7.5 tons
- D3: Motor vehicles or long vehicles, with a maximum total weight over 7.5 t but not exceeding 12 t.
- D4: New D4 Category for 12t+. Vehicles weighing more than 12 tons must have a D4 category vignette. D4 category has 10-day, 31-day, and annual vignette options. This category now also offers a new 1-day vignette, instead of a 4-day one. 1-day vignettes are valid only for the D4 category, on the date of validation until midnight. The cost of this tag is HUF 2,000. Buses between 3.5 and 12 tons fall into the D2 category; buses over 12 tons fall into the D3 category.

Within the **Czech Republic**, the use of highways and speedways by motor vehicles with at least four wheels or vehicles plus trailers is from 1995 subject to a fee (see Table 3.11).

**Table 3.11 Vignette prices for 2005 in Czech Republic (Prices in EUR, including VAT)**

	< 3.5 t	3.5 t <> 12 t	> 12 t
Annual	30.06	233.78	467.56
2 months	10.02	58.44	116.89
15 days	6.68	21.71	43.42
1 day			8.35

Source: Road and Motorway Directorate of the Czech Republic, using 29.943 CZK / EUR average conversion rate of European Central Bank from January to September 2005

Vehicle category is defined by the vehicle licence determining the total weight of the motor vehicle or the vehicle plus trailer.

Several countries are preparing a road pricing system for a freight transport (according to relevant common directives) possibly adopting the German or Austrian-style system. However, it has to be noted how the existing experiences in new Member States highlight the importance of an adequate transport modelling as an essential support to decision making. Currently, barriers such as different data collection and accounting systems lead to inappropriate and poor cost calculations.

Current practices in new Member States show that these countries are slowly moving towards European standards, although often the current situation in old Member States does not show a clear way forward: this will hopefully be solved by future EU initiatives (such as a new directive on charging HGVs).

### 3.2.1.5 Other EU countries

A number of countries have toll motorways. Tolls are set largely on cost recovery principles, rather than to reflect marginal social cost. Some countries still have a time-based supplementary charge for use of motorways. At the present time, European Legislation (the 1999 Eurovignette Directive) still requires that time or distance based supplementary charges should be confined to motorways and confined to the average cost of providing and maintaining the infrastructure. Although proposals exist to amend this to allow for charges on all roads, and for greater differentiation according to external costs, the amendment would still tie the average level of charge to average infrastructure cost (i.e. excluding externalities). Agreement on this compromise measure has just been reached.

### 3.2.2 Charging for use of rail infrastructure

This section reviews the current tariff structures that exist across the EU. The section draws on the European Conference of Ministers of Transport's paper "Railway Reform and Charges for the use of Infrastructure" (ECMT, 2005).

Table 3.12 summarises the charging structure for rail infrastructure in the EU. Charging regimes can be distinguished by the following characteristics and each is discussed in more detail below:

- ⇒ pricing principles adopted (marginal cost pricing, marginal cost pricing with mark-ups, full cost recovery and full cost recovery less state subsidy);
- ⇒ type of mark-up (if any) (either two-part tariffs or mark-ups on the variable component);
- ⇒ type of variable charging (e.g. by train-km or gross t-km);
- ⇒ charges for different elements of cost (e.g. maintenance, renewal and environmental).

**Table 3.12 Rail Infrastructure Charges – Overview**

	Pricing Principle	Fixed Charges	Charges per Gross t-km	Train-km	Path-km	Other
<b>Austria</b>	MC+		✓	✓		
<b>Belgium</b>	FC-					See annex 1
<b>Bulgaria</b>	MC+		✓	✓		
<b>Czech Republic</b>	MC+		✓	✓		
<b>Denmark</b>	MC+			✓		Charges per train for bottlenecks and bridges
<b>Estonia</b>	FC	✓	✓	✓		
<b>Finland</b>	MC+		✓			
<b>France</b>	MC+	✓		✓	✓	
<b>Germany</b>	FC-			✓		
<b>Hungary</b>	FC			✓	✓	
<b>Italy</b>	FC- (Traffic management only)	✓		✓	✓	Also charge per node
<b>Latvia</b>	FC			✓		
<b>Netherlands</b>	MC			✓		
<b>Poland</b>	FC			✓	✓	
<b>Portugal</b>	MC			✓		

	Pricing Principle	Fixed Charges	Charges per Gross t-km	Train-km	Path-km	Other
<b>Romania</b>	FC	✓	✓		✓	
<b>Slovenia</b>	FC			✓		
<b>Sweden</b>	MC+		✓			Øresund bridge surcharge
<b>Switzerland</b>	MC+		✓	✓		Also charge per node
<b>UK</b>	MC+	Franchisees only		✓		Per v-km by type of vehicle

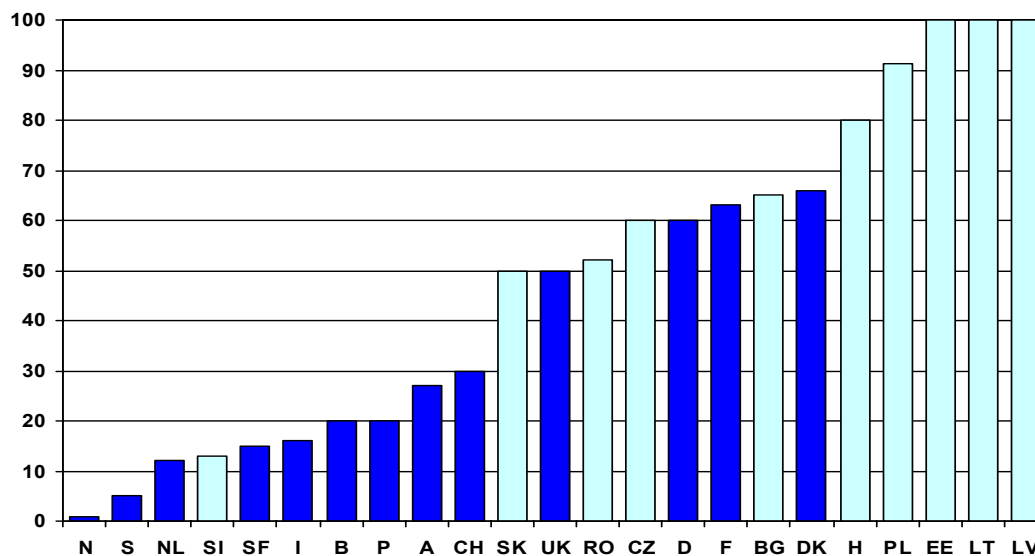
Source: ECMT (2005)

### 3.2.2.1 Principles

Marginal cost pricing is usually advocated in order to encourage efficient use of the railway network. However railways tend to exhibit economies of density and so the marginal cost of extra network utilisation is below the average cost. Thus full cost recovery is not achieved through (simple) marginal cost pricing. Figure 3.3 shows the percentage of total expenditure<sup>9</sup> on rail covered by infrastructure charges.

Therefore, two broad pricing principles can be distinguished between; pricing by marginal cost (MC) and pricing to recover full cost (FC) (usually through some average cost pricing scheme). There are two further pricing principles reported in Table 3.12, marginal cost plus pricing (MC+) and pricing to recover full cost less government grants (FC-). Both MC+ and FC- are aimed at full cost recovery less government grants, however the MC+ approach is based on marginal cost pricing plus some mark-up which is the least distorting in terms of incentives (see the section below on mark-ups). So although both the pricing systems in Czech Republic and in Germany aim to recover full cost minus government grants, the Czech system is based on marginal cost plus a mark-up while the German system is based on an average cost principle.

**Figure 3.3 Percentage of total expenditure covered by infrastructure charges**



Source: ECMT (2005).

Note: Light shading indicates central and eastern European countries

<sup>9</sup> Total expenditure is not necessarily equal to total cost as total cost may exclude external costs.

## **Type of mark-up**

There are two kinds of mark-up used in charging MC+ pricing; a mark-up on the variable charge and/or a separate fixed charge (not related to actual usage). Where mark-ups on variable charges are implemented, economic theory states that the least distorting method of doing this is to inversely relate the proportionate mark-up on marginal cost to the elasticity of demand for each user group (Ramsey pricing).

A separate fixed charge is an example of a two part tariff. This has the advantage that once an operator has decided to enter the market, he pays only marginal costs, that is, incentives to act efficiently are not distorted unless the fixed part of the tariff is prohibitive of the operator entering the market. In some charging systems that implement two part pricing, such as Estonia, the fixed element is based on planned use of the network. This may discourage small operators, particularly freight operators where planned use is uncertain, from entering the market if this charge element is high. In the UK, a fixed access charge is levied on the passenger franchise operators (the dominant passenger train operator in a region), however no fixed charge is paid by freight and passenger open access operators.

## **Type of variable charge**

As well as the proportion of revenue collected by actual usage charges differing between European countries, there are also differences in what unit of usage is used as the basis for charging. A mixture of number of train-km, t-km and train path km is used by systems in Europe. In terms of charging marginal cost, the unit of usage should reflect the driver of the marginal damage caused to the network. Therefore to reflect different cost drivers (and, as is likely, to reflect distributional concerns) a mixture of charging measures have been implemented several European countries.

The UK system has adopted a per v-km charge, which is unique to each type of vehicle cleared for running on the UK network. This charge is calculated by reference to the relative damage each vehicle does to the network with reference to its unsprung mass, axle load and maximum speed (amongst others). Such a measure should (if calculated correctly) reflect the true marginal damage a vehicle causes to the network as a result of its use.

## **Elements of costs charged**

Across Europe elements of maintenance, renewals, train planning and operations, congestion and scarcity, accidents and environmental costs are used as the cost base to determine both marginal cost (in the MC and MC+ approaches) and average cost (in the FC and FC-approaches).

Maintenance, renewals and train planning and operations costs tend to be borne by the infrastructure manager, that is, they are internal from the perspective of the infrastructure manager. Congestion refers to the delays imposed on other trains by the running of additional trains on a network. In a planned (timetable) situation it reflects the cost of not being able to recover quickly from incidents on the network due to the extra utilisation of the system. Scarcity reflects that in a planned system with allocated train paths, once a path is allocated to a service other services are excluded from the path and have to take a less optimal path as a result. Marginal costs based on both accident and environmental costs aim to collect the extra cost or extra risk imposed on others by the use of the network by an operator.

Table 3.13 shows the elements of cost taken into account in variable usage charges. No country charges for all of these categories and only Switzerland, Germany and France charge for 4 of these categories. All except Italy charge for maintenance expenditure and 13 out of 18 countries charge for train planning and operations. Charges for congestion and scarcity, accidents and environment are only undertaken by a minority of countries.

**Table 3.13 Categories Included in Costs as Variable charges**

	Maintenance	Renewals	Train Planning and Operations	Congestion and scarcity	Accidents	Environment
Austria	✓	X	X	✓	X	X
Czech Republic	✓	X	✓	X	X	X
Denmark	✓	X	X	✓	X	X
Estonia	✓	✓	✓	X	X	X
Finland	✓	✓	X	X	X	✓
France	✓	✓	✓	✓	X	X
Germany	✓	✓	✓	✓	X	X
Hungary	✓	✓	✓	X	X	X
Italy	X	X	✓	✓	X	X
Latvia	✓	✓	✓	X	X	X
Netherlands	✓	X	✓	X	X	X
Poland	✓	✓	✓	X	X	X
Portugal	✓	X	✓	X	X	X
Romania	✓	X	✓	X	X	X
Slovenia	✓	✓	✓	X	X	X
Sweden	✓	X	X	X	✓	✓
Switzerland	✓	✓	✓	✓	X	noise bonus
UK	✓	✓	X	✓	X	X

Source: ECMT (2005)

### 3.2.2.2 Practical Experience of charging for congestion and scarcity in rail track access charges in EU-25

ECMT (2005) presents evidence on the degree to which charges for congestion and scarcity are currently levied in rail track access charges in Europe. Only Great Britain has a congestion charge per train-km explicitly related to estimates of congestion costs. However, charges per train-km in Italy and Germany vary by train speed and type of route. In Germany there is an explicit utilization factor, with a higher charge for heavily used lines. Italy uses a simple approach of setting standard speed profiles for each route designed to optimise the line, and charging higher prices for paths that deviate from the profile, either by seeking faster or slower paths that disrupt the optimal service profile. Slovenia is proposing an off-peak discount. There is also a charge per node in Switzerland and Italy that varies with the implicit amount of congestion at the node by categorizing nodes according to traffic levels.

When charging for scarcity, it is appropriate to levy a reservation charge, regardless of whether the reserved path is used or not. France has such a charge. Switzerland has a train path cancellation charge. This seems a curious way of dealing with the issue, as it is likely to hamper rather than help the reallocation of paths to higher value uses. Germany (and the proposals for Slovenia) charges more for ad hoc paths than for regular paths, which is rather the opposite of a reservation fee, but may be justified in terms of costs of train planning.

With respect to capacity charges, a number of approaches are found. Several countries have surcharges on the use of particular stretches of track. For instance, Austria has a surcharge of EUR 0.5 per train-km for certain bottleneck stretches in the vicinity of Vienna, whilst Denmark has charges of up to EUR 110 per train for the use of the key transit routes (this is in addition to bridge charges of up to EUR 900 per train for use of the major water crossings; this is a pure cost recovery issue, recovering the railways share of the costs of these privately financed bridges). Germany also has a surcharge for busy sections. Some countries (Switzerland, Italy) also have charges for the use of busy nodes, and Italy levies a surcharge on trains which is greater the more their speed deviates from the norm for the route in question.

In addition to these explicit capacity charges, some countries (e.g. Germany, France) have separate charges for different category of route (urban, high speed, secondary etc). Generally charges are higher for busier routes, although it is not clear how far this is price differentiation according to demand as opposed to capacity issues.

### ***3.2.2.3 Practical experience in new Member States***

Pricing policies in new Member States present several commonalities, as it is illustrated below.

A main difference between Baltic-states and CEEC is the state of advancement of the reform concerning the separation between infrastructure managers and railways undertakings. CEEC have got further with rail reform than the Baltic-states. General aims of this latter group and other new candidate countries are similar to former but meantime fulfilled aims of e.g. Slovakia, Poland or Hungary.

#### CEEC

The general aim of the access charging system on the CEEC rail infrastructure is to cover the total and justified costs of the infrastructure manager connected to making infrastructure available to the available to the users.

More specifically the access charges for using the railway infrastructure should cover:

- ⇒ maintenance costs,
- ⇒ traffic operation costs,
- ⇒ the infrastructure manager's administration costs connected with making railway infrastructure available,
- ⇒ the infrastructure manager's investment expenditures on managed lines,
- ⇒ additional costs of the infrastructure manager – connected with costs of extraordinary journeys and security service being provided in the railway area as well as in the trains.

In addition, subsidies from national budgets cover:

- ⇒ investments resulting from international agreements,
- ⇒ investments, repairs, exploitation and maintenance of railway lines with purely military significance,
- ⇒ preparation and realisation costs of investments related to railway lines of national importance.

The principles for rail network access charges are currently under revision in various countries, including Poland and Hungary.

### Baltic states

The charge system in Baltic states is based on four major principles:

- ⇒ to satisfy the financial needs of the public railway infrastructure (100%),
- ⇒ to establish (gradually) the same conditions for competition in freight and passenger transport,
- ⇒ to achieve the optimal conditions for intermodal competition, taking into account social costs, environmental issues, and the economic interests of the country,
- ⇒ to achieve the maximal utilization of the public railway infrastructure capacity.

In **Latvia** this implies that the government only provides minimal financing from the State budget (mainly as co-financing from EU funds for investments). Hence charges for the usage of the railway infrastructure are a main source of Latvian Railways' revenues. In practice the revenues from freight transit flows from Commonwealth of Independent States (CIS) to the Latvian Ports account for a large share in Latvian Railways incomes.

### **Legal and institutional background**

On the basis of the some selected examples (Latvia, Lithuania, Poland, Czech Republic, Hungary) the current legal and institutional background in new Member States is presented.

#### *Institutional framework*

##### CEEC

There are three bodies responsible for the rail infrastructure charging scheme in Poland:

- ⇒ the Minister specific for transport issues determines in the decree the principles of railway network charging and the announcing procedure,
- ⇒ the President of the Railway Transport Office (UTK) supervises the correctness of the basic charges for using railway infrastructure and additional charges for additional services and approves unit rates of access charges,
- ⇒ the Infrastructure Manager (PLK) defines access charges and publishes the list of approved unit rates.

In the Czech Republic the liberalisation of the rail network and the establishment of new railway undertakings is the start up of the infrastructure charging reform applied to national and regional railways.

### Baltic states

There are three railway regulatory institutions in **Latvia**:

- ⇒ the State Railway Administration allocates the infrastructure capacity and issues licenses to the freight operators,
- ⇒ the State Technical Inspection issues safety certificates,

- ⇒ the Independent Regulator sets the methodology for calculation of the charges and approves the tariffs for the utilities. Furthermore the Independent Regulator issues licenses to the passenger operators.

The operations are undertaken by the State Joint Stock Company "Latvian Railway" (LDz), which is not separated from the infrastructure manager. In addition there are currently three other passenger operators and two other freight operators. LDz accounts for 92% of the freight operations and 89% of passenger operations.

The three main regulatory institutions of **Lithuania** are:

- ⇒ the Ministry of Transport and Communication defines the main directions of railway transport development,
- ⇒ the State Railway Inspectorate (SRI), which among other things licenses operations of railway undertakings. SRI also sets the concrete size of charge for the use of the railway infrastructure,
- ⇒ the LG Infrastructure manager is a designated infrastructure manager in Lithuania. The accounts of LG acting as infrastructure manager and acting as railway undertaking are separated. The LG infrastructure manager provides - in cooperation with SRI - track access to operators. The LG Infrastructure manager collects the charges.

It is planned that a new infrastructure manager will be designated. LG is the only company which are currently undertaking freight and passenger operations. However a private company has received a license for some selected types of freight and passenger operations.

In **Estonia** the main regulatory institutions are:

- ⇒ the Ministry of Economic Affairs and Communication is responsible for operating licences and laying down the methodology of railway infrastructure access fee calculation,
- ⇒ the Railway Inspectorate observes the fulfilment of railway safety and decides on approval of railway network statement and the railway infrastructure access fee based on the applicable methodology and the accounting data of the railway infrastructure manager,
- ⇒ the Railway Infrastructure manager allocates the network capacity.

### *Legal framework*

In **Hungary** the ongoing railway reform determined the changes in responsibilities in setting tariffs. Hungary accepted and applied the rules of several EU directives relating to rail sector (2001/12/EC amending the 91/440/EEC directive, 2001/13/EC amending the 95/18/EK directive, 2001/14/EC replacing the 95/19/EC directive) and implemented them in the national jurisdiction through various decrees (decree on the working permission of the railway companies, on the charge for the use of railway infrastructure, on the allocation of the railway path capacity and on the accountancy separation of railway-activities within railways companies). According to the joint decree 66/2003 of Ministry of Economy and Transport and Ministry of Finance and the decree 67/2003 (modified by 48/2004) of Ministry of Economy and Transport in Hungary, the Railway Capacity Allocation Company is responsible for publishing the infrastructure charging framework on the rail network.

The tariff conditions and preferences can be found in the Network Statement. The Ministry of Economy and Transport determines the rules for setting the charges in the Regulation for the Calculation of Infrastructure Costs and Charges. The Railway Capacity Allocation Company

publishes the Network Statement in the Official Journal of the Ministry of Economy and Transport.

The Hungarian State Railways as infrastructure operator applies a two-tier (tariff) system, including basic charge and the charge for the services utilised. The structure of the basic charge is described below.

The infrastructure divisions of the railway undertakings are allowed to collect infrastructure charges, covering costs of train movements on the network and of administration of capacity allocation procedure which latter emerges at the Railway Capacity Allocation Company. Therefore, railway undertakings transfer a determined amount monthly to the company.

The new Law on Rail Transport is under discussion in the Parliament, which refers to the full liberalisation of the railway sector, to the separation of the state and the railway company and to the establishment of an independent railway authority which is liable for the regulatory framework.

In **Poland** the legal principles for establishing unit rates are set out in:

- ⇒ Act of 27 June 1997 on railway transport,
- ⇒ Decree of Ministry of Transport and Maritime Economy of 12 August 1998 on detailed principles and conditions for providing traffic operations on railway lines.

The principles for increasing/reducing unit rates are set out in:

- ⇒ Act of 28 March 2003 on railway transport,
- ⇒ Decree of Ministry of Infrastructure of 7 April 2004 on access and usage conditions for railway infrastructure.

In **Estonia** the Act on Railways was issued on 19 November 2003, (RT I 2003, 79, 530), entered into force 31 March 2004.

### **Methods and barriers for implementation and application**

In rail transport the introduction of a new tariff system is likely to encounter more difficulties than in the road sector because the state could oppose the introduction of a system which is likely to bring deficits it will have to cover. In Hungary the competition law raises regulation problems, because the access charge to rail infrastructure, which is set at a high level, can strongly restrict the appearance of smaller suppliers on the market, thus preserving monopoly/oligopoly.

Data collection and calculation of infrastructure charges and external costs is a problematic issue in Central and Eastern European railway undertaking, because of the lack of exact current and historic data on costs of operation. As a first step, simple approaches are recommended: these countries should try to separate fixed and variable costs, based on existing research results in other countries, and then pass to more sophisticated approaches to the calculation of costs and charges.

### **Current practice**

#### *General structure of infrastructure charges*

#### CEEC

The charging system for infrastructure access in **Poland** includes:

- ⇒ Basic charge for journey executed according to allocated train paths

- ⇒ Additional charge for additional services
- ⇒ Initial charge for:
  - Annual Timetable updating
  - Individual Timetable preparation
  - Changing of train path parameters already applied

The basic charge in Poland is executed as:

- ⇒ reservation charge - defined in the contract adequately to scale of planned performance for the given month, generally amounts 100%,
- ⇒ user charge – determined for real use of railway lines after final financial settlement of infrastructure usage.

The principles for calculation of the basic charge are provided below together with information on possible reductions and increases in the basics charge. Thereafter the concept of additional charges is presented.

In **Hungary** the basic charge includes the following elements:

- ⇒ charge for granting train path,
- ⇒ charge for the running of train

(two-component basic charge: train-km and number of trains).

Besides it, a charge for access to services also has to be paid by the railway operators.

As discussed before, charges are published by the Railway Capacity Allocation Company, charges are based on cost calculations of infrastructure division of the Hungarian State Railways.

### Baltic states

In **Estonia** the railway infrastructure access fee for the main and additional services is composed of the costs related to making available the railway infrastructure for use and reasonable business profit. Calculation of the user fee for main and additional services for ensuring access is based on the total costs of the railway infrastructure manager, which include direct costs related to the service provided by the railway infrastructure manager, capital expenditure (i.e. depreciation), a proportional part of the general costs of the railway infrastructure manager and reasonable business profit. There are various calculation methods for fees paid by passenger and freight operators.

The railway infrastructure access fee payable by the rail transport undertakings to the railway infrastructure manager for the main services for ensuring access consists of the following parts:

- ⇒ the part of fixed costs, which is based on the planned train-km,
- ⇒ the part of variable costs, which is based on actual gross t-km.

In **Latvia** the charge is, as mentioned, based on a full cost coverage approach. The charging scheme is based on charges per train-km for three different line categories, where category 1 and 2 are classified as being of "strategic importance" and category 3 as being of "regional importance".

More specifically the charge for railway infrastructure usage is based on the following relatively simple principle:

$$\text{Charge} = \text{Total costs (during the year)} / \text{train-km (planned)} * \text{Correction factor}$$

Where:

- ⇒ the total costs during the year are the necessary costs to ensure the opportunity to use the particular category of railway infrastructure, including costs for maintenance, renewals and train planning/operations,
- ⇒ the planned amount of train-km are estimated according to the requests of freight and passenger operators,
- ⇒ the correction factor is established by the infrastructure manager to secure optimal capacity utilisation, i.e. to correct for too big or too small demand.

Furthermore, for both schemes charges are differentiated on

- ⇒ freight and passenger operators,
- ⇒ three types of passenger trains.

In **Lithuania** the charge for the use of public infrastructure consists of:

- ⇒ a train traffic charge (accounts for 30% of all public railway infrastructure costs (excluding infrastructure electrification costs),
- ⇒ a reservation of the timetables charge (accounts for 30% of all public railway infrastructure costs (excluding infrastructure electrification costs),
- ⇒ an access to railway network charge (accounts for 40% of all public railway infrastructure costs (excluding infrastructure electrification costs),
- ⇒ an electric network use charge consists of the costs of that part of the electrified railway infrastructure installations which ensure electric traction charge for the use of.

#### *Additional charges*

The additional charge is collected for additional services according to individual contracts or commissions, e.g.:

- ⇒ infrastructure manager's special activity connected with exceptional or hazardous transport,
- ⇒ providing extra information about the train route including statistical data,
- ⇒ preparing the Timetable Study,
- ⇒ enabling journeys with individual timetable or on the 6-hour-available-route base,
- ⇒ other - in compliance with Network Statement.

#### **Conclusions**

The ongoing railway reforms set new challenges for the new Member States. In most cases there is already an appropriate regulatory framework to make the railway sector ready for market opening in the frame of liberalisation. At present two-parts tariffs are generally applied between infrastructure manager and railway operators, where the fixed component, not proportional to delivery performance, has the goal to cover general costs, and to ensure the access to rail infrastructure, while the other component, proportional to delivery

performance and measured usually in km, is going to cover the costs of operation and maintenance of infrastructure (occasionally even of traction). Charges are differentiated according to service quality, load, time, etc. In current practice the calculation of the charges of rail infrastructure is made rather on average cost basis than on marginal cost basis. In addition, only internal costs for enterprises are included, while external costs are generally not taken into account. At the same time it needs to be considered that generally rail infrastructure managers, beside cost recovery considerations, when setting prices take into account also market-considerations. This often leads to lower prices than those ensuring cost recovery, thus generating the need of significant subsidies.

Summarising, the main disadvantages of the current systems in new Member States are believed to be that the:

- ⇒ current system is based on the unit rate estimated on the costs carried by infrastructure manager in the previous year but not on the planned costs within the timetable period,
- ⇒ unit rate is related to railway section load and historical costs and does not comply with standard of available railway line (e.g. distinction after maximum technical speed and timetable speed on particular railway sections),
- ⇒ the high rate in the freight transport is a barrier for freight traffic development and its competitiveness with road traffic considering long-term objectives.

### ***3.2.3 Charging for the use of inland waterways and maritime transport infrastructure***

In this section the relevant issues and the experience with charging in inland waterway transport and maritime transport are dealt with<sup>10</sup>. As such this part deals mainly with issues in freight transport. As already explained in earlier sections, in recent years, European transport policy has moved towards an internalization of all external costs. It aims at providing a basis for a sustainable and economically efficient transport system. A number of countries have introduced differentiated, use-dependent charges for several transport modes, particularly road and rail. For historical and legal reasons, until now specific charges related to external costs have not been imposed on inland shipping and maritime transport (with the exception of Sweden for maritime transport).

In the following sections we deal with inland waterway and maritime transport specifically on open issues and obstacles to the design and implementation of a tariff determination, the current state of methodology. The practice will be dealt with in meaningful examples (if appropriate) and lessons learned.

#### ***3.2.3.1 Inland waterways***

##### **Current practice**

About 8% of European transport takes place by inland waterway, 70% of all inland waterway transport is carried on the river Rhine and its tributaries. On the river Rhine, under the Mannheim Convention, charges are prohibited.

For most other waterways, Member States levy charges on a variety of principles (EC 1998). In contrast to the Mannheim Convention, several Member States (Luxembourg, France,

---

<sup>10</sup> Large part of this introductory section is based on CE (2004).

Germany (under the Mosel convention), Belgium, Finland, the UK (largely for leisure craft) and The Netherlands), apply quite sophisticated charges, levied according to type and size of vessel, type and volume of cargo, number of passengers, frequency of travel, and time of day (each country has its own particular approach). The charges contribute to a variety of maintenance, operating, and capital costs, but demand appears to be quite sensitive to changes in the charge, and so charges are difficult to raise. In Germany, fewer charges are levied, with no navigation charges applied on the Rhine, the Elbe, the Oder or the Danube. On other waterways (accounting altogether for less than 20% of all traffic) charges are levied (for example, under the Mosel convention) similar to those described above. Such charges recover up to 25% of the operating and maintenance costs of the waterways.

Some countries (particularly France and the UK) charge other users of the canal networks (non transport users such as water companies, industrial and agricultural users). These organisations make more use of the canal than transport (the split is roughly 80/20) and in these countries, contribute significantly to the costs of the infrastructure. By and large, charges for the use of inland waterways in Member States contribute to but do not cover variable infrastructure costs. Government subsidies are still required to some extent in all Member States.

**Table 3.14 Inland waterway costs and cost recovery, 1998**

Country	Type of charge	Recovery of costs	Note
Belgium	Variable <sup>a)</sup>	7.5% of investment	It should be borne in mind that only 20% of the use of inland waterways is thought to be attributable to navigation.
France	Variable	10% of receipts	
Germany	Variable for 20% of traffic	13% of running costs	
UK	Variable	8.75% of maintenance costs	
Finland	Variable	21% of maintenance and development costs	

Source: DGVII Questionnaire

<sup>a)</sup> Variable charges tend to change according to weight, distance, boat type, type of travel

### Specific reasons for charging, which elements do play a role?

In the previous section we have seen that the present charging is mostly used for covering the infrastructure costs that can be attributed to inland waterways (inland waterways have in some cases a function for water management in a region). The 2001 White Paper calls for the integration of external costs into the infrastructure charge. Charges should reflect both the costs for infrastructure maintenance and environmental impacts of transport. Furthermore, modes of transport should be treated equally, according to the White Paper. The Paper announces a framework directive, to be proposed in 2002, which however has not been issued so far (EC 2001).

The external costs related to transport can be identified as

1. marginal external cost of air pollution (local emission component)
2. marginal external cost of global warming (global emission component);
3. marginal external cost of accidents;
4. marginal external cost of noise;
5. congestion and scarcity.

The TIPMAC project carried out a survey of available estimates of marginal costs for the various modes of transport (Maffii and Martino, 2003), based mainly on the EU funded projects RECORDIT and UNITE. According to this survey, no estimates for infrastructure and congestion costs related to inland waterway transport are available. For the other external cost categories the following can be observed:

1. marginal external costs of air pollution: based on the surveys, an average for the EU-15 of 8 Eurocent per v-km is found;
2. marginal external cost of global warming: an average for the EU-15 of 17 Eurocent per v-km is found;
3. marginal external cost of accidents; in the few surveys held no significant cost was observed resulting in a zero cost estimate for accidents related to inland waterways;
4. marginal external cost of noise; in the few surveys held no significant cost was observed resulting in a zero cost estimate for noise.

It can also be noted that, especially with pollution, estimates of external cost differ considerably across countries (this means that regional charging is an important element in defining a policy and not implementing a uniform European charge).

Charges for inland waterways according to the TIPMAC method would vary between 12 (Finland) and 43 (Luxembourg) Eurocents per v-km, and would cover only external costs.

Although the costs of congestion are mainly internal to the inland waterways sector, they nevertheless should receive attention with a view to allocating scarce capacity in locks.

For infrastructure costs it is important to determine the share of fixed and user dependent (i.e. variable costs). Costs of buoying for example are fixed since they arise even with a minimum amount of traffic. Besides, freight ships are not the sole users of waterways, with yachting bearing part of the responsibility for maintenance expenditures. The report of CE (Van Essen et al., 2004) provides estimates of the amount of user dependent infrastructure costs, set at 53 Eurocents per v-km (27 Eurocents per v-km for recreation vessels).

### **Methods for implementation**

In order to levy the charge different methods can be used:

- ⇒ Fuel charges (possibly differentiated by emission classes)
- ⇒ Waterway charges (possibly differentiated by emission classes and vessel size)
- ⇒ Harbour- and lock dues (possibly differentiated by emission classes and vessel size)

Fuel charges cannot differentiate between vessel sizes, but on the other hand they do not require a monitoring system. As such these would cover only the external cost of global warming and, possibly, pollution. The incentive would be to reduce fuel consumption and thereby reduce emissions. However, a fuel charge is explicitly prohibited under the Mannheim Convention, and its possible introduction would then require an amendment to the latter.

The waterway charges and lock dues can additionally discriminate between vessel size and thereby capture infrastructure related costs as well (marginal cost is higher for larger barges for congestion and infrastructure maintenance costs).

## **Barriers to implementation**

For each of the levying methods, the advantages and disadvantages are listed below:

- ⇒ Fuel charges can be implemented with a distinction by type of fuel bunkered (which is easy to implement but could lead to fraud and requires control) and fuel consumed (requires advanced techniques and control).
- ⇒ A waterway charge could be collected in two distinct ways. First, it could be based on the exact distance sailed, measured by a GPS based electronic device. Second, it could be collected at locks, charging ships according to distance between locks or, in some cases, according to the average distance between a lock and the preceding locks. The first system would be more precisely targeted and have no perverse effects on sailing distance: it would not be possible to take a detour to avoid paying charges. The second system would be easier to implement, since it does not require the setup of a new tax collection system and the installation of GPS systems. However, the latter objection could become irrelevant as the River Information System (RIS) is being implemented and other, even more advanced electronic communicating devices are becoming more popular among shippers – and obligatory in some countries.
- ⇒ The levy point of differentiated harbour and lock dues is rather unproblematic. Harbour dues are charged by the harbour authorities, often public enterprises owned by the municipalities in which the harbours are located. Lock dues are levied by the waterway authorities (although no lock dues are currently levied on the Dutch state waterways). However this option does not allow to relate charges to the actual distance sailed.

### ***3.2.3.2 Maritime transport***

By virtue of its geography, its history and, nowadays, of globalisation, the European Union is still very dependent on maritime transport:

- ⇒ Over 90% of its external trade and some 43% of its internal trade goes by sea; more than 1 billion tonnes of freight are loaded and unloaded in EU ports every year.
- ⇒ Maritime companies belonging to European Union Member States control one third of the world fleet, and some 40% of EU trade is carried on vessels controlled by EU interests.
- ⇒ The maritime transport sector - including shipbuilding, ports, fishing and related industries and services - employs around 2.5 million people in the European Union.

### *Shipping*

Maritime shipping has comparatively low infrastructure and external costs, although emissions of sulphur dioxide and nitrogen oxides are significant and give rise to concern. Preparatory actions in the first phase should therefore include consideration of emissions from shipping in the context of ongoing international discussions on the matter. At present Community legislation provides for a mandatory tax exemption for fuel used in ships. In the second phase, consideration would be given to the introduction of minimum standards for fuel quality and the Commission should consider the possibilities for levying environmental fuel charges that vary in respect of emissions. Alternatively, fairway charges could be introduced that would be differentiated on the same basis. All such changes would have to be compatible with international agreements in this area.

### *Ports and infrastructure*

As set out in the Commission's Green paper on Ports and Maritime Infrastructure (EC 1997), the Community's ports policy should aim at creating equitable conditions of competition across ports in the EU whilst maximising the efficiency of the use of the ports sector as a whole. In line with the general principles set out in the White Paper (EC, 2001), the Commission, therefore, considers that port users should pay for the costs they impose. However, it is recognised that marginal cost charging would not always suffice to fully recover infrastructure costs from users. Higher charges should, therefore, be allowed, provided they are non-distortive. The Community framework in this field would, therefore, require cost-related charging with marginal costs as the minimum.

The debate on the green paper has shown that there is a broad consensus on the need for improved transparency of port financing. Accordingly, as a first step, an inventory of the systems under which the community's main ports are financed needs to be established showing how public and private sources of finance are used. The Commission should take the necessary steps for the establishment of such an inventory as a priority matter, including any modification of accounting and reporting requirements that may be needed. Considerable interest has also been shown in the possibility of further clarification of the extent to which the Treaty rules on State aid impact on investment decisions in the ports sector. This possibility should also be pursued in parallel to the establishment of the inventory. Both exercises would be pursued in close contact with the organisations representative of the ports sector whose close co-operation can make a decisive contribution to this early realisation.

For reasons explained further below, State aid rules would not provide a complete solution to the problems of the sector since by their nature they apply only to payments that favour particular enterprises, not to the provision of public infrastructure to which all have equal access. Accordingly, it would also be necessary to continue work on a framework for port charges as part of the more general approach to co-ordination of investment in infrastructure. The provision of maritime infrastructure outside the port would also be addressed in that context.

The financing of ports and maritime infrastructure and policies on charging their users vary from one country to another, reflecting the considerable differences in the approach taken towards their ownership and organisation. Ports may be owned by the State, regional or local governments or by private enterprises. In the past, ports tended to be seen mainly as suppliers of services of general economic interest provided by the public sector and financed by the taxpayer, whereas now the trend has moved towards considering ports as commercial entities which ought to recover their costs from port users who benefit from them directly. The port industry can therefore be seen as an industry in transition.

### **Current practice**

There are no charges for operating ships on the open sea, however some Member States charge for fairway use. From 1 January 1998 Sweden has introduced environmentally differentiated fairway charges (for more information see Kågeson, 1999 and Commission Expert Group on Transport and Environment 2003).

Sweden has long had a fairway due to cover costs of icebreaking and other shipping-related expenditures. Fairway dues are not linked to the distance travelled, but are imposed as a flat fee per vessel. They are based on two charging components. The first one is based on the

gross tonnage (GT) of the ship, while the second component is based on the amount of goods loaded and unloaded in Swedish ports.

In 1998, the GT charge has been differentiated in order to reduce SO<sub>2</sub> and NO<sub>x</sub> emissions. The differentiation with respect to sulphur in the ships' bunker fuel is straightforward. A ship which certifies that it is only using low sulphur bunker fuel (< 0.5% S for ferries, <1% S for other ships) will be granted a discount of 0.9 SEK (approximately EUR 0.10) per GT. To receive rebate for low sulphur bunker fuel the ship owner has to provide a document certifying that the ship permanently and under all conditions is operated with bunker fuel containing less than 0.5% sulphur for ferries and less than 1% sulphur for other ships. Currently, more than 1,000 ships qualify for sulphur rebate. In case sulphur certificate exist the general random ship inspections involve control of sulphur content of fuel.

For NO<sub>x</sub> emissions the differentiation scheme is slightly more complicated. Most ships, except tankers, pay at least a base rate of 3.40 SEK/GT (approximately EUR 0.37). If their NO<sub>x</sub> emissions in standardised test cycles exceed 2 g/kWh, they pay 0.16 SEK/GT more for every gram of NO<sub>x</sub> emitted per kilowatt-hour. The maximum charge of 5 SEK/GT (approximately EUR 0.55) is reached when a ship emits 12 g/kWh or more.

### **Specific reasons for charging, which elements do play a role?**

In the White Paper (EC 2001) the Commission announces to look at the tariffs currently applied in Sweden in this sector, particularly port taxes and taxes to reduce pollutant emissions, in order to see whether this approach might encourage greater account to be taken of external costs elsewhere in the Community. In the light of this examination a Community framework may be proposed which links port taxes to these costs.

The survey carried out in TIPMAC (Maffii and Martino, 2003), shows that there are only estimates for air pollution and global warming costs related to maritime transport, for both short sea shipping (SSS) and ferry transport. For the external cost categories the following can be observed:

1. marginal external cost of air pollution: based on the surveys an average for the EU-15 of EUR 0.26 per v-km is found for maritime goods transport (SSS) and an average of EUR 1.65 per v-km is found for maritime passenger transport (ferry);
2. marginal external cost of global warming: an average for the EU-15 of EUR 0.92 per v-km is found for maritime goods transport and an average of EUR 9.23 per v-km is found for maritime passenger transport;

It can also be noted that the estimates of external cost differ considerably per country (this means that regional charging is an important element in defining a policy and not implementing a uniform European charge).

### **Methods for implementation**

As seen in the previous section the current marginal cost pricing covers only the air pollution and the global warming, both caused by ship emissions. The air pollution is caused by the emission of SO<sub>2</sub> and NO<sub>x</sub> and the global warming is mainly caused by the emission of CO<sub>2</sub> and C<sub>4</sub>H. There are three main methods to implement pricing measures to decrease ship emissions: taxation and/or charging, en-route charging and differentiated dues. We will describe them in turn hereafter, based on NERA (2004b).

### *Taxation/charging*

A tax/charge in this context would be intended to reduce shipping emissions, rather than to raise revenue, as is the case with most existing taxes. (Note that any of the approaches considered here could be designed to be revenue neutral through the redistribution of any revenues to the marine sector.) We consider three taxation/charging approaches that differ in whether fuel or emissions is taxed and, for the fuel taxes, whether fuel purchases or fuel consumption would be taxed. The fuel taxes would only target SO<sub>2</sub> emissions while the emissions tax would target all the ship emissions.

- ⇒ Tax/charge at point of sale: This approach would tax sulphur fuel content in excess of a given level (e.g. 1.0%) at the point of fuel sale in Europe. No monitoring of individual ships would be necessary although the taxing authority would need to test fuels for sulphur and assign appropriate taxes.
- ⇒ Fuel-use tax/charge: This approach would tax the sulphur in fuel used by each ship (above a given level, e.g. 1.0%). Continuous or frequent monitoring of ship fuel use and sulphur content would be necessary.
- ⇒ Emissions tax/charge: This approach would tax emissions from ships, with emissions weighted by sea region and distance from shore. Continuous monitoring or estimating total emissions would be involved.

### *En-route charging*

En-route charging has been used for many years in the aviation sector to provide revenues to fund European air-traffic control services, essentially providing a payment for use of the air traffic control infrastructure. Charges are based on the distance travelled within the relevant airspace and the weight of the aircraft. Such an approach could be applied to maritime traffic to charge vessels for emissions en route. The primary difference between this program and an emissions tax/charge is that the en-route charge would be based upon estimated rather than monitored emissions. Two approaches are identified that vary in whether or not specific ship movements would be monitored.

- ⇒ Trip-based charges: This approach would charge ships based upon generic shipping travel patterns. Periodic emissions monitoring would be used to establish emission rates.
- ⇒ Distance-based charges: This approach would charge ships based upon the actual distance travelled, including variations by region and distance from shore. Periodic emissions monitoring would be required.

### *Differentiated dues*

A system of differentiated port or fairway dues would take advantage of the fact that many ports and some countries already impose charges on vessels that use their facilities and waters. Differentiated charges in this context would involve basing port dues in part on emissions of various pollutants. Such a system of differentiated dues has been used in various Swedish ports since 1998 to encourage reductions in NO<sub>x</sub> and SO<sub>2</sub> emissions, with about 20 Swedish ports using such a revenue-neutral system. Other countries have developed similar programs that impose dues differentiated on the basis of environmental criteria. Three approaches are developed that differ in whether the dues are levied for the use of ports or fairways and, for ports, whether the program is voluntary or mandatory.

- ⇒ Voluntary differentiated port dues: This approach would provide ports with a differentiated dues framework, with ports free to use the framework or not.
- ⇒ Mandatory differentiated port dues: This approach would require ports within the EU to adopt a differentiated dues system.
- ⇒ Differentiated fairway dues: This approach would use a differentiated fairway dues system to encourage improvements in emissions characteristics of ships using EU fairways.

## **Barriers to implementation**

### *Taxation/Charging Alternatives*

#### ⇒ Tax or Charge at Point of Sale

A tax on the sulphur in fuel oil purchased in the EU would probably have relatively little effect on overall EU emissions. Although the fuel tax would reduce emissions from ferries and small ships that operate in EU waters, large container ships could simply fill bunkers with fuel in non-EU countries. Indeed, the tax could encourage ships to travel further to obtain untaxed fuel, thereby increasing overall emissions. Moreover, a fuel tax would not target NO<sub>x</sub> and would not be easily modified to provide any geographic specificity. Given the likely lack of environmental effectiveness – and the probably strenuous objections of shipowners and fuel suppliers – the fuel tax is not likely to be a viable alternative.

#### ⇒ Fuel-use Tax or Charge

Although a fuel-use tax would be ineffective in reducing NO<sub>x</sub> emissions, it could reduce SO<sub>2</sub> emissions because shipowners could not avoid it by filling up with cheaper, high-sulphur oil in non-EU ports. But it would not be easily amenable to geographic targeting. In addition, the approach would not provide incentives to take some potentially low-cost options to reduce emissions, such as the installation of control technologies unless they also reduced fuel use. In addition, the administrative costs would be considerable, although the costs might be reduced by relying upon self-reported estimates of fuel consumption and sulphur content. A fundamental political difficulty with all taxation approaches is that they generally require unanimous agreement by the European Council. It is possible that variations on these approaches that apply a combination of charges and rebates could avoid this difficulty, although an attempt to construct a legitimate “non-tax” instrument in this way could prove difficult. For example, a fuel-use tax designed to be revenue neutral (by redistributing revenues to the shipping sector) would almost certainly face fewer political obstacles. Nonetheless, taxation policy is notoriously difficult to reach agreement on, and this could be an insurmountable obstacle (particularly given the potential objections of shipowners and fuel suppliers). Moreover, any tax or charge might be subject to challenge on legal grounds under the United Nations Convention on the Law of the Sea (UNCLOS, Part 2, Section 3), which guarantees innocent right of passage for foreign-flag vessels without being subject to charges except for services received (though a legal case could be made that the use of the EU airspace for waste disposal justifies the charge).

#### ⇒ Emissions Tax or Charge

Although an emissions tax or charge would be potentially efficient – by encouraging cost-effective emission reductions in shipping and could be applied to NO<sub>x</sub> as well as

SO<sub>2</sub> emissions – this approach is also likely to face the political and legal difficulties noted above. Indeed, this version is likely to face even greater difficulties because of the additional monitoring and administrative difficulties of implementing it.

### *En-Route Charging Program*

#### ⇒ Trip-Based Charges

A trip-based en-route charging programme would be likely to face legal and political obstacles similar to an emissions tax or charge. As with the emissions tax, however, structuring the charge to be revenue neutral could reduce the legal and political complications. En-route charging would also face the same potential challenge under UNCLOS as the other taxation/charging approaches. As noted above, a fundamental difference between the emissions tax and the trip-based en-route charge is that the trip-based charge would be based upon a simplified formula rather than monitored emissions. Thus, monitoring and administrative costs would likely be lower under the trip-based approach.

#### ⇒ Distance-Based Charges

Generally speaking, the distance-based approach would face similar obstacles to those faced by the trip-based approach. Using a distance-based approach would, however, improve the accuracy of the charges as measures of the environmental effects of each route beyond the accuracy in the trip-based scheme. But this greater accuracy would come at the expense of greater administrative and monitoring costs. All of the legal, political and shipowner objections to the trip-based charge approach would also apply.

### *Differentiated Port/Fairway Dues Program*

#### ⇒ Voluntary Port Dues

Differentiated port/fairway dues would build upon the experience in Sweden and elsewhere and thus could be relatively inexpensive to implement. Indeed, this voluntary approach is perhaps the instrument least prone to face legal or political obstacles. The existing experience also provides some indication of the likely effects of the program, including its environmental effects and administrative costs, although the comprehensive review in Sweden is not yet available. Relatively crude estimates suggest that the approach has reduced SO<sub>2</sub> emissions by about 30% and NO<sub>x</sub> emissions by about 10%. Of course, evaluations of the Swedish programme's success are still relatively preliminary, and the scheme is far more modest in scope than a EU-wide programme would be. The voluntary nature of this approach – as well as the lack of transparency of actual dues paid – would be likely to limit its environmental potential. Moreover, competition among ports might also reduce the potential stringency, although this effect would be mitigated if overall revenues from port dues were the same. In addition, because the differentiation would be based upon emission rates – rather than overall emissions – control options to reduce travel would not be encouraged.

#### ⇒ Mandatory Port Dues

Requiring a mandatory differentiated port/fairway dues system would be likely to face strong opposition from port authorities (the European Sea Ports Organization, for example, has indicated that it would oppose a requirement for dues differentiation). The advantage of the mandatory approach would be greater uniformity of treatment

and greater potential environmental and cost-saving advantages. It may be possible to develop an intermediate version; for example, the Commission could monitor the effects of a voluntary programme in order to meet various emissions targets (although such an evaluation would not be simple). If the targets were not met with the voluntary approach, some mandatory scheme could be devised.

⇒ Fairway Dues

The differentiated fairway dues approach would require some coordinated effort by most Member States to institute fairway dues. It is not clear whether such a system would legally be considered a tax subject to unanimous agreement by all Member States, but presumably a majority of Member States would have to implement potentially significant restructuring of the method of providing marine services. Against this substantial set of disadvantages is the potential advantage that the fairway dues approach could increase the potential environmental gains from this programme

### **3.2.4 Charging for the use of air transport infrastructure**

According to ICAO, a charge is a levy that is designed and applied specifically to recover the costs of providing facilities and services for civil aviation (ICAO, 2004). The charging system in the air transport sector is articulated according to the three big cost areas, i.e. airport services, air navigation services and ground handling services.

#### **Airport charges**

*Airport charges* are generally levied by the airport infrastructure manager on the airlines (or private users). Passenger charges, which should in principle be paid directly by passengers, are usually for practical reasons levied on airlines, which recover these costs from the passenger through ticket prices.

Airport charges can include:

- ⇒ **Landing and take-off charges** (for the use of approach, landing and take-off facilities and services) are generally levied on the basis of technical features of the aircraft (MTOW – Maximum Take Off Weight as certified in the airworthiness certificate). This charge can be differentiated according to the place of departure/destination (inside the EU vs. outside the EU) and to the time of arrival/departure (day vs. night or other).
- ⇒ **Parking and hangar charges** (for the use of terminals, aircraft parking space, hangars and other facilities and services) are generally based on the weight of the aircraft (see above) and the length of staying.
- ⇒ **Passenger service charges** are due for the use of infrastructure and common areas for boarding, landing and passenger reception. Charges are paid by the airline to the airport manager *per passenger boarded* at departure and are in general transferred by the airline to the passenger on the ticket price. The charge can be differentiated according to the place of departure/destination (inside the EU vs. outside the EU).
- ⇒ **Security charges** remunerate the costs for security measures, equipment, facilities and personnel. They can include security check operations for passenger and hand luggage and 100% hold baggage screening.
- ⇒ **Noise-related charges** (for financing of noise alleviation and prevention measures) can be imposed on aircraft movements (take off and landing). They are normally

imposed on top of landing and take off charges, differentiated according to the level of noise emissions (e.g. based on the ICAO classification). The revenues from this charge are often earmarked to finance e.g. schemes to reduce noise emissions from aircraft, to complete and improve acoustic pollution monitoring systems, to pay compensation to residents living near the airport area.

- ⇒ **Freight loading/unloading charges** can be due for loading and unloading of freight (except mail) and are paid by the airline proportionally to the weight of the goods.
- ⇒ **Terminal charges** can be collected for air traffic services (including the use of navigation landing equipment) provided to aircraft landing at airports or performing transit flights through the control zone. Some countries have established bilateral agreement with EUROCONTROL entrusting it for billing and collection of terminal charges (currently France - billing only, Ireland, Denmark, Italy - billing and collection and Moldova).
- ⇒ **Other charges** can be levied for instance for the use of special lighting equipment, or for freight loading and unloading.

Airport charges are set autonomously by airport authorities, in compliance with regulation issued by the Civil Aviation Authorities (CAA). If airports are publicly owned, the charges are set by the CAA. ICAO periodically monitors pricing practices among its members, and issues guidance about the underlying principles of charges setting.

In addition to cost recovery purposes, charges are also in some cases used for management purposes, e.g. decreasing congestion at peak hours (aircraft charges differentiation by time of day) or promoting the use of less impacting aircrafts (noise charges).

As a general comment, it seems that the price structure does not reflect management and operating costs, and does not in general differentiate according to changes in demand during the day.

ICAO's guidance to CAA, however, when talking about landing charges states that "allowance should be made for the use of a fixed charge per aircraft or a combination of a fixed charge with a weight related element, in certain circumstances, such as congested airports and during peak periods" (ICAO 2004).

Table 3.15 summarises the charging practices in selected airports in the Member States.

**Table 3.15 Current practice in Airport charging in selected airports**

Airport	Landing and take-off charge	Passenger charge	Transfer charge	Parking charge	Other
<b>Austria</b> Vienna International Airport	<b>YES</b> Landing facilities and installations (lighting, a/c parking positions within the free parking time, marshalling, etc.)	<b>YES</b> Passenger service charge: use of terminal building (installations and facilities by departing passengers); infrastructure "passenger" charge: provision of check-in facilities and transfer facilities (communications-weighing- and conveyer-technique for the check-in of passenger and services)	<b>YES</b> EUR 8.21 per transfer passenger (within a period between the minimum connecting time and no later than 120 minutes after scheduled arrival of the inbound flight)	<b>YES</b> 4hrs free of charge, afterwards the charge per 24h period is calculated in a % of the applicable landing fee	Infrastructure "Ramp": for the provision and utilisation of infrastructure facilities and installations which are used for the supply of ground handling services (400hz, air bridges, baggage sorting area, container storage area, de-icing coordination, waste disposal, environmental control)
<b>Belgium</b> Brussels International Airport	<b>YES</b> Investment in and operating costs of runways, taxiways, taxi lanes, lighting & airside signalisation, fire brigade, snow removal, marshalling, bird control and other infrastructure and services needed for landing and take-off of airplanes	<b>YES</b> Investment in and operating costs of surfaces used by and services for O&D passengers (airside & landside terminals, piers, ...)	<b>YES</b> Investment in and operating costs of surfaces used by and services for transfer passengers (airside terminals, piers, ...)	<b>YES</b> Investment in and operating costs of aprons and other infrastructure and services needed to operate parking places for airplanes.	Security charge for local and for transfer passengers Power system PCA/400 HZ
<b>Denmark</b> Copenhagen International Airport	<b>YES</b> Landing and take-off charges cover the costs of runways, taxiways, apron and appropriate services	<b>YES.</b> The security charge is included in the passenger charge	<b>YES</b> A 50% transfer discount is applied on the passenger charge	<b>YES</b> But they only account for 2% of the total revenue	
<b>Finland</b> Helsinki-Vantaa Airport	<b>YES</b> Landing charges cover the costs of building and maintaining the runways, lightning-systems etc.	<b>YES</b> Passenger charges cover the costs of building, maintaining and developing the terminal buildings and services	<b>YES</b> Passenger charge for (INTINT) transfer passenger is EUR 3.87 whereas passenger charge in international traffic is EUR 11.10 and in domestic traffic EUR 7.23	<b>YES</b> If parking lasts over two hours	Terminal navigation charges, which are based on maximum take off weight (MTOW) of aircraft and electricity charges
<b>France</b> Aéroport Nice Côte D'Azur	<b>YES</b> Financial amortisation of investments, operational and maintenance charges of runways	<b>YES</b> It embodies all the surface and installations used by passengers (halls, waiting lounges, baggage delivery, display, baggage trolleys etc.)	<b>NO</b>	<b>YES</b>	Lighting charge
<b>France</b> Aéroports de Paris (CDG, ORY)	<b>YES</b> Runways, taxiways, directional panels. Aids for approach and	<b>YES</b> Areas of the terminals used by passengers and public for:	<b>YES</b> As of April 1 <sup>st</sup> 2003, a transfer Passengers charge is applied, and its	<b>YES</b> One part based on the maximum take off weight for	Lighting charge (all types of lighting for visual aid: border, central, panels) with transformers

Airport	Landing and take-off charge	Passenger charge	Transfer charge	Parking charge	Other
	landing are not included but paid through the approach charge recovered by CAA.	enplaning: final part of the access road, lobby, passport and security controls, boarding area disembarkment: arrival gallery, passport control, baggage claim, custom inspection, arrival lobby. Part of the terminal building: zone restricted to passengers and proportional part of the common zone	amount is different from that of the charge for origin/destination passengers (10% less currently and 30% in 2005)	contact stands only - one part based on the maximum take off weight and the parking time for both contact and remote stands. As of April 1 <sup>st</sup> 2003, the first hour of the variable part for contact stands is no longer free of charge.	and cabling
Germany Frankfurt Main/International Airport	<b>YES</b> Landing and take-off charges cover the costs of runways, taxiways, apron and appropriate services	<b>YES</b> Passenger charges cover the costs of the terminals as far as they are not used by lessees	<b>YES</b> They do not include a rebate but are lower than the charges for originating passengers because this category of passenger uses more parts of the terminal than transfer passengers. Compared to domestic passenger, the rate is 16.5% lower (EUR 1)	<b>YES</b> They cover the costs of those apron areas where the aircraft are parked	The airport is not providing air traffic control services; these are provided by a subsidiary of the Federal Republic of Germany
Germany Munich Airport	<b>YES</b> Runways, lighting, taxiways, aprons, apron and traffic control, supervision and management	<b>YES</b> Terminals (incl. High Risk Terminal) Passenger and Terminal services and management	<b>YES</b> 22% rebate on charges for domestic or international passenger	<b>YES</b> EUR 2.30 per ton maximum take off weight; 4 hours generally free of charge; overnight 22 pm to 6 am free of charge	
Greece Athens International Airport	<b>YES</b> The aircraft landing charge intends to cover all costs associated with runways, taxiways as well as all other airport costs related to the landing and take-off of aircraft (such as lighting, security, fire rescue etc). Costs (direct or allocated) include asset depreciation, operational costs and interest expenses, plus the allowable profit margin as per the airport regulation. Landing charges are assessed on the maximum permissible take-off weight of the aircraft expressed in metric tones. Charges are increased over night and during the peak period of summer time.	<b>YES</b> The passenger terminal facilities charge intends to cover the costs of Passenger Terminals and other airport costs related to the processing of passengers through the passenger terminals (excluding the cost of passenger and hand baggage screening and the cost of the baggage handling system, for which separate charges apply). Costs (direct or allocated) include asset depreciation, operational costs and interest expenses, plus the allowable profit margin as per the airport regulation. Under the broad term "passenger charges" the security charge, which covers the cost of passenger and hand baggage screening is also	<b>NO</b> There is no differentiation in the charges between origin/destination and transfer passengers. However, the airport development fund tax imposed by the Greek State is 100% exempt for passengers who transfer through the airport	<b>YES</b> Aircraft parking charges (either in hangar space or in Areas elsewhere) are applied in all cases (i.e. there is no initial free parking time) with the aim to receive 10% of the aeronautical charges. They are assessed on the basis of aircraft weight and parking time.	

Airport	Landing and take-off charge	Passenger charge	Transfer charge	Parking charge	Other
		included (a service previously undertaken by the police but now outsourced to a third-party security company)			
<b>Ireland</b> Aer Rianta (3 airports)	<b>YES</b> Runways, Taxiways, Landing aids, Fire services	<b>YES</b> Passenger service charge, (per departing passenger) is EUR 2.75.	<b>YES</b> It amounts to EUR 0.70 (about 25% of the passenger charge)	<b>YES</b> Per 30 minutes or part thereof	Air bridge charges for use of an air bridge; information network services (INS) charges for pre-clearance of US immigration at Dublin and Shannon
<b>Italy</b> Rome-Fiumicino Airport	<b>YES</b> They generally would cover all maintenance and operating costs related to: Taxiways, runways, airside lighting, surveillance, draining and water system, oil extractor, airside fencing, de-icing machinery, electric system, control tower, offices dedicated to CAA, safety activities etc.	<b>YES</b> Passenger terminals (elevators, toilets, passport control posts, cleaning and maintenance, etc.) shuttle bus and people mover train services between terminals, information desks, signage (internal and external), landside road system, free parking, baggage trolleys, drainage and water system, climate control, first aid, terminal surveillance, electric system, CAA offices, etc...	<b>NO</b>	<b>YES</b> They cover maintenance and operating costs related to: stands, drainage system, apron lighting, and common parking area for handlers, etc.	They generally cover maintenance, operating costs, depreciation and remuneration related to passenger security (body check and baggage control), freight charge (per Kg of freight loaded and unloaded) and centralised infrastructures (i.e. baggage handling system, baggage claim belts, loading bridges, CUTE, flight information display system, 400Hz in remote stands, etc...)
<b>Italy</b> Milan Airports (MXP/LIN)	<b>YES</b> Runways, taxiways, associated lighting and generally all aircraft movement area	<b>YES</b> All passenger terminal facilities as far as common areas are concerned (departure/arrival halls, transit area, check-in area and baggage reclaim area, etc) with the exclusion of air bridge charges which are a supplementary charge	<b>NO</b>	<b>YES</b> The first 2 hours are free of charge	<b>Passenger security</b> which includes - body check and hand baggage control - check 100% hold baggage <b>freight charge</b> (per Kg of freight loaded and unloaded) <b>centralised infrastructure</b> (baggage handling system, baggage claim belts, loading bridges, CUTE, flight information system, 400Hz in remote stands, etc...)
<b>Portugal</b> ANA-S.A. (7 airports)	<b>YES</b> Costs related with air-side activity (runways, lighting etc.). Decree Law 102/90 and implementing Decree No 38/91, repealed by Implementing Decree 12/99. According to a Portuguese Law 8 February 2002, landings will be charged only by airlines MTOW and no longer differentiated by	<b>YES</b> Costs related with terminal activity Passengers will be charged according with their destination: -international passengers - intra EU passengers travelling outside Schengen area (74% of International) - passengers travelling inside Schengen area (59% of international).	<b>NO</b>	<b>YES</b> But the first 3 hours are free of charge (90 minutes after landing and 90 minutes before take off)	Use of air bridges

Airport	Landing and take-off charge	Passenger charge	Transfer charge	Parking charge	Other
	origin/destination of the flight. By decision of the Portuguese Regulator, landing charges will not be increased in 2002.	By decision of the Portuguese Regulator, passenger charges will increase 2.8% in July 2002.			
Netherlands Schiphol Group	<b>YES</b>	<b>YES</b>	<b>YES</b> The transfer tariff is per departing transfer passenger equal to EUR 4.08 (on comparison: the passenger service charge per departing O/D passenger amounts to EUR 11.85)	<b>YES</b> According to the Regulation on airport charges ( <i>Havengeldregeling</i> ) the parking charge is payable per 24 hours of part thereof. No parking charge is due if parking takes place for a period of less than six hours.	The Security Service Charge has been introduced from April 2003 (EUR 10.80 per departing O/D passenger and EUR 1.60 per departing transfer passenger) and has replaced the former Airport Security Charge and Security Levy of the Ministry of Justice.
Spain Aena (47 airports)	<b>YES</b> Runways, taxiways and exit taxiways, holding bays. Visual aids and beacons, fauna control system. Follow-me and runway maintenance vehicles. Part of the runway for the landing service according to technical criteria. Facilities devoted to noise control and reduction. Fire-fighting service: vehicles, buildings and equipment (Law 25/98, 13 July).	<b>YES</b> Part of the terminal building: zone restricted to passengers and proportional part of the common zone. Inner signposting, furniture of the passenger zone, trolleys. Information monitors and panels, loud-speaking service	<b>YES</b> Passengers in direct transit are free from the passenger charge. Connecting passengers or in transfer are subject to the payment of the passenger charge	<b>YES</b>	Use of air bridges. Airport security charge per departing passenger (passenger and luggage inspection and control service), increased in 2002. Power system at 400Hz. Fire fighting system.
Switzerland Zurich Airport	<b>YES</b> Runways, taxiways, express taxiways, tarmac, docking system, marshalling, apron control, lighting, signage, maintenance, cleaning, noise, special night noise, emission, fire brigade, airside security, fauna control system, fencing, office space, CAA/police	<b>YES</b> Landside traffic, free trolleys, check in facilities, information desks, terminal management, signage, cleaning, security, counters/offices for customs, police and CAA, noise, gate facilities	<b>YES</b> The airside part of the passenger charge	<b>YES</b> MTOW related, 5 hours free	Noise, emission cargo, fuel De-icing, bag sorting and cute (via handling agent)
United Kingdom Manchester Airport	<b>YES</b> Airfield licence, sound insulation grants & vortex scheme, lighting, runways; apron and tower management; navigation aid; de-icing; instrument landing system (ILS); cargo	<b>YES</b> Passenger facilitation charge: terminal, FIDS, heating, lighting, maintenance, bussing, baggage trolley service, air bridges Passenger security charge: body check, handbag control, hold baggage system, policing, reconciliation	<b>YES</b> Transfer passengers pay only passenger security charge	<b>YES</b> Based on time and MTOW	Noise surcharge; common user equipment charge per passenger;

Source: ACI-EUROPE 2003

Airport charges often do not allow for the full recovery of the costs of service providing. Airports often have to subsidise aeronautical charges with commercial (non-aeronautical) revenues. Airports adopt different attitudes towards the inclusion of commercial revenues into the price cap formula: the single-till approach, which includes commercial revenues and the dual-till, which contemplates a separation of revenues from commercial and from aeronautical activities, such that only the latter are considered for pricing. Table 3.16 shows the findings of an ACI-EUROPE research on this issue research for selected EU airports (ACI-EUROPE, 2005).

**Table 3.16 Relation of aeronautical charges to costs in selected airports**

Airport	Cost-relatedness (do aeronautical charges cover aeronautical costs?)
<b>Austria</b> Vienna International Airport	⇒ <b>YES</b>
<b>Denmark</b> Copenhagen International Airport	⇒ <b>NO</b> Narrow coverage of expenses today. The Danish Government believes in separating aeronautical and non-aeronautical revenues (dual till system).
<b>France</b> Aéroport Nice Côte D'Azur Aéroports de Paris (CDG, ORY)	⇒ <b>NO</b> Airport charges do not fully cover costs. Extra aeronautical charges subsidise aeronautical charges.
<b>Germany</b> Frankfurt Main/International Airport	⇒ <b>NO</b> Aeronautical charges not fully cover costs. Other revenues subsidise aeronautical charges. In 2001 total revenues increased by 6% vs. an increase of total costs by 13.1% In 2003 total costs were covered for 86,5% by total revenues.
<b>Greece</b> Athens International Airport	⇒ <b>NO</b> Aeronautical charges currently cover approximately 60% of corresponding costs (despite the dual-till system, for the time being part of the commercial revenues subsidise aeronautical charges).
<b>Ireland</b> Dublin Airport Authority PLC	⇒ <b>NO</b> Currently airport charges are subsidised by commercial revenues through a single till mechanism.
<b>Italy</b> Rome-Fiumicino Airport Milan Airports (MXP/LIN)	⇒ <b>NO</b> Costs of infrastructure are not covered by the current level of charges (still in average lower than EU level).
<b>Poland</b> Warsaw International Airport	⇒ <b>YES</b>
<b>Portugal</b> ANA-S.A. (7 airports)	⇒ <b>NO</b> Single-till system
<b>Netherlands</b> Schiphol Group	⇒ <b>NO</b> A dual till system is applicable, thus airport charges are cost-oriented on an overall level and based on all aviation costs including financing costs.
<b>Spain</b> Aena (47 airports)	⇒ <b>NO</b> Costs in 2002 were covered for 85% by aeronautical charges.
<b>Sweden</b> Luftfartsverket (LFV) (1)	⇒ <b>NO</b> Cost-recovery on aeronautical charges is 81%.
<b>Switzerland</b> Zurich Airport operated by Unique	⇒ <b>NO</b> Cost-recovery on aeronautical charges is 80%. The objective is to establish a dual-till system.

Airport	Cost-relatedness (do aeronautical charges cover aeronautical costs?)
---------	---

United Kingdom  
"Designated airports"  
(Gatwick, Heathrow, Stansted,  
Manchester). (2)

⇒ **NO**  
charges are set under the single-till principle

Notes:

(1) Luftfartsverket (LFV) is the Swedish airport authority and operates 19 airports in Sweden

(2) All the other airports are free to set their own charges (subject to notification to the CAA before they take effect). The CAA deals with complaints against airport operators by interested parties in cases where airports are exploitative, discriminatory or predatory. The BAA's Scottish airports have a voluntary cap on charges increases.

Source: ACI-EUROPE 2005

## Route charges

Route charges represent the remuneration for the costs incurred by States for the provision of services related to air traffic management<sup>11</sup>, communication, navigation and surveillance systems, meteorological services and other ancillary services, when related to international traffic.

A common *Route Charging System* has been established by Member States in order to harmonise the setting of charges levied on aircraft operators for en-route navigation facilities. This is a regional system in which route charges are set by Member States on the basis of the same formula (based on the costs incurred by the States to provide air traffic facilities and services) and are collected by EUROCONTROL on behalf of Member States as a single charge per flight. EUROCONTROL (through CRCO – Central Route Charges Office) manages the collection of air traffic data from Member States, the billing procedure, the collection of charges and the redistribution of income to the States<sup>12</sup>.

### Route Charge calculation

The charge per flight (**R**) is calculated on the basis of distance flown and aircraft weight and takes into account all the charges (**r<sub>i</sub>**) generated in the Flight Information Regions (FIR) of the individual States (**i**), according to the formula below:

$$R = \sum_n r_i$$

The individual charge (**r<sub>i</sub>**) is calculated as follows:

<sup>11</sup> “Air traffic management is the aggregation of the airborne and ground-based functions required to ensure the safe and efficient movement of aircraft during all phases of operations. It consists of air traffic services (ATS), airspace management (ASM) and air traffic flow management (ATFM)” (ICAO 2004).

<sup>12</sup> The EUROCONTROL route charges system is governed by the *Multilateral Agreement relating to Route Charges*, an international agreement signed in 1981. The accession to the EUROCONTROL Convention implies simultaneous accession to the Multilateral Agreement. Membership to EUROCONTROL and the common route charges system is expected to eventually include all States belonging to the European Civil Aviation Conference (ECAC).

$$r_i = d_i \times p \times t_i$$

where:

- ⇒ The **distance factor (d<sub>i</sub>)** is equal to one hundredth of the great circle distance, expressed in kilometres, between the aerodrome of departure within, or the point of entry into, the airspace of the FIRs of State (**i**) and the aerodrome of first destination within, or the point of exit from, that airspace.
- ⇒ The **weight factor (p)** is calculated on the basis of the Maximum Take-Off Weight (MTOW) as certified in the airworthiness certificate.

**(d<sub>i</sub>xp)** is defined as the **number of service units**.

- ⇒ The **unit rate (t<sub>i</sub>)** is calculated by the individual State (**i**) applying the costing principles provided by ICAO (see ICAO 2004).

Unit rates have as cost basis the “full costs of providing the air navigation services, including appropriate amounts for cost of capital and depreciation of assets, as well as the costs of maintenance, operation, management and administration” (ICAO 2004). Governments can decide to recover less than full cost, on the basis of own policy consideration. Unit rates are composed of two parts:

- ⇒ A **national unit rate**, calculated dividing the en-route facility cost-base of the State concerned for the reference year by the number of service units generated in the airspace of that State during the same year.
- ⇒ An **administrative unit rate**, aimed at recovering CRCO costs and identical for all States, calculated dividing CRCO costs by the number of service units generated in the whole charging area.

National unit rates are annually calculated by States on the basis of guidelines (see EUROCONTROL 2004) and approved by commissions representing the Member States<sup>13</sup>.

A particularly delicate matter for the definition of the cost basis and the calculation of unit rates is the exact identification of costs related to en-route services with respect to other aeronautical costs. To this purpose, EUROCONTROL gives guidance about how to allocate costs between General Air Traffic (GAT) and Operational Air Traffic (OAT) services, between IFR (Instrument Flight Rules) and VFR (Visual Flight Rules) flights and between en route and approach and aerodrome control services.

### 3. Groundhandling service

*Groundhandling service charges* are paid by airlines to the airport manager for the access to the centralised infrastructure and related services<sup>14</sup>. The groundhandling services market has

---

<sup>13</sup> The web site [http://www.eurocontrol.be/crco/public/standard\\_page/basic\\_unit\\_rates.html](http://www.eurocontrol.be/crco/public/standard_page/basic_unit_rates.html) provides unit rates by country.

long been characterized by scarce competition. The Council Directive 96/67/EC on the access to this market at Community airports is a step towards a gradual opening-up of the sector. Charges for groundhandling services are determined on the market on the basis of a multiplicity of factors such as cost, market power, medium and long term objectives of the operator. Charges are often negotiated on a one-to-one basis between the handling services operator and the customer, and are therefore extremely uneven.

According to Directive 96/67, airport managers can reserve for themselves or for another body the management of the centralized infrastructure used for the supply of groundhandling services, should the complexity, cost, or environmental impact make divisions or duplication inefficient (for instance, infrastructures such as baggage sorting, de-icing, water purification and fuel distribution systems). In this case, charges are set by the airport manager (or the body entrusted).

### **3.3 Impact assessment**

#### ***3.3.1 Impact categories***

Within this chapter we explore the chain of reactions (impacts) that result from a pricing policy. Within the description of the impact of pricing policies we make a distinction between direct and indirect impacts (Bröcker et al., 2004 and Tavasszy et al., 2004).

Transport initiatives include the full range of interventions in the transport market: those concerning the development of infrastructure and those concerning the use of infrastructure. Examples of the first type are construction or maintenance of roads and railways (links in a network). These types of initiatives usually aim at enhancing the capacity of a network so as to improve the accessibility of cities or regions. Examples of the second type are transport pricing, speed reductions or improved timetables. These aim to change traveller behaviour and/or improve the quality of service provided by the network.

##### ***3.3.1.1 Direct transport network effects***

Consider a situation in which pricing is introduced, which increases the generalised time and money cost of travel for the user. This change to the network affects a range of traveller decisions.

Route choice: As journey times and prices on the link rise, travellers within the corridor find it worthwhile to reroute. This causes further ripple effects. Further away, these network effects become less distinct, although in theory they are present. These effects are estimated using an assignment model, which represents equilibrium travel volumes, costs and distances on the network. From these, changes in emissions, noise, safety and so on can be derived.

Mode choice: Suppose there is a parallel public transport network to the road network. The increase in road journey times and travel costs causes some travellers to switch to public transport. This effect will be captured in a mode choice model.

Time of travel choice: Pricing is likely to increase cost of peak period journey times when the system is used to capacity, more than off-peak journey times because of the likely charging of

---

<sup>14</sup> Ground handling services include: ground administration and supervision, passenger handling, baggage handling, freight and mail handling, ramp handling, aircraft services, fuel and oil handling, aircraft maintenance, flight operations and crew administration, surface transport and catering services.

scarcity costs. This causes some people to change their chosen time of travel (peak spreading), so as to take advantage of the relative improvement in off peak travel conditions. This effect has often not been modelled (i.e. peak and interpeak have been modelled separately), but the importance of this response is increasingly recognised, and models of transport time choice are becoming available.

Destination choice: Pricing might increase the generalised cost of travel between the places while leaving the cost of travel between other places unchanged. As a result unpriced destinations become more accessible causing some travellers to switch. This effect of trip redistribution is captured in a trip distribution model.

Induced trips: a decrease in generalized cost in accessibility between  $i$  and  $j$  resulting from a transport pricing initiative might encourage people to make new trips which they would not have otherwise made (this is a rebound effect induced by a decrease of congestion on priced links). In principle, this effect is captured in a trip generation model where the trip rates are sensitive to the travel cost which change as the network is improved. In practice, though, trip generation is frequently modelled as inelastic to travel cost. When pricing is implemented this results in increased generalised costs and would lead to a reduction of trips (travelling upwards the demand curve).

There are many other potential responses to changes in travel conditions. Trips may be linked into multi-purpose trips or separated; car occupancy might be affected; there might be car ownerships effects.

So the following conclusions can be drawn:

- transport network models are capable of representing some of the most important effects of transport pricing initiatives;
- but other effects are generally not modelled
- in practice there are likely to be different lags on the various responses. Route choice and departure time adjustments may occur rather quickly when the network is changed, while the other responses will be lagged. This is partly because of information loss and partly because of habit and adjustment costs.

### ***3.3.1.2 Indirect effects***

The previous sections have analysed the responses to transport pricing initiatives that are contained within the transport markets – they are reflected in trip rates, destination choice, route choice and so on. The transport scheme changes the accessibility surface of the local or regional economy and one would expect the land-use, production and labour market patterns to change as a consequence. Households and firms will wish to relocate in order to take advantage of the new opportunities and these changes will be facilitated by the property development sector. New residential, commercial or industrial settlements may develop. As a consequence new commuting and physical distribution patterns may occur, and the competitiveness of firms in particular locations may change, and so therefore may local economic competitiveness. These are the **indirect effects** of a transport pricing initiative on the rest of the economic system: impacts on land-use, migration and the local economy will in turn have rebound effects on the transport system. A spatial redistribution of activities (production, work, home) will again lead to a different pattern of transport choice-making. It is these rebound effects which we call **indirect transport network effects**. In IASON the indirect effects of pricing have been studied.

### 3.3.2 *Interurban road pricing: evidence from modelling*

In this section we will describe the results of models run in three studies carried out in Europe:

1. the IASON project, where an impact assessment of SMCP in the road freight market throughout Europe was carried out (Tavasszy, Renes and Burgess, 2004);
2. the ECMT study “Reforming transport taxes” (ECMT, 2003), which used the TRENEN model mostly to examine the impact of pricing reform in Britain, France and Germany;
3. the MC-ICAM project, which used a variety of models (Niskanen and Nash, 2004 and Henstra et al, 2003).

#### 3.3.2.1 *Evidence from the IASON project*

##### **Direct impacts**

In IASON an impact assessment of SMC pricing in the road freight market throughout Europe was carried out. The SCENES Regional Economic and Transport Model was applied to assess the direct effects on the transport system of a charging of road freight transport.

Charges were applied to Interzonal links as follows:

1. Each link is charged pro-rata by distance with the appropriate values for each SCENES zone or *mountainous* area it passes
2. The zone-specific heavy lorry charge in Eurocents/km is determined from the above table and based on a detailed breakdown by zonal population density.
3. Exogenous lorry charge were calculated from:  $\Sigma$  link distance within zone x charge/km for that zone

For Intrazonal trips, *effective* zonal densities were determined and related to the charging levels and used for identifying the charges to apply for *shorter* Intrazonal freight links ( $\leq 20$  km). The *longer* intrazonal freight movements ( $> 20$  km) are charged as interzonal links using the zonal average population density. Apart from this distinction the method employed is the same as for Interzonal links, with the exception that when a zone overlaps a *mountainous* area the proportion of overlap by area has been used as the weighting factor by which to apply the mountainous charge rate. The remainder is charged at the intrazonal rate (for shorter intrazonal trips), or interzonal rate (for longer intrazonal trips). Light trucks and intrazonal movements were assumed to be charged at a level of 81% of the interzonal, heavy goods vehicle trips. This assumption is based on a detailed inventory of external costs as carried out within the TIPMAC project and explained previously.

This charging regime was tested using the SCENES model, for the year 2020. The model compares a base scenario against an alternative scenario that includes the charging. It indicates the following impacts:

- ⇒ Changes in the routes used by trucks
- ⇒ Changes in the fleet of trucks

- ⇒ A shift to combined transport, including rail and shipping
- ⇒ Increased sourcing of production inputs and consumer goods from local suppliers
- ⇒ Changes between EU regions in the location of manufacturing and service industries.

We elaborate on the key impacts observed below.

**Less traffic in urban areas.** As roads in urban and metropolitan areas are charged at a higher level, road freight traffic tends to move away from these areas, and concentrate on the more rural, interurban routes. This increases the journey lengths by trucks for some movements, but it reduces the overall exposure of the population to the truck traffic.

**Higher proportion of the larger trucks.** The charges on each small/medium truck (typically 7.5 to 10 tonnes gross vehicle weight) are 81 percent of those on a heavy truck (typically 33-40 tonnes gross vehicle weight). But the cost per tonne carried rises more sharply for the small/medium trucks, because there are fewer tonnes of payload on the small/medium trucks to absorb the charges. The cost increase encourages the use of larger trucks, and hence better consolidation of road freight. This impact varies by commodity, however.

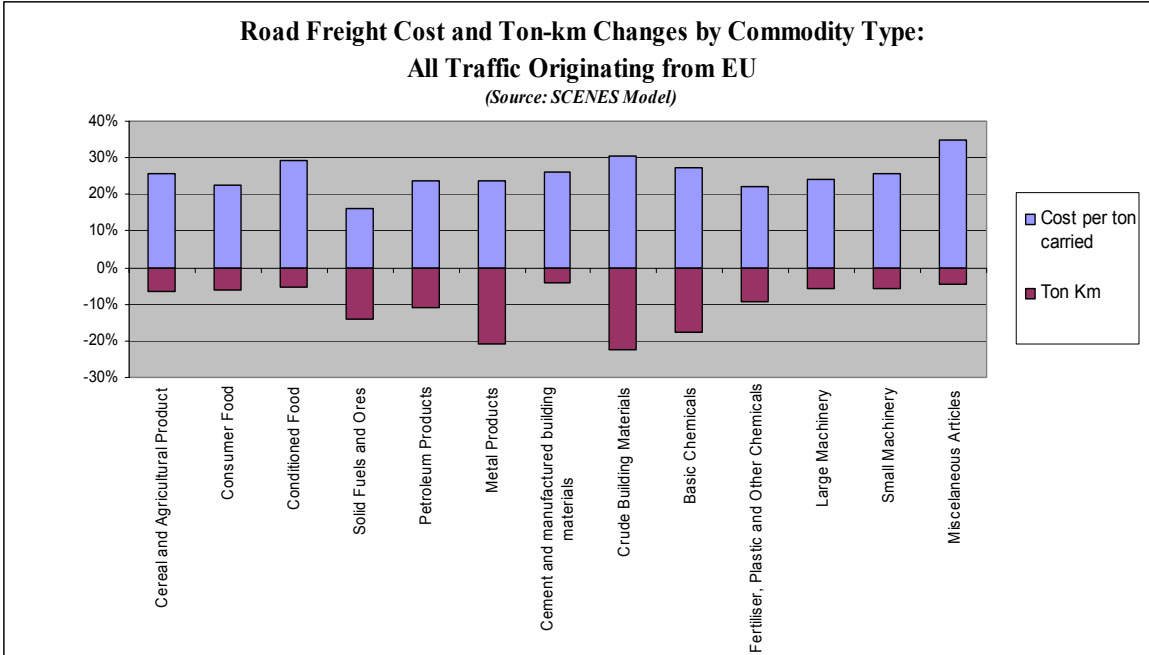
**Growth on combined and intermodal transport.** A modest two percent of road freight tonnes is transferred to rail and coastal shipping. However, these are the medium to long distance movements. In the EU, six percent of road t-km shift to rail and shipping. Nevertheless, the model shows that without reductions in local distribution costs for rail and water-borne freight, the extent of modal shift from road will be very limited for unitised cargo.

**Changes in trade and industrial location.** Approximately half of the reduction in total truck traffic stems from long term changes in the patterns of trade. As road costs rise, production inputs and consumer goods are sourced in greater proportions from suppliers nearby. This leads to changes in the location of manufacturing and service industries within the EU.

Figure 3.4 provides an overview of the present transport cost levels and the reductions in transport performance (t-km) after charging, for different categories of goods. It shows that the sensitivity to charges differs considerably among these goods types. The traditional bulk and semi-bulk products reduce their t-km more readily, through shortening of trips as well as modal shift. The value dense, finished products, such as food, machinery and other unitised cargo, tend to have much smaller falls in road traffic levels, in spite of considerable rises in road freight costs.

Figure 3.5 shows the total t-km changes by country, for traffic originating from the EU. Tonne kilometre reduction tends to be small in the periphery, especially in Greece and Ireland, and also in Spain, Portugal and Finland. Road freight traffic from the core regions, especially Germany, sees reduction in t-km higher than the EU average. The level of charging in the peripheral countries is lower. Nevertheless, the changes also reflect the availability of non-road alternatives in different countries.

**Figure 3.4 Road Freight Cost and t-km Changes by Commodity Type: All Traffic originating from EU**



Source: Bröcker et al. (2004)

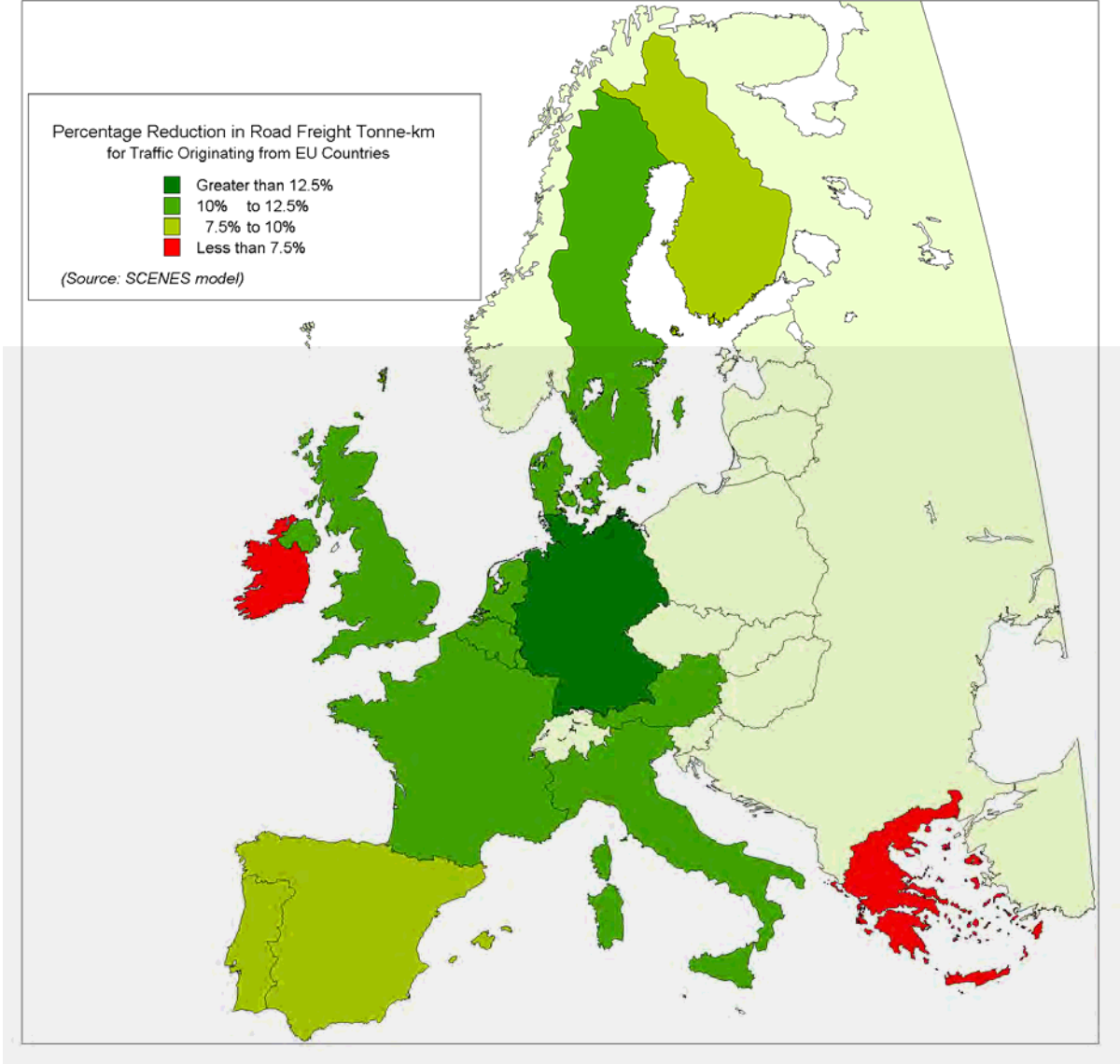
The corresponding reduction in CO<sub>2</sub> equivalent emissions, mirrors the spatial pattern of tonne kilometre changes. However, the extent of reduction is greater, reflecting the improved efficiency in the use of trucks.

However, we define all the above effects as **direct transport network effects**, these are usually quantified with a advanced transport model.

**Indirect impacts**

An interesting spatial pattern emerges from SMC pricing, that leads to a general increase in travel cost and transportation cost. Note that, in order to isolate the spatial effect of the pricing itself, we assume no redistribution of revenues. Revenues are “burned”. Exactly the same spatial pattern would emerge, if a lump-sum redistribution proportional to GDP instead of burning was assumed. Only the level would be different, the weighted average of effects would be close to zero. In fact it would be slightly negative, because the welfare loss exceeds the revenue slightly. Note, however, that this is only the case because the intended welfare gain resulting from internalisation of externalities is not included in our model. Neither do travel times react on a reduction of travel flows induced by higher out-of-pocket costs, nor is an improved environment felt by the households as a utility gain in our model. It should be emphasised that the overall negative welfare impact of the pricing scenarios must not be misinterpreted as a statement against efficiency gains from SMC pricing. The IASON experiments just isolate the effects which form the cost side.

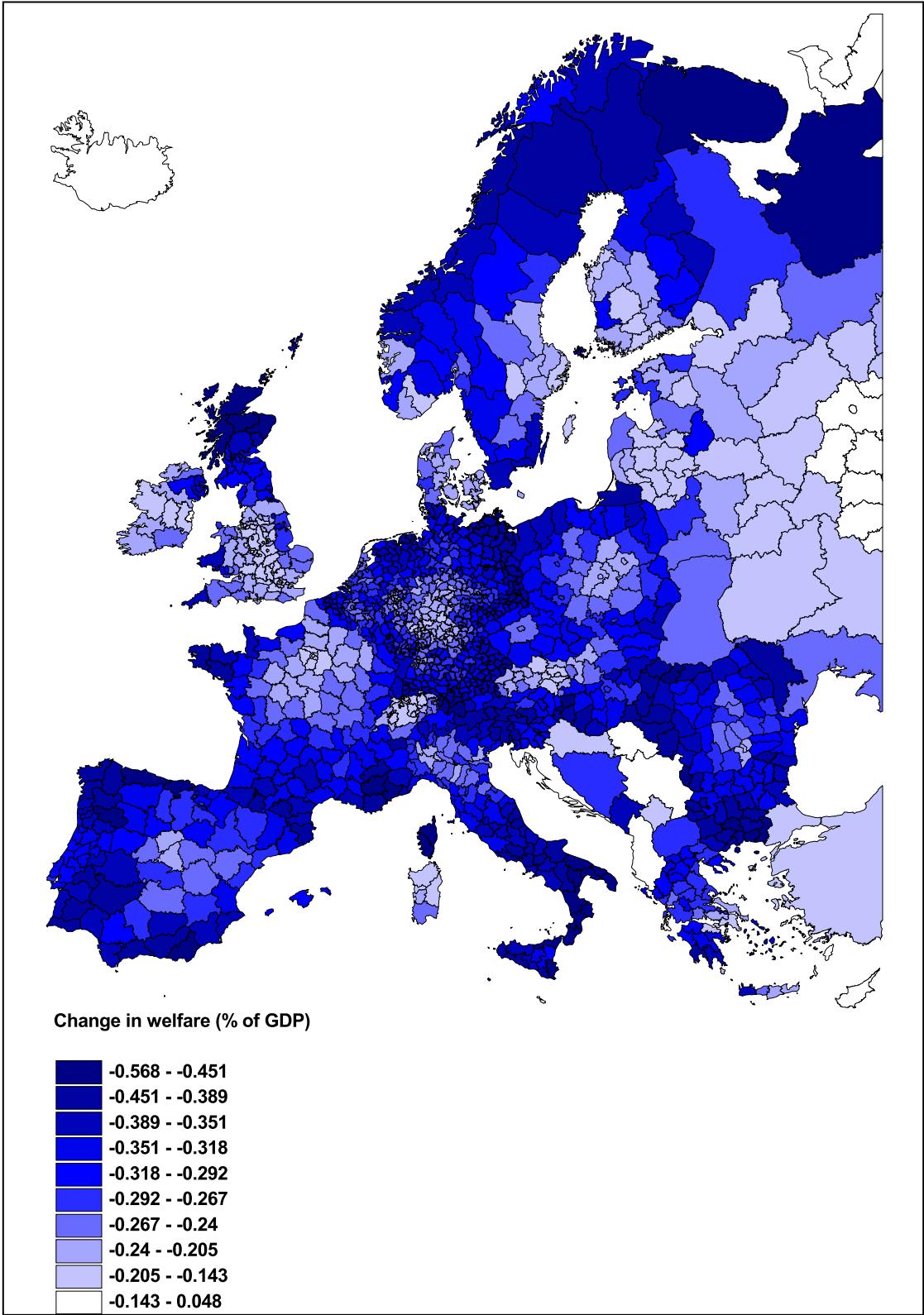
**Figure 3.5 Percentage Reduction in Road Freight t-km by EU Country of Origin**



Source: Bröcker et al. (2004)

The spatial pattern is an overlay of two centre-periphery patterns, a national and a European one. Within each country, regions with a high market potential suffer from the smallest losses, those in the national periphery lose most. This is most clearly observable in large countries like UK, France, Germany, Spain, Italy and Poland, but even in smaller countries such as Greece (see the light colour around Athens on the map in Figure 3.6) or Denmark. These national patterns are overlaid by a similar, though less pronounced pattern on a European scale, so that peripheral regions will suffer most (see e.g. Portugal, Scotland, Southern Italy or Northern Norway and Finland). It should also be noted that SMC pricing is enforcing spatial inequality, because the aggregated welfare loss is the larger, the bigger is the assumed inequality aversion. This is because peripheral regions tend to be poorer than central ones. The impact of the inequality aversion parameter is however small, which means that even though the spatial distribution is contradicting the cohesion objective, the degree of increasing inequality is too small to be regarded as a real problem. Besides effects on the general commodity markets (as measured by GDP) also effects on other markets such as labour, land and housing markets and also the government budgets.

Figure 3.6 Scenario with SMCP Applied to Road Freight in 2020 (IASON)

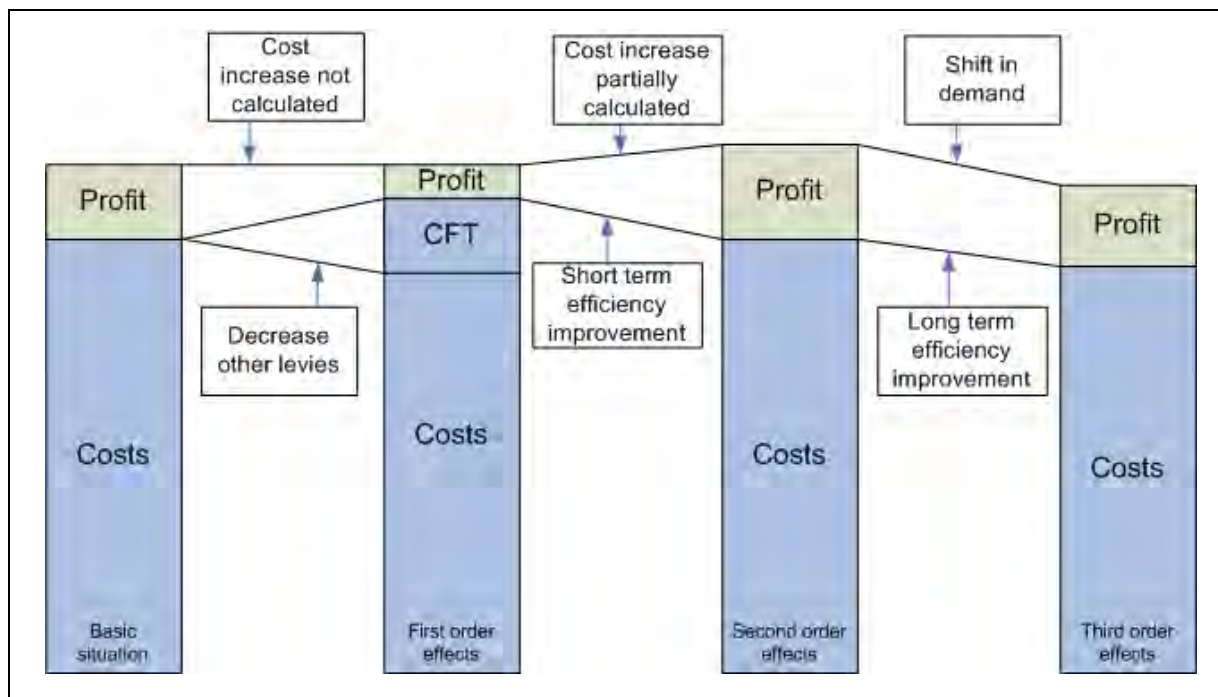


Source: Bröcker et al. (2004)

## Conclusions

Figure 3.7 summarises the direct and the indirect effects in a case for freight transport. The initial situation is without a charge, the first order effect is likely to reduce the profitability of transport firms. Transport firms try to increase their efficiency (less empty riding, improved logistics) and will also put the cost of SMC pricing onto their customers so as to increase the profitability. This will lead to a long term adaptation of demand, in the end leading to less transport with the specific mode (and also an overall reduction of demand).

**Figure 3.7 Inter-temporal impacts of pricing (including industry reactions).**



Source: TNO

### 3.3.2.2 Evidence from the ECMT Study

Work on modelling optimal charges for transport was undertaken for the ECMT and EC, and the results suggest that, taking together Britain, France and Germany, net welfare gains to society of over EUR 100 billion a year could be achieved (ECMT, 2003).

Table 3.17 below illustrates the effects of marginal social cost pricing in non-urban areas in 2000 on traffic volumes of various modes. In aggregate the impacts are small and variable. Peak car traffic falls in Britain and Germany though not in France. Bus traffic increases somewhat in Britain and greatly in Germany. Rail loses peak passenger traffic, but gains off peak in Britain and Germany. In these countries rail also gains freight but the impact on road freight is small. The main reason for these differences is the starting point in terms of existing charges in the different countries.

**Table 3.17 Change of traffic volumes in non-urban areas in 2000 (in %)**

Mode	Great Britain	France	Germany
Cars peak	-5%	0%	-4%
Cars off-peak	1%	0%	-1%
<i>Sub-total cars</i>	-2%	0%	-3%
Buses peak	5%	0%	14%
Buses off-peak	4%	-3%	24%
<i>Sub-total buses</i>	5%	-2%	19%
Passenger rail peak	-10%	-9%	-2%
Passenger rail off-peak	3%	-11%	9%
<i>Sub-total passenger rail</i>	-4%	-11%	3%
Trucks and vans peak	-1%	0%	0%
Trucks and vans off-peak	1%	2%	1%
<i>Sub-total trucks and vans</i>	0%	2%	0%
Freight rail	6%	-1%	5%

Source: ECMT (2003)

### 3.3.2.3 Evidence from the MC-ICAM models

Four simulation-modelling case studies were carried out for interurban transport, focusing on the Netherlands, the UK, the EU-15 and Norway. The case studies concentrated mainly on freight transport, as being the priority problem, but also considered the interaction between freight and passenger charging, between modes of transport, and between charges and the rest of the economy, including via the use of revenue. In three of the case studies, existing dynamic network models were used: SMILE for freight transport in the Netherlands, SCENES for freight and passenger transport covering all of Europe and PINGO/NEMO for freight transport in Norway. A new, more aggregate, model was developed (KUL) for the fourth case study dealing with freight and passenger transport in the UK.

The three case studies in which the dynamic network models were used evaluated the following implementation paths (IPs) defined in Niskanen et al. (2003):

1. “Do nothing” (or “Do min”)
2. “First best”
3. Phased implementation starting with HGVs
4. “Only road pricing for freight transport”
5. “Only road pricing, all traffic”

⇒ KUL - The case study shows that an increase in peak period road freight taxes increases welfare, given that road congestion is an important issue and freight and passenger taxes are below the marginal external cost. The welfare optimising charge for freight transport depends on the level of road passenger transport charges and on the use of tax revenues.

⇒ SMILE - with the do-nothing approach, total transport volume of all modes was found to increase by 55% between the years 2000 and 2020. All modes grew, but the modal shares of inland waterway (IWW) and rail slightly increased at the expense of road transport (by 0.5% and 0.7% respectively). In absolute terms road transport accommodated most of the growth. It was found that there would be a reduction in environmental and safety costs per kilometre due to technical developments, but the higher transport demand causes total

externalities to still increase. The other IPs showed between 0.2-1% lower total transport volume compared to the do nothing approach. There was additional market share for road transport under all implementation paths. The highest welfare gain is found under full internalisation of external costs with geographical differentiation of charges.

⇒ PINGO/NEMO – with all IPs, the sum of total freight transport on road, rail and water in Norway increased and the increase was greatest when marginal social cost pricing (MSCP) was applied to all modes and revenue was redistributed to the consumers. The second largest increase was when MSCP was applied to only road, and revenue was redistributed to the consumers. The do-minimum modal split is in favour of road transport due to greater advances in fuel efficiency for road transport than other modes. MSC pricing IPs were in favour of waterborne transport in the short run due to marginal cost pricing leading to increased transport costs for road transport, but in the long run it was in favour of road transport due to the improvements in technology which led to less road transport taxes. It was found that both MSCP and improved technology reduce external costs over time. The overall welfare effects were measured by effects on household utility plus external costs of freight transport plus revenue redirected as funds for unspecific use in the public sector. Generally, the effect of marginal social cost pricing on household utility is negative when revenues are directed to the public sector but positive if revenue is redistributed to households.

#### ***3.3.2.4 Evidence from SPECTRUM (new Member States)***

The direct and indirect influence on traffic demand, “multiplicatory” effects of changes in fuel prices and motorway charges are the most relevant conclusions of the SPECTRUM analysis. Most important conclusions of the analysis are in the following (see more details in SPECTRUM, 2004).

Fuel prices as general policy instruments are proposed to be applied only under special circumstances or for special reasons, e.g. internalisation of external costs for marginal cost based pricing, considerable lack of central state budget, undesired modal split or serious congestion problems on all roads.

While fuel price has a limited influence on the traffic flow in general, but it has a strong economic effect, motorway charges have relatively small welfare effects but they are sensitive enough to influence the traffic demand. Effects of motorway charges are called “economic regulatory paradox”, where the instrument with smaller welfare influence has stronger effect to the user behaviour. In case of motorway charges it is very important to state clearly to the public: the charges are not measures to ensure extra profit to the infrastructure manager or to the state budget.

Improvement of motorway network has strong economic effects on regional as well as national level. This statement is also proven when motorway is charged.

#### ***3.3.3 Interurban road pricing: evidence from practical experience***

Whilst charging reforms have taken place in both the road and rail sectors, research on the impacts of charging reform is focused very heavily on the road sector. This concentration on road is, to a large degree, understandable as most observers acknowledge that the various measures to charge more appropriately for the use of the road system give rise to the most significant impacts. The paucity of evidence on the impacts of charging reform in the rail

sector represents something of a gap in the research at present. In relation to actual reforms of rail infrastructure charging, it is believed that the high infrastructure charges in some of the central European countries, most notably in Poland, suppress the demand for transit rail traffic, though there is no 'hard' evidence of this. Where modelling work has considered rail infrastructure charging reform, it tends to look at both road and rail charges changing together, without separating out the different impacts – again on the basis that it is likely that the road impacts will dominate.

This section will concentrate on experience in Switzerland, Germany, Austria and Great Britain.

## **Switzerland**

The Swiss Heavy Vehicle Fee (HVF) came into operation on January 1<sup>st</sup> 2001. The charge was levied on the entire Swiss public road network, applying to both Swiss and foreign vehicles alike, weighing over 3.5 tonnes. The tax is calculated based on the distance travelled, weight and emissions of the vehicle. In assessing the impact, it has to be acknowledged that the HVF was not implemented in isolation, but the weight limits were also increased at the same time.

Balmer (2003) explains that the introduction of the HVF led to remarkable changes within road transport. There was a change in fleet composition because in the year before the introduction of the HVF, sales of heavy goods vehicles increased by 45%. Truck owners saved money as new vehicles belong to the lowest and therefore cheapest emission class and the admissible weight of the trucks in the fleet could be better matched to the actual needs of the market. The HVF system led to a concentration in the hauler industry, either through mergers or closure of smaller firms. Larger firms were able to manage their vehicles more efficiently and avoid empty runs as empty vehicles cost as much as fully loaded vehicles. In terms of road performance, nationally there was a change to the growth trend as annual increases of vehicles on motorways were replaced by a fall after the change from a flat fee to a distance related fee. In transit traffic across the Alps, the higher weight limit led to an increase in articulated lorries, which was almost outbalanced by a decrease in lighter lorries. This meant that the total number of lorries crossing the Swiss Alps in 2001 was stable and is currently about equal to the level before the HVF.

It was indicated by Balmer (2003) that no significant impact could be measured in 2003 on the performance of rail transport. This may have been due to fact that the competitiveness of rail due to the HVF was outbalanced by increased productivity in road transport because of the higher weight limit. Railways had to improve their productivity as well to gain a higher market share.

Gross annual revenue generated by the HVF in 2002 was EUR 600 million and the average implementation costs were roughly 8% of gross annual revenue at EUR 45 million. The net revenue of the HVF was EUR 525 million which was distributed in the following amounts; EUR 5 million for reimbursement to cantons for their operational costs, EUR 10 million for reimbursement for additional enforcement, EUR 175 million for share cantons, and EUR 335 million for the share federation which is used mainly for rail projects (Balmer, 2003).

A study after four years found that even though there were higher costs of transport by road haulage, there were no significant changes in the modal split. The study states "The new traffic regime has led to a sustained change in the road haulage sector. The trend towards an ever growing number of lorries on the roads has been broken and the negative effect on the environment shows a significant decrease. The rail sector's share of freight remained steady."

(Swiss Federal Office for Spatial Development, 2004). McKinnon (2005) stated that once the new trans-Alpine rail tunnels which are largely funded by HVF revenue are opened in 2007 and 2014/15, rail would capture a much larger share of the Swiss freight market.

### **Austria**

The Austrian charge came into force on January 1 2004. It applies to all vehicles exceeding 3.5 tonnes, using the Austrian motorways and expressways. It is based on the distance travelled and the number of axles. The expected total revenue for 2004 was EUR 600 million.

### **Germany**

The German heavy goods vehicle (HGV) charge was introduced in January 1 2005, applying to all lorries exceeding 12 tonnes gross weight. The tax is calculated based on the vehicle's environmental status (engine emission levels) and the number of axles.

The scheme is expected to raise around EUR 2.4 billion a year, which is proposed to be spent on road and rail infrastructure. Six months on since it was introduced, Kossak (2005) stated that revenue of EUR 1.4 billion has been generated, which is in-line with the expectations. 11 billion v-km have been travelled in the past six months, where 30-35% is performed by foreign trucks. It was found that there has been no traceable increase of transport charges and no significant impact on the structure of the trucking industry. Also there seems to be no traceable impact on consumer prices, however according to model calculations, the increase would be 0.15% on average if the toll was fully compensated. So far, there has not been any significant shift from road to rail or inland waterways. However in some areas, many trucks use alternative toll-free routes which causes environmental and safety problems. These routes are expected to be tolled next year. It has been estimated in Germany that 'up to 5% of truck traffic has diverted away from motorways to minor roads to avoid the charges.' (International Freighting Weekly, 2005)

### **Conclusions on impacts of road infrastructure charges**

Practical experience suggests that heavy goods vehicle charging can have significant effects on the types of vehicles selected and the way they are used. There is however no real evidence of charges in mode split, although in the case of the longest lived of these systems, the Swiss, that is not surprising since the impact of charges was offset by permitting heavier vehicles.

The modelling exercises also suggest that efficient pricing would have a significant, but small impact on mode split. Overall impacts are highly positive for economic welfare in all studies.

### ***3.3.4 Inland waterways and maritime transport***

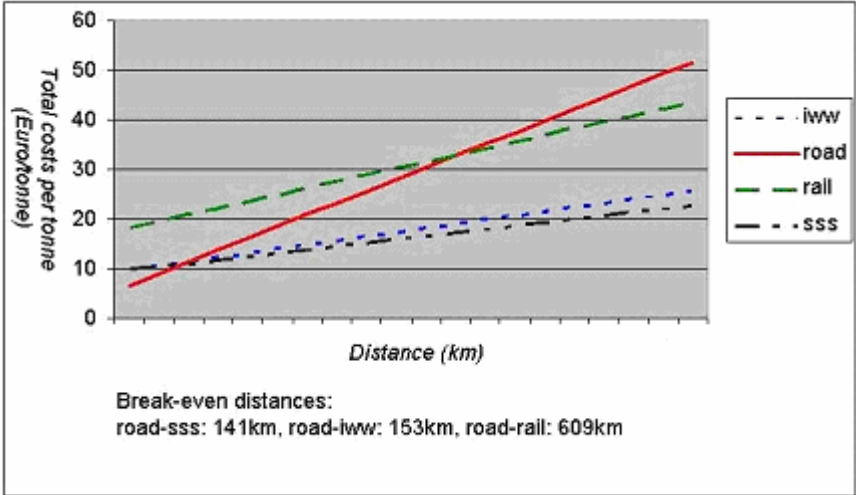
#### ***3.3.4.1 Evidence from inland waterways***

##### **Cross elasticities in relation to other transport markets**

Once charging is introduced their consequences need to be analysed in the transport market as a whole. Current competition between different modes is shown in Figure 3.8 for unitised transport to and from Rotterdam (in total cost per tonne, expressed in tonnes to ensure

comparability although TEU would be more appropriate). This cost situation for inland waterways (which had in 1998 a break even distance of about 350 km) is one of the causes for the relatively fast growth of container transport by inland waterways on the Rhine in the last decade). The situation in 2002 is illustrated in Figure 3.8.

**Figure 3.8 Break even points in intermodal transport in relation with Rotterdam, 2002**



Source: TIPMAC project

It can be observed that if marginal cost pricing were applied, the cost increase for road transport would be significant, while for rail, inland waterway and sea transport the increase would be negligible. It can be concluded that the corresponding charges (as promoted e.g. by TIPMAC for what concerns Rotterdam) would not have a sizeable effect on the demand for intermodal transport (this however varies within Europe depending on the specific commodities consumed and produced in regions).

In the water sectors, reform of infrastructure charges will be more heavily linked to intra and inter modal competition. In countries where there is little intra-modal competition and where the mode is strongly positioned in relation to other modes, the level of charges will be less important an issue than where inter and intra modal competition is strong. It is also likely that acute capacity problems will focus attention on pricing to reflect scarcity. The stronger competition and the more acute capacity problems the more sophisticated a system is likely to be both justified and acceptable.

All in all, it is fair to admit that generalisation based on existing case studies is problematic. As illustrated in MC-ICAM (Niskanen and Nash, 2004), an implementation path is interpreted as a sequence of second-best optima, defined by successive sets of constraints on pricing which in turn depend on successive sets of underlying barriers, and it is the latter element that will ultimately determine the viable implementation paths – and the most desirable among these – for a specific situation.

**Economic and social consequences**

At present the inland waterways sector consists of a large share of small ships (ships less 650 tonne deadweight capacity). Most of these ships are in a “captain/owner” construction. A relation exists between the class index of the waterways and the average size of the vessels (in

France with relatively much of its waterways in the lower ECMT class, therefore we observe a larger share of small vessels in France). It could be the case that due to the introduction of marginal cost pricing (related with other developments such as the RIS) the smaller vessels cannot bear these costs (diseconomies of scale). A more professional way of working is needed in order to deal with new technology, this could have an adverse effect on the modal split especially in areas with smaller waterways.

### **Spin off to other sectors and industries**

The introduction of pricing and levying mechanisms could go hand in hand with better ICT services, especially in relation to RIS. Furthermore, the increase in the weight of fuel costs (currently about 1/3 of the total cost) would stimulate technological developments of ship engines, and earlier replacement of less efficient engines.

#### ***3.3.4.2 Evidence from the maritime sector***

### **Cross elasticities in relation to other transport markets**

In most countries maritime transport has a considerable share in freight transport. In some of these countries there is no competition, because regions are normally only accessible by maritime transport (at least for larger shipments), think of inter island transport in Greece and the UK. So in these cases there will be no modal split effect. In other countries it could harm the position of maritime transport as it is competing with the inland modes, unless price increases there were greater.

### **Economic and social consequences**

As the maritime sector is a professional sector where a lot of regulations are already implemented and will still be implemented in the near future, the introduction of pricing regimes will not have impacts which are larger than present ongoing regulations such as port services regulation. At the moment there is already discussion within the European Commission on introducing a charge on marine transport with respect to global warming effects.

### **Spin off to other sectors and industries**

The marginal cost pricing will push the development of so-called ‘green vessels’, more environmental friendly vessels. These vessels have for example a totally new hull shape design, electric-diesel propulsion and a double-skinned hull to decrease the consequences after an accident. These new vessels will cause an increase in the development of new ship building technology and industry.

The Swedish example shows that marginal cost pricing can help in reducing the external environmental effects. Currently, 37 ships in Sweden qualify for NO<sub>x</sub> rebate. Ships having NO<sub>x</sub> certificates will have emissions measured at a regular basis in order to make sure that emission levels are in line with the certificate. Preliminary calculations show that with these 37 ships, NO<sub>x</sub> emissions could be reduced by approximately 36,000 tonnes per year.

### 3.3.4.3 Conclusions

Some general conclusions can be drawn from the above considerations:

- ⇒ A modal shift towards inland waterways and maritime transport, depending on the levels of SMC pricing, is to be expected.
- ⇒ Possible effects on routing in inland waterways, levying charges on some parts of the river network, could attract traffic to the non-charged routes/harbours.
- ⇒ Pricing affects the decision making in industries that rely in water transport. It is sometimes stated that firms will relocate as a result of the German MAUT and will therefore investigate less transport intensive solutions by opening up branches close to customers (this would lead to more maritime transport to German ports and thereby avoiding Dutch ports).
- ⇒ The impact can be different with respect to the commodities transported, this certainly counts for inland waterway transport where a large part consists of bulk transport and container transport is becoming an increasingly important market segment.
- ⇒ For inland waterways there would be a limited reaction on GDP as a considerable amount of inland waterway transport concern traditional bulk such as construction and animal feeding products which have in general low added value. The transport costs form in general a large part of the market price. However the containers/unitised load is a strong growing segment in inland waterways, a charging policy could have a negative impact (depending on pricing in other transport markets).
- ⇒ For a large part the demand in maritime and inland waterways is inelastic, so the chance of setting off the charges to clients will be large. Depending on the height of the charge this could lead to rerouting (for example instead of taking a longer route in the UK to a port, now a closer seaport will be chosen in order to reduce the road leg).

## 3.4 Revenue use

### 3.4.1 Overall summary of state of the art

Research on the impacts of transport pricing reforms based on social marginal cost has produced abundant evidence consistently indicating that the implementation of reforms will generate effects unevenly distributed across modes and countries. In particular, it can be said with a reasonable degree of confidence that substantial surpluses can be expected on more congested roads, while substantial deficits are more likely to happen on the other roads and on rail. The EC is turning a growing attention to the issue of how surpluses should best be used, i.e. how the government that receives the money should best transfer back the benefits to the community: both research and experience show that alternative ways of spending revenues are likely to have significant effects on the efficiency of the scheme itself, on income distribution (between groups, between regions, etc.) and on public acceptance.

The debate on the use of revenues assumes relevance in a context where the EU and Member States are facing both pressing infrastructure investment financial requirements (see e.g. TEN-T and TEN-E) and stringent budget constraints. Issues like the opportunity, feasibility and efficiency of solutions whereby revenues from pricing the use of transport infrastructure are earmarked to the transport sector itself (with implications such as cross-financing between modes of transport) are likely to swiftly reach the top of the policy agenda.

A number of studies on acceptability of transport pricing have concluded that earmarking of revenues for transport-sector-related purposes is a key requirement to achieve public acceptance (Schade & Schlag, 2000; Ubbels & Verhoef, 2005). Though it seems to be clear that earmarking matters (in particular in the road sector), it is still unclear which type of earmarking is more or less acceptable to the different stakeholder groups (cf. Suter et al., 2005). In particular in less well researched sectors like air and water further studies are required to obtain more information about the revenue preferences of different stakeholders.

### ***3.4.2 Various approaches to the problem of pricing and investments for a transport infrastructure***

The standard neo-classical approach to the problem of pricing and investments for a transport infrastructure is based on a substantial body of literature which sets out from the conceptual work of Mohring and Harwitz (1962). An overview of these theoretical contributions has been carried out in the REVENUE project<sup>15</sup> and can be found in Laird et al. (2004) and Proost et al. (2004).

Laird et al. (2004) summarise the main findings of this literature as follows:

- ⇒ Assuming the presence of constant economies of scale in the transport system and the prevalence of “first-best” conditions, optimal pricing set at the level of marginal social costs would allow the network to fully recover its costs, including capital costs (self-financing theorem).
- ⇒ The hypothesis of increasing returns to scale or discrete capacity undermines the possibility of transport infrastructure self-financing under marginal social cost pricing regimes (this may be true of rail infrastructure, as well as scheduled transport services).
- ⇒ For highways, the empirical evidence suggests that returns to scale are approximately constant with respect to capacity, and that prices based on social marginal costs (SMC) can therefore be approximately cost-recovering for an optimally designed system.
- ⇒ In the prevalence of second-best conditions in the transport system, the theory does not provide clear evidence about the implications of MSC pricing on cost recovery (e.g. competing modes priced above or below MSC, indivisibility of capacity which prevents demand to adjust smoothly, sub-optimality of past investment which can not be optimised readily).
- ⇒ Internalising external effects such as environmental and accidents impacts into the price mechanism through Pigouvian taxes will imply either a surplus or a deficit, depending on the price elasticity of demand.

This traditional neo-classical approach based on comparative statics models has been criticised as not useful to give answers in the context of the pricing-investments relationships in the transport sector. The two major criticisms consists in the fact that this economic modelling i) does not consider the variety of decisions situations at the micro level and ii) does not consider inter-sectoral links, which are essential in the long run (Rothengatter, 2005). These critics move from the consideration that when taking into account pricing and investment for transport infrastructure, the following concerns arise:

---

<sup>15</sup> REVENUE – Revenue Use from Transport Pricing is a EU funded project under the 5<sup>th</sup> Framework Programme.

- ⇒ Dynamic changes of the transport system in the long run are more important than short-run optimisation.
- ⇒ Setting incentives and procurement correctly is the key issue for political management.
- ⇒ It appears that the institutional levels deciding on investment and pricing in the transport sector are becoming more complex, including multiple principals and agents with different decision competences.
- ⇒ Political decisions, in this environment, imply an application of different instruments like taxation, charging, budget allocation, subsidisation and regulation, which are scheduled with different intensities over a range of time.

Recent studies such as the REVENUE project analyse the possibility to introduce elements of dynamics within the framework of a neo-classical approach. The MOLINO model is a tool developed in the context of an attempt to devise a more general and systematic theoretical framework to the question of the use of revenues from transport infrastructure charging (Proost et al. 2005 and Suter et al. 2005). Some dynamic features are introduced in MOLINO combining neo-classical optimisation calculus with recursive simulation features. The theoretical framework developed in REVENUE, takes into account the issues of procurement, of multiplicity of government levels and of multiple regulators. The main features of this theoretical work are summarised below.

### **1. Cost structure, pricing and deficits**

The self-financing theorem holds if marginal cost of capacity expansion is constant. Empirical evidence highlights that for roads this assumption approximately holds, while for the rail sector the evidence is controversial.

### **2. Public Finance aspects**

The cost of an investment depends also on the way it is financed: it is very likely in fact that public funding comes mostly from labour taxes, which implies a high efficiency cost. This has two implications: i) that the cost-benefit ratio of an investment also depends on the way it is financed and ii) that revenues might be optimally used to reduce existing labour taxes.

Equity and efficiency considerations can therefore appropriately be included in transport pricing and investment studies provided that sufficient information is available about the users of the infrastructure and the way the infrastructure is funded (who actually pays for the subsidies to fund the investment).

Considering the issue of competition between government levels, it was found that the existence of vertical tax competition (several government levels taxing or subsidising the same car or rail traffic) may be an important limitation of funding options for lower government levels. The limited competition between alternative routes and alternative transport options makes the risk of monopoly charging a likely event.

Finally, political economy models can help to explain the excessive demand (lobbying) for specific transport investments in some regions (common agency lobbying models) and earmarking as a way to commit politicians not to waste the money raised (dynamic political perspective).

### **3. Infrastructure funds and Contract theory**

The choice between public and private management (and the balance between them) of a transport infrastructure depends highly on the divergence of objectives (correcting for

externalities on the public side, gaining market power on the private side) and on financial aspects (cost of public funds compared to the risk premium; leverage, ratings, etc.).

Efficiency gains obtained through the experience of contracting out can to some extent be translated into efficiency parameters: contracting out can generate an efficiency gain of say 5 to 20% in some cases (Proost et al., 2005).

The case for an investment agency is also discussed. Advantages would be that independence would ensure the credibility of commitments and the continuity of infrastructure development, that skills in contract engineering could be accrued and that an independent agency could help to reduce information asymmetries.

An alternative perspective is also presented in REVENUE, which is linked to the evolutionary theory and the related System Dynamics modelling (SDM). This kind of models allow for the modelling of dynamic feedback mechanisms, which permits to analyse “realistic scenarios with respect to their long-term impacts in form of generating the whole picture of the adjustment process instead of giving its outcome at the end of the simulation period” (Rothengatter, 2005). A drawback in the use of SDM is that optimisation possibilities are reduced: this implies that its application in the analysis of pricing and investments at a network level in an environment with a multiplicity of principal and agents would result in a large scale model with limited optimisation features. For a more extensive treatment of the use of SDM in the REVENUE project references can be found in Proost et al. (2005) and Link and Stewart-Ladewig (2005).

### ***3.4.3 Evidence from research about the impacts of alternative uses of revenues***

The main findings of research about the impacts of alternative uses of revenues from transport pricing are summarised hereafter, based on the review carried out in Laird et al. (2004) and the case studies implemented in the REVENUE project. The findings of the interurban case studies are described in Link and Stewart-Ladewig (2005), while the results of the urban case studies can be found in Fereday et al. (2005).

The findings of the REVENUE interurban case studies are highly case-specific: it appeared clearly that to draw more general conclusions, a stronger body of comparable case studies is needed. The applicability of the results as policy recommendations is limited by the fact that they are derived through theoretical models whose assumptions are not necessarily holding in the real world.

The REVENUE findings are summarised according to the financial impacts of pricing reforms, efficiency and equity impacts, institutional implications and acceptability of the schemes.

#### **Impacts on government budget**

Reforming transport prices towards social marginal cost (based) pricing is likely to have impacts on the budget of a country both in terms of structure of taxes and of level of budget.

On the first issue, the introduction of a new pricing scheme that aims at making the user financially liable for the costs it imposes on society means that the whole system of taxes and tariffs in the areas of environment, labour, health, must be re-designed in order to avoid citizens to pay twice for the same damage. To this end, such a reform imperatively calls for a

close collaboration between ministries with competences for transport, finance, environment, health, labour.

On the second issue, recent studies (see e.g. ECMT, 2003) reveal that the introduction of marginal social cost pricing would result in an over-recovery of infrastructure costs at an aggregated level, i.e. at a national level and considering the whole transport system. However, as it was also anticipated by the 1998 White Paper (EC 1998), disaggregating this result by mode and/or spatially (e.g. urban vs. non urban) would shed light on sensible divergences in terms of cost recovery. At a modal level, the road mode would experience a substantial over-recovery of costs, while the contrary would happen to rail. A similar unbalance is likely to happen considering a disaggregation in terms of “urban vs. non-urban”: in urban areas the highest impacts are concentrated, due to the high density of receptors, and therefore charges should be higher leading to a likely over-recovery, while the contrary happens in non-urban areas.

The REVENUE project analysed in some case studies the issue of the impact on budget of the introduction of marginal social cost pricing and of how best possible deficits could be covered in selected infrastructure: in particular, this issue was analysed for the airport of Zurich (Schreyer et al., 2005) and for the construction of new road infrastructure in France (Raux, Mercier and Souche, 2005).

The case studies largely confirmed the findings from existing literature, concluding that pricing schemes that include elements of marginal social cost pricing lead to an increase in welfare, without however allowing for recovery neither of investment costs nor of operators’ costs. However, a result which deserves further investigation comes from the Swiss case study: in this case study, a pricing scheme based on the marginal cost of infrastructure operation and maintenance, congestion, environmental burdens and accidents which *replaces* all other taxes (such as fuel and vehicle taxes) scores lower welfare gains with respect to a scheme where charges based on marginal and environmental costs are added *on top of* existing taxes, and also to the status quo. In the case study, this can be explained as follows “the welfare effect of having higher charging revenues due to introducing marginal cost-based charges on top of existing taxes can be explained by welfare gains of the federal and the local government from higher toll revenues which allow to finance infrastructure projects with cheaper money, e. g. funds from a kind of Pigouvian tax (the HVF charge) rather than from distortionary labour taxes. These welfare gains outweigh the welfare losses within the transport sector from charges which are above the optimal level.” (Link and Stewart-Ladewig, 2005). More details on this case study can be found in Creteigny, Springer, Suter (2005).

The case studies also investigated the question of how best deficits arising from marginal social cost pricing can be covered (public subsidies, mark-ups on optimal prices, Ramsey pricing). In the case of the Zurich airport (Schreyer et al., 2005), pricing schemes alternative to marginal social cost pricing, such as Ramsey pricing, are found to fulfil the financial needs of the investment, (runway extension and additional noise protection measures), although not increasing welfare (they are not able to outweigh the negative consumer surplus calculated). The case study investigating the pooling of revenues from diverse sources to finance infrastructure in France (Raux, Mercier and Souche, 2005), concludes that a good compromise in terms of economic efficiency, cost recovery requirements and acceptability could be complementing social marginal cost pricing with subsidies from an infrastructure fund (like the existing AFITF in France), fed by motorway company dividends and land fees.

## **Impacts on efficiency**

In practice, a government deciding how to spend revenues from the pricing of transport infrastructure faces a set of options that can be broadly listed as follows:

1. Should revenues go to the general budget for reallocation according to general priorities or should they be earmarked for a specific purpose?
2. If earmarking is the case, should it be outside or within the transport sector?
3. If earmarking within the transport sector is the case, which mode/territorial area/user category should be preferred (i.e. could cross-subsidisation be allowed)?

The decision on the alternatives above should be taken based on efficiency and equity considerations, but also on pragmatic institutional and acceptability implications.

Some attempts at analysing the *efficiency* impact of earmarking transport revenues outside the transport sector have been made: there is evidence that, keeping equity considerations aside, a reduction in labour taxes would be a more efficient way of recycling revenues than social security transfers (Mayeres and Proost, 2003).

When considering earmarking to the transport sector, the REVENUE case studies provide additional insights into the issue of cross-subsidisation between modes and between different types of roads. The high specificity of results for the interurban case studies suggests that no general conclusion can be drawn concerning earmarking: earmarking for use on the same road, cross-subsidy between roads and cross-subsidy between modes may all be desirable, depending on circumstances. Although in more than one aspect the case studies do not show converging results, they pinpoint interesting topics to be further explored concerning the effects of earmarking and cross-financing.

⇒ *Cross-subsidisation between modes*

The case study on HGV tolling in Germany investigates the issue of how to use revenues from a tolling scheme in an optimal way: the case study confirms that, irrespective of the charging principle, directing all the revenues raised to the general budget yields the higher efficiency. If HGV charging is to be implemented for e.g. acceptability or legal feasibility reasons, it is welfare superior to keep the money within the road sector instead of e.g. subsidising the rail sector (Doll, 2005).

On the other hand, the Swiss case study investigates the optimal way of raising funds for a given investment: the findings suggest that cross-subsidisation from road to rail could be an efficient solution, since the current scheme - which implies that two thirds of the HGV charging revenues are used to finance the construction of a new rail tunnel - is an efficient way of financing the tunnel, and that a full earmarking could even improve this result (Cretegnny, Springer, Suter, 2005).

Welfare increases due to cross-subsidisation from road to rail are also shown from the French case study on intermodal funds (Raux, Mercier and Souche, 2005).

Part of the divergence of these results can be explained by how the case studies have been adapted to fit to the use of the model used (MOLINO) and by how some parameters have been used (e.g. the marginal cost of public funds). In addition to this, the case studies are not directly comparable due to the fact that the deal with different research questions (how to use revenues from a tolling scheme in an optimal way vs. how to raise funds for a given investment in an optimal way).

⇒ *Cross-subsidisation between different types of roads*

The results from the case study on the German HGV tolling system (Doll, 2005) and the French intermodal fund (Raux, Mercier and Souche, 2005) are divergent: in the former case

an allocation within the road transport system (motorways maintenance) is the most efficient solution when road operation and investment for both motorways and other trunk roads are public. If, on the contrary, they are privatised, a more efficient solution is to allocate funds in such a way that operators avoid deficits. In the latter case study, there are efficiency gains against the status quo in using AFITF funds (motorway dividends and land fees) to finance new motorways<sup>16</sup>. Again, the interpretation of these diverging results has to take into account that case studies are not fully comparable (see Link and Stewart-Ladewig, 2005).

### **Impacts on equity**

The existing literature on transport pricing has highlighted that pricing reforms towards marginal social cost pricing would have fundamental equity impacts: in fact on one side the application of the user pays principle would imply a reallocation of payments for costs imposed to the whole society by users with respect to the current situation, and on the other the consequent change in relative prices would likely affect real incomes in a different way depending on the socio-economic groups<sup>17</sup>. Literature also indicates that the ways revenues are spent can play an important role in determining the overall distributional effects of a pricing scheme. In addition, surpluses arising from pricing reforms and earmarked towards the transport sector offer an opportunity to reduce inflows from the state general budget. Resources freed could be used for other purposes, generating additional distributional effects.

The REVENUE case studies offer some insights into the issue of the impacts on equity of alternative uses of charging revenues, although within the limits of the model used and of the specificity of the case study (for a detailed description of the MOLINO model, see Suter et al, 2005 and for the implications of the application of MOLINO on the urban and interurban case studies see Link and Stewart-Ladewig, 2005 and Fereday et al., 2005).

For instance, the Switzerland case study (earmarking of HVF to a railway fund) shows that the introduction of a more efficient transport financing system would not put low income households at a disadvantage. The differences between welfare impacts on low income households and high income households are small. In the freight sector, transit transport is less affected by higher transport prices than domestic traffic.

The case study on the implementation of an urban infrastructure fund in the region of Berne (Cretegnny, Springer and Suter, 2005) highlights implications on the spatial distribution of benefits: if the infrastructure fund is partly financed by a general tax, such as fuel tax, users from non-urban areas would in practice finance urban transport.

### **Institutional aspects**

Implementing pricing reforms and deciding on the utilisation of possible revenues (as well as on how to cover possible deficits) raises fundamental institutional questions as to who bears these responsibilities, and how coordination could best be ensured should these responsibilities not reside with the same institutions. The impacts on efficiency of decentralising investment decision making to lower levels of government, agencies and private firms are a key issue here.

---

<sup>16</sup> This result depends on the construction costs of the project, the transport demand and the substitutability with the competing road.

<sup>17</sup> See Mayeres and Proost (2003) for an analysis of the welfare effects of optimal pricing on different income groups. See Crawford (2000) for an analysis of the distributional effects of the London congestion charging proposal.

A case study carried out in the framework of the MC-ICAM project on the city of Brussels considers the efficiency implications of alternative distributions of authority between the municipal level and the regional level. This study suggests that the best solution would be for the region to centralise all decisions on cordon pricing, parking charges and how to use revenues. However, a solution whereby the city manages the parking charges system and shares the associated revenues with the region leads to limited welfare losses with respect to the previous solution. On the contrary, higher losses should be expected if the city manages the cordon charging system, which is expected to have more impacts on those living outside from the city (De Palma, et al. 2003).

The performances of alternative financing structures and the role of public and private agencies have also been studied in the REVENUE project, both from a theoretical point of view and with the help of case studies.

Some of the REVENUE case studies investigated the influence that alternative regulatory frameworks have on welfare and on charging schemes and the use of revenues. In the Finnish case study on a stretch of motorway between Turku and Helsinki, the application of a public-private partnership scheme (PPP) compared with the current Design&Build model is studied: it was found that a PPP financing scheme yields a welfare increase. On the contrary, in the German tolling case study the private operation of infrastructure is found to be less efficient than the public alternative.

### **Acceptability**

Although acceptability issues related to pricing reforms will be treated more extensively in Chapter 3.5, it is worth here mentioning the critical role that alternative uses of revenues from transport pricing can play to foster the acceptance of a pricing reform to the wider public (see Nash, Niskanen and Verhoef, 2003). Surveys carried out in the EU projects PRIMA and PATS reveal that if citizens are assured that revenues raised from transport charges are used to finance investments in transport (e.g., as in the PATS surveys, to reduce air pollution and improve public transport), they would accept to pay higher taxes. One of the key elements of the system is the transparency of the pricing scheme as well as that of the revenue allocation scheme (PATS, 2001).

The REVENUE case studies broadly confirm the findings from previous research, while offering additional insights. The case study on the intermodal funds in France (Raux, Mercier and Souche, 2005) draws specific conclusions concerning the acceptability of infrastructure funds based on the experience of FITTVN funds (Fonds d'Investissement pour les Transports Terrestres et les Voies Navigables) which preceded the AFITF funds (Agence pour le Financement des Infrastructures de Transport de France)<sup>18</sup>. Acceptability can be increased if i) a clear definition of the objectives and scope of the fund requirements is made, ii) fund revenues are kept separate from the general budget and are used to meet the specific aims of the fund – even at times of budget constraints, iii) interest groups participate in the initial design and functioning of the fund and iv) the fund is compatible with European guidelines in terms of both the level of charges raised to feed the fund, and the use of revenues.

---

<sup>18</sup> The FITTVN fund, fed by a “land settlement tax” and a tax on hydroelectric energy, was criticised both in France and from the EU because i) projects financed through the fund were not clearly identifiable with respect to those financed through general budget, ii) the fund implied cross financing from road to rail and iii) the aim of land development and improvement of combined transport were never achieved (Raux, Mercier and Souche, 2005).

A case study was specifically carried out in REVENUE on the acceptability of distance related road charges in transit traffic through Switzerland and Germany and on the acceptability of different dimensions of the German HGV charging scheme, amongst others the use of revenues. The first issue has been explored through a key informant survey, while the second through a company survey with German road hauliers (both methodology and results are described in detail in Link and Stewart-Ladewig, 2005). The main results are as follows:

- ⇒ Earmarking to the transport sector revenues from HGV charging is strongly preferred to the flowing of funds to the general budget: however, there is an aversion towards cross-subsidisation of sectors other than road (despite the fact that earmarking schemes are in place both in Germany – intermodal funds – and in Switzerland - use of two thirds of the HGV charging revenues for rail).
- ⇒ Operators are strongly in favour of using revenues to compensate those affected by the HGV charges: the compensation should take the form of vehicle taxes reduction and fuel tax rebate.
- ⇒ The acceptance of a given level of charges is closely related to the use of revenues: German hauliers would accept higher charges if revenues were used for road maintenance and relief of bottlenecks.
- ⇒ The institutional setting related to the allocation of responsibilities plays an important role in the acceptance.

### **3.4.4 Current practice of revenue recycling schemes**

#### **3.4.4.1 Evidence from EU-15**

A review of the current practice in use of revenues from charging transport infrastructure has been carried out in REVENUE (Suter et al., 2005). Based on this review, allocation schemes existing in Europe are described in the following, by mode.

#### **Road transport**

- ⇒ Revenues earmarked for the improvement of existing and the construction of new road infrastructure
  - Austria: revenues from motorway charging are allocated to ASFINAG (private company publicly owned planning and managing the motorway and highway network).
  - Germany: HGV charging revenues are allocated to VIFG (private company publicly owned) to be spent on transport projects (priorities are set by the federal government).
  - Belgium: revenues are spent by the regions.
  - United Kingdom: revenues from urban road pricing must be re-invested in the transport sector during the first ten years.
- ⇒ Intermodal funds (cross-subsidisation)

- France: the AFITF fund is financed by motorway toll revenues and public subsidies and finances infrastructure building, mainly in the high-speed rail sector.
- Switzerland: the FinöV fund is financed by the charging of HGV and is used for two thirds to finance heavy rail infrastructure construction (mainly the Gotthard and Lötschberg tunnels), while the remainder goes to the cantons which reinvest it - among other things - in the transport sector (road construction and maintenance).

⇒ Fuel tax revenues are in most cases not earmarked, however:

- Finland, Netherlands: a small part of the fuel tax is earmarked to cover the expenses made for guaranteeing the supply of fuel by maintaining a strategic oil reserve.
- Germany: a small part (3%) is earmarked to urban public transport.
- Switzerland: half of the revenues are used for construction and maintenance of the national motorways and for the construction of the new transalpine railway tunnel.
- United Kingdom: revenues from increases in fuel taxes above the inflation level must be used for transport projects.

⇒ Vehicle taxes

- Germany, Switzerland: earmarked by the central government to the regions.

### **Rail transport**

Revenues from charging train operators and final users are used within the sector. Cross-subsidisation from other modes (road) to rail can be observed in some countries (see above France and Switzerland).

### **Urban public transport**

As well as for rail transport, urban public transport revenues do not allow for full cost coverage and the sector in general benefits from financing from other transport sectors (see e.g. Netherlands, Portugal), from other sectors of the economy or from the general budget.

### **Air transport**

In the air transport sector earmarking is a common practice. Noise charges are often allocated to finance noise abatement measures, as well as security taxes to security measures within airports.

Aviation charges stay within the airport authorities/operator that supply the service, as well as take off and landing fees, handling fees etc.

In France, an aviation fund exists (BAAC) which collects aviation charges and redistributes them to the airports operated. In the United Kingdom, all airports falling under the British Airport Authority (BAA) transfer a share of their profits to it (7.5%).

## **Inland waterways**

In general revenues from pricing the use of inland waterways and the related facilities are kept by the charging authority. France is the only country where a specific earmarking scheme exists (a share of the hydro power tax is allocated to inland waterways).

## **Maritime transport**

Port revenues are usually retained by the port in question.

### ***3.4.4.2 Evidence from the new Member States: the Hungarian case***

#### **Road transport**

In Hungary the Law on Road Transport (Act I of 1988) and the Law on the Road Fund (Act XXX of 1992) determined the use of revenues in road transport sector. Between 1989 and 1998 the financing resources needed for the national road network were collected in a separated part of the budget, the Road Fund. Its main resources were:

- ⇒ An earmarked tax in the fuel price paid by motorists (decreasing in proportion due to inflation).
- ⇒ The vehicle tax paid to the municipalities.
- ⇒ Fines and penalties paid by overloaded heavy goods vehicles.
- ⇒ Credits of the Road Fund.

The decreasing resources and the continuous indebtedness of the Fund, the lack of transparency of the operation and distribution procedures of the Fund endangered the efficiency of control and final settlements. In 1998 the government decided to abolish the Fund together with other budgetary funds and replaced it with the UFCE, the Road Maintenance and Development Target. The UFCE had competencies of generating resources for the development and maintenance of the national road network. The government promised that the amounts customary in the former Road Fund (in real value) would figure in the UFCE. After the elimination of the Road Fund, the financing of the motorway network was legally assigned to the Hungarian Development Bank (MFB). From 1996 to 1999 the motorway charges collected on M1/M15 motorways went to the private motorway company. After its bankruptcy the government decided to take over all rights and responsibilities, including collection of charges. Road transport related revenues are not earmarked since 1998.

Unfortunately the UFCE did not meet the promised expectations on requested amounts by public road maintaining and operating companies. In 2004 the estimated road transport related revenues were about 2000 million EUR in Hungary, where ratio of fuel taxes is about 70%. 350 million EUR amount was spent on operation, maintenance, reconstruction and new construction of public road network. The estimated revenue recycling ratio is about 17,5%.

In the budgets for years 2001 and 2002 there was not even a target for the construction of new motorways. Therefore it is unclear up to now what amount of public resources really was paid for 2001 and 2002 for renewal and construction works, but scientific estimations put this amount to over EUR 600 million. Revenues from motorway charges are allocated to the motorway management companies (for operation and maintenance works, in case of private concessionaires also for covering costs of capital).

Concerning the M5 motorway, a considerable social pressure was put on policy makers against high charges applied by private concession company. The concessionaire tried to cover the real costs of the motorway through charges, not take into account the relative low level of households' income.

The further involvement of private capital into infrastructure development was abandoned by a political decision in 2001. A government decree stated that:

- ⇒ motorway network had to be developed from public resources (budget and credits with state warrant),
- ⇒ the toll levels must be set in a way that only the maintenance, renewal and operation costs of motorways are covered.

After general elections in 2002 the new government changed the first statement and started to prepare calls for new concession motorway projects.

### **Rail transport**

In Hungary, revenue use in the rail sector is more clear and transparent than in road. As previously described, revenues of the infrastructure management division of the railway companies cover the train operating costs on the network and costs of administration of capacity allocation procedure. This last cost item is transferred monthly to the Railway Capacity Allocation Company.

## **3.5 Acceptability**

The aim of this section is to provide a brief overview of recent acceptability studies, surveys and experiences and to identify open issues, acceptability barriers, and issues where additional knowledge is needed. This applies to all modes with no specific geographical dimension, although meaningful country-specific examples could be relevant.

Plans to apply the pricing principle into transport have typically faced serious doubts and strong opposition. The arguments against it range from technological and institutional problems ('is it possible in practice?') to political and acceptability related problems ('do people really want it?'). Generally, acceptability can be conveniently described by questioning "*acceptability of what, through whom and under which conditions and circumstances*". This means that acceptability is not static and it is extremely dependent on several factors. Firstly, acceptability varies with the pricing measure under consideration. Some key dimensions of a pricing system are for example (see Niskanen et al., 2001):

- ⇒ coverage or scope of the pricing system (e.g. geographical or spatial coverage, modal coverage, user groups covered, externalities covered);
- ⇒ composition and level of pricing measures (e.g. types and combinations of prices or charges or taxes used, maximum tolls or price caps, minimum or maximum total revenues, budget constraints, etc.);
- ⇒ degree of differentiation of pricing measures (e.g. 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);

- ⇒ rules and principles governing revenue use (e.g. allocation of revenues generated – for instance, between ear-marking (hypothecation) or circulating the revenues through the general state budget);
- ⇒ use of supplementary non-price measures (e.g. investment, non-price regulation, information provision, etc.).

Secondly, acceptability varies with different persons, groups, or organizations. Which groups actually exert an influence on the implementation of pricing in transport is likely to differ from case to case. Thirdly, acceptability varies with wider mode and country-specific conditions and circumstances (e.g. past experience with pricing in transport or in other areas). Thus, it is not surprising that no single commonly agreed and widely used theoretical basis for analysing acceptability issues and decision making is available. The remaining part will follow the overall mode-related structure of IMPRINT-NET.

### **3.5.1 Road**

Acceptability issues in the road sector can be divided into *urban vs. interurban* pricing and between pricing of *heavy goods vehicles* (freight) vs. *private cars*. Whereas acceptability of urban transport pricing is well researched but not considered in this project (for a recent overview see Schade and Schlag, 2003) large scale acceptability studies specifically dedicated to the interurban dimension are not existing. Problems of non-acceptability with regard to charging interurban car (private) traffic have been rather moderate (Jiménez-Roig and Sort, 2000). One notable exception is the failed introduction of interurban road pricing in the Netherlands (Rekeningrijden). A recent case study within the TIPP-Project about Rekeningrijden showed the importance of interest groups and the media for transport policy implementation (Verhoef and Ubbels, 2004). The most important criteria to explain the failure of Rekeningrijden has been information provision (an insufficient communication policy of the government), a lack of the perceptions that the policy measure would be effective and the feeling that Rekeningrijden would amount mainly to a redistribution of income to the state. With respect to communication, the government in the Netherlands failed to explain the working of prices in a convincing manner. Even though the population seems to be very aware of the congestion problems in the Randstad area the government apparently was not able to explain to the public that road pricing would be an effective means of dealing with this problem. Many people apparently believed (and continue to believe) that road building is still the most effective way to cope with congestion. Concerning the role of the media it could be demonstrated that a small group of institutions and interest groups was able to fight Rekeningrijden successfully by finding the right access to the media. This pointed out the importance of thinking out a well defined media policy before the phase of implementation of a certain policy measure in transportation takes place. However, the most important cause for the failure of Rekeningrijden was the feeling of the Randstad population that their personal welfare would be reduced with the introduction of tolling. Many believed that the only effect of Rekeningrijden would be to lower their disposable income without generating any substantial effect on congestion. Thus, it was mainly lacking perceived effectiveness and deficiencies in the way the scheme was communicated to the public that caused the failure of Rekeningrijden.

With regard to *heavy goods vehicles* the DESIRE-project stated that acceptability of an interurban road pricing scheme (IRPS) among different stakeholders will vary depending upon a multitude of factors, some of them related to the initial situation, others to the

distinctive feature of the IRPS and its introduction. They identified the following important factors:

⇒ Population density	⇒ Problem perception and pricing purposes	⇒ Average infrastructure costs
⇒ Technical aspects	⇒ Pricing principles and revenue use	⇒ Harmonisation and interoperability
⇒ Tolling tradition	⇒ Implementation and enforcement strategy	⇒ Economic and environmental impacts
⇒ Transit volumes	⇒ Privacy concerns	

The following six stakeholder groups were identified to be strongly involved in the process of introduction of any IRPS (see DESIRE, 2001):

**Public authorities, promoters:** The main departments involved are Finance, Transport, Environment and Justice/Police. The intensity of the role of the Finance department will depend on the rate of privatisation of the IRPS. The department of Transport will be the main one responsible for the implementation and the achievement of the formulated transport policy goals. The department of Environment will have a clear goal to reduce the negative external ecological effects of transport. The specific role of the department of Justice/Police for the enforcement of law will be dependent on the rate of privatisation of public functions in the IRPS.

**Shipping industry:** The main interest of the shipper is having a reliable transport operation at a decent price. Therefore, their acceptability of an IRPS can be high if they expect overall improvements of transport service quality (e.g. due to reduced congestion, better logistics supply), even if transport costs will increase.

**Product providers, manufacturing industry:** The introduction of a technologically advanced IRPS could result in a significant increase in the businesses of telecom providers; hardware providers of on-board-systems, roadside equipment and back office systems and content providers for additional services to transport companies and drivers.

**Haulage companies:** Because of the high competition in the transport market they will have to compensate for the higher variable transport costs by rationalization, merging (economies of scale) and implementation of better logistics. The acceptability of this actor group will be generally low but may differ between countries regarding to their geographic position and the structure of the transport sector.

Seidel et al. (2004) report conditions about the (finally) successful implementation of the **new HGV toll** in Germany. They show that pricing policies can overcome even serious problems within the implementation process by a strong political commitment and acceptability of all key actors. The following issues determined the success of the policy (cf. Seidel et al., 2004):

- ⇒ The gap between the increasing road traffic and the lack of infrastructure funding was perceived as one of the most serious problems in Germany today by all actors.
- ⇒ There was a strong political consensus (i.e., few goal conflicts) that a HGV toll was warranted.

- ⇒ The hauliers support its introduction because they feel that it will increase the fairness of competition with foreign truckers. They see clearly that basing the financing of the road infrastructure on user fees will lead to a levelling of the playing field because German and foreign trucks will pay the same charge. Under the former system foreign truckers could profit from the lower level of gasoline taxes in their home countries by avoiding refuelling in Germany. The Eurovignette system (taken together with the corresponding agreements on minimum levels of gasoline taxes and motor vehicle taxes) was intended to mitigate these competitive disadvantages to a certain degree but still the German truckers felt themselves treated in an unfair manner. Thus fairness considerations played a role here too.
- ⇒ Politicians supported the system for the following reasons:
  - The revenues will raise money for infrastructure investment
  - The toll will help to price some HGV traffic off the motorways and onto the railway. The first effect is popular with car drivers (who do not pay any toll but benefit from less congestion). The second effect is popular with environmentally concerned voters and the railway industry.

In this way almost all actors profit from the system. In addition, this policy measure is considered to be effective and it violates nobody's perception of fairness. Therefore even the embarrassing technical problems and at times sarcastic reporting in the media could not stop the plans to introduce the toll.

### 3.5.2 Rail

A review of the current situation in rail transport with respect to pricing mechanisms and the identification of barriers to pricing reform has been recently done by Matthews et al. (2002) and Matthews and Nash (2002) summarized by Adler et al. (2002). They identified five major stakeholders important for acceptability: i) railway infrastructure managers, ii) train operators, iii) passengers, iv) policy makers and governmental bodies, and v) the business community e.g., freight forwarders and shippers.

However, Adler et al. (2002) argue that *train operators* will be the most impacted by the proposed pricing strategy as they pay the charges. Nevertheless, it is expected that they will gain substantial benefits in terms of operation, and will have the opportunity in collaboration with infrastructure operators and owners to support investment projects that will enhance the capacity of the railway system, whilst increasing the potential for providing new, advanced services. More specifically, the implementation of new infrastructure will enable train operators to provide a new range of services such as express delivery, and to enter new markets beyond the heavy manufacturing industry. Table 3.18 summarises the acceptability barriers for all groups of stakeholders identified in the analysis.

**Table 3.18 Acceptability barriers to marginal cost based pricing strategies for railways**

Stakeholding Group	Barriers to Acceptability
Infrastructure Operators	Applicability of the pricing strategy
	Effectiveness/efficiency of the pricing strategy
	Risk of losing part of the market share of a specific truck or railroad terminal

	Use of pricing strategy revenues
<b>Policy Makers</b>	Political cost
	Effectiveness/efficiency of the proposed pricing strategy
	Applicability of the proposed pricing strategy
<b>Train Operators</b>	The extent of effectiveness/efficiency of the proposed pricing strategy
	Risk of losing part of the market share due to the increase in competition
	The level of charges imposed
	The use of the revenues deriving from increased charges (e.g. possible redistribution in the form of railway investments/capacity and service expansion)
	Perception of equity of measures/discriminatory practices against particular user groups (e.g. small operators)

Source: Adler et al., 2002

### 3.5.3 Air

A review of the current situation in the air sector with respect to pricing mechanisms and the identification of barriers to pricing reform has been recently done by Adler et al. (2002). They identify that the air transport industry consists of many players, including airlines, airports, ground transport authorities, local, state and EU governments, the travelling public, cargo and the general public. In general terms, airlines are the users of airports, with passengers and cargo representing derived demand. The airlines within Europe are owned by a variety of institutions. Some are fully privatised, others are entirely government owned, and some are a public-private partnership. In general, airlines aim to maximize profits and consequently desire to minimize charges paid to airports and EUROCONTROL. Airports within Europe are generally publicly owned with one or two notable exceptions. Government interest also lies in the employment opportunities provided by the air transport industry, through which they collect both labour and transport taxes. The general public is affected by airports directly, through noise and congestion issues both from the air and on the ground and indirectly through house values. The results of an analysis to identify the barriers of different stakeholders towards pricing included airport operators, airlines, policy makers, passengers and the business community i.e. freight forwarders and shippers. Results are summarised in Table 3.19.

**Table 3.19 Summary of stakeholder groups and barriers to acceptability in air transport**

Stakeholding Group	Barriers to Acceptability
<b>Airlines</b>	Increased charges
	The market-based slot allocation process characteristics
	The use and the transparency in use of additional revenues
	The level of service and benefit provided to airlines operating off-peak hours
	The feasibility of the required changes in the provision of services by the airlines
	The risk of losing market share
<b>Airport Operators</b>	The risk of losing some market share, particularly if congestion pricing and new slot market mechanisms are not implemented at competing airports

Stakeholding Group	Barriers to Acceptability
	The degree of effectiveness and applicability of the proposed pricing strategy
<b>Business Community</b>	The risk of jeopardizing certain shipper services
	The use and the transparency in use of pricing strategy revenues
<b>Passengers</b>	Increase in fare prices
	Disruption of socio-economic activities either due to the reduction of available flights or due to changes in the provided flight schedules
	The use and the transparency in use of pricing strategy revenues
<b>Policy Makers</b>	Airline industry distortions
	Economic distortions
	Political costs

Source: Adler et al., 2002

### 3.5.4 Water

Studies about the acceptability of pricing measures of different stakeholders in water transport do almost not exist. Zografos (2002) reports on two case studies, namely short sea shipping (SSS) in Greece and inland waterway transport on the river Rhine.

For SSS Zografos identifies five important categories of stakeholders including port operators, shipping lines, policy makers, passengers and the business community. The main barriers towards acceptability are summarised in Table 3.20.

**Table 3.20 Acceptability barriers for port pricing strategy of short sea shipping**

Stakeholding Group	Barriers to Acceptability
<b>Port Operators</b>	Applicability of the port pricing strategy
	Effectiveness/efficiency of the port pricing strategy
	Risk of losing market share
	Use of port pricing strategy revenues
<b>Policy Makers</b>	Equity
	Effectiveness/efficiency of the proposed port pricing strategy
	Political cost
<b>Shipping Line Operators</b>	Institutional/regulatory framework governing the identification of the level of fares
	The ability/flexibility of the shipping line to change the scheduled service
	The feasibility of the new schedule imposed by compliance with proposed scheme
	The level of port charges imposed
	The risk associated with the reduction of the market share of the line
	The use of revenues derived from the increase in port charges e.g. possible redistribution in the form of port investments and/or capacity expansion
	Perception of equity of measures/discriminatory practices against particular user groups (e.g., small users)

Stakeholding Group	Barriers to Acceptability
<b>Business Community</b>	Institutional/regulatory framework governing the fare level specification
	Decrease of the current level of service
	Reduction/cut in lines being served
	Disruption of logistical activities
	Increase in the transportation cost of goods
<b>Passengers</b>	Non-transparent use of revenues
	Increase in fare level
	Decrease of current level of service
	Risk of disruption to passengers' socio-economic activities due to reduction in service

Source: Adler et al., 2002

For inland waterways four categories of stakeholders were considered in the analysis: infrastructure operators, barge operators, policy makers and the business community (i.e. shippers and freight forwarders). The main barriers of these groups towards acceptability are summarized in Table 3.21.

**Table 3.21 Acceptability barriers for port pricing strategy of inland waterways**

Stakeholding Group	Barriers to Acceptability
<b>Infrastructure Operators</b>	Use of revenues derived from charges
	The risk related to the reduction of the market share of the mode
	Effectiveness of the proposed scheme
<b>Barge Operators</b>	Ability to pass part of the charges on to the shippers
	The level of charges
	The use of the revenues derived from the charges
	The risk related to the reduction of the market share of the mode
	Effectiveness of the proposed scheme
<b>Policy Makers</b>	Expected effectiveness/applicability of the proposed measures
	Harmonization between international and national regulatory framework
	Two judicial systems / regulatory frameworks
	Political cost
<b>Business Community</b>	Level of charges
	Increase in the transportation cost of goods
	Degree of charges passed on to end users
	Use of revenues generated by the charges

Source: Adler et al., 2002

## 4. Main topics for discussion in the Expert Groups

The overall aim of the Expert Groups (EGs) is to bring together researchers, policy makers and stakeholders (industry, environmental groups, etc.) to discuss pricing reforms in their sector. Each modal EG adds to this general aim a series of specific objective, according to the conditions of the sector in terms of advancement of research about cost calculation and impacts, institutional setting, legislation, etc.

The following sections describe the specific objectives of each EG, provide a short background and identify the main topics for discussion as they can be outlined at the outset of the project.

### 4.1 Interurban road transport

#### Objectives

---

- ⇒ Seeking consensus on the determination of marginal social cost, concentrating on issues where controversy remains (e.g. split of road infrastructure costs between fixed and variable, allocation of variable costs to measures of use, treatment of congestion, external costs of accidents, valuation of environmental effects);
- ⇒ considering barriers to pricing reform in the road sector, and ways of overcoming them in the light of practical experience
- ⇒ highlighting differences in the situation on the interurban road sector which require special attention for certain member states (e.g. those with poor infrastructure, heavy transit traffic and acute budgetary difficulties).

#### Background

---

The key issue in inter urban road pricing from the point of view of EC policy is the pricing of heavy goods vehicles, including both the debate over the Eurovignette Directive and the experience of those countries who have already implemented a kilometre based pricing system (namely Switzerland, Germany and Austria).

There is now an agreement within the Council of Ministers on the revision of the Eurovignette Directive, which would permit kilometre based charges on all roads, with a ceiling of average allocated infrastructure costs but more fine differentiation in time and space on the basis of congestion, accident and environmental costs. This however, leaves major disagreements both within Parliament and amongst stakeholders:

- ⇒ the industry demands earmarking of funds for road building, but whilst this is recommended in the agreement it is not mandatory
- ⇒ Parliament and environmental groups insist on full internalisation of external costs, but this is strongly opposed by industry who argues that these costs cannot be adequately measured.
- ⇒ The measurement of wear and tear and allocation of infrastructure costs between vehicle types remains controversial

- ⇒ mark ups to fund rail infrastructure, even in sensitive regions, are resisted by much of industry
- ⇒ peripheral states remain worried that high charges in core countries will damage their economies, whilst transit countries are concerned that charges will be held below the level of costs they incur.

A compromise has now been agreed between the Council of Ministers and Parliament allowing the revised Directive to go ahead.

Whilst it will be natural to concentrate on heavy goods vehicles, since that is where the competence of the EC to legislate lies, the private car should also be considered. There is an obvious interaction between the two, inasmuch as goods vehicle operators do not see why they should be charged for external costs if car users are not.

## **Main topics for discussion**

---

### **Measurement**

- ⇒ Update on research findings (e.g. drawing on the GRACE project).
- ⇒ The measurement of marginal social cost, infrastructure costs (or other costs categories) allocation procedures.
- ⇒ Need for greater transparency and implications in terms of infrastructure expenditures monitoring. Need for European guidelines on cost calculations (e.g. methodology, conditions or needs for harmonisation, etc)

### **Impacts and implementation**

- ⇒ Impacts of marginal social cost pricing or other policy options. Experiences in member states (e.g. Germany and Austria).
- ⇒ Understanding the impact of charging for these costs on levels of road traffic, mode split, choice of types of vehicles, vehicle routeing and time of day choices.
- ⇒ Broader economic impact, including in particular regional and equity impacts.
- ⇒ Structure and complexity of charges
- ⇒ Institutional arrangements and rules (e.g. earmarking, cross financing)
- ⇒ Choice of technology

## **4.2 Rail**

### **Objectives**

---

- ⇒ Seeking consensus on the determination of marginal social cost (concentrating on controversial issues such as split of infrastructure costs between fixed and variable, allocation of variable costs to measures of use, variability of cost elasticities, treatment of congestion, scarcity, accident and environmental costs);

- ⇒ to examine research and experience on the impact of differences in pricing structures and levels
- ⇒ considering barriers to efficient pricing in the rail sector and ways of overcoming them;
- ⇒ highlighting particular problems of certain member states (e.g. poor infrastructure, high transit traffic, lack of government funding) and ways of overcoming them.

## **Background**

---

The starting point from the point of view of EC policy is the implementation of rail infrastructure charges in line with directive 2001/14. This directive allows for charges to be based on marginal cost, but with specific mark-ups in different circumstances. Its implementation has involved a great deal of effort in different countries to devise suitable charging systems, with a considerable degree of diversity of response. Some countries have adopted very low charges based broadly on short run marginal cost whilst others have adopted much higher charges based broadly on long run marginal cost and incorporating the allowed for mark-ups. Some countries have several different charges disaggregated according to route, train type, time period etc, whilst others have much less disaggregated charging structures. In addition, some countries have adopted charges that are apparently not in line with the directive. What emerges is a wide variety of charging regimes in different parts of the EU which, it is believed, leads to distortions in both the level of rail traffic and the routing of international traffic. A recent DGTREN workshop concluded that it was the high level of charges in certain countries rather than diversity of structure of charges that was the real problem.

The reasons underpinning the different approaches to the directive, and the impact that such a mix of charging regimes has, will be important questions to understand in greater depth. Perspectives on these questions are likely to differ between government and industry, and, within the industry, between freight and passenger sectors.

There is also new research being undertaken in the area of measurement of the marginal social cost of rail infrastructure use, e.g. within the GRACE project which could serve to inform charging levels and structures. Findings from this research, including specific work looking at generalisation of cost estimation, may be an important means of developing a greater degree of consensus on the subject and a greater degree of harmonisation of charging approach across the EU.

## **Main topics for discussion**

---

### **Cost Measurement and Charging Approaches**

- ⇒ Identification of the marginal wear and tear costs, external congestion and scarcity costs, external accidents costs, environmental costs of rail infrastructure use.
- ⇒ Understanding the implications of cost levels and cost structures for efficient charge levels and structures;
- ⇒ Understanding the impacts of more efficient rail infrastructure charges, including the impacts of greater harmonisation of charging regimes and the impact on end-user prices, particularly in relation to the freight market.

- ⇒ Need for greater transparency and implications in terms of infrastructure expenditures monitoring

### **Investment, Subsidy and Regulatory issues**

- ⇒ The role of rail infrastructure charges in cost recovery and the generation of rail investment funds;
- ⇒ The process for agreeing infrastructure charges and the need for an independent regulator to oversee charge-setting and dispute resolution, including the implications for setting charges in the presence of franchising.
- ⇒ Need for European guidelines on cost calculations (e.g. methodology, conditions or needs for harmonisation, etc)
- ⇒ Particular problems of financing rail infrastructure under severe budget constraints.

## **4.3 Inland waterways and maritime transport**

### **4.3.1 Introduction**

In order to discuss the whole range of policy issues that relate to the properties of the implementation path itself and to develop our conclusions concerning the most likely (and desirable) progress in implementing marginal cost-based pricing policies, we first consider the different dimensions that in our view best characterize the pricing system and that have been discussed above. As discussed earlier, the five key dimensions and the key policy questions, which are concerned with the progress in the dimensions, are i) the scope of the pricing system, ii) the combinations of pricing measures and their levels, iii) the appropriate degree of differentiation, iv) how to use revenues, v) possible supplementary measures and actions finally vi) the technological aspects.

Perhaps a natural first question regarding the non-technical (economic, social) aspects of the pricing system concerns its scope or coverage: What should be priced and who should pay? The answers here in part depend on constraints regarding the number of market segments that can be priced distinctly e.g. by: geographical or spatial coverage, modal coverage, user groups covered and externalities covered. An important question related to these issues is about priority: in what order? Evidently, the answer is partly affected by potential existence of synergy benefits.

A second key question concerns the optimal prices themselves: What should be the level and composition (i.e. which pricing instruments to use) of prices? Here, allowance may need to be made for maximum tolls or price caps, budget constraints determining minimum or maximum total revenues etc, and also possible distortions in other links, modes, regions and sectors.

A third key question concerns the degree of differentiation – across vehicles / infrastructure users, over time and spatially. This in particular should be a key issue when considering pricing schemes in the longer run. The desired extent of differentiation depends on the additional welfare benefits associated with the further stages as compared to the costs of implementing a more sophisticated pricing system.

It has long been argued by both researchers and policymakers that the use of revenues is a crucial issue for transport pricing. It has been argued, and also shown in various studies, that the way revenues are used can have great welfare impacts – often much greater than the direct

impacts of pricing. And it is demonstrated in many occasions to be a critical question from the acceptability viewpoint (public and political).

MC-ICAM has emphasised that the implementation of marginal cost pricing should be considered within broader policy packages including use of revenues and other supplementary non-price measures.

Potential supplementary/supporting measures here include investments to increase capacity, non-price regulation in various forms, and information provision systems. They may also refer to other related policies like land use policies. Other types of policies that may be relevant to consider are related to institutional reform with the aim to remove or lower legal and institutional barriers. But similarly we can include/consider here also policies or actions that aim (directly) to promote technological development, and improve other practical preconditions (enablers) such as estimates of pricing relevant marginal costs and other relevant data.

Finally the question of which technologies are at hand to implement pricing strategies is central. The methods of collecting have to be efficient and implementation cost should not be too high. Further also the technology determines the flexibility of the system, further also synergies with other possible uses of infrastructure management and/or private initiatives should be investigated.

### ***4.3.2 Maritime transport***

An important issue is identifying and comparing of current cost accounting and of allocation practices in different ports in the EU. The issue of how current port pricing strategies relate to actual costs of different user (ship) categories will be addressed. All cost categories will be subject of discussion, but special attention will be paid to infrastructure costs in ports. The above issues will be discussed in the theoretically part of the expert meetings. After this part a more practically oriented part will follow, where the focus is to identify the major barriers for implementing SMCP based pricing reforms in maritime transport, and critical success factors to break these barriers will be pinpointed, based on implemented (best) practices, like the Swedish fairway charging system and given the international character of maritime transport.

#### **Background**

---

- ⇒ Infrastructure costs largely not dependant on use
- ⇒ Externalities:
  - Congested ports
  - Contribution to pollution
- ⇒ Current pricing
  - Port charges vs. handling charges
  - Non-transparency of current charges
- ⇒ Implementation aspects
  - Legal framework: International / intercontinental
  - Public (municipal or national) vs. private ports

- Acceptability in the light of modal shift objectives

## **Main topics for discussion**

---

### **The state of the art**

- ⇒ Review of current port pricing strategies and financing of infrastructures
- ⇒ State of the Art in terms of methodologies for valuing actual costs (per user category). What do social marginal costs mean in the maritime sector, which are important categories?
- ⇒ Possible pricing strategies, externalities to focus
- ⇒ Identification of possible improvements for charging scheme

### **Costs measurement and accounting practices**

- ⇒ Current practices in EU ports with respect to infrastructure cost calculation, accounting and cost allocation.
- ⇒ Which externalities should be charged and who will receive the revenues?
- ⇒ Latest developments in research on identification and measurement of the main cost categories?
- ⇒ Need for European guidelines on costs calculation or monitoring of expenditures;

### **Impacts**

- ⇒ What are the possible impacts for the sector (on traffic, on costs and revenues, on the broader economy, on equity, etc.)?
- ⇒ What are the socio-economic impacts?

### **Implementation issues (enabling factors and barriers)**

- ⇒ Which externalities should be charged and who will receive the revenues?
- ⇒ Choice of technology
- ⇒ What are the barriers for implementing social marginal cost based pricing reforms: institutional, legal and acceptability?
- ⇒ How to overcome these barriers, given the international character of maritime transport?

### **4.3.3 Inland waterways**

The first issues to discuss are the methodological issues concerning the determination of the social marginal costs and what these mean for any implementation of pricing measures. The focus will be on wear and tear, congestion and environmental effects. This discussion will be a more theoretical discussion. The issues concerning the major barriers for implementing SMC based pricing reforms in inland shipping will be discussed in the practically oriented part of the expert group meetings. Important issues are institutional barriers, like the Mannheim convention, and acceptability barriers, like mode shift issues.

#### **Background**

---

- ⇒ Externalities:
  - Congestion/scarcity in ports and certain locks/bridges.
  - Environmental costs
  - Infrastructure costs largely not dependant on use
- ⇒ Current pricing limited to port, lock and canal dues
- ⇒ Implementation aspects
  - Legal framework (Mannheim convention)
  - Acceptability
  - River Information Services system: can they be actually used?

#### **Main topics for discussion**

---

##### **Overview and state-of-the-art**

- ⇒ What should pricing be based on; on which externalities to focus?
- ⇒ What are the possible directions for charging schemes reform?
- ⇒ Review of national practices in terms of charging regimes and financing of infrastructures.

##### **Costs measurement and accounting practices**

- ⇒ The focus will be on wear and tear, congestion and environmental effects.
- ⇒ Review of research on infrastructure cost calculation methodologies;
- ⇒ Identification and measurement of the main external cost categories?
- ⇒ What does social marginal cost mean in the inland shipping environment?

##### **Impacts of pricing reforms**

- ⇒ What are the possible impacts for the sector (on traffic, on costs and revenues, on the broader economy, on equity, etc.)?

- ⇒ What are the socio-economic impacts?

### **Implementation issues (enabling factors and barriers)**

- ⇒ Choice of technology
- ⇒ What are the barriers for implementing social marginal cost based pricing reforms: institutional, legal and acceptability?
- ⇒ How to overcome these barriers?

## **4.4 Air transport**

### **Objectives**

---

- ⇒ Highlight progresses, gaps, uncertainties in the measurement of social costs related to the use of air transport infrastructure.
- ⇒ Analysis and interpretation of current practices in tariff setting in EU-25.
- ⇒ Analysis of enabling factors and barriers to the implementation of pricing reforms in EU-25.

Particular attention will be given to the possibilities and implications of reforms in pricing policies in the new Member States.

### **Background**

---

The charging system in the air transport sector is articulated according to three big cost areas, i.e. ground handling services, airport services and air navigation services.

While the ground handling services market is largely deregulated (Directive 96/67/EC) and prices are mainly determined on the market, both airport and air navigation services are regulated by EU and national legislation.

Airport charges are set autonomously by airport authorities, in compliance with regulation issued by the Civil Aviation Authorities (CAA), or by the CAA itself if airports are publicly owned. Charges are generally imposed to recover costs to provide airport services (which include landing and take-off assistance, parking and hangar, passenger service, security, terminal assistance and other services such as for instance freight loading/unloading, infrastructure for the provision of ground handling services, special power equipment, etc.), and additionally in some cases for management purposes (e.g. managing congestion and environmental impacts – in particular noise). Although tariff levels may differ, it is a common feature that they vary with aircraft features (e.g. weight or noise category), type of flight, duration of use of infrastructure (e.g. parking). In the present situation, landing or passenger charges levels vary significantly between countries and airports (even within the same country) and the relationships between actual costs and charges lacks of transparency. Airport charges often do not allow a full recovery of the costs of service providing, and airports subsidise aeronautical charges with commercial revenues.

In the context of the European Single Sky policy, rules are also in place for both en-route and terminal charges. These charges aim at covering the costs generated by air traffic flow management and are collected by EUROCONTROL on behalf of Member States.

Pricing research in the aviation sector has not reached the maturity stage of other modes (see e.g. road and rail transport), and measurement of impacts and costs is still a debated issue. This has impacts on the range of pricing policies which are possible to adopt: for instance, new pricing mechanisms such as en-route charging, have not been studied because en-route impacts and costs have yet to be accurately measured.

Some of the research looking into the measurement of average and marginal costs in the transport sector and possible implementation paths for pricing reforms based on social marginal costs also looked at the air transport sector. Concerning costing, the objective of *UNITE (UNification of accounts and marginal costs for Transport Efficiency)* objective of the project was to support policy makers in setting charges for the use of transport infrastructure by the provision of appropriate methodologies and empirical evidence.

Recent and more specific studies concern:

- ⇒ Impact on the environment of Air Traffic Management: the project “ATM Flight Efficiency and its Impact on the environment”, executed by EUROCONTROL, was set up to develop indicators that can be used to measure the impact of the ATM (Air Traffic Management) system on the environment. These indicators measure the efficiency of the actual routes and profiles flown in terms of distance, flight duration, fuel burn and costs to airlines and environment.
- ⇒ Evaluation of delay costs: The study “Evaluating the true cost to airlines of one minute of airborne or ground delay” evaluated the true cost to airlines of one minute of airborne or ground delay. The Transport Studies Group at the University of Westminster (London) completed the study for the Performance Review Unit (PRU), at EUROCONTROL (Brussels). The key objectives of the Study were essentially to establish transparent reference values, which are operationally meaningful, for the costs incurred by airlines as a result of airborne and ground delays.

## **Main topics for discussion**

---

### **The state of the art**

- ⇒ Comparative review of current airport charges setting rules and pricing strategies (e.g. single till versus dual till approaches).
- ⇒ Experiences in differentiation of charges (e.g. peak vs. off-peak charging, environmental differentiated charges, etc.).
- ⇒ Review of past and on-going research activities or relevant studies.
- ⇒ Direction for charging schemes reform and possible impacts (on traffic, on costs and revenues for airports and airlines, on the broader economy, on equity, etc.).

### **Costs measurement and accounting practices**

- ⇒ State-of-the-art of infrastructure cost calculation and accounting practices.
- ⇒ State of the art of research on identification and measurement of the main external cost categories.
- ⇒ Need for European guidelines on cost estimation.

### **Implementation issues (enabling factors and barriers)**

- ⇒ Latest development for re-organisation of airspace and air navigation to meet capacity and safety needs: Single European Sky, Functional Airspace Blocks, etc.

- ⇒ Harmonisation and interoperability (e.g.: aircraft classification).
- ⇒ Choice of technology.
- ⇒ Acceptability of new charging schemes and Attitude of Air Transport Industry (lobbying, air carriers ...).
- ⇒ Procurement of investments in infrastructure and equipment (public, private, PPP) and cost recovery.

## 4.5 Revenue use

### Objectives

---

Specifically, the objective of the expert group will be to address issues that come into question when considering financing and transport pricing policy:

- ⇒ Firstly, how can the necessary funds be raised to meet the need to finance new infrastructure?
- ⇒ Secondly, if a decision is taken to raise more money from users than would be implied by pure marginal social cost pricing, how may this most efficiently be done?
- ⇒ Thirdly, if marginal social cost pricing actually raises a surplus for the mode or area in question, how may this be spent to promote efficiency, equity and acceptability? Is earmarking desirable and if so should it be administered?

The emphasis will be on interurban transport, although lessons from the urban sector will also be considered.

### Background

---

Revenue raising and use has implications for economic efficiency, equity and acceptability. Clearly, revenue is already raised from existing transport systems, through a mixture of taxation and charges, and accrues to the state and the transport operator. National governments use this tax revenue along with other tax revenue (e.g. income tax) to fund their activities which may include further changes in the transport system. Marginal social cost pricing in the transport sector implies a significant reform of transport pricing. Such a significant reform appears very likely, for acceptability reasons, to have to be linked to how the revenue raised is used for instance with the surplus revenue being hypothecated for further investment in the transport sector.

Research suggests that marginal social cost pricing for infrastructure use will generate at least as much if not more funding than is required for cost recovery, including servicing of capital costs (EC, 1998; ECMT, 2003). However, this is at an aggregate level and revenue surpluses will occur for some modes and in some areas, whilst revenue deficits will occur in others. Typically we would expect surpluses for road networks and deficits for public transport systems that have high sunk costs (e.g. rail). Congested areas (e.g. urban environments) are likely to generate surpluses, whilst uncongested environments may be in deficit. The problem in financing new infrastructure therefore occurs if the new infrastructure operates with a revenue deficit. The Commission's 2001 White Paper proposed national or regional transport infrastructure funds as a mechanism by which surplus revenue could be hypothecated to facilitate transport projects that lessen or offset the external costs associated with transport.

The White Paper envisages that surplus revenues from one mode (or area) may be used to finance projects associated with a different mode or in a different area.

Clearly, such a policy of revenue use will raise efficiency, equity and therefore ultimately acceptability issues. If revenue is to be hypothecated to the transport sector this may result in a lowering of economic efficiency. This is because either there are insufficient economically efficient transport projects, or transport projects are less efficient than other types of project (e.g. education) which could have been financed through the revenue surplus. Issues associated with equity may occur as the surplus revenue may well be directed to modes or areas which do not benefit those who contributed to the revenue surplus – thus one sector of the population may experience an increase in costs whilst another sector experiences the benefit. This may be unacceptable to those who bear the majority of the costs. Prices for transport infrastructure in areas or modes where revenue deficits exist may therefore need to be set at a level higher than marginal social costs would suggest in order to raise the necessary finance for new projects. Alternatively more local infrastructure funds (e.g. regional funds) may give the required degree of acceptance. However the success, in terms of economic efficiency and equity, of such funds depends upon how they are administered – i.e. who decides the prices to be charged, who decides which projects are to be invested in and what constraints the fund administrators are subject to.

### **Main topics for discussion**

---

The following is a first outline of the issues related to the use of revenues from transport pricing. The content of the seminars, which will start later on in the project, will be defined at a later stage. Notwithstanding that at this stage we would envisage the four seminars addressing the following subject areas:

- ⇒ **Introduction:** Overview of the issues to be considered and planning of the programme for future seminars. Presentation of results of research in the field (e.g. REVENUE, FUNDING).
- ⇒ **Revenue raising:** Revenue raised from MSC pricing; other approaches to revenue raising (tolls, two part tariffs, price differentiation).
- ⇒ **Revenue use:** Transport infrastructure investment requirements; hypothecation; other uses of revenues (public transport subsidies, environmental improvement etc.).

## 5. References

- ACI-EUROPE (2003). *Airport charges in Europe*. ACI-EUROPE study 2003 available at [www.aci-europe.org](http://www.aci-europe.org).
- ACI-EUROPE (2005). *Building for the future. Paying for the airports of tomorrow*. ACI-EUROPE study 2005 available at [www.aci-europe.org](http://www.aci-europe.org).
- Adler, N. (2003). "Barriers to Efficient Cost-based Pricing of Rail, Air and Water Transport Infrastructure in Europe". Paper presented at the IMPRINT-EUROPE seminar, Brussels, 13-14 May, 2003
- Adler, N., Berechman, Y., Fagiani, P., Farkas, G., Henstra, D., Matthews, B., Nash, C., Nilsson, J.E., Niskanen, E., Tanczos, K., Zografos, K. (2003). *Marginal cost pricing implementation paths to setting rail, air and water transport charges*. Deliverable 5, MC-ICAM (Marginal Cost Pricing in Transport – Integrated Conceptual and Applied Model Analysis). Funded by 5th Framework RTD Programme, Leeds.
- AEAT (2002). MOIRA, AEA Technology.
- Anthony Vigor (2006). "Germany delivers the goods". Transport Times, 13 January 2006
- Atkins (2005). *Post Opening Project Evaluation – M6 Toll After Study: Traffic and Safety Summary*.
- Bak M. (2003). "Implementing pricing policies in interurban road transport in NAS countries in the light of present transport policy - the example of Poland". Paper presented at the fourth seminar of the IMPRINT-EUROPE Thematic Network "Implementing pricing policies in transport: With special regard to NAS countries", Budapest, 16-17 October 2003.
- Balmer, U (2003). "Practice and experience with implementing transport pricing reform in heavy goods transport in Switzerland". Paper prepared for the fourth seminar of the IMPRINT-Europe thematic network, Brussels 13-14 May 2003.
- Beattie J, et al. (1998). "On the Contingent Valuation of Safety and the Safety of Contingent Valuation: Part 1-Caveat Investigator". Journal of Risk and Uncertainty, 1998, vol. 17, Issue 1, pp. 5-25.
- Bickel, P., Schmid S., Tervonen J., Hämeikoski K., Otterström T., Anton P., Enei R., Leone G., van Donselaar P., Carmigchel H. (2003). *Environmental Marginal Cost Case Studies*. Deliverable 11. UNITE (UNification of accounts and marginal costs for Transport Efficiency). Funded by 5<sup>th</sup> Framework RTD Programme. Stuttgart.
- Boiteux M. and Baumstark L. (2001). *Transport: choix des investissements et coût des nuisances*. Commissariat Général du Plan. Paris.
- Bokor Z., Kővári B., Mészáros F. and Rónai P. (2003). *Task Report 6.4: Capacity management and specific inter-urban measures - Interurban Road Instruments*. SPECTRUM, funded by the European Commission, 5<sup>th</sup> Framework Transport RTD, Budapest/Leeds.
- Booz Allen Hamilton (2000). *Usage costs: issues raised in the Regulator's consultation*. Available at [www.rail-reg.gov.uk](http://www.rail-reg.gov.uk).
- Bossche M. A. van den, Certan C., Goyal P., Gommers M., Sansom T (2000). *Marginal Cost Methodology*. Deliverable 3. UNITE (UNification of accounts and marginal costs for

- Transport Efficiency). Funded by 5<sup>th</sup> Framework RTD Programme. Institute for Transport Studies, Leeds.
- Bossche M. A. van den, Certan C., Veldman S., Nash ., Johnson D., Ricci A., Enei R. (2002). *Guidance on Adapting Marginal Cost Estimates*. Deliverable 5. UNITE (UNification of accounts and marginal costs for Transport Efficiency). Funded by 5<sup>th</sup> Framework RTD Programme. Netherlands Economic Institute (NEI), Rotterdam.
- Bowker, R (2002). "Britain's Railway – Time for a New Radicalism. The Sir Robert Reid Railway Lecture 2002" The Institute of Logistics and Transport (London).
- Brewer, P.J., Plott, C.R. (1996). "A binary conflict ascending price mechanism for the decentralized allocation of the right to use railroad tracks". *International Journal of Industrial Organisation* 14 (6), 857-886.
- Bröcker, J., Meyer, R., Schneekloth, N., Schürmann, C., Spiekermann, K., Wegener, M. (2004). *Modelling the Socio-economic and Spatial Impacts of EU Transport Policy*. Deliverable 6. IASON (Integrated Appraisal of Spatial economic and Network effects of transport investments and policies). Funded by 5<sup>th</sup> Framework RTD Programme. Kiel/Dortmund: Christian-Albrechts-Universität Kiel/Institut für Raumplanung, Universität Dortmund.
- CAPRI (2001). Final Report. CAPRI - Concerted Action on Transport Pricing Research Integration. Funded by 4th Framework RTD Programme. ITS, University of Leeds, Leeds, January 2001.
- Capros, P. and Mantzos, L. (2000). *Kyoto and technology at the European Union: costs of emission reduction under flexibility mechanisms and technology progress*, *Int. J. Global Energy Issues*, 14, pp. 169-183.
- Carlin, A and R.E Park (1970). "Marginal cost pricing of airport runway capacity". *American Economic Review* 60, 310-319.
- Carthy T, Chilton S. Covey J, Hopkins L, Jones-Lee M, Loomes G, Pidgeon N, and Spencer A (1999). "On the Contingent Valuation of Safety and the Safety of Contingent Valuation: Part 2-The CV/SG 'chained approach". *Journal of Risk and Uncertainty*, 17:3 187-213.
- CE Solutions for environment, economy and technology (CE) (2003). *Charges for barges? Preliminary study of economic incentives to reduce engine emissions from inland shipping in Europe*. Delft 2004.
- Chesneau, S., Hustache, J-C., Fuller, I. (2003). *ATM flight efficiency and its impact on the environment, 2002 study*. EUROCONTROL Experimental Centre note. EEC/ENV/2003/001.
- Commission Expert Group on Transport and Environment (2003). "Review of infrastructure charging systems", Working Group III, October 2003.
- Cook, A., Tanner, G., Anderson, S. (2004). *Evaluating the true cost to airlines of one minute of airborne or ground delay, Final report*. Edition 4, 17 February 2004. Transport Studies Group, University of Westminster, London.
- Crawford, I. (2000). *The distributional effects of the proposed London congestion charging scheme*. Institute for Fiscal Studies, London.

- Cretegnny, L., Springer, U., Suter, S. (2005). *Case Study Switzerland*. Annex 4 to Deliverable D4, Report on the Implementation of Interurban Case Studies. REVENUE (Revenue Use from Transport Pricing). Funded by 5<sup>th</sup> Framework RTD Programme, ISIS, Rome.
- Criqui, P. and Viquier, L. (2000). "Kyoto and technology at world level: costs of CO<sub>2</sub> reduction under flexibility mechanism and technical progress". *International Journal of Global Energy Issues*, 14, pp. 155-168.
- De Ceuster G, et al. (2005). ASSESS Final Report, DG TREN, European Commission.
- De Palma, A. Lindsey, R., Kilani, K., Proost, S., Sen, A., Vold, A., Moilanen, P., and Niskanen, E. (2003). *Welfare Effects – Urban Transport*. Deliverable 7, MC-ICAM (Marginal Cost Pricing in Transport – Integrated Conceptual and Applied Model Analysis). Funded by 5<sup>th</sup> Framework RTD Programme. ITS, University of Leeds.
- Department of Transport (1993). "Gaining access to the Railway network. The Government's proposals".
- DESIRE (2001). *Possible Designs of Inter-Urban Road Pricing Schemes for Heavy Goods Vehicles*. Deliverable 2. EU-project DESIRE, funded by the European Commission, 5<sup>th</sup> Framework Transport RTD.
- Dimitrios Tsamboulas, Dimitris Korizis, Angeliki Kopsacheili (2001). *Mediterranean Short-Sea Shipping including Piraeus Port Marginal Cost Case Study*. Annex 7 to Deliverable 10. UNITE (UNification of accounts and marginal costs for Transport Efficiency). Funded by 5<sup>th</sup> Framework RTD Programme. ITS, University of Leeds, Leeds.
- Dings, J.M.W. et al., 2002. *External Costs of Aviation*. CE Delft.
- DIW, INFRA, Herry, NERA. *Infrastructure capital, maintenance and road damage costs for different heavy goods vehicles in the EU*. Berlin.
- Doll C. (2002). *Transport User Cost and Benefit Case Studies*. Deliverable 7. UNITE (UNification of accounts and marginal costs for Transport Efficiency). Funded by 5<sup>th</sup> Framework RTD Programme. ITS, University of Leeds, Karlsruhe.
- Doll, C. (2005). *German HGV toll case study*. Annex 2 to Deliverable D4, Report on the Implementation of Interurban Case Studies. REVENUE (Revenue Use from Transport Pricing). Funded by 5<sup>th</sup> Framework RTD Programme, ISIS, Rome.
- Donselaar and Carmighelet (2001). *Infrastructure, environmental- and accident costs for Rhine container shipping*. Annex 8 to Deliverable 10. UNITE (UNification of accounts and marginal costs for Transport Efficiency). Funded by 5<sup>th</sup> Framework RTD Programme. ITS, University of Leeds, Leeds.
- DotEcon (2002). *Auctioning Airport Slots*. A report for the HM Treasury and the Department of the Environment, Transport and the Regions. Available online at [www.dotecon.com](http://www.dotecon.com)
- Duerinck et al. (1999). *Prospective study of emissions in Belgium until 2008/2012 of the greenhouse gases included in the Kyoto Protocol. Costs and potential measures and policy instruments to reduce GHG emissions*. Vito & KU-Leuven.
- ECMT (2003a). *Optimal Transport Pricing: Final Report of the ECMT/EC DG-TREN research project comparing current transport taxes and charges with an optimal pricing benchmark*, London.
- ECMT (2003b). *Reforming transport taxes*. European Conference of Ministers of Transport, France.

- ECMT (2005). *Charges for the Use of Infrastructure in ECMT Railways. Report and Recommendations*. Paris.
- ECORYS and Mettle (2005). *Charging and pricing in the area of inland waterways, Practical guideline for realistic transport pricing, Final report*. Rotterdam, 04 August 2005 (DGTREN). Available at [http://europa.eu.int/comm/transport/iw/index\\_en.htm](http://europa.eu.int/comm/transport/iw/index_en.htm) (last consultation March 2006).
- Entec UK Ltd (2002). Quantification of emissions from ships associated with ship movements between ports in the European Community. Final Report to the EC. Available at <http://europa.eu.int/comm/environment/air/background.htm#transport> (last consultation March 2006).
- ERAIL (2005). European Railways Administrations Institutions and Legislation (ERAIL). Final report to European Commission, DG Transport and Energy. Available at: <http://europa.eu.int/comm/transport/rail/countries/erail-report-jun2005.pdf>
- Essen, van H.P., B.H. Boon, M.J. Koetse, F.R. Bruinsma (2004). *Onderhoud en beheer van infrastructuur voor goederenvervoer*, Structuur en hoogte van kosten.
- ETSAP (1996). *Energy Technology Systems Analysis Programme (ETSAP)*. Energy Research Center of Netherlands. Petten, NL.
- EUROCONTROL (2003). *Guidance on the Rules and Procedures of the Route Charges System*. October 2003.
- EUROCONTROL (2004). *Principles for Establishing the Cost-Base for Route Facility Charges and the Calculation of the Unit Rates*. Doc. N° 04.60.01 November 2004.
- European Commission (EC) (1991). *Railway Directive 91/440 on the development of the community's railways*. Brussels.
- European Commission (EC) (1992). *White Paper: European Union Common Transport Policy*. Brussels
- European Commission (EC) (1995). *Green Paper: Towards Fair and Efficient Pricing in Transport*. COM(95)691, December 1995. Brussels.
- European Commission (EC) (1996). *White Paper: A Strategy for Revitalising the Community's Railways*. COM (96)421 FINAL. Brussels.
- European Commission (EC) (1997). *Green paper: Sea ports and maritime infrastructure* COM(97)678, December 1997. Brussels.
- European Commission (EC) (1998). *White Paper: Fair Payment for Infrastructure Use: A Phased Approach to a common transport infrastructure charging framework in the EU*. COM (98)466, July 1998. Brussels.
- European Commission (EC) (1999a). *Calculating Transport Accident Costs*. Final Report of the Expert Advisors to the High Level Group on Infrastructure Charging, Published by European Commission, 27<sup>th</sup> April 1999.
- European Commission (EC) (1999b). *Calculating Transport Environmental Costs*. Final Report of the Expert Advisors to the High Level Group on Infrastructure Charging, Published by European Commission, 30<sup>th</sup> April 1999.
- European Commission (EC) (1999c). *Calculating Transport Congestion and Scarcity Costs*. Final Report of the Expert Advisors to the High Level Group on Infrastructure Charging, Published by European Commission, 7<sup>th</sup> May 1999.

- European Commission (EC) (1999d). *Calculating Transport Infrastructure Costs*. Final Report of the Expert Advisors to the High Level Group on Infrastructure Charging, Published by European Commission, 28<sup>th</sup> April 1999.
- European Commission (EC) (1999e). *Estimating Transport Costs*. Final Report of the Second High Level Group on Infrastructure Charging, 26<sup>th</sup> May 1999.
- European Commission (EC) (1999f). *Directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructures*. Brussels.
- European Commission (EC) (1999g). *ExternE Externalities of Energy. Vol 7 – Methodology 1998 update*. A Report produced for the EC – DG XII, Luxembourg, Office of Publications for the European Communities, Luxembourg.
- European Commission (EC) (2001a). White paper: *European transport policy for 2010: time to decide*. COM (2001)370, September 2001. Brussels.
- European Commission (EC) (2001b). *Directive 2001/14/EC on the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure and safety certification*. Brussels.
- European Commission (EC) (2003). *Proposal for a directive of the European parliament and of the council amending Directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructures*. Brussels.
- European Commission (EC) (2005). *Airport capacity, efficiency and safety in Europe*. Commission Staff Working Document. Available at: [http://europa.eu.int/comm/transport/air/safety/doc/2005\\_09\\_13/2005\\_11\\_15\\_consultation\\_paper\\_en.pdf](http://europa.eu.int/comm/transport/air/safety/doc/2005_09_13/2005_11_15_consultation_paper_en.pdf)
- European Parliament and Council (1999). Directive 1999/62/EC of the European Parliament and of the Council of 17 June 1999 on the charging of heavy goods vehicles for the use of certain infrastructures.
- Fahl et al. (1999). *E<sup>3</sup>Net*. In: Forum für Energiemodelle und Energiewirtschaftliche System-Analysen in Deutschland (Hrsg.) (1999) *Energiemodelle zum Klimaschutz in Deutschland*, Physica-Verlag, Heidelberg.
- Fereday D., R. Tricker, L. Pickup, B. Norheim, J-T Bekken, J. Laird, C. Nash, S.P. Sheperd (2005). *Urban Case Studies*. Deliverable 5. REVENUE (Revenue Use from transport Pricing). Funded by 5<sup>th</sup> Framework RTD Programme, ISIS, Rome.
- Friedrich, R. and Bickel, P. (eds.) (2001). *Environmental External Costs of Transport*. Springer Verlag, Heidelberg.
- Fuller, I., Hustache, J-C., Kettunen, T. (2004). *ATM flight efficiency and its impact on the environment, 2003 study*. EUROCONTROL Experimental Centre note. EEC/SEE/2004/005.
- Gaudry, M., and Quinet, E (2003). *Rail track wear-and-tear costs by traffic class in France*, Universite de Montreal, Publication AJD-66.
- Gibson, S, G Cooper and B Ball (2002). “Capacity charges on the UK rail network”. *Journal of Transport Economics and Policy*, 36, 2, 341-354
- Grether, D, M. Isaac and C. Plott (1989). *The allocation of scarce resources: Experimental Economics and the problem of allocating airport slots*. Underground Classics in Economics, Westview Press.

- Henstra D, et al. (2003). *Marginal cost pricing implementation paths in interurban transport - Evaluation of welfare effects*. Paper presented at the fourth seminar of the IMPRINT-EUROPE thematic network, Brussels 13<sup>th</sup>-14<sup>th</sup> May 2003
- Herry, M. and Sedlacek, N. (2002). *Road econometrics – Case study Austria*. Deliverable 10 Annex A1c. UNITE (UNification of accounts and marginal cost for Transport Efficiency). Funded by EU 5<sup>th</sup> Framework RTD Programme. ITS, University of Leeds, Leeds.
- Himanen, V., Idstrom, T., Gobel, A., Link, H. (2002). *Infrastructure Costs Case Studies - Helsinki-Vantaa Airport Case Study*. Annex 5 to Deliverable 10. UNITE (UNification of accounts and marginal costs for Transport Efficiency). Funded by 5<sup>th</sup> Framework RTD Programme. ITS, University of Leeds, Leeds.
- HLG (1998). On Pricing Principles. Final Report of the First High Level Group on Infrastructure Charging, 2nd June 1998.
- HLG (1999a). Calculating Transport Accident Costs. Final Report of the Expert Advisors to the High Level Group on Infrastructure Charging, Published by European Commission, 27th April 1999.
- HLG (1999b). Calculating Transport Congestion and Scarcity Costs. Final Report of the Expert Advisors to the High Level Group on Infrastructure Charging, Published by European Commission, 7th May 1999.
- HLG (1999c). Calculating Transport Environmental Costs. Final Report of the Expert Advisors to the High Level Group on Infrastructure Charging, Published by European Commission, 30th April 1999.
- HLG (1999e). Calculating Transport Infrastructure Costs. Final Report of the Expert Advisors to the High Level Group on Infrastructure Charging, Published by European Commission, 28th April 1999.
- HLG (1999f). Estimating Transport Costs. Final Report of the Second High Level Group on Infrastructure Charging, 26th May 1999.
- HLG (1999g). Options for Charging Users Directly for Transport Infrastructure Operating Costs. Final Report of the Third High Level Group on Infrastructure Charging, 9th September 1999.
- HM Treasury (2003). *Modernising the taxation of the haulage industry – Progress Report Two*. HM Treasury, HM Customs and Excise, and DfT publication, 6<sup>th</sup> May 2003
- Holland Mike (EMRC), Steve Pye, Paul Watkiss (AEA Technology), Bert Droste-Franke, Peter Bickel (IER) (2005). *Damages per tonne emission of PM2.5, NH3, SO2, NOx and VOCs from each EU25 Member State (excluding Cyprus) and surrounding seas*. Prepared for European Commission DG Environment in the framework of CAFE Programme. <http://europa.eu.int/comm/environment/air/cale/activities/estimates.htm> (last consultation 15th March 2006)
- ICAO (2004). *ICAO's Policies on charges for airports and air navigation services*. ICAO document 9082, 7<sup>th</sup> Edition, 2004.
- INFRAS/IWW (2000). *External Costs of Transport: Accident, Environmental and Congestion Costs of Transport in Western Europe*. Zürich/Karlsruhe.
- Intergovernmental Panel on Climate change (IPCC) (1999). *Aviation and the global atmosphere*. Cambridge University Press.

- Jan Owen Jansson and Robert Ericsson (2002). *Swedish Seaport Case Study: Price Relevant marginal cost of Swedish seaport services*. Annex 6 to Deliverable 10. UNITE (UNification of accounts and marginal costs for Transport Efficiency). Funded by 5<sup>th</sup> Framework RTD Programme. ITS, University of Leeds, Leeds.
- Johansson, P. and Nilsson, J. (2004). "An economic analysis of track maintenance costs". *Transport Policy* 11(3), pp. 277-286.
- Johnson, D and C. Nash (2005). *Charging for Scarce Capacity: A Case Study of Britain's East Coast Main Line*. Third Rail Conference on Railroad Industry Structure, Competition and Investment, Stockholm.
- Kågeson, Per (1999). "Economic Instruments for Reducing Emissions from Sea Transport", T&E Air Pollution and Climate Series 11, T&E 99/7.
- Kossak, I.A (2005). "Tolling HGVs on Germany's Autobahns", Boston US-TRB meeting, July 2005.
- Laird, J.J., Nash, C.A. and Nellthorp, J., Macário, R., Van der Hoofd, M., Carmona, M., Proost, S., Suter, S. and Lieb, C. (2004). *State of the Art and Conceptual Background*. Deliverable 1. REVENUE (Revenue Use from Transport Pricing). Funded by 5<sup>th</sup> Framework RTD Programme, ISIS, Rome.
- Latvian Railways (2005). "The infrastructure charging system at Latvian Railway (LDz) - Perspectives of the infrastructure manager". Presentation at the Workshop on Rail Infrastructure Charges: Efficiency, Cost Recovery and the Development of International Train Services. Paris, 1-2 February 2005.
- Lindberg G. (2002). "Recent progress in the measurement of external costs and implications for transport pricing reforms". Paper presented at the second seminar of the IMPRINT-EUROPE Thematic Network held in Brussels, 14/15 May 2002. Available at: [http://www.imprint-eu.org/public/Papers/IMPRINT\\_Lindberg.pdf](http://www.imprint-eu.org/public/Papers/IMPRINT_Lindberg.pdf).
- Lindberg G. (2003). "Estimating external cost". Paper presented at the IMPRINT-EUROPE seminar held on the 1<sup>st</sup> October 2003, Brussels. Available at: [http://www.imprint-eu.org/public/Papers/IMPRINTHGV\\_lindberg.pdf](http://www.imprint-eu.org/public/Papers/IMPRINTHGV_lindberg.pdf).
- Lindberg, G. (2002). *Marginal accident costs – case studies*. Deliverable 9. UNITE (UNification of accounts and marginal costs for Transport Efficiency). Funded by 5<sup>th</sup> Framework RTD Programme. ITS, University of Leeds, Leeds.
- Lindberg, G. (2002). *Marginal Cost of road maintenance for heavy goods vehicles on Swedish roads*. Deliverable 10 Annex 2. UNITE (UNification of accounts and marginal costs for Transport Efficiency). Funded by 5<sup>th</sup> Framework RTD Programme. ITS, University of Leeds, Leeds.
- Link H. and Stewart-Ladewig L. (2005). *Report on the implementation of interurban case studies*. Deliverable 4. REVENUE (Revenue Use from Transport Pricing). Funded by 5<sup>th</sup> Framework RTD Programme, ISIS, Rome.
- Link, H. (2005). "An econometric analysis of motorway renewal costs in Germany." Forthcoming *Transportation research Part 1* 40 pp. 19-34.
- Link, H. and Nilsson, J. (2005). "Infrastructure". In Nash, C. and Matthews, B. (eds) *Measuring the Marginal Social Cost of Transport*. Forthcoming.
- Link, H. and Stewart-Ladewig, L. (2005). *Road Haulier Acceptability of HGV Charges*, Annex 7 to Deliverable D4, Report on the Implementation of Interurban Case Studies.

- REVENUE (Revenue Use from Transport Pricing). Funded by 5<sup>th</sup> Framework RTD Programme, ISIS, Rome.
- Link, H. et al. (2002). *Case studies in marginal infrastructure costs*. Deliverable 10. UNITE (UNification of accounts and marginal costs for Transport Efficiency). Funded by 5th Framework RTD Programme. ITS, University of Leeds.
- Link, H., Dodgson, J., Maibach, M. and Herry, M. (1999). *The costs of road infrastructure and congestion in Europe*. Physica/Springer, Heidelberg.
- Lloyd's Register (1999). *Marine Exhaust Emissions Quantification Study – Mediterranean Sea. Final Report*. Study carried out for the EC, DG XI. December 1999. Available at <http://europa.eu.int/comm/environment/air/background.htm#transport> (last consultation March 2006).
- Maffii S. and Martino A. (2003). *Common Assumptions and Scenarios*. TIPMAC Deliverable 1. Funded by 5<sup>th</sup> Framework RTD Programme, TRT, Milan.
- Matthews B., Nash C., (2002). *Railway Infrastructure Charging in Britain - the Process of Reorganisation and Reform*. Task Report 5.2. MC-ICAM (Marginal Cost Pricing in Transport – Integrated Conceptual and Applied Model Analysis). Funded by the European Commission, 5<sup>th</sup> Framework Transport RTD. Institute for transport Studies, University of Leeds.
- Matthews B., Nash C., Nilsson J-E. and Farkas G. (2002). *Institutional and Technological Barriers to Implementation - Rail Transport*. Task Report 5.2 part 1. MC-ICAM (Marginal Cost Pricing in Transport – Integrated Conceptual and Applied Model Analysis). Funded by the European Commission, 5<sup>th</sup> Framework Transport RTD. Institute for transport Studies, University of Leeds.
- Mayeres I. and Proost S. (2003). *Reforming Transport Pricing: an economic perspective on equity and acceptability*. Available at: <http://www.kuleuven.be/etenrWP2002-12>.
- McCubbin, D.R. and Delucchi, M.A. (1996) *The Social Cost of the Health Effects of Motor-Vehicle Air Pollution*, Report #11 in the Series: The Annualised Social Cost of Motor-Vehicle Use in the United States, based on 1990-1991 Data, UCD-IST-RR-96-3 (11), Davis, California, US.
- McKinnon, A.C (2005). “Application of road-user charging to trucking operations in Europe: A review of the tolling schemes and assessment of their possible impact on logistics systems”. Conference Proceedings Logistic Research Network 2005, Plymouth.
- Ministry for Economy and Transport (2004). *Hungarian Transport Policy 2003-2015*. May 2004.
- Ministry of Transport (2005). “Principles of railway network access charging in Poland. Presentation. Workshop on Rail Infrastructure Charges: Efficiency, Cost Recovery and the Development of International Train Services”. Poland Ministry of Transport, Paris, 1-2 February 2005.
- Mohring, H., and M. Harwitz (1962). *Highway Benefits: An Analytical Framework*. Northwestern University Press: Evanston, IL.
- Munduch, G., Pfister, A., Sogner, L. and Stiassny, A. (2002). “Estimating Marginal Costs for the Austrian Railway System”. Working paper 78. Department of Economics Working Paper Series. Vienna University of Economics & B.A., Vienna.

- Nash C, B Matthews, B Menaz and E Niskanen (2003). "Charges for Heavy goods vehicles: EU policy and key national developments", Paper presented at the IMPRINT-EUROPE Workshop on charges for heavy goods vehicles, October 1, 2003
- Nash, C, S. Coulthard and B. Matthews (2004). "Rail track charges in Great Britain – the issue of charging for capacity". *Transport Policy* Vol. 11, No 4, October 2004.
- Nash, C.A., Niskanen, E. and Verhoef, E. (2003). *Policy conclusions from MC-ICAM*. Paper presented at the fourth IMPRINT-EUROPE seminar "Implementing Pricing Policies in Transport: Phasing and Packaging", 13-14 May 2003, Leuven. <http://www.imprint-eu.org/seminars.htm#sched>
- Nash, Chris (2005). "Rail infrastructure charges in Europe". *Journal of Transport Economics and Policy* 3, Volume 39, pp. 259-278.
- National Economic Research Associates (NERA) (1998), "An Examination of Rail Infrastructure Charges". London.
- National Economic Research Associates (NERA) (2004a). "Evaluation of the feasibility of alternative market-based mechanisms to promote low-emission shipping in European Union sea areas", London 2004.
- National Economic Research Associates (NERA) (2004b). *Study to Assess the Effects of Different Slot Allocation Schemes. A Final Report for the European Commission, DG TREN*. January 2004.
- NEA, OGM, University of Oxford, TINA, Erasmus University of Rotterdam, TIS (2005): ERAIL Monograph - Lithuania. Prepared for European Commission, DG TREN. Available at [[http://europa.eu.int/comm/transport/rail/countries/lt/mne\\_en.htm](http://europa.eu.int/comm/transport/rail/countries/lt/mne_en.htm)]
- NEA, OGM, University of Oxford, TINA, Erasmus University of Rotterdam, TIS (2005): ERAIL Monograph - Latvia. Prepared for European Commission, DG TREN. Available at [[http://europa.eu.int/comm/transport/rail/countries/lt/mne\\_en.htm](http://europa.eu.int/comm/transport/rail/countries/lt/mne_en.htm)]
- Nerhagen L. (2003). "Health costs of transport air pollution in urban areas in Sweden". Paper presented at the ECE/WHO "Pan-European Program on Transport, Health and Environment".
- Nerhagen L. and Johansson H. (2003). "Variations in the external costs of transport air pollution – The case of Sweden". VTI notat 36A-2003.
- Nilsson, J (2003). Marginal cost pricing of airport use: The case for using market mechanisms for slot pricing, Swedish National Road and Transport Research Institute, VTI notat 2A-2003.
- Nilsson, J-E (2002). "Towards a Welfare Enhancing Process to Manage Railway Infrastructure Access". *Transportation Research A*, 36, 5, 419-436.
- Niskanen E. and Nash C. (2004). *Final Report for Publication*. MC-ICAM. Implementation of Marginal Cost Pricing in Transport – Integrated Conceptual and Applied Model Analysis. Funded by 5<sup>th</sup> Framework RTD Programme. Institute for Transport Studies, University of Leeds.
- Niskanen, E et al. (2003). *Phased Approach*. Deliverable 6. MC-ICAM. Implementation of Marginal Cost Pricing in Transport – Integrated Conceptual and Applied Model Analysis. Funded by 5<sup>th</sup> Framework RTD Programme. Institute for Transport Studies, University of Leeds.

- Niskanen, E., de Palma, A., Lindsey, R., Marler, N., May, T., Nash, C., Schade, J., Schlag, B., Verhoef, E. (2003). *Pricing of urban and interurban road transport: Barriers, constraints and implementation paths*. Deliverable 4. MC-ICAM. Implementation of Marginal Cost Pricing in Transport – Integrated Conceptual and Applied Model Analysis. Funded by 5<sup>th</sup> Framework RTD Programme. Leeds, Dresden.
- Office of the Rail Regulator (ORR) (1997). *The periodic review of Railtrack's access charges: a proposed framework and key issues*.
- Office of the Rail Regulator (ORR) (2000). *Periodic review of Railtrack's access charges: Final conclusions Volume I*. Available at [www.rail-reg.gov.uk](http://www.rail-reg.gov.uk) .
- PATS (2001). *Recommendations on transport Pricing Strategies*, Final Report. TIS.pt, Portugal.
- Preston, J., Whelan, G.A., and Wardman, M.R. (1999). “An Analysis of the Potential for On-track Competition in the British Passenger Rail Industry”. *Journal of Transport Economics and Policy*, 36, (1) 77-94.
- PRIMA (2000) *Pricing Measures Acceptance*, Final Report, Inregia, Sweden.
- Proost S., A. de Palma, R. Lindsey, Y. Balasko, D. Meunier, E. Quinet, C. Doll, M. van der Hoofd, E. Pires (2004). *Theoretical Framework*. Deliverable 2. REVENUE (Revenue Use from Transport Pricing). Funded by 5<sup>th</sup> Framework RTD Programme. Leuven.
- Proost S., S. Van der Loo, A. de Palma, and R. Lindsey (2005). “A cost-benefit analysis of tunnel investment and tolling alternatives in Antwerp”. ETE WORKING PAPER SERIES n°2005-07.
- Quinet, E. (2003). “Short Term Adjustments in Rail Activity: The Limited Role of Infrastructure Charges”, *Transport Policy*, Vol.10, No.1.
- Raux, C., Mercier, A., Souche, S. (2005). *Case Study 4.4: The French Multimodal Fund*, Annex 3 to Deliverable D4. REVENUE (Revenue Use from Transport Pricing), Funded by 5<sup>th</sup> Framework RTD Programme, ISIS, Rome.
- RECORDIT (2003). Final report. RECORDIT - Real Cost Reduction of Door-to-Door Intermodal Transport. Funded by 5<sup>th</sup> Framework RTD Programme, ISIS Rome 2003.
- Rees (1976). *Public Enterprise Economics*, Wiedenfield and Nicholson, London.
- Rothengatter, W (2002) *Charging systems for the use of transportation infrastructure*, Institute for Economic Policy Research (IWW)
- Rothengatter, W. (2005). *Pricing and Investment in Transport under Privatised Institutional Regimes*. Paper presented to the REVENUE Final Conference, Brussels November 30<sup>th</sup> 2005.
- Rothengatter, W. et al. (1996). *Bottlenecks in the European Transport Infrastructure*. Technical Report. Study on behalf of the European Centre for Infrastructure Studies (ECIS). April, 1996.
- Sansom, T., Nash, C., Mackie, P., Shires, J.D. and Watkiss, P. (2001). “Surface Transport Costs and Charges: Great Britain 1998”. A Report for the DETR.
- Schade, J., Schlag, B. (2000). *Acceptability of urban transport pricing*. VATT Research Report No. 72. Helsinki.
- Schade, J., Schlag, B. (Hrsg.) (2003). *Acceptability of transport pricing strategies*. Oxford: Elsevier.

- Schmid, S, Bickel, P., Friedrich, R. (2001), External Cost Calculation for Selected Corridors. RECORDIT (Real Cost Reduction Of Door-To-Door Intermodal Transport) Deliverable 4. Funded by 5th Framework RTD Programme. IER Stuttgart.
- Schreyer, C., Schmidt, N., Maibach, M. (2002). *Road econometrics – Case study motorways Switzerland*. Deliverable 10, Annex A1b. UNITE (UNification of accounts and marginal costs for Transport Efficiency). Funded by the EU 5<sup>th</sup> Framework RTD Programme. ITS, University of Leeds, Leeds.
- Schreyer, C., Sutter, D., Peter, M., Maibach, M. (2005). *Case Study 5: Zurich Airport*, Annex 5 to Deliverable D4. REVENUE (Revenue Use from Transport Pricing). Funded by 5<sup>th</sup> Framework RTD Programme, ISIS, Rome.
- Seidel, T., Matthes, A., Wieland, B., Schlag, B., Schade, J., Verhoef, E., Ubbels, B., Tánčzos, K., Kosztyó, Á., Mészáros, F. (2004). *Political acceptability of transport policies in Germany - the HGV toll*. Case Study. EU-project TIPP. Funded by the European Commission, 5<sup>th</sup> Framework Transport RTD, Dresden/Helsinki.
- Seminar hosted by Estonian Ministry of Economic Affairs and Communications and The World Bank (2004): Transport sector restructuring in the Baltic States toward EU accession.
- Simpson, D. and P. Wind (2005). *Source-receptor matrices derived from EMEP model runs carried out for the CAFE process*. Meteorologisk institutt (met.no), Oslo.
- Suter S., U. Springer, A. de Palma, R. Lindsey, S. van der Loo, A. Ricci, P. Fagiani, P. Moilanen, M. van der Hoofd, M. Carmona and J. Baker (2005). *Case Studies Specification*. Deliverable 3. REVENUE (Revenue Use from Transport Pricing). Funded by 5<sup>th</sup> Framework RTD Programme. March 2005.
- Suter, S., Springer, U., de Palma, A., Lindsey, R., van der Loo, S., Ricci, A., Fagiani, P., Moilanen, P., van der Hoofd, M., Carmona, M., Baker, J. (2005). *Case Studies Specification*. Deliverable 3. REVENUE (Revenue Use from Transport Pricing). Funded by the European Commission, 5<sup>th</sup> Framework RTD Programme, Rome.
- Swiss Federal Office for Spatial Development (ARE) (2004). “Fair and Efficient: The distance-related Heavy Vehicle Fee (HVF) in Switzerland”, Berne.
- Tánčzos K, Bokor B., Farkas G. and Nash C. (2004). *Special conference for Newly Associated States (NAS)*. Deliverable 5. IMPRINT-EUROPE (Implementing Pricing Reforms in Transport). Funded by 5<sup>th</sup> Framework RTD Programme. ITS, Leeds.
- Tánčzos K., Bokor Z., Farkas G.. and Nash C. (2004). *Special conference for Newly Associated States (NAS)*. Deliverable 5. IMPRINT-EUROPE (Implementing Pricing Reforms in Transport). Funded by the 5<sup>th</sup> Framework Programme. University of Leeds.
- Tánčzos, K., Murányi, M., Orosz, Cs., Gedeon, A. (1998). “Large size transport infrastructure investments in Hungary”. *Scientific Review of Transport* 9, 332-340.
- Tavasszy, L., Renes, G., Burgess, A. (2004). *Final report for publication: Conclusions and recommendations for the assessment of economic impacts of transport projects and policies*. Deliverable 10. IASON (Integrated Appraisal of Spatial economic and Network effects of transport investments and policies). Funded by 5<sup>th</sup> Framework RTD Programme. TNO Inro, Delft, Netherlands.
- Tervonen, J., Idström, T. (2004). *Marginal Rail Infrastructure Costs in Finland 1997-2002*. Report from the Finnish Rail Administration. Available at [www.rhk.fi](http://www.rhk.fi).

- Thomas F. (2003) *Marginal cost for wear and tear attributable to heavy vehicles inherent in 'effectsamband 2000'*, VTI-notat 6A-2003.
- Thomas, J. (2002). *EU task Force on Rail Infrastructure charging: summary findings on best practice in marginal cost pricing.* Presented at the third seminar of the IMPRINT-EUROPE Thematic Network. Available at <http://www.imprint-eu.org/seminars.htm>.
- Timár, A. (2004). "*Situation of road transport in Hungary*". Presentation at Hungarian Academy of Sciences in Hungarian. Budapest, June.
- Timms, P. et al. (2005). *Transferability of the SPECTRUM framework: theory and practice.* Deliverable 11. SPECTRUM project. Funded by the European Commission, 5<sup>th</sup> Framework Transport RTD. Institute for Transport Studies, University of Leeds.
- Ubbels, B., Verhoef, E. (2005). "Acceptability of road pricing and revenue use in the Netherlands". Paper presented at the 45<sup>th</sup> Congress of the European Regional Science Association "Land Use and Water Management in a Sustainable Network Society", Vrije Universiteit Amsterdam, 23-27 August 2005.
- University of Westminster (2004). Evaluating the true cost to airlines of one minute of airborne or ground delay. Commissioned by Performance Review Commission (EUROCONTROL).
- Verhoef, E., Ubbels, B. (2004). *Political history and acceptability of road pricing in The Netherlands.* Task Report 4.3. TIPP project. Funded by the European Commission, 5<sup>th</sup> Framework Transport RTD, Dresden/Helsinki.
- Workshop on Economic Valuation of Health Effects due to Transport, June 12-13 2003, Stockholm.
- World Health Organisation (WHO) (1999). *Health Costs due to Road Traffic-related Air Pollution – An impact assessment project of Austria, France and Switzerland,* Synthesis Report, published by Federal Department of Environment, Transport, Energy and Communications – Bureau for Transport Studies, Bern, Switzerland.
- Yance, J.V (1970). The theory of air carrier demand for slots, Secretary of Transportation, USA, 1970/01.
- Zografos K. (2002). *Acceptability Barriers of Pricing Strategies for Rail, Air & Water,* Task Report 5.5. MC-ICAM. Implementation of Marginal Cost Pricing in Transport – Integrated Conceptual and Applied Model Analysis. Funded by 5<sup>th</sup> Framework RTD Programme. Institute for Transport Studies, University of Leeds.