Final Report for Publication

POSSUM

ST-96-SC.107

Project Coordinator: **Professor David Banister**

Partners:

University College London (GB)
Free University Amsterdam (NL)
National Technical University of Athens (GR)
EURES - Institute for Regional Studies in Europe (DE)
FOA/ESRG - Environmental Strategies Research Group / Defence Research Establishment (SE)
VTT - Technical Research Centre of Finland (FI)
Warsaw University of Technology (PL)
Scientific Centre for Complex Transport Problems (RU)

Project Duration: **17 September 1996 to 17 December 1998**

Date: **December 1998**

PROJECT FUNDED BY THE EUROPEAN COMMISSION UNDER THE TRANSPORT RTD PROGRAMME OF THE 4TH FRAMEWORK PROGRAMME

CONTENTS

THE POSSUM CONSORTIUM

Organisation	Acronym	Address	Contacts	Telephone	Fax	Email
University College London	UCL	The Bartlett School of Planning University College London 22 Gordon Street London WC1H 0QB United Kingdom	Prof. David Banister Dominic Stead	44-171-504-4891 44-171-380-7456 44-171-380 7501 44-117-965-6261x3224	44-171-380-7502 44-171-380-7502 44-117-976 3895	d.banister@ucl.ac.uk d.stead@ucl.ac.uk & Dominic.Stead@uwe.ac.uk
Free University of Amsterdam	FUA	Economic and Social Institute Free University of Amsterdam De Boelelaan 1105 1081 HV Amsterdam Netherlands	Prof. Peter Nijkamp Hadewijch van Delft	31-20-444-6091 31-20-444-6090 31-20-444-6096	31-20-444-6004 31-20-444-6004	pnijkamp@econ.vu.nl hdelft@econ.vu.nl
National Technical University of Athens	NTUA	Department of Geography and Regional Planning National Technical University of Athens Zographou Campus 157 73 Athens Greece	Prof. Maria Giaoutzi Zenia Dimitrakopoulou	301-77-22-749 301-77-22-756 31-77-22-672	301-77-22-750 301-77-22-750	giaoutsi@central.ntua.gr zeniakam@central.ntua.gr
Institute for Regional Studies in Europe	EURES	EURES Baslerstraße 19 79100 Freiburg Germany	Ruggero Schleicher-Tappeser	49-761-70-44115	49-761-70-44144 32-2-289-1099	r.schleicher@eures.de freiburg@eures.de
Environmental Strategies Research Group / Defence Research Establishment	ESRG	ESRG/FOA Box 2142 103 14 Stockholm Sweden	Prof. Peter Steen Karl Henrik Dreborg Leif Hedberg Jonas Akerman:	468-402-3802 468-402-3803 468-402-3805 468-402-3809	468-402-3801 468-402-3801 468-402-3801 468-402-3801	steenp@system.ecology.su.se dreborgk@system.ecology.su.se hedbergl@system.ecology.su.se akermanj@system.ecology.su.se
Technical Research Centre of Finland	VTT	P.O.Box 1901 Helsinki FIN-02044 VTT	Dr. Veli Himanen Anu Tuominen	358-9-456-4598 358-9-456-5976	358-9-464-850	veli.himanen@vtt.fi Anu.Tuominen@vtt.fi
Warsaw University of Technology	WUT	Transportation Engineering Division Warsaw University of Technology A1 Armii Ludowej 16 00-637 Warsaw Poland	Prof. Wojciech Suchorzewski	48-22-8253-727	48-22-8253-727	suchorzewski@zik.il.pw.edu.pl
Scientific Centre of Complex Transport Problems	MRI	34 W Sofiyskaja nab RV-113035 Moscow Russia	Prof. Viacheslav Arsenov	095-233-89-13	095-231-14-54	

0. EXECUTIVE SUMMARY

The POSSUM project has successfully developed a new methodology for investigating policy scenario building at the European Level for the period 1995-2020. Innovative methods based on backcasting have been used to establish targets for economic, development and environmental objectives set out in the EU Common Transport Policy. These targets have been used as a framework for the construction of Images of the Future. These Images combine contextual elements (outside the scenario building process) and strategic elements (included in the scenario building process) to present visions of the future (2020). The contextual elements cover the expansion of the EU, the key roles that different decision makers play and levels of cohesiveness or competition within Europe. The two main strategic elements are technological innovation and decoupling (the reduction in the transport intensity of the economy).

Comprehensive lists of policy measures have been classified according to type (market-based, regulation, lifestyle-orientated and public service). These measures have been packaged according to particular themes. The innovative packaging process permits the mixing of different policy measures so that the targets set can be achieved. It moves beyond the expectation that individual policies will achieve sustainable mobility.

Packaging of actions allow transport and other related policies (e.g. on land use, development, taxation and technology) to be combined so that there is a much greater probability of target achievement. The policy packages are then presented in terms of paths, which explore when actions are needed, who is responsible, and the scale of implementation. Guidelines are suggested for the selection of the initial measures.

The scenario building methodology has provided a new approach to policy analysis at the European level. The POSSUM consortium has used a modified backcasting methodology which is both normative and designed to reflect desirable policy futures to 2020. The main modification has been the addition of an explorative scenario methodology in which different external developments (in relation to the transport sector) are chosen (this is the explorative element), and for each of these a possible solution to the problems posed for the transport sector in terms of sustainable mobility has been sought (the backcasting element). Through this innovative methodology, Policy Scenarios can be produced that combine strategic policy elements and contextual factors.

The policy packages have been developed from combining individual policy measures into mutually supporting groups. The packages have then also been combined into paths to attain the targets set for the achievement of each Image of the Future. The processes of packaging policies and the identification of policy paths are iterative and involve both the expertise of the consortium and external experts through the validation process. The path also describes the course of action over time, including the possible difficulties in implementation. Ten different policy packages have been described, each with a construction logic, the main measures and impacts on stakeholders:

1. Ecological tax reform
2. Liveable cities
3. Electric city vehicles
4. Long distance links – substituting for air travel
5. Fair and efficient distribution of mobility – tradeable mobility credits
6. Promoting subsidiarity in freight flows
7. Promoting dematerialisation of the economy
8. Minimising specific emissions
9. Resource efficient freight transport
10. Customer friendly transport services

These ten package have then been combined, some with particular variants, with other policies to create four policy paths, two related to Image I and two to Image II. These are the detailed policy scenarios for sustainable mobility 2020. They represent possible alternatives, rather than policy options. But they illustrate both the range of measure packages and paths available as well as the scale of change required. Clear principles for implementation are also developed, based on acceptability, lead-times, dynamic effects and adaptability, including comments on the role that the EU Commission can play.

The policy conclusions are clear:

1. If the transport is to become more sustainable, then positive action is required along the two main strategic elements – decoupling and technology. Technology alone cannot achieve sustainability in transport, even though it has a key role to play, particularly in the longer term.
2. Actions are needed both in the transport sector and in other related sectors. Some of these non-transport actions are linked to structural changes in society, macro economic policy interventions and the impact of technology.
3. New policy actions are required now if the targets (2020) are to be achieved.
4. Other EU policy priorities such as regional development and the development of the TENs can be included within the policy scenarios, but care has to be practised to ensure actions in these priority areas do not result in less sustainable mobility.
5. Policy actions must be packaged so that the principles of acceptability and adaptability can be applied to ensure successful implementation.
6. Certain common actions are apparent in several of the paths. Whatever future evolves, it is important to implement these common actions.
7. Under particular conditions it may be possible to introduce both strong decoupling and strong technology. This would be the optimal solution since it would ensure sustainable mobility in the longer term (beyond 2020).
8. The use of scenario analysis, as used in the POSSUM project, can help to identify more innovative policy options (tradeable mobility credits, for example).
9. Transport has to be more closely linked with other policy concerns of the EU. More emphasis must be placed on influencing economic, structural, agricultural, tourism and other policies to find the means to decouple transport growth from economic development.

1. INTRODUCTION

Transport is one of the largest sources of environmental pollution. The large number of significant environmental impacts associated with transport range from local through to global, and across a large range of issues including air quality, energy use, waste production and health (quantification of some of these impacts in the United Kingdom are shown as examples in Table 1.1). Many of these impacts are increasing. Others are beginning to decrease but these impacts may start to increase again in the longer term unless action is taken to reduce transport growth.

Transport policy-making has begun to respond to the issues of sustainability but is increasingly being required to do more. Whilst the future policy-making environment is uncertain, it is necessary to identify the key issues of policy-making likely to be of importance over the medium and long term if effective strategic decisions are to be made.

The main task of the POSSUM consortium has been to construct scenarios for achieving the objectives of sustainable mobility and to assist the Commission in future decisions about the Common Transport Policy and the development of the Trans-European Networks. The overriding aim of the study is to find ways *'to facilitate movements of persons and goods in agreement with a strategy of sustainable development. The concept includes mobility levels, but also the technical systems required to enable mobility'* (Hunhammar, 1997).

More specifically the POSSUM project aims at identifying future key issues – in the context of sustainable mobility - for policy makers at the European level, such as:

- PACKAGING - how policies can be packaged to increase their effectiveness (by maximising linkages and synergies);
- TIMING - the timescales required for the introduction of policies, and the time over which policies might have most effect;
- IMPLEMENTATION - the public acceptability of different types policies and the potential barriers to implementation; and
- RESPONSIBILITIES - the responsibilities of decision-makers and other stakeholders in policy development and implementation, the key organisations which need to act to achieve specific policy goals, the level of coordination between different levels of decision-making required.

For a sector (in this case transport) to be sustainable, the global concept of sustainable development has to be broken down on a per capita basis. The resources and risks have to be evenly distributed both within and between generations in order to comply with a sustainable development. It should be acknowledged in this respect, that there is yet no scientific agreement on a definition of sustainable development. However, it can be argued that sustainable development would achieve an equitable development that can continue in the long term. Four issues are usually stressed in this respect: ecological scale limits, inter-generational equity, intra-generational equity and increased or maintained quality of life (Hunhammar, 1997).

TABLE 1.1 ENVIRONMENTAL IMPACTS OF TRANSPORT IN THE UNITED KINGDOM

Environmental media	*Environmental impacts*	*Transport's contribution (1995 unless otherwise stated)*
Energy and mineral resources	➢ Energy resources used for transport (mainly oil-based). ➢ Extraction of infrastructure construction materials.	➢ 44.8 million tonnes of petroleum consumed by transport. ➢ transport accounts for approximately one-third of the UK's total energy consumption. ➢ approximately 120,000 tonnes of aggregates per kilometre of 3-lane motorway. ➢ 78 million tonnes of roadstone extracted.
Land resources	➢ Land used for infrastructure.	➢ approximately 4.2 hectares of land per kilometre of 3-lane motorway. ➢ 1,725 hectares of rural land developed for transport and utilities per annum (1992).
Water resources	➢ Surface and groundwater pollution by surface run-off. ➢ Changes to water systems by infrastructure construction. ➢ Pollution from oil spillage.	➢ 25 percent of water pollution incidents in England and Wales caused by oil. ➢ 585 oil spills reported in the UK. ➢ 142 oil spills requiring clean-up in the UK.
Air quality	➢ Global pollutants (such as carbon dioxide). ➢ Local pollutants (such as carbon monoxide, nitrogen oxides, particulate matter, volatile organic compounds).	➢ 25 percent of the UK's carbon dioxide emissions (CO_2). ➢ 76 percent of the UK's emissions of carbon monoxide (CO). ➢ 56 percent of the UK's emissions of nitrogen oxides (NO_X). ➢ 51 percent of the UK's emissions of black smoke (particulates). ➢ 40 percent of UK emissions of volatile organic compounds (VOCs).
Solid waste	➢ Scrapped vehicles. ➢ Waste oil and tyres.	➢ approximately 1.5 million vehicles scrapped. ➢ more than 40 million scrap tyres.
Biodiversity	➢ Partition or destruction of wildlife habitats from infrastructure construction.	
Noise and vibration	➢ Noise and vibration near main roads, railway lines and airports.	➢ approximately 3,500 complaints about noise from road traffic. ➢ approximately 6,500 complaints about noise from air traffic.
Built environment	➢ Structural damage to infrastructure (e.g. road surfaces, bridges). ➢ Property damage from accidents. ➢ Building corrosion from local pollutants.	➢ more than £1.5 million annual road damage costs.
Health	➢ Deaths and injuries from accidents. ➢ Noise disturbance. ➢ Illness and premature death from local pollutants.	➢ 3,500 deaths. ➢ 44,000 serious injuries. ➢ 49 percent of people who can hear noise from aircraft or trains consider it a nuisance (1991). ➢ 63 percent of people who can hear noise from road traffic consider it a nuisance (1991). ➢ between 12,000 and 24,000 premature deaths due to air pollution. ➢ between 14,000 and 24,000 hospital admissions and re-admissions may be associated with air pollution.

Sources: Banister (1998); Central Statistical Office (1997); Committee on the Medical Effects of Air Pollutants (1998); Department of the Environment, Transport and the Regions (1997a, b, c & d); Department of Trade and Industry (1997); Maddison et al. (1996); OECD (1988) and Royal Commission on Environmental Pollution (1994).

The end result of the POSSUM project is a set of policy scenarios aimed at achieving regional development, economic efficiency and environmental protection objectives. In this way, European transport policies will be assessed for their consistency and

feasibility by means of a qualitative scenario approach based on backcasting. The scenarios are explicitly policy oriented and expert based, and aim to help European and other decision-makers by presenting policy choices clearly, while the additional impacts of several external factors are controlled. In this way, we feel that we may contribute to future decision making processes at both European and national levels (Table 1.2).

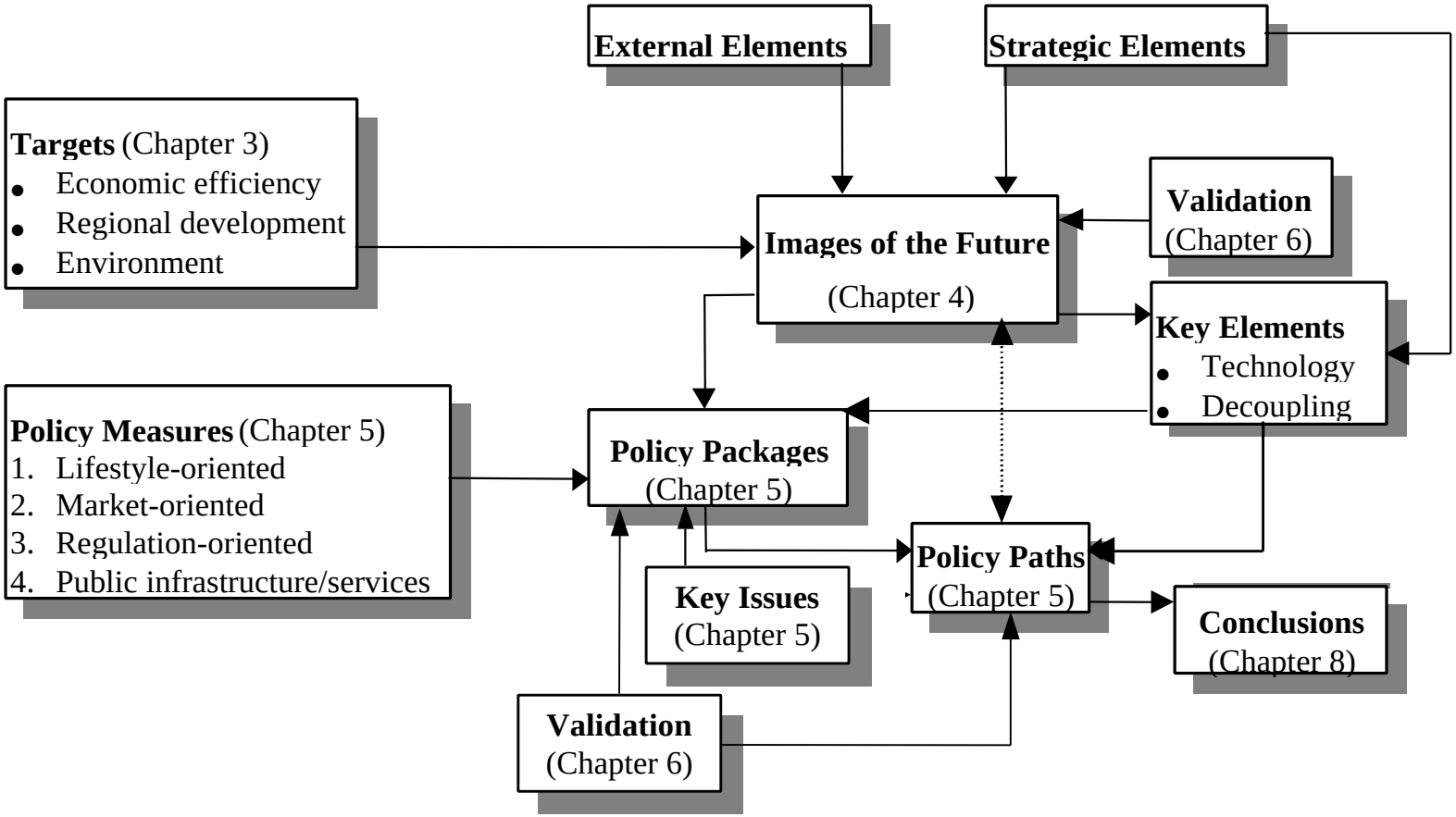
TABLE 1.2 ADVANTAGES OF USING SCENARIO ANALYSIS

Conventional forecasting analysis:	Backcasting scenario analysis:
Focus on quantified variables	Focus on qualitative pictures
More emphasis on details	More emphasis on trend breaches
Results determined by the status quo	Results based on future Images
From present to future (forecasting)	From future to present (backcasting)
Deterministic analysis	Creative thinking
Closed future	Open future
Statistical econometric tests	Plausible reasoning
From simple to complex	From complex to simple
From quantitative to qualitative	From qualitative to quantitative
Single track thinking	Multi-track thinking
Reactive problem driven	Pro-active vision thinking
Multiple implicit assumptions	Transparent simple assumptions
Limited set of options	Open range of options
Model-determined mind	Alertness to signals of uncertainty

Source: Rienstra (1998).

This final report brings together the main outputs from the POSSUM project. Chapter 2 outlines the methodological framework, including steps towards the Policy Scenarios. This is followed by the identification of the main targets for sustainable mobility (Chapter 3), the Images of the Future for European transport by 2020 (Chapter 4) and the Policy Measures and Packages (Chapter 5). These three stages are supplemented by an extensive validation process (Chapter 6), including the appropriateness of the Images of the Future and Policy Measures and Packages in the Central and Eastern European Countries (CEEC) and Commonwealth of Independent States (CIS) in Chapter 7. Poland and Russia are used as case studies to examine these issues in the CEEC and CIS respectively. The final chapter (Chapter 8) draws some conclusions from the POSSUM project and discusses the ways in which such approaches can be further developed as part of the European transport policy making process. Figure 1.1 illustrates the POSSUM approach. This approach is explained in more detail in the following chapter (Chapter 2) in the discussion of the POSSUM methodology.

FIGURE 1.1 THE POSSUM SCENARIO BUILDING METHODOLOGY



2. METHODOLOGICAL FRAMEWORK

2.1 INTRODUCTION

The POSSUM project uses scenario analysis to explore long-term, strategic policy-making issues, such as the future timing and interaction of policies or the potential barriers and obstacles to policy implementation. There is a growing awareness that in the long term the development of society is characterised by large uncertainties, that often makes a prognosis-based approach inadequate. Scenario analysis is increasingly being used in long-range policy research, since it provides a way of identifying future issues and problems for policy making in an environment of uncertainty (POSSUM Consortium, 1997a).

The POSSUM consortium have taken the CEC definition which describes a scenario as *"a tool that describes pictures of the future world within a specific framework and under specified assumptions. The scenario approach includes the description of at least two or more scenarios designed to compare and examine alternative futures"* (CEC, 1993). More generally, scenarios are visions of possible future states which seem plausible under different sets of assumptions and provide a background against which policy assessments can be made. Scenarios are distinct from forecasts which are normally based on trend extrapolation. The scenarios develop alternative futures in a structured way, which helps to identify policies that are robust and adaptable across a wide range of possible futures. Scenario planning, therefore, is not concerned with one particular future.

In order that the set of scenarios covers a sufficiently wide range of possibilities, each scenario is relatively extreme but *plausible*. For practical reasons, a small number of scenarios were selected to keep the research manageable. The scenarios in our study concern the transport system in Europe up to the year 2020. This reference year allows us to assume quite radical changes, and the impacts of policy packages may be clear in that year. A shorter time period may reduce the possibilities of analysing large shifts in the technical and institutional environment, while a later time horizon may limit the policy relevancy of the scenarios. The scenarios will discuss both goods and passenger transport. However, the description will be at a rather strategic level so that we will not explicitly discuss the impact of special features on transport systems in each country and city.

The spatial area (Europe) includes EU-countries, EFTA-countries, CEEC-countries and CIS-countries. First, the analysis will be focused on Europe in general, in which a distinction will be drawn between central and peripheral regions. In a later stage the impacts for CEEC and CIS countries will be analysed more explicitly. In this respect it is noteworthy that an expansion of the EU towards the CEEC countries may impact the other EU. Road transport volumes in the CEEC/CIS countries are expected to increase but currently have a lower level of traffic volume than the EU countries. This may lead to increased traffic emissions in these countries in conflict with environmental targets such as lower the emissions. These issues will be included in the external frameworks of polarisation and cooperation (Chapter 4).

The objectives of the Common Transport Policy (CTP) may be summarised by three terms: regional development, economic efficiency and environmental protection. Therefore, the scenarios will be focused on achieving targets for these three issues. Although the broad objectives may be clear, they are rather abstract and can be interpreted in different ways. A more detailed way of defining the policy issues is therefore necessary to focus the scenario experiment. These policy issues may be found by an extensive literature search; however, experts (scientists, policy makers and stakeholders like car drivers, industry, and so on) may also have views on the strategic issues. Because the POSSUM-methodology is explicitly expert-based, experts from all European countries - including CEEC countries - have been asked to indicate the main policy problems to be discussed in the scenarios.

The time horizon for the analysis is 2020 which means that all goals should be fulfilled by that time. The goals should be seen as tentative and intermediary however. In the very long run, more far reaching goals will probably be set (e.g. CO_2 emissions[1]). An important question in this context is how to avoid solutions that fulfil the targets for 2020 but are unlikely to fulfil more stringent targets in the very long run.

An important feature of the POSSUM-scenario analysis is that it based on expert group validation. Transport and environmental experts are used at various points in the research process to provide input (Figure 1.1). Experts include transport scientists, environmental scientists, planners, policy analysts, social psychologists and transport policy makers.

2.2 METHODOLOGY OF SCENARIO CONSTRUCTION

The POSSUM methodology involves *backcasting* technique comprising of three main stages: the identification of *policy targets*, the definition of *Images of the Future* and the development of *policy packages and paths*. The backcasting technique and three main stages are discussed in turn below.

2.2.1 Backcasting

The POSSUM scenario methodology is essentially of a *Backcasting* kind. Backcasting[2] was introduced by Robinson[3] and is a particular kind of scenario approach, where the scenarios are chosen to reflect desirable developments. According to Robinson:

> *desirable futures can be attained. It is thus explicitly normative, involving working backwards from a particular desirable future end-*

1. See IPCC (1996), Technical Summary in *Climate Change 1995. The science of climate change.* WG1. Cambridge.
2. The Backcasting approach is analysed by Dreborg, K.H., '*Essence of Backcasting*', Futures, vol. 28, No. 9, pp 813-828, 1996.
3. Robinson, J:, '*Energy backcasting: a proposed method of policy analysis*,' Energy policy, December 1982.

point to the present in order to determine the physical feasibility of that future and what policy measures would be required to reach that point."[1]

The backcasting approach is of special interest when the task is to find long term solutions to a major societal problem and/or when policy-making involves substantial change. This is the case with the POSSUM project. The pure backcasting model has, however, been modified in order to highlight the impact of certain external factors (see below).

It is obvious that transport policies may have a great impact on the development of transport in the long run. It is, however, also true that driving forces and conditions beyond the control of transport policy makers will have an impact as well, and also influence the conditions for policy making. This is the question of *external* versus *internal factors*, which is highly relevant in the context of transport policy analysis.

External variables are factors that are *outside the transport system of Europe*. Examples of such factors are changes in values and life-styles. A distinction can also be made between transport policy (internal) and other policy areas (external), but it is important to note that these are often interdependent. For example, land-use planning has a considerable impact on transport demand in the long run, while, conversely, large infrastructure programmes (which is part of transport policy) has an impact on residential patterns.

Because of the existence of salient external factors, the pure backcasting model has been modified by the addition of an element of explorative scenario methodology. This means that different external developments (in relation to the transport sector) are chosen (the explorative element), and for each of these a 'solution' to the problems of the transport sector has been sought (the backcasting element). The solutions all meet a set of targets regarding environmental protection, efficiency and regional development.

The result is Policy Scenarios that combine **strategic policy elements** and **contextual elements**[2] in a systematic way. The policies considered are both transport policies and other policies with an impact on the transport sector. The contextual elements are transport-external factors that have a large impact on transport in the long run.

Hence, the main components of the policy scenarios are:

1. the definition of **goals** or **targets** to be met by the end of the studied period of time;
2. a set of important **contextual factors** (since the method combines the backcasting approach with an element of explorative scenario methodology); and
3. the main **strategic elements** associated with each scenario.

1. Robinson, J., '*-Futures under glass: a recipe for people who hate to predict*', Futures, October 1990.
2. We prefer the term *contextual elements or factors* to *external factors*. We are talking about factors that are external to the transport sector, but which are not external in relation to the scenarios. Instead they form a very essential part of them.

These three components are used to construct different Images of the Future that focus on the situation at the end of the period (see chapter 4). To build complete policy scenarios that include the trajectory from today up to an Image of the Future, a fourth building block is needed:

4. **policy measures, paths and policy packages** that would promote a development towards goal fulfilment.

In choosing external factors, we have tried to select those qualities of society that we believe have a profound and widespread influence in the long run on patterns of consumption, production and settlement and thus on transport. Hence, we have tried to identify factors affecting long term structural features of society, rather than accidental or catastrophic events that could also have an impact on transport. The *climate for co-operation* at different levels of society, *attitudes to the environment* and the balance between *local and international life-styles* are fundamental and salient external factors. These factors will not only influence transport directly but will also affect the conditions for policy-making. These contextual factors are presented in chapter 4.

More accidental external occurrences, such as a new oil crisis, may appear in almost any scenario and are not therefore included in any specific Image. However, a sensitivity test could be worthwhile. This could be performed by subjecting all Images of the Future or policy scenarios to the same occurrence and assessing the likely impact on goal attainment.

2.2.2 The Identification of POSSUM Policy Targets

The identification of policy targets used a combination of four separate, complementary approaches. These comprise:

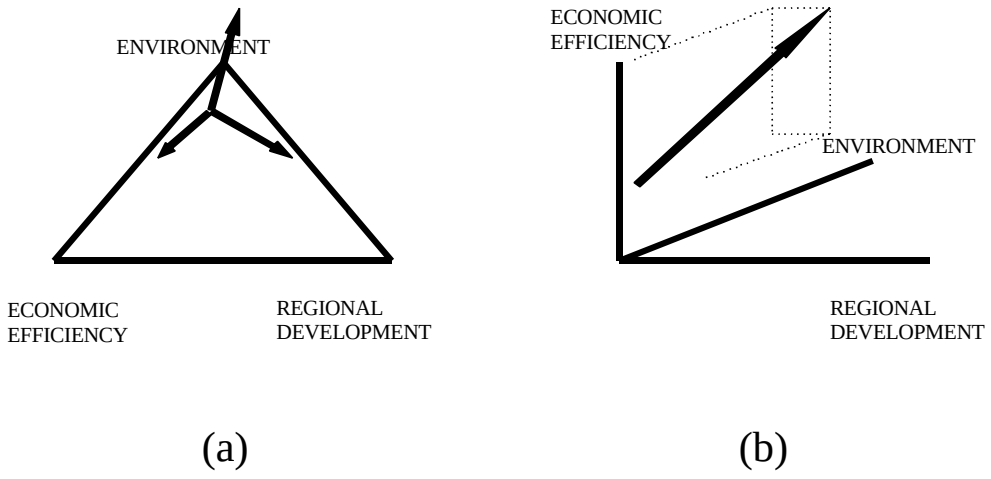
1. **literature review –** important issues for future transport policy, particularly in relation to sustainable development, were identified from a wide range of literature sources. European transport policy statements were used as a guide to identify current policy targets and issues of concern;
2. **internal workshops** – discussions within the POSSUM consortium identified a number of important issues for transport policy in the future ('hotspots') that are emerging or are likely to emerge in the next 20 years;
3. **strategic policy issues** – (similar to the 'hotspots' above) were identified by means of a questionnaire survey of Dutch students, a group of Polish transport experts and a group of European transport experts;
4. **review of sustainability targets** – a review of sustainability targets relevant to the transport sector helped to identify current environmental targets for transport policy.

Each of the four approaches helped to identify potential policy targets either directly (as in the case of the literature review and the review of sustainability targets) or indirectly where important issues were first identified and then targets were developed from them (as in the case of the internal workshops and the exercises to identify strategic policy issues). The main results from these four approaches are presented in more detail in POSSUM Deliverable 1 (POSSUM Consortium, 1997a). A choice was made early in the POSSUM project to identify policy targets for the three main issues

of environmental protection, economic efficiency and regional development, which coincide with the three main themes of current European Common Transport Policy (see Banister and Stead, 1997).

The extent to which targets are conflicting or complementary was examined as part of the process of selecting policy targets. A conflict between the three main types of targets is conventionally assumed, in which a trade-off between these three main goals is necessary (represented in Figure 2.1a where a shift towards one goal automatically implies a shift away from the two others). An alternative proposition however is a complementary relationship between these three main goals (represented in Figure 2.1b where a three-dimensional relationship illustrates that movement towards one goal does not necessarily imply movement away from the two others). Analysis indicates that there is often some complementarity between economic efficiency and environmental protection objectives. There also appears to be some complementarity between economic efficiency and regional development objectives but not between environmental protection and regional development objectives. Results of this analysis are presented in more detail by Rienstra et al. (1998).

FIGURE 2.1 VIEWS OF THE RELATIONSHIP BETWEEN ECONOMIC EFFICIENCY, REGIONAL DEVELOPMENT AND ENVIRONMENTAL PROTECTION



(a) Conventional Conflicting View of Policy (b) Complementary View of Policy

2.2.3 The Identification of Images of the Future, Policy Packages and Paths

The Images of the Future are the second building block of the POSSUM methodology and specify the future conditions under which policy-making will take place. The POSSUM Images of the Future describe the characteristics of society and transport at the target year (2020). They form the framework for identifying suitable policy packages and paths (discussed in section 2.2.4) to reach the POSSUM policy targets (see section 2.2.2).

Three Images of the Future were selected in this study, reflecting different assumptions about *external factors* and *strategic elements*. The external factors include assumptions about issues such as the dominant level of policy making (local, national or international) and the degree of cooperation between these different levels of policy-making. The strategic elements include assumptions about changes in *technology* and *decoupling* between the present and 2020.

The actual mix of strategies in each Image of the Future was designed by first assessing the potential of new technologies for each Image, taking into account the key character of the Image and the associated external factors. Next, decoupling was calculated as a residual, in the sense that changes of transport intensity (which is closely related to decoupling) are assumed to fill the gap between the sustainability goals and what is achieved by the technological improvements.

As part of the identification of Images of the Future, key issues and key states were also identified. The key issues specify important policy areas between the present and the target date (2020) for each of the three Images of the Future selected for examination in this study. The key issues include potential problems for policy-making, sectors where policy must be focussed and important changes in transport demand. The key states specify the strategic policy steps between the present and 2020 for each of the three Images of the Future. The key issues and key states act as an intermediate step between the Images of the Future and the identification of policy packages and paths.

The process of backcasting provides the basis for identifying policy measures that are compatible with both the scenarios and the policy targets. These measures are assembled into packages and paths in order to maximise synergies, minimise any anticipated problems of implementation and improve the acceptability of the policy changes.

2.3 CONCLUSIONS

The purpose and advantage of scenarios is that they are a kind of structured brainstorming technique, which may widen the perceptions of researchers as well as policy makers regarding possible future opportunities, policy options and other related developments – they may also give more insight into their impacts. In addition, they may increase the mental willingness to at least consider a broad spectrum of developments, since the resulting future is presented in an attractive way. Scenarios are important tools for strategic policy analysis, especially in situations where policy makers have too much biased and unstructured information. Scenarios provide a clear and easily accessible (although not detailed) insight into policies and their impacts by constructing and evaluating several policy choices and packages. Also the sensitivity of the outcomes to changes in policies may be made clearer. It may thus be concluded that the scenario methodology has a positive role to play in analysing the future of uncertain situations, and the complex future of transport policy choices and systems.

In summary, the methodology has involved two main steps:

1. *The construction of reference scenarios* – to highlight possible goal conflicts and to identify policies that would optimise each goal. The method involved a bottom-

up approach, the use of questionnaires and expert groups in order to provide a well-founded view of key policy issues and important external factors (see POSSUM Consortium 1997a). The main lessons from this exercise are twofold. First, the exercise indicates that it is necessary to find ways to reconcile the three goals of the CTP (economic efficiency, environmental protection and regional development). Decoupling transport growth from economic growth may help to reconcile these goals. Second, the work shows that the extent to which decision-making is coordinated has an important influence on the success or failure of policies.

2. *The development of policy targets, Images of the Future, policy measures, paths and packages.* Policy targets were developed to provide directions for policy measures, paths and packages and to help construct the Images of the Future. The method involved a review of policy targets from literature, questionnaires and internal consortium workshops. The Images of the Future were developed as one of the first steps of the backcasting process with the aim of describing society and the policy-making environment in 2020. The Images of the Future were developed using mainly a top-down approach. External workshops were used to validate the Images of the Future. The strategic steps on the path to the Images of the Future were then identified as a preliminary step to the development of policy measures, paths and packages. This included consideration of time-lines, policy priorities, intermediate goals and the potential of different policy measures for achieving the targets. For each Image of the Future, policy measures, paths and packages were developed to meet the POSSUM targets using a combination of a deductive approach starting form the Images of the Future and an inductive approach starting from possible policy measures.

Both of these two main stages included validation activities (see Chapter 6).

3. TARGETS OF SUSTAINABLE MOBILITY

3.1 THE GENERATION OF TARGETS

Potential targets of sustainable mobility are selected using a 'top-down' process. As a means of establishing convergence, validating and checking the selection process, a 'bottom-up' approach is also used to select targets of sustainable mobility. This approach involves the review of existing targets of sustainable development relevant to transport and sustainable development as an alternative means of identifying potential targets of sustainable mobility. The two approaches are discussed in more detail below.

3.1.1 The Top-Down Approach

The top-down approach is characterised by a deductive, comprehensive, systematic strategy using a combination framework, in which targets are derived from principles, goals, sectors, issues and causal relationships. Since transport has significant impacts on the environment, the economy and society, it is important that targets are developed for these three *domains* (key dimensions) of sustainable development. Within each of these three domains, there are a number of *issues* relevant to transport and sustainable development. Many of the environmental issues associated with transport have been catalogued (e.g. OECD, 1993 and 1996; CEC, 1992), whilst other issues are perhaps less well documented, although several recent literature sources cover these issues (e.g. OECD/ECMT, 1995; Maddison et al., 1995; World Bank, 1996). An inventory of key issues associated with transport and sustainable development has been compiled by reviewing recent literature, and is presented in Table 3.1, along with potential indicators for the development of *targets* for each impact.

TABLE 3.1 KEY DOMAINS, ISSUES AND POTENTIAL INDICATORS

Domain	Issues	Potential Indicators
Social	Accessibility	Walk distances to local services/facilities
	Health	Report incidences of transport-related illnesses
		Number of poor air quality days
	Safety	Road accident rates (casualties and deaths)
	Noise	Proportion of population affected by noise
	Visual Intrusion	Proportion of population affected by visual annoyance
Economic	Congestion	Road vehicle kilometres/road length
	Building Corrosion	NO_2 emissions
	Road and Bridge Damage	HGV vehicle kilometres
Environmental	Resource Depletion	Energy consumption
	Climate Change	Loss of agricultural land
		CO_2 emissions
	Acidification	NO_2 emissions
	Air Pollution	Emissions of NO_X, VOCs, CO, etc.
	Waste Generation	Vehicles scrapped related to vehicles recycled
	Water Pollution	NO_2 emissions

Since social, economic and environmental impacts are often interrelated, many of the impacts in Table 3.1 could be included in more than one category. Accidents, for example, are listed as a social impact of transport, but they also have an impact on the economy in terms of health care, sickness benefits, etc. The *goals* of sustainable mobility, as outlined in the EU CTP can be summarised as: unimpeded movement of goods and persons; coherent, integrated transport systems; economic and social cohesion; environmental protection; safety promotion; social improvement; and the development of transport links to or from Europe (CEC, 1992). Potential indicators for the development of *targets* for each of these seven goals are presented in Table 3.2.

TABLE 3.2 GOALS OF SUSTAINABLE MOBILITY AND POTENTIAL INDICATORS

Goals	Potential Indicators
Unimpeded movement of persons and goods (accessibility)	Average trip length, access to public transport services
Coherent, integrated transport systems	Intermodality
Economic and social cohesion	Congestion, unemployment
Environmental protection	CO_2, NO_x, waste, fuel use, etc.
Safety promotion	Road accidents and deaths
Social improvement	Incidence of ill health (asthma, bronchitis etc.)
Development of transport links to/from Europe	Number of passengers to/from Europe

3.1.2 The Bottom-Up Approach

This approach is characterised by an inductive, knowledge-based strategy. It involves the review of existing targets of sustainable development (proposed or used) from literature, and the selection of targets relevant to transport (Stead, 1997). Most of the existing targets (proposed or in use) reflect environmental impacts, rather than social or economic impacts.

The bottom-up approach provides examples of the types of targets related to transport and sustainable development that have been proposed or are in use. The outcomes of the top-down and bottom-up approaches allow checking and verification that all the key issues have been considered. Synthesis of the outcomes of the top-down and bottom-up approaches leads to the identification of a comprehensive set of potential targets of sustainable mobility.

3.2 TARGET SELECTION

The target selection process requires a set of selection criteria against which potential targets can be evaluated. Reviewing a selection of literature on social, environmental, health and sustainability indicators, Maclaren (1996) identifies a list of criteria commonly used to evaluate indicators in the selection process. The criteria include:

- scientifically valid;
- representative of a broad range of conditions;
- responsive to change;
- relevant to the needs of potential users;
- based on accurate accessible data;

- based on data that are available over time;
- understandable by potential users;
- comparable with indicators developed in other jurisdictions;
- cost-effective to collect;
- attractive to the media; and
- unambiguous.

In addition to satisfying these criteria, it should also be possible to devise threshold and target values, identifying acceptable and desirable conditions, for each indicator. If thresholds and targets cannot be determined, the desirable trend direction should be stated (Mitchell et al., 1995). Policy targets have particular value in focusing attention on the link between the policy-implementation process and the outcomes, and influencing the achievement of policy (Stead 1997). Both top-down and bottom-up approaches were used to develop the targets. The literature review, POSSUM working group meeting, and expert group surveys (Mons conference delegates, students and Polish experts) can be defined as part of the bottom-up approach. The domain framework, issues framework and goals framework (Tables 3.1 and 3.2) are part of the top-down approach.

POSSUM has focused on the goals of environmental protection, regional development and economic efficiency. The *environmental protection* goal is the most impelling, in the sense that it has to do with the long term survival of society. It is also a new kind of goal, that may require new solutions, including structural change. This is the primary goal on which the scenarios are developed. *Economic efficiency* is an important goal for any sector of society. Of course, an efficient transport sector contributes to the general economic development of society. However, the POSSUM Consortium has not chosen to define a goal of this kind for transport, but have instead confined ourselves to a goal for efficiency of the transport sector itself. The reason is that transport is just one of many factors influencing the general economic development. The goal of *regional development* is very important to EU, especially in the face of enlargement. However, much as in the case of the economic development at large, transport is but one of many activities influencing regional development and equity. A total of seven policy targets are chosen. Quantification of the environmental targets is based on critical environmental thresholds. The targets are summarised in Table 3.3.

TABLE 3.3 POSSUM POLICY TARGETS FOR 2020

Environmental Targets:

- 25% reduction of CO_2 emissions from 1995-2020.
- 80% reduction of NO_X emissions from 1995-2020.
- No degradation of specially protected areas.
- Marginal increase of net infrastructure surface in Europe.

Regional Development Targets:

- Improve relative accessibility of peripheral regions (both internal and external). This general target includes cost and time, and allows for substitution of physical accessibility by telecommunications.

Economic Efficiency Targets:

- Full cost coverage (including external costs) of transport under market or equivalent conditions.
- Reduce public subsidies to all forms of transport to zero, except where there are particular social equity objectives.

3.3 CONCLUSIONS

Targets of sustainable development are used in the POSSUM project as a means of identifying targets for policy, and assessing the impact of policy measures, paths and packages, across a range of key sustainability issues, comprising the three themes of regional development, economic efficiency and environmental protection. Targets help communicate qualified information which can help to explain how change occurs through time. Economic targets have been used for this purpose for some time. They do not explain why particular trends are happening but they can provide policy makers and the public with information about temporal and regional change.

The chapter has discussed a variety of international, national and regional/local targets of sustainable development to have been developed for transport and other sectors. Relevant targets from other sources have been used to compile a set of potential targets for the POSSUM project. The process of target design, generation and selection begins with a scoping exercise, in which principles of sustainable development are identified and the concept of sustainable mobility is discussed.

The range of frameworks for developing targets is then discussed. Each framework has a number of distinct advantages and disadvantages. Many of the disadvantages or problems, however, may be overcome by using a combination approach (using several frameworks in parallel). The POSSUM project therefore adopts this approach in the development of targets. Potential targets for use in the project are generated within a combination framework comprising domain-based, goal-based and issue-based frameworks. This ‘top-down’ approach is supplemented by a ‘bottom-up’ approach, in which targets from other sources are reviewed in order to establish convergence, validate and check the process of target generation (POSSUM, 1997a and b; Rienstra et al, 1997).

4. IMAGES OF THE FUTURE

4.1 BUILDING BLOCKS OF THE IMAGES OF THE FUTURE

4.1.1 Goal Structure

When looking towards 2020, the structural framework of society cannot be taken as given. Scenarios of the future must explore the significance of changes in values and attitudes, land use patterns and the spread of IT. This means that a goal of accessibility does not necessarily imply that transport has to grow at the same pace as GDP or some other measure of welfare. The overriding goal of transport policy is to facilitate accessibility, while at the same time fulfilling such goals as sustainability, economic efficiency, equity (e.g. regional) and safety.

4.1.2 Main Strategic Elements

Technology

Within the transport sector, there is a substantial potential for reducing emissions and increasing energy efficiency through *vehicle technology and alternative fuels*. In order to estimate their role in achieving the POSSUM targets assumptions have been made on the volume of transport growth (Table 4.1) and the rate of change of technology (Table 4.2).

TABLE 4.1 ASSUMED TRANSPORT VOLUME DEVELOPMENT BETWEEN 1995 AND 2020 IN EU-15 + NORWAY, SWITZERLAND AND TURKEY

	Mode	Volume (Billion passenger-km / billion tonne-km) 1995	Assumed Increase Reference Case 1995-2020	Actual Increase 1970-1995
Passenger	Car	4070	50%	125%
	Aeroplane	400	200%	250%
	Bus	370	30%	50%
	Train	290	20%	40%
Freight	Lorry	1130	100%	160%
	Train	240	0%	-5%
	Inland Water	120	10%	10%

Source: ECMT (1997), EUROSTAT (1997).

TABLE 4.2 PROJECTED EMISSIONS FROM TECHNOLOGICAL AND FUEL CHANGES COMBINED WITH REFERENCE CASE TRANSPORT VOLUMES

Assumed changes in technology 1995 - 2020	Change in CO_2 emissions 1995-2020	Projected CO_2 emissions in 2020 compared to the POSSUM CO_2 target	Change in NO_X emissions 1995-2020	Projected NO_X emissions in 2020 compared to the POSSUM NO_x target
1. only fossil fuels with present average technology	+ 67 %	+ 123 %	+ 71 %	+ 754 %
2. only fossil fuels with high efficiency improvement	+ 24 %	+ 65 %	- 61 %	+ 95 %
3. only fossil fuels with very high efficiency improvement	+ 11 %	+ 47 %	- 66 %	+ 71 %
4. methanol introduced with very high efficiency improvement	- 7 %	+ 24 %	- 70 %	+ 51 %
5. electric cars introduced with high efficiency improvement	+ 15 %	+ 54 %	- 63 %	+ 87 %
6. electric cars and methanol introduced with very high efficiency improvement	- 14 %	+ 15 %	- 71 %	+ 45 %

Source: POSSUM, 1997.

Notes:

1. Assumptions about changes in technology between 1995 and 2020 (situations 1 to 6) are set out in POSSUM Deliverable 2 (POSSUM, 1997)
2. Fuel cell cars are not assumed to have taken a significant market share in 2020 although they constitute an extremely important option in the long run, particularly in the context of research and development. Transport volumes (2020) for these cases are assumed to be accordance with Table 4.1. This may be called a Reference Case (RC) development. As there are no 'official' forecasts from the CEC, these figures are highly uncertain. Only the EU-15, Norway, Turkey and Switzerland are included in these figures. Given that the CEEC/CIS countries should be allowed to increase their transport volumes more than these countries (which seems reasonable), the following estimates may be to optimistic. What may at least to some extent offset this is the fact that the present technology in CEEC/CIS is more inefficient especially regarding NO_X emissions. The present shares of diesel cars, catalytic petrol cars and non-catalytic petrol cars are uncertain. It has been assumed that the respective shares are 20%, 40% and 40%. Since catalytic converters (or equivalent) only became compulsory in the whole EU in January 1993, the share of catalytic petrol cars was probably somewhat lower than this in 1995. Given the underlying assumptions, it can be seen that new technology and fuels are very important. However, the target levels of POSSUM are reached in none of the cases (Table 4.2), so these measures alone are not sufficient.

For alternative (non-fossil) fuels, the options include electricity, hydrogen, ethanol and methanol. Other fuels like biogas can still be important for niche markets. Electricity has a potential niche in urban vehicles (and maybe in the long run for all-purpose cars). Hydrogen could finally be the fuel of the future (produced with solar electricity and used in fuel cells), but complexity in distribution and storage makes it less likely to be fully introduced by 2020. Ethanol and methanol derived from biomass both have similar properties, but with present processes methanol gives a higher yield in energy terms. Methanol is also suitable for fuel cells and may during a transitional period be produced from fossil gas. Methanol and electricity have been used in the Images of the Future. It should however be emphasised that the actual choice of alternative fuel(s) is by no means easy to foresee since there are a lot of strong interests involved. Furthermore there is the question if one should stick to fossil fuels until the final solution (possibly hydrogen) is developed, which may take a lot of time, or shift to an intermediate option (like methanol). A decision on the new principal fuel for road transport could be taken

at the EU level, but immediate action would be enhanced if there is agreement between the EU, the US and Japan. Six cases (presented in Table 4.2) illustrate the possible changes in emissions from transport that may occur as a result of the introduction of various technological and fuel efficiency measures up to 2020. Note that the assumed changes in transport volumes must be regarded as indicative only since there is much uncertainty.

It can be concluded from Table 4.2 that the CO_2 target (in POSSUM) is easier to achieve than the NO_x target, particularly if fuel-cells are not introduced quickly. On the other hand these targets are only intermediate, and it seems that the NO_X target is much closer to what could be called a sustainable emission level than the CO_2 target. We have to keep in mind what strategies are possible for the development after 2020. That is, to what extent are the different policy scenarios consistent with further cuts in emissions after 2020? For example the relationship between the CO_2 and the NO_x targets seems crucial to the choice of engines in road vehicles, especially lorries and buses. Also taking health aspects into consideration, abandoning the diesel engine in city traffic would have air quality benefits. Given the POSSUM targets (2020), a realistic option might be to abandon diesel engines for long distance lorries. However, in the longer perspective this does not seem very attractive, at least not until fuel-cells get into the market. It is assumed that diesel engines in cars will be phased out since a large part of car travel takes place in densely populated areas. This discussion is only valid if diesel engines cannot meet strict emission standards (as is the case today). If different cars could be used for different purposes, through car rental or car pooling, there might be a niche for diesel cars as long-distance cars. Electric vehicles would then be the choice for city driving.

A great problem in the calculations above is that NO_x emissions are notoriously difficult to estimate due to large 'off-cycle emissions'. The level assumed for the average car fleet is not the technical limit for 2020 but is very demanding of policy measures. For example, a new mid size (American context) car with advanced technology could reach a fuel consumption of 4.5 l/100 km in 2015. This means a 55% cut in fuel consumption compared to 1995, with the incremental price estimated as 2320 US dollars (Duleep, 1995)

Decoupling

One of the reasons why a technological solution is not sufficient for reaching the POSSUM sustainability targets is the *trend of increasing transport volumes.* The rate of mobility is currently outstripping the environmental improvements offered by technology. Current travel trends indicate increasing journey distances to carry out activities that were previously carried out with less travel. Thus, the rate of growth in mobility has to be curbed if sustainability is to be achieved. As car ownership and use increases, transport capacity is likely to be exceeded more and more. Thus, time constraints may become a travel-limiting factor in the longer term. However, long-distance travel, particularly by air, is likely to increase much more before time constraints become a limiting factor. With present attitudes, it is difficult to see a limit to the number of things people want. The demand for mobility increases when incomes increase. In principle, all measures to make travelling cheaper, more comfortable or faster generate a larger amount of transport. This can also be formulated in the following

way: the possibility of reaching places with less effort leads to more travelling because it creates more opportunities for satisfying desires. A way of living where people try to take advantage of all these opportunities runs the risk of making their lives fragmented. From the point of view of the environment and the utilisation of resources, it may be claimed that faster transport is doubly problematic. It makes it possible to travel a longer distance within a certain time, while at the same time the energy use per distance travelled increases.

In the area of freight transport it is also difficult to see natural limits to demand if the costs of transport continue to be low. The fact is that in a situation with continued growth and unchanged values it is difficult to see any saturation levels for transport volumes in the near future. This means that if the goal is a sustainable development, the transport volumes must be limited. On the other hand, it is not obvious that all types of transport can or should be limited to the same extent. One way of solving the conflict between the environmental, regional and efficiency objectives is *decoupling transport growth (tonne-kilometre or passenger-kilometre) from economic growth*. The dynamic that has led to the very strong increase in transport volumes during the last decades may then be controlled. By decoupling we mean a decrease of transport intensity, measured as tonne-kilometre and person-kilometre per unit of GDP. This requires that the growth rate of transport volumes is less than that of GDP. When the growth rates are equal, no change in tranport intensity or transport decoupling has occurred.

Over the period 1975 to 1995 passenger transport actually grow faster than GDP as an average of EU 15 countries. The quotient between passenger transport and GDP growth was 1.4. For freight transport, the corresponding value was 1.0, which means that the growth in GDP was matched by the growth of freight transport.

Transport intensity is different in different sectors and will also change differently. Furthermore, when the economy grows the relative shares of different sectors will change, affecting the average transport intensity and, hence, decoupling. Growth tends to be strong in some new branches, such as IT related activities. These activities are characterised by low materials content and high content of knowledge and services. The result is relatively low transport intensity. On the other hand, transport distances tend to increase for most traditional sectors. The reasons being more cost efficient transport technology, changes in transport infrastructure and the removal of certain trade barriers. Given these trends, it is unlikely that the decoupling required to reach the POSSUM targets will take place spontaneously. Determined policy action will be needed in this area.

Three factors that are likely to have an impact on decoupling are consumption patterns, production processes and location decisions. These are discussed in turn below.

The amount of transport needed as an input to production is dependent on the structure of demand for goods and services. One element is the distribution between goods and services. The consumers can use increased wealth to buy more services rather than goods. Services are often less dependent on transport and more locally produced than goods. However services are not always preferable to goods from an environmental point of view. The most obvious case is leisure travel by air or car. In many sectors products can be substituted by services. This applies to some products (leasing systems,

joint use of durable consumer goods, repair systems) and mobility (i.e. car-sharing initiatives, public transport).

The type of goods consumed also affects the need for transport as an input. There is a clearly discernible tendency that bulk production with high materials content is reducing in relative importance, while high-tech products, with little materials content but a high content of know-how, increase in relative importance. This trend is likely to continue, which will tend to reduce physical transport - other things being equal. Local demand, with a preference for locally produced goods, is another way to reduce transport. Increased consumption of IT-services can be a substitute for goods, for travels in connection to shopping or even for leisure travels (e.g. virtual reality).

Given the pattern of consumption, the need for transport is also a function of how the production is organised and of the design of products. Traditionally, economic growth in the open world market oriented economies is associated with the globalisation process. Often this process is associated with a concentration and centralisation of production, which itself creates additional transport demand due to longer distances between producer and consumer, especially where economies of scale exist. This is the typical case of mass production.

Since the economic crisis of the seventies a new production paradigm has emerged, *flexible specialisation*, characterised by flexible technologies for specialised and segmented markets, small production series and flexible adjustment to changing consumer tastes. The economic success is determined by economies of scope, not economies of scale. The success of this type of production strongly influenced the reshaping of the European economic space. It is characterised by strong intra-regional links and the 'networking' of enterprises. Cooperation and clustering within industrial districts may create external benefits. The transport needs of such regional production clusters are ambivalent, as short distances between interlinked business become a strategic success factor, but regional production clusters are the basis for world market oriented success-stories and hence require long-distance transport. In general they are more transport efficient, than global activities, since the backward linkages of the production processes are regionalised.

Alternatives to globalisation and flexible specialisation are local production for local markets or a combination of global and local production, the so called *glocal production*. Glocal production can be characterised by large network-firms which combine economies of scale and scope and maintain a network of local and global organisational units with close communication links. Information technology has a key role to play. Transport needs can also be reduced by the design of products. Material flows can be reduced by dematerialisation /miniaturisation of the products, increased durability and design to make service and recycling easier.

The informatisation of the economy largely influences the location of firms and individuals, but the impact is unclear. On the one hand the opportunities of tele-working, tele-conferencing etc. would rise, which would imply a decrease in physical transport. On the other hand, a consequence would be that proximity to suppliers buyers or public transport is of less importance to location choices. This would mean that spatial concepts like 'compact city' and 'specialisation and concentration' will decrease in

importance and that the minimum volume of travel demand needed for public transport modes is not reached. The spatial policy of the government must influence these locational choices.

The structurally determined daily journeys for such purposes as work, services or shopping can probably be reduced without challenging today's values. Most of us would probably see a reduction in this type of journeys as a positive development, for example through increased doorstep delivery service and tele-working. Other journeys, especially leisure-time experience-oriented journeys, are valued more highly. The places people often go to have a value of their own and sometimes the travelling itself can have a value (e.g. beautiful scenery or enjoyable driving).

In conclusion, there is a potential to decouple transport growth from economic growth. It is however very hard to say to what degree. The decoupling is crucial to fulfil the all the targets simultaneously as transport volume growth has to be limited in order to meet environmental targets. The potential to decouple is partially dependent on 'spontaneous' developments such as trends in production technology, IT and consumers values. The 'green consumers' prefer locally produced goods and the production makes it possible to organise production processes in a way to make local production economically feasible. To achieve the desired degree of decoupling in the scenarios this development has to be supported by policy measures.

4.1.3 Contextual Elements

We have employed the degree of '*cooperation*' or '*polarisation*' as a core feature of the Images of the Future. We think this is an essentially external factor relative to sustainable mobility, transport policy and the transport sector. Furthermore, it will greatly affect the achievements and relative merits of different transport policies.

The concepts of cooperation and polarisation essentially pertain to the way society copes with *market failure* and *public goods and bads.* Here agreements and common policies beside the market are often needed. The climate for cooperation will then be of crucial importance. Is there a spirit of cooperation and social responsibility or is the dominant behaviour free-riding? Do people act like citizens or like self-interested profit maximisers? This will affect what policies are possible and suitable and what targets can be achieved.

Even those who want to act according to the common interest, may fail to do so because of the logic (structure of incentives) inherent in the situation. Hence, the 'rules of the game' may have to be changed. There is a rich literature on this problem area in economics, political science, ecology and mathematics (game theory), dealing with the closely related issues of Collective Actions (Olson, 1971; Hardin, 1982), Prisoners Dilemma (Axelrod, 1984), and Tragedy of the Commons (Hardin, 1968; Ostrom, 1990). A full description is given in POSSUM (1997b).

Many environmental problems are related to so called *social dilemmas*. One example is a situation called The Tragedy of the Commons. Originally, this concept refers to situations where a group of people share *a common*, natural resource (e.g. a lake for fishing). Over-use will ruin the resource. Hence, it is in the common interest to restrict

use to what is sustainable. Yet, the individual will be tempted to take a greater share than is reasonable, because if s/he does not, the others may do so and ruin the resource, making him/her a loser. This is largely a matter of trust - or lack of trust

Social dilemmas similar to the Tragedy of the Commons, occur at all levels of human interaction, i.e. within groups of individuals, within and between business companies and at all levels of political decision making. Examples include:

- national Governments choosing a policy regarding CO_2 emissions (global level);
- urban commuters choosing between a convenient but polluting trip by car or a less convenient but cleaner trip by some public means of transport (local level).

The attitudes to cooperation in such situations will be crucial to the possibilities of solving the problem at stake. Here, different assumptions are made in different Images of the Future.

An international life style seems to be spreading. People increasingly travel to exotic places. Simultaneously, however, some groups of people exhibit a more local life style with a taste for locally produced goods and services as well as for exploring one's native district. The relative strength of these two life styles in the future will have a strong impact on the demand for travel and freight transport. Therefore we distinguish between:

- the case of a widely spread 'local' life style;
- the case of a dominant international life style.

Another example of a potentially important factor is the strength and spread of green values. Is the emerging green consciousness more or less a fad or a profound shift in our view on man's relation to nature and nature's degree of resilience against perturbations? The following alternatives are identified:

- the case of a strong concern for the environment and future generations among broad groups in society. The preservation of the environment is seen as a necessary condition for the long term wealth of human-kind, or even for its survival (see *Images I and III*);
- the case of a well informed but pragmatic and more short term view on the environment. The relation to other societal goals is essentially perceived as a trade-off, where the environment does not take precedence over the others (see *Image II*).

We have not studied the case of dominant materialistic values and withering green attitudes, because we think that a successful policy for sustainability will not be possible in such a case. Probably a broader public devotion to the idea of a sustainable development would be required for the POSSUM targets to be reachable by 2020. If this is so, an important question is how a shift in values and attitudes might come about.

The rise of the environmental issue in the minds of people is probably dependent - in the future as in the past - on a mix of own experiences, education and media reports on scientific results. New scientific findings on the harmful health effects of

particulates emissions in urban areas or strong evidence of a global warming effect may impress on the general public as well as on politicians. Also, a deliberate and persistent public policy of information and opinion forming as well as incorporation of the environmental dimension at all levels of the educational system may play an important role in the long run. Such policies will fall outside the transport sector, which shows the strong interdependence between different policy fields.

4.1.4 Additional Issues

In addition to these basic components of the Images of the Future, there are a series of other questions that have been addressed in the design process. It is only possible to list them here, but they are fully discussed in the background report (POSSUM, 1997b).

1. Innovations and Niche Markets - The market uptake of new technologies and systems are often problematic, because of high costs compared to established technologies. Uptake of new technologies may, however, be facilitated by creation of *niche markets* where novel concepts can be introduced, start to grow and enter a learning curve where costs step by step will decrease, making it possible to compete in other markets as well.

2. Regional Development and Innovation - The production style of flexible specialisation does not automatically lead to a convergence of economic development within Europe. The success conditions are regionally embedded and cannot easily be reproduced over the whole European territory. However territorialised production styles offer new opportunities for formerly backwards regions, but no guarantees for regional convergence.

3. Economic Efficiency in the Transport Sector - An economic efficiency target in POSSUM is full cost coverage of transport under market or equivalent conditions. Subsidies should be minimised and market principles should prevail in the operation of the transport system and in assessing new investments. This has important implications for the financing and operation of transport, as well as its organisation. The role of governments may be reduced, but it will always be present.

4. Key Issues in the Development of the European Transport System

- The continuing concern over CO_2 emissions as the key environmental variable at the global scale;
- The future of the railways and the role that High Speed Trains (HST) have in centralising accessibility and growth in Europe;
- Aviation in the future - this is the fastest growing transport sector (6% per annum).
- Urban overload, leading to unacceptable levels of pollution and congestion;
- Freight transit, such as through the Alps;
- Developments in the CEEC/CIS countries and their interaction with the EU.

These key issues (hotspots) are discussed in Chapter 5 as a basis for the policy measures introduced later in Chapter 5.

4.2 CHOICE OF IMAGES OF THE FUTURE

Different developments in society at large will demand different policy approaches to transport issues. Therefore, the scenarios are designed to show different combinations of policy alternatives, combining strategic and contextual elements.

4.2.1 Strategic Elements

There are two main categories of change needed to achieve the POSSUM targets by the year 2020 (see the discussion on 4.1.3):

1. a reduction of energy use and emissions per person kilometre travelled and tonne-kilometre of freight by means of technological improvements, new fuels, improved load factors and modal shifts (*Technology*); and
2. a decrease in transport intensity of GDP, that will allow the volume of transport to increase at a rate which is less than the economy at large (*Decoupling*);

All Images of the Future rely on both strategies, but in different proportions – three combinations are examined:

1. A moderate pace of technological improvements combined with a considerable degree of decoupling (Technology+ /Decoupling+++).
2. A fast dissemination of cleaner technologies and fuels combined with a moderate degree of decoupling (Technology+++ /Decoupling+).
3. *Both* fast technological improvements *and* a considerable degree of decoupling.

However, a Technology+++ /Decoupling+++ case would seem to be rather unlikely, because the costs of achieving such far reaching transformations in both dimensions would probably be too high. Therefore, we have chosen as a third case a Technology++ /Decoupling++ solution.

4.2.2 Contextual Elements

Successful handling of many environmental problems requires agreements and cooperation outside the market, either by political intervention or by 'grassroots' initiatives by those affected, or some combination of both. Hence the attitudes towards cooperation in society will affect the possibilities of meeting the environmental targets – three alternatives are distinguished:

1. **Local, Regional and EU cooperation**, where policies are mainly driven by local and regional initiatives (bottom-up politics). Local and regional aspects are high on the political agenda, while global environmental issues are a little lower down. Green values are pushed by 'grassroots' movements rather than by national or EU politicians, who lag behind but try to meet the demands of the people. There is polarisation at the global level, where EU the US and Japan take different stands on questions such as global warming, and tend to protect their own markets against competition from outside.
2. **Global and EU cooperation**, with free trade and a striving for consensus on environmental issues. At the local and regional levels the attitudes towards cooperation are more passive, as the politic agenda is mainly driven by national and EU politicians. The focus is more on high level problems (top-down politics). Politicians take the lead and try to influence opinions.

3. **Local - Global cooperation** promotes an accord between local, regional and supranational initiatives and objectives - a kind of harmony between bottom-up and top-down politics. Green values are widespread, with both local and international lifestyles.

In all cases cooperation runs relatively smoothly at the EU level[1].

4.2.3 Combining The Strategic and Contextual Dimensions into Images of the Future

The Images of the Future result from the combination of the three strategies based on cooperation at the local, national/global, and combined levels, together with differing levels of technological development and decoupling (Table 4.3). In total there are nine combinations, but not all seem equally plausible. In the first column (Table 4.3), the emphasis is on decoupling rather than technological improvement. Radical decoupling demands behavioural changes (mode choice, choice of residential area etc.) which in turn requires 'grassroots' involvement and commitment. This is prevalent in D1, but not so much in D2. Where there is cooperation at all levels, a balanced strategy (TD3) would seem to be preferable to scenario D3. Hence, our choice from this column is D1 - *EU Coordination of Active Citizens (Image I).*

TABLE 4.3 THE NINE IMAGES OF THE FUTURE OBTAINED FROM COMBINING THE TWO DIMENSIONS

Contextual Elements	**Strategic Elements**		
	Technology+/ Decoupling+++	Technology+++/ Decoupling+	Technology++/ Decoupling++
Local, Regional + EU cooperation	**D1**	T1	TD1
Global + EU cooperation	D2	**T2**	TD2
Local-Global cooperation	D3	T3	**TD3**

In the second column (Table 4.3), the general strategy emphasises a fast technological evolution and dissemination, while the degree of decoupling is moderate. This strategy seems to require global cooperation on such issues as regulation of CO_2 emissions (T2). Option T1 lacks international agreements in this area, and is, therefore, not so likely. T3 would be possible, but here the conditions are favourable for both technological improvements *and* decoupling, making a more balanced strategy attractive, as in scenario TD3 in column 3. Consequently, we have chosen scenario T2 as the most interesting and internally coherent case in the second column – this is *Global Cooperation for Sustainable Transport (Image II).*

Finally, the cases in column 3 (Table 4.3) all exhibit a balanced strategy of fast technological development and a considerable degree of decoupling. However, in TD1 the conditions for really fast technological improvements are not so favourable, while in TD2 the popular engagement which seems to be necessary for a far reaching decoupling, is not present. Both conditions are fulfilled in the case *TD3*, and this *is*

1. The case with polarisation at the EU level has been discussed in Deliverable 1 (see POSSUM 1997a). In that case, no Common Transport Policy exists. It is of limited interest here and has been used only for reference purposes.

our choice from column 3 - Accord on Sustainability (Image III). In summary, three Images of the Future are selected for investigation:

- *Image I – EU Coordination of Active Citizens (D1)*
- *Image II – Global Cooperation for Sustainable Transport (T2)*
- *Image III – Accord on Sustainability (TD3)*

4.3 IMAGE I: EU COORDINATION OF ACTIVE CITIZENS

4.3.1 Society at Large

There has been a trend towards more 'local life-styles' and green values among the general public. People increasingly take responsibility for the common good and attitudes towards collective actions are positive, especially at the local and regional levels.

People are pushing the politicians to adopt stricter environmental regulations and standards, especially at the local level (urban areas). At the global level no agreement on harmonising standards is achieved. Also, demand is affected. People are willing to pay for greener products as well as for locally produced goods. Settlement patterns and location of workplace and service functions are also affected. Many urban sub-centres have developed to a higher degree of self-sufficiency and city centres are being re-urbanised. There is an increased acceptability for urban public transport, bicycles, and electric urban cars.

Production is more local and mainly serves local markets, but is based on licenses and the know-how of the big international firms and networks (glocal production). There is also an increasing share for the service sector, with traditional manufacturing industry showing a declining share of total production. GDP grows at a moderate pace, green GDP develops faster. Freight transport volumes have actually levelled off.

A tax base reform (in line with a dematerialisation strategy) has taken place in the EU countries, shifting taxation from labour to the use of natural resources and energy, with the aim to stimulate conservation of resources. This and green demand have made producing firms reduce their use of energy, materials and hazardous substances etc.

4.3.2 General Approach to Transport Policy

The shift in values and life styles has led to a higher acceptability for changes in residential and travel patterns, providing an opportunity to bring the growth of transport volumes under control. Therefore *the prime political strategy vis á vis the environmental goal, is to promote a decoupling of transport growth from GDP growth*. As mentioned above, the shift in demand has in itself led to a considerable degree of decoupling regarding freight. This is complemented by policy measures intended to reduce structurally enforced travel, such as commuting to work and service trips. Here, urban land use planning and measures to facilitate telecommuting are important. A *policy for cleaner transport* (pertains to both personal travels and freight) is also important. This consists of three parts:

1. measures to promote a *shift in modal split* towards a higher share for cleaner modes (e.g. more public transport, a higher share for freight by rail etc.);
2. measures intended to make each mode cleaner, by *spread of cleaner technologies*;
3. measures to increase load factors.

Measures affecting modal choice form an important part of the general policy. Cleaner technologies are supported by research and development funding, and niche markets for introduction of new vehicles, and systems such as car pooling with specialised vehicles are all created. There is no great need for new inter-regional infrastructure, the exception being the improved quality of links to the former CEEC countries. Railways and other public transport are kept in public hands but they operate independent from the governments. EU has an important role in coordinating regional and national policies and in harmonising targets and standards in Europe (Tables 4.4 and 4.5).

TABLE 4.4 CHARACTERISTICS OF THE TRANSPORT SECTOR

General	Total mobility the same as 1995 but lower than reference levels Some electric vehicles but technological innovation moderate Low image of car but rising sharply in CEEC/CIS Niche vehicles, car rental, smart cards used Car use for commuting is reduced, but increased for leisure
Urban	Concentration on development in cities and corridors Telecottages and teleshopping Reduction in work and shopping travel Shift to public transport and bicycle - higher occupancies Less space for cars in cities - limited parking Lower speed limits and priority to public transport
Long Distance	Telephone and videoconferencing widespread Long distance leisure travel important Public transport competitive in price but not fast Air travel a growth mode, but also rail and rental car Limited investment in HST, use of existing track
Freight	Local and glocal production Dematerialisation and decentralised production Load factors increased, particularly in distribution Intermodality promoted
Vehicle Technology and Fuels	Electric vehicles account for 20% of travel Cars 15-20% lighter, with feebates[1] related to weight Diesel vehicles reduced due to emissions problems City bus and lorries have hybrid drives with gas turbines and otto engines
Organisation and Financing	Market incentives - road pricing Public transport publicly owned, but independent from government Little new road infrastructure Some reorganisation of railways to CEEC/CIS countries
Regional Development	Regions are less economically specialised and more self sufficient Increased glocal production

1. *feebates* are a combination of charges (fees) and rebates, such as the charging of fees on inefficient, polluting cars and rebating the proceeds to efficient, clean cars (see von Weizsäcker & Jessinghaus, 1992 for example).

TABLE 4.5 IMAGE I IN FIGURES FOR THE EU 15+3 COUNTRIES

	Billion Person-km or Billion tonne-km	Volume 1995	Volume 2020 (Reference Case)	Volume Image I		Volume Image I/ Volume2020	Volume Image I/ Volume 1995
	Car (fossil)	4070	6105	2560	}		
	Car (methanol)	–	–	–	}	0.5	0.8
	Car (electric)	–	–	640	}		
	Aircraft	400	1200	720		0.6	1.8
	Bus	370	481	700		1.5	1.9
	Train	290	348	660		1.9	2.3
	Total Person	5130	8134	5280		0.7	1.0
	Lorry (diesel)	1130	2260	1129	}	0.5	1.0
	Lorry (methanol)	–	–	–	}		
	Train	240	240	300		1.3	1.3
	Inland Water	120	132	150		1.1	1.3
	Total Freight	1490	2632	1579		0.6	1.1

Note:
Reference Case (see Table 4.1)

To sum up, main elements of the transport policy are:

- measures intended to reduce structurally enforced travel, such as land use planning, promotion of tele-commuting etc. (*Decoupling*)
- measures such as standards and pricing, intended to achieve a shift of passengers from private cars to public transport and a shift of freight from lorries to train and ship *(Modal shifts).*
- funding of research and development and promotion of market uptake, by the creation of niche markets for novel systems for example (*Cleaner technologies*).
- New transport networks links to CEEC countries and to some extent to other peripheral regions (*Regional equity*).

4.4 IMAGE II: GLOBAL COOPERATION FOR SUSTAINABLE TRANSPORT

4.4.1 Society at Large

There is a certain degree of green consciousness and an acceptance of policy measures intended to mitigate the environmental problems, i.e. those related to transport. However, these issues are not pushed by a broad opinion among the public. Rather, it is the politicians that are at the forefront, trying to find solutions at the EU and global levels. Politicians are relatively successful in forming opinions and there is an understanding that transport must in principle pay it is full costs. But most people are not inclined to accept a major change of travel behaviour. Also, there is some green demand, but of a relatively small size.

The international life-style has gained strength. Many people prioritise the broader international output to the narrow local assortment. Also, there is a trend towards segmentation of society into different lifestyles that go across the world. Many enterprises have specialised on a specific segment of customers and provide their specific brand across the world. An early sign of this trend was in the 1990s when Swatch and Mercedes exploited Swatch's knowledge of a certain market segment, to launch the Smart car. Production is increasingly characterised by 'flexible specialisation', and economic development is generally dynamic with a relatively high average GDP growth. Some regions of Europe tend to lag behind, though. Despite a trend towards dematerialisation, transport volumes continue to grow due to increasing distances. A high degree of accord has developed in the relations between EU, the US and Japan as regards international regulations and standards in order to cope with global environmental problems.

4.4.2 General Approach to Transport Policy

The widespread environmental consciousness among leading politicians at the world stage, makes it possible to reach agreements on international standards and norms for cleaner vehicles, reductions of CO_2 emissions and similar levels of taxation of externalities, at least in the OECD area. The accord among world leading politicians impress the general public and makes it possible to gain popular support for such measures. However, as mentioned above, people will not accept measures that interfere with their habitual ways of living, such as using private cars and living in sparse residential areas.

Consequently, the prime policy regarding the environmental goal in Europe is to *make transport cleaner*. Although some measures are directed towards *raising the share of cleaner modes* (per person-km), the emphasis is on promoting the *development and introduction of cleaner technologies and fuels*. As people adhere to the private car, much of research and development is directed towards improving the technology of the conventional all-purpose car. However, also more far-sighted policies exist and are promoted by the EU, such as creation of niche markets for fuel cell vehicles. This is achieved by experiments with environmental zones (Tables 4.6 and 4.7).

TABLE 4.6 CHARACTERISTICS OF THE TRANSPORT SECTOR

General	People not willing to change travel behaviour
	Car travel increases moderately
	Methanol is the principal alternative fuel
	Traffic levels significantly lower than reference case
	More flexible working hours
Urban	Telecommuting widespread
	Urban decentralisation continues
	Space in urban areas still allocated to the car
	Public transport not gained much market share
Long Distance	Air travel growth with global economy
	Business travel high by air and HST
	Leisure travel has grown particularly by air and car
	Prices higher on intercontinental flights from CO_2 taxes
Freight	High volumes of goods and long distance transport compared to Image I
	Trade across EU borders is high
	Rail gains a substantial market share
	Freight centres for intermodal distribution at periphery of cities
	Harmonisation of rail standards across Europe (including communications, signals and organisation)
	Extensive use of IT and new management strategies
Vehicle Technology and Fuel	R+D projects generously funded at EU level
	Cooperative research with US and Japan to establish common technical standards
	All purpose cars are dominant - hybrid electric with a gas turbine, DISC engine or fuel cell power
	Battery cars are niche market vehicles
	Cars are 25% lighter, with feebates levied according to weight
	Methanol accounts for 20% of fuel used by all traffic, particularly lorries
	Fuel cells with on-board methanol reformers introduced in the markets for lorries, buses and cars
Organisation and Financing	Market incentives - private sector initiatives
	Road pricing introduced and roads are privately managed
	Rail and other public transport privately owned
	Private sector builds new infrastructure with government guarantees
	Construction of railways in south region and upgrading/modernisation of the existing railways in CEEC/CIS countries.
	New HST, but mainly in the core area due to high construction costs - public transport in peripheral areas subsidised
Regional Development	Flexible specialisation based on knowledge and local resources, but export oriented
	Goods flows increase
	Investment in telecommunications

TABLE 4.7 IMAGE II IN FIGURES FOR THE EU 15+3 COUNTRIES

	Billion Person-km or Billion tonne-km	Volume 1995	Volume 2020 (Reference Case)	Volume Image II		Volume Image II/ Volume2020	Volume Image II/ Volume 1995
	Car (fossil)	4070	6105	4260	}		
	Car (methanol)	–	–	100	}	0.7	1.1
	Car (electric)	–	–	0	}		
	Aircraft	400	1200	960		0.8	2.4
	Bus	370	481	547		1.1	1.5
	Train	290	348	700		2.0	2.4
	Total Person	5130	8134	6567		0.8	1.3
	Lorry (diesel)	1130	2260	0	}	0.6	1.2
	Lorry (methanol)	–	–	1400	}		
	Train	240	240	400		1.7	1.7
	Inland Water	120	132	160		1.3	1.2
	Total Freight	1490	2632	1960		0.7	1.3

Note:
Reference Case (see Table 4.1)

Policies to reduce transport intensity and volumes (*decoupling*) are also employed, but mainly by the use of pricing. This strategy has led to a somewhat more uneven distribution of accessibility which may be one of the major obstacles for realising this Image.

To sum up, the main elements of the transport policy are:

- International agreements on CO_2 emissions and other regulations.
- Internalising externalities of transport by means of taxation and feebates. All modes should in principle pay their full costs.
- Funding of research and development for cleaner technologies.
- Promotion of new markets by the creation of niche status for novel systems.
- Transport operations are largely privatised, but funding of new infrastructure is mainly public. Due to the political goal of regional equity, transport services to peripheral regions are subsidised where necessary.

4.5 IMAGE III: ACCORD ON SUSTAINABILITY

4.5.1 Society at Large

A spirit of cooperation permeates all levels of interaction - among individuals, locally, regionally, at the national and EU levels, as well as globally. Of course, some problems are still difficult to handle, but there is a respect for other parties' true interests and a willingness to find win-win solutions. The high level of interest and initiatives in societal matters by the general public, has led to a strong support for the principle of subsidiarity. At the same time the overarching political structures of Europe are powerful because of the consensus among leading economic powers of the world regarding many global issues, such as the environment. A kind of balance of power has evolved, based on a strong popular involvement in local and regional affairs and a more passive support for EU coordination and politics in high level issues.

4.5.2 General Approach to Transport Policy

The opinion among people and the political climate at higher levels is such that, the solutions of Image I and Image II could be combined with an even better goal attainment as result (synergy effects). However, financial constraints will restrict what is attainable. The regions and municipalities of Europe largely choose their own ways in coping with local emissions, congestion etc., while the targets are agreed at higher levels (Tables 4.8 and 4.9).

TABLE 4.8 CHARACTERISATION OF THE TRANSPORT SECTOR

General	Total mobility higher than 1995 but lower than reference levels Strong support for decoupling and good conditions for technological development Cars introduced with high capital costs (e.g. fuel cell cars, hypercars) High risk of methanol on biodiversity means limited impact - mainly introduced in the freight sector
Urban	Concentration on development in cities and corridors Shift to public transport and bicycle - higher occupancies Telecottages and teleshopping in decentralised locations Less space for cars in cities - limited parking
Long Distance	Long distance leisure travel the highest in this Image Air travel a growth mode, but also rail and rental car Limited investment in HST, better use of existing and new tracks
Freight	Local and glocal production Dematerialisation and decentralised production Load factors increased, particularly in distribution Intermodality promoted
Vehicle Technology and Fuels	Technological development is fast, with focus on niche vehicles Methanol restricted to 10% of all fuel - mainly for lorries Fuel cell cars account for 4% of fleet High share of high mileage vehicles - including taxis, rental cars Cars 15-20% lighter, with feebates related to weight
Organisation and Financing	Market incentives - road pricing Public transport publicly owned, but independent from government Little new investment in infrastructure Investment in IT infrastructure high Investment in R+D high to achieve technical level in new vehicles
Regional Development	Regions are less economically specialised and more self sufficient Increased glocal production as well as globalisation of some markets (e.g. financial markets)

TABLE 4.9 IMAGE III IN FIGURES FOR THE EU 15+3 COUNTRIES

	Billion Person-km or Billion tonne-km	Volume 1995	Volume 2020 (Reference Case)	Volume Image III		Volume Image III/ Volume2020	Volume Image III/ Volume 1995
Passenger	Car (fossil)	4070	6105	2800	}		
	Car (methanol)	–	–	–	}	0.6	0.9
	Car (electric)	–	–	700	}		
	Aircraft	400	1200	800		0.7	2.0
	Bus	370	481	700		1.5	1.9
	Train	290	348	660		1.9	2.3
	Total Person	5130	8134	5660		0.7	1.1
Freight	Lorry (diesel)	1130	2260	500	}	0.5	1.1
	Lorry (methanol)	–	–	725	}		
	Train	240	240	300		1.2	1.2
	Inland Water	120	132	140		1.1	1.2
	Total Freight	1490	2632	1665		0.6	1.1

Note:
Reference Case (see Table 4.1)

4.6 COMPARISON OF IMAGES OF THE FUTURE

These three Images of the Future differ fundamentally from each other as they mix different priorities according to levels of cooperation, the top down or bottom up approaches, the importance of technology in achieving the targets, and the nature and extent of decoupling (Table 4.10). These elements are presented in the upper part of the Table (points 1-5). The consequences of adopting the different Images of the Future are also elaborated through the other comparative figures given in Table 4.10 (points 6-18), which give a flavour of the expected changes in activities, travel, modal split, distance and the relative importance of other policy factors. It is important to realise that there are a wide range of choices that can be made, all of which can contribute directly and indirectly to sustainable mobility.

TABLE 4.10 COMPARISON OF THE IMAGES OF THE FUTURE

	Image I	Image II	Image III
1. Levels of cooperation	Local, EU	EU, Global	Local, EU, Global
2. Valuation of environment in the population	High	Moderate (Although higher than today)	High
3. Structure of production system	Much local and 'Glocal' production. Dematerialisation.	Relatively much trade inter-regional trade. Some dematerialisation.	Much local and 'Glocal' production. Dematerialisation.
4. Technological development of vehicles	Moderate pace	Fast	Fast
5. Attitude towards change travel behaviour	Positive (given there are environmental benefits)	Negative	Positive (given there are environmental benefits)
6. Reduction of enforced travel (work, service etc.)	Large	Moderate	Large
7. Modal shift, personal travel	Considerable	Small	Considerable
8. Modal shift, freight transport	Small	Considerable	Small
9. Car travel compared to 1995 (EU)	- 20%	+ 10%	About -10%
10. Car travel compared to 1995 (CEEC/CIS)	About + 70%	About + 100%	About + 80%
11. Cars per 1000 inhabitants (EU)	350 (1995: 420)	500	400
12. Average car mileage per year (1000 km)	13 (1995: 13)	11	12
13. Urban land-use	Decentralised concentrations. Relatively high share of public transport and bike.	Some urban sprawl.	Decentralised concentrations. Relatively high share of public transport and bike.
14. Role of railways	Alternative to car. Low cost prior to high speed.	Alternative to air travel. High speed prior to low cost. Also much freight by rail.	Alternative to both car and air transport. More freight by rail.
15. Infrastructure investment	Little transport infrastructure Much IT	Quite some rail infrastructure Some IT	Little transport infrastructure Much IT
16. Public spending on research and development	Moderate	Moderate	High
17. Environmental risks	Fewer environmental risks	Large use of biomass Large high altitude emissions	Fewer environmental risks
18. The Long view (possibilities to further reduce emissions after 2020)	Rather good	Limited	Rather good (Already lower than targets in 2020)

4.7 DISCUSSION OF TARGETS AND CONSEQUENCES

4.7.1 Target Achievement

The Images of the Future have been designed to meet the POSSUM targets and it is now necessary to examine whether the targets can be reached, and if so, the level of difficulty likely in achieving them.

Even though there are considerable problems with data, particularly in the CEEC/CIS countries, it is possible to make comparisons between the three Images of the Future. The fulfilment of the environmental and other targets are to a large extent achieved dependent on the degree of decoupling. The NO_X target is more demanding than the CO_2 target, but also closer to what could be called a sustainable level. It is achieved

for EU15+3 in all the Images of the Future, but further cuts may be necessary to allow for increasing transport volumes in CEEC/CIS to achieve the POSSUM targets overall. The target on special protected areas is fulfilled in all Images of the Future, and the limited increase in new infrastructure will be achieved, but in Image II it requires the removal of some old infrastructure. A normative summary of the extent to which targets may be achieved for each of the three Images of the Future is presented in Table 4.11.

TABLE 4.11 SUMMARY OF TARGET ACHIEVEMENT

Targets	Image I	Image II	Image III
CO_2-emissions -25% EU 15+3	-36%	-36%	-44%
CO_2-emissions -25% CEEC/CIS	+26%	+36%	+24%
CO_2-emissions -25% EU 15+3+CEEC/CIS	-29%	-28%	-37%
NOx-emissions -80% EU 15+3	-78%	-80%	-82%
No degradation of special protected areas	Target fulfilled low infrastructure investments.	Target fulfilled moderate infrastructure investments.	Target fulfilled low infrastructure investments.
No or minor increase of net infrastructure surface in Europe	Target fulfilled	Target may be fulfilled if some outdated infrastructure is removed	Target fulfilled
Improve relative accessibility of peripheral regions (both internal and externally)	Target fulfilled, main means is improved telecommunications	In general target is fulfilled, but social distribution of accessibility is rather uneven	Target fulfilled, main means is improved telecommunications
Full cost coverage of transport under market or equivalent conditions	Yes but operated by public sector	Yes but subsidies to infrastructure investments in peripheral regions	Yes but subsidies to research and development on advanced vehicles

Accessibility targets will be hard to achieve and success is likely to depend on the level of telecommunications substitution for travel, as this would increase intra-regional accessibility. A potential source of tension in Image II is the uneven distribution of accessibility resulting from the introduction of road pricing and market principles to transport. The efficiency target will be fulfilled, although there may be some problems in Image I with subsidies to public transport and infrastructure to CEEC/CIS and in Image II with financing research and development and infrastructure.

In Image II, individual mobility is highly valued, even though transport demand is reduced through taxation, road pricing and other economic incentives. This implies that mobility will to a great extent depend on individuals economic strength and consequently there is an apparent risk for a strong opposition especially if there is an unequal economic distribution in society. One measure to decouple is a tax-shift, from labour to taxation of resource and consumption. This is a case where the major impacts will take place outside the transport sector, as well as having implications within the transport sector.

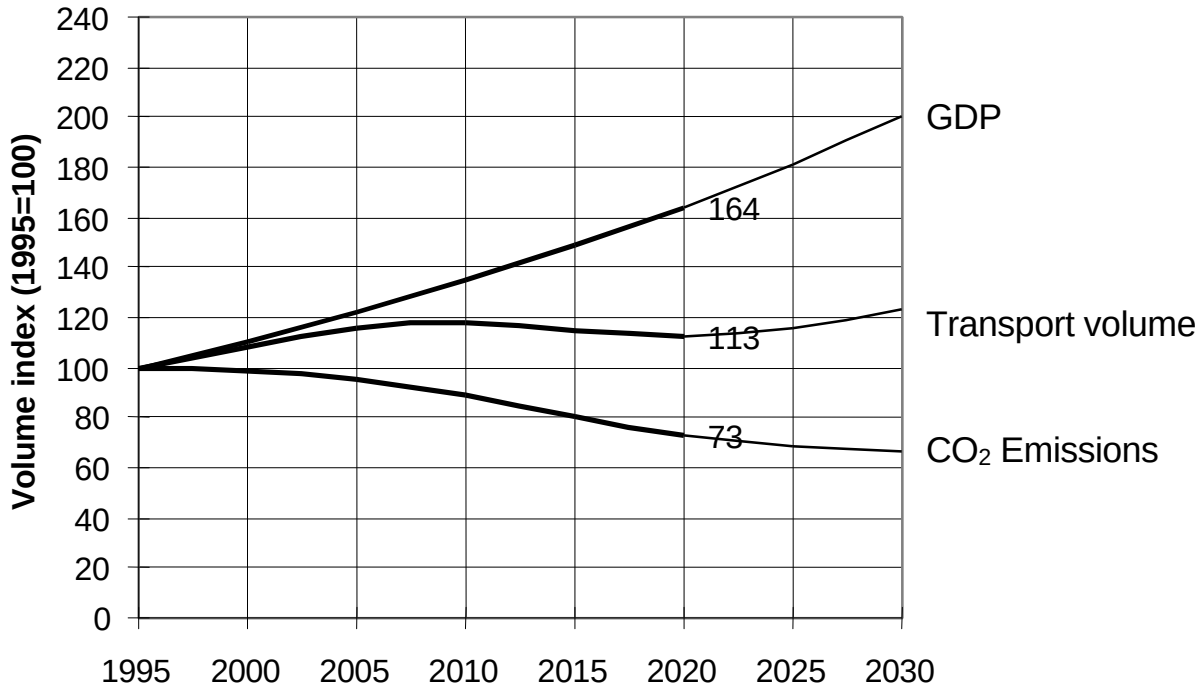
Road transport volumes in the CEEC/CIS countries are expected to increase, and they have today a lower level of traffic volume than the EU countries. This may lead to increased traffic emissions, in conflict with the ambition to lower the emissions and

decrease the negative impact on the environment. However, it would be unreasonable to require implementation of *vehicle* emission standards in the whole area of the EU and the CEEC/CIS. A transitional period should be allowed for CEEC/CIS countries taking into account the much lower car density in these countries. One way to reach equity, would be to set an emission limit for each country, based on an average limit *per capita* for CO_2, NO_X and VOC emissions from road traffic in those countries. A limit based on the present EU countries per capita emissions from road traffic, therefore, would give space for an increase of the traffic volume in the CEEC/CIS countries. The per capita limit should decrease during the years as a means to decrease the environmental pollution in line with the POSSUM targets.

4.7.2 The Potential Role of Technology and Decoupling

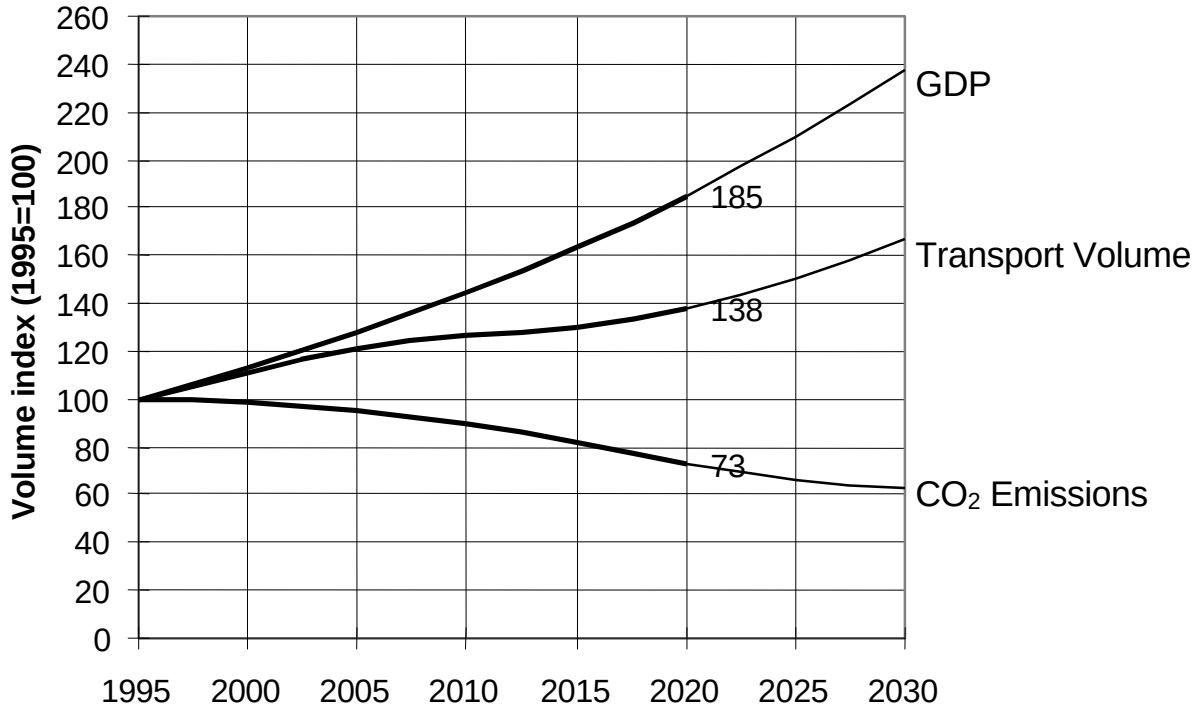
The relative contributions to goal fulfilment provided by new technology and decoupling is illustrated in Figure 4.1 (Image I) and Figure 4.2 (Image II). The three curves show the development of GDP, transport volume and CO_2 emissions.

FIGURE 4.1 DEVELOPMENT OF GDP, TRANSPORT VOLUMES AND CO_2 EMISSIONS FOR IMAGE I[1]



1. The difference between GDP and transport volume on the graph indicates the extent to which decoupling occurs. The difference between the two lines is also influenced by changes in technology, which works in synergy with other measures.

FIGURE 4.2 DEVELOPMENT OF GDP, TRANSPORT VOLUMES AND CO_2 EMISSIONS FOR IMAGE II[1]



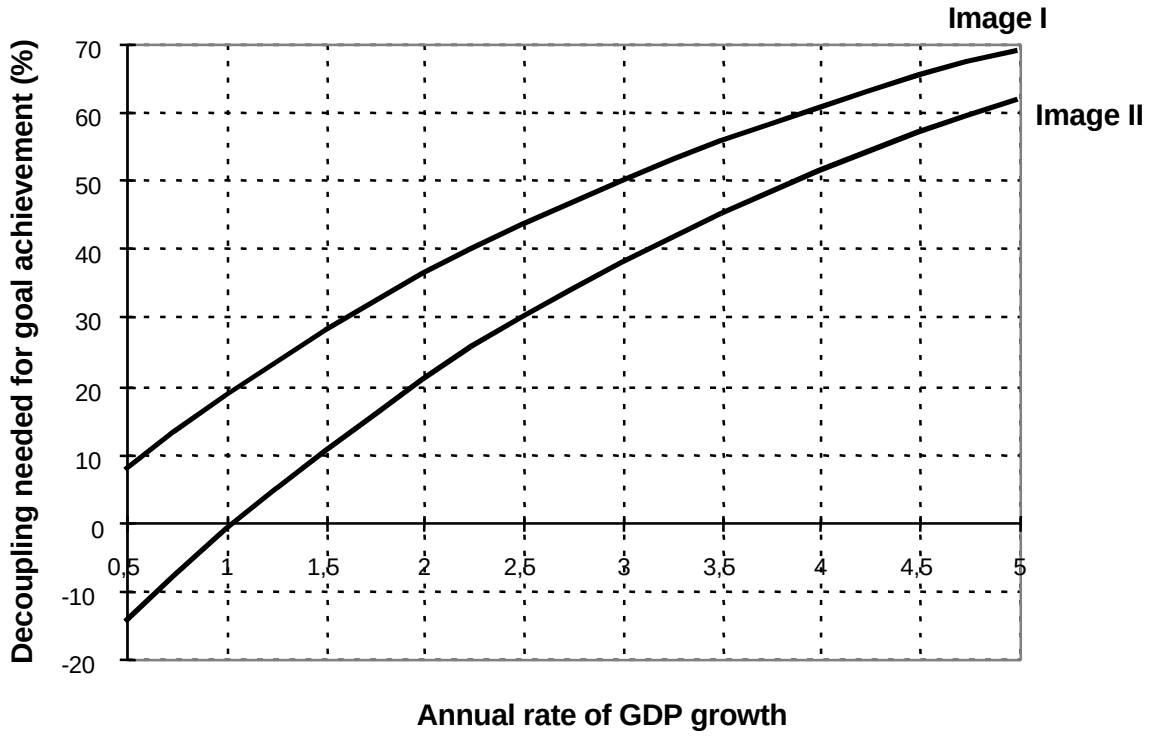
The vertical gap between the GDP curve and the transport volume curve may be interpreted as the decoupling effect, whereas the gap between the transport volume curve and the emissions curve represents the effect of improved technology.

The development beyond 2020 is indicated with thinner curves. We can see how the transport volume curves begin to bend upwards again, as the decoupling potential of the structural and behavioural changes considered in the Images of the Future eventually is exhausted. What assumptions lie behind the form of the decoupling curve? It seems reasonable to assume that it will take some time for the typical contextual conditions (e.g. changes in life styles and values) of each Image to develop and have an impact on transport intensity. The same will probably hold for deliberate decoupling policies. Once the process is set in motion, however, the decoupling effect will accelerate for a period but gradually lose momentum and eventually come to a halt when the potential of the structural changes of society considered in the scenarios have been exhausted[2]. Of course, a new wave of structural and behavioural change – policy induced or otherwise – may follow and possibly start before the waves have died away. This will probably also be necessary to reach the POSSUM targets: technological improvements alone may not be enough to keep emissions at an acceptable level after 2020.

1. The difference between GDP and transport volume on the graph indicates the extent to which decoupling occurs. The difference between the two lines is also influenced by changes in technology, which works in synergy with other measures.
2. This line of argument is based on theories of logistic growth with applications on technological diffusion processes and population dynamics etc. See e.g. Grübler, Arnulf, *The Rise and Fall of Infrastructures*, Heidelberg 1992, and Hofbauer & Siegmund, *The Theory of Evolution and Dynamical Systems*, Cambridge University Press, Cambridge 1988.

Figures 4.1 and 4.2 build on the assumption of an annual GDP growth rate of 2% in Image I and 2.5% in Image II[1]. These are the standard values for the Images of the Future (Image III also has an assumed growth rate of 2.5%). Of course, some deviations from these values are possible and compatible with the general features of the scenarios, but there should be a somewhat faster growth in Image II than in Image I. It should be noted, though, that a higher growth rate will require a higher degree of decoupling, provided that the goals shall be met and the technological improvements are given. This may be very difficult to achieve. Our estimate is that the required decoupling levels may be possible to reach at the standard growth rates (2% and 2.5%). However, at 3 % growth in Image I and 3.5% in Image II the need for decoupling would be so high that it does not seem to be realistic by 2020. Figure 4.3 illustrates this.

FIGURE 4.3 DECOUPLING REQUIRED FOR GOAL ACHIEVEMENT IN IMAGES I AND II



4.7.3 Important Issues

Vehicle Technology – Images I and II have a different focus when it comes to priorities of vehicle research and development. The 'bottom up' Image I has favoured development of niche vehicles such as electric city-vehicles. Image II, which relies on international cooperation, results in development and a widespread use of efficient multi-purpose cars. The automobile industry works on a global market. In the very near future a new generation of internal combustion engines will be phased into the car fleet (they are already marketed in Japan). These engines (e.g. lean burn engines) have about 15-20% better fuel efficiency, although it is uncertain whether NO_X

1. The numbers relate to traditional GDP. Estimates of green GDP or prosperity is estimated to be roughly the same in each of the Images of the Future.

emissions will be reduced. Even so, this is not sufficient in the longer term. There are limits to engine efficiency in terms of fuel consumption, and the opportunities for weight reduction in vehicles is central to all Images of the Future. Environmental concerns have to be balanced against safety. This process of technological development needs to be started immediately, with a phasing out of the least efficient heavy vehicles.

Vehicle Fuels – In Images I and III, the decision on new fuels can be postponed because attitudes are in favour of modal shifts and niche vehicles and lower transport volumes. In Image II, immediate action is required to provide an infrastructure for methanol to reach the environmental targets. This however implies a higher fuel cost compared to Image I. So a strategy stressing decoupling may give time enough to leap-frog directly to a transport system based on hydrogen produced by direct or indirect solar energy.

Transport Infrastructure Investment – There is a different profile in the investments in transport infrastructure between Images I and II. The emphasis on decoupling in Image I, means a higher share of public transportation in urban areas and utilising the existing railroad network. In Image II car mobility is higher and a High Speed Train (HST) network in Europe is built.

Information Technology – IT will enormously influence everyday life in the future EU. The development path can however be influenced in order to be more or less in line with sustainable mobility. The crucial point is to ensure the full potential of IT in increasing accessibility and decreasing the need for physical movement and at the same time avoid any travel increasing mechanisms.

Land Use Planning – The focus in land use planning is to reduce the structurally forced travel (to and from work, shopping and service etc.). If successful, such a policy will increase the scope for (more desired) leisure travel. Decentralised concentration (subcentres with telecottages and local services connected by high quality public transport) is one interesting concept as it impacts on both transport volumes and emissions per km (modal shift to environmentally benign modes). Measures to decrease travel can be achieved through demand management and planning interventions.

The Longer Term – The POSSUM targets for environmental protection 2020 are unlikely to be final goals. When the developing countries increase their standard of living the environmental space and available resources for the developed countries (on a per capita basis) has to be lower. This means that long term environmental targets are likely to be much tougher than the 2020 targets used in the scenarios. The need for further dematerialisation will also increase if development shall be in line with sustainable development.

The rate of change differs between different measures, which is also dependent on how forced the change is. The turnover of cars are much faster than for the built infrastructure. If changes are realised at the rate of replacement of worn out machinery, the costs can be low or zero. In each of the three Images of the Future we

have assumed that most of the changes follow a ‘natural’ replacement rate. In some cases the environmental targets has resulted in earlier scrapping of vehicles.

The dynamics when passing the year 2020 is also of importance. Will a continued development along lines before 2020 result in further improvements with respect to the objectives? One example is the introduction of fuel cell/hybrid cars. They are assumed to have quite a small share of the market in all Images of the Future by 2020. A further market penetration will improve the environmental situation even more.

To sum up the POSSUM environmental targets should be viewed as intermediate targets, especially in terms of CO_2. In the long run a more ambitious level should apply. Therefore, when discussing and assessing the POSSUM Images of the Future (and subsequently the scenarios) one should also consider the prospects of realising very long term goals (to 2050), as these may influence the choice of strategy up to 2020.

5. POLICY MEASURES AND PACKAGES

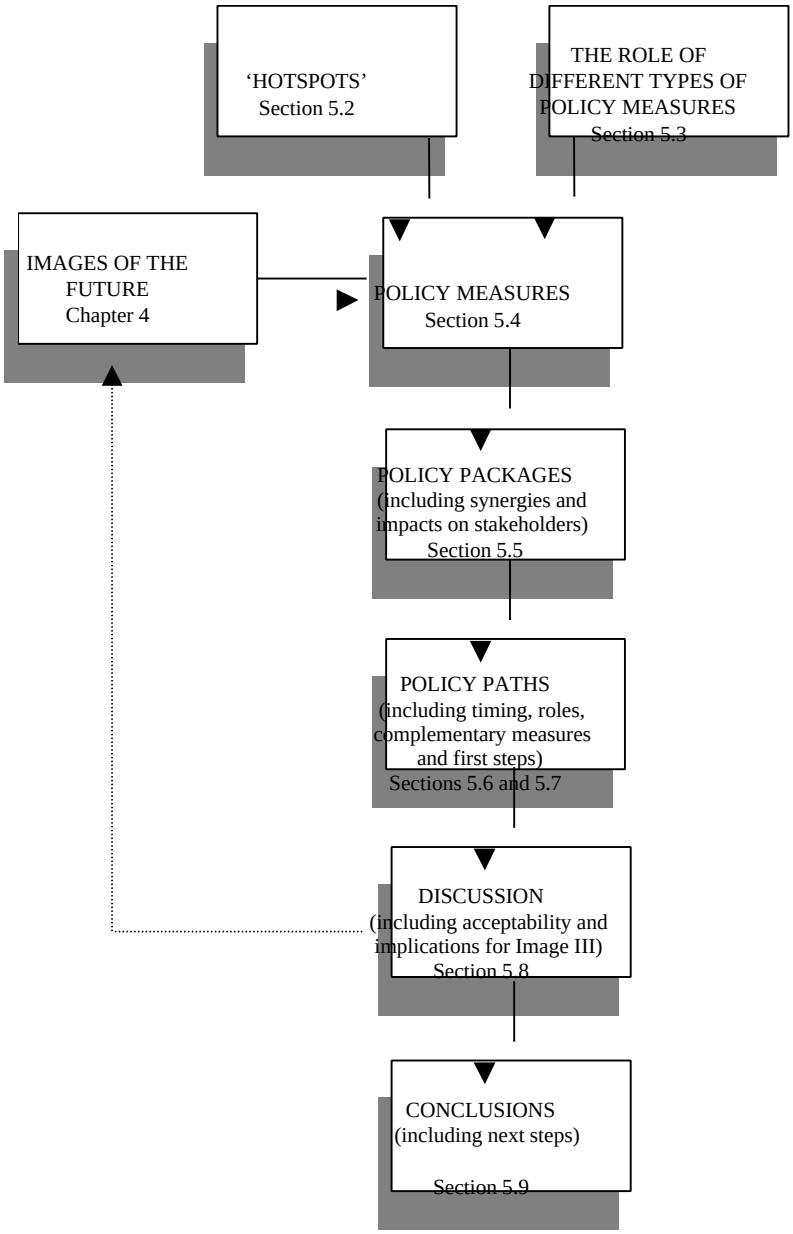
5.1 INTRODUCTION

Policy measures and subsequent policy packages and paths are identified in this chapter. In the first stage, key issues for future transport policy ('hotspots') are identified. These are used to help ensure that the range of potential policy measures for inclusion in policy packages and paths (designed to reach the POSSUM targets) are able to tackle the key issues for future transport policy. The second step in the identification of policy measures and subsequent policy packages and paths is the review of different types of policy measures and their potential contribution to the achievement of the POSSUM targets. Having identified the hotspots and the potential contribution of different policy measures to the achievement of the POSSUM targets, a comprehensive list of policy measures is constructed in the third stage. The influence of these measures on each of the hotspots is indicated by means of a matrix. The matrix is also used to identify:

- The influence of each measure on technology, passenger transport, freight transport and transport organisation;
- The extent to which each of the policy measures might contribute to the three broad types of POSSUM targets (environmental protection, regional development and economic efficiency);
- The policy orientation of each measure; and
- The timescale of effect of the policy measures – whether impacts are likely to be short, medium or long-term.

Fourth, policy packages are developed by combining sets of policy measures that are likely to work well together (i.e. which create synergies). Each of the policy packages are designed to relate to a specific Image of the Future. The development of policy paths is the fifth stage of the process in which policy packages are combined together. Finally, issues of acceptability and the implications for Image III are considered. The various stages of the process are illustrated in Figure 5.1.

FIGURE 5.1 THE PROCESS OF IDENTIFYING POLICY MEASURES, PACKAGES AND PATHS



5.2 HOTSPOTS

Key issues for future transport policy ('hotspots') are identified in this section. These are used to help ensure that the range of potential policy measures for inclusion in policy packages and paths are able to tackle the key issues for future transport policy. Five hotspots are considered in this section:

1. Global environment;
2. Urban pollution and congestion;
3. Freight transport (particularly at critical points, such as the trans-Alpine region);
4. The future of railways; and
5. Air transport growth (including issues concerning deregulation).

5.2.1 Global Environmental Issues

Fossil fuel use and other human activities enhance the greenhouse effect, which may cause the global climate to change. There are several different greenhouse gases, but carbon dioxide (CO_2) is the most important contributor.

Carbon dioxide concentrations in the atmosphere have increased from the pre-industrial level of 280 parts per million by volume (ppmv) to 360 parts per million in 1994. The anthropogenic release of carbon has increased rapidly over the last century and was approximately 6.1 Gigatonnes of carbon in 1994 due to fossil fuel use only. The anthropogenic emissions and concentrations are quite easily measured but a change in climate is very difficult to detect. Several recent events of extreme weather and an increase of both global mean surface air temperature and sea level may, however, indicate that the climate is actually changing (IPCC, 1996).

The IPCC was set up in 1988 to assess the scientific information on climate change, impacts and response strategies. It has conducted model simulations on global emissions, atmospheric concentrations and temperature increases on the long term. An important factor is also that the world population is estimated to increase during this period. This implies that a stable average emission level is to be shared by a growing population. According to United Nations' estimates, the world population is estimated to increase from the current level of almost 6 billion to nearly 10 billion in 2050 (United Nations, 1992). If a goal of for example a stabilisation at 450 ppmv is be to reached and assuming an equal per capita distribution, the per capita carbon emissions should decrease from current levels to 0.6 tonnes of carbon per capita per year in 2050. If the goal is instead set to 550 ppmv a slight increase could be permitted but followed by a decrease to 0.7 tonnes of carbon per capita and year in 2050. It should be stressed that an atmospheric CO_2 concentration at these levels is estimated to generate a significant climate change and could not be considered sustainable.

It must furthermore be stressed that the emissions are very unevenly distributed over the globe today. The per capita emissions in the US are in excess of 5 tonnes of carbon per capita per year, in Europe it is above 2 tonnes of carbon per capita per year while three quarters of the world's population emits less than 0.5 tonnes of carbon per capita and year. The world average is slightly above 1 tonne per capita (Klimatdelegationen, 1995). Even if the goal stated by a sustainable development is to level these differences, it is unlikely that this could take place already until 2020. The chosen scenario targets will therefore be at a level somewhere between the desired sustainable level and today's level – a level that could conceivably be reached.

In conclusion, there is no guaranteed sustainable level of CO_2 emissions. Model calculations and the agreed climate conventions indicate that at least a global stabilisation is needed. Given the uneven distribution of emissions and growing world population it is however clear that the industrialised countries will have to reduce their emissions significantly. The POSSUM target is therefore a reduction of 25 percent and should be regarded as an intermediate target. A short-term reduction target is highly subjective, aiming at the scientific long-term estimation of what is necessary in

order to reach a sustainable level but simultaneously it ought to be possible from political, economical and social point of views.

5.2.2 Urban Pollution and Congestion

Traffic levels have substantially increased in Europe over recent decades. They are set to continue increasing without policy interventions. A number of factors underlie these trends including cheaper transport, rising incomes, changing labour markets, smaller households, increased leisure time, a higher proportion of the elderly in the population, and land-use changes.

Increasing travel has resulted in congestion, pollution and accidents in all types of urban (and non-urban) areas. Car reliance is increasing, with adverse effects on all the population, but particularly on those without a car. The associated social and economic costs amount to billions of ECUs. In most EU countries, the costs of congestion amounts to more than two percent of GDP, with local pollution amounting to at least a further one percent of GDP. Estimates of the long-term costs of CO_2 emissions vary between 1 and 10 percent of GDP (OECD/ECMT, 1995). The monetarisation of external costs is subjective and uncertain but helps to quantify the extent of some impacts.

Until recently, the pull factors (demand-led factors) were of a higher order of importance than the push factors (supply-led or capacity-led factors) in transport planning. Transport policy was driven by demand and the continued growth in demand was accommodated. This ‘predict and provide’ approach to transport is now being replaced by a ‘new realism’, which has evolved over the last five years. The five stages of the new realism comprise:

- consensus that projected traffic growth is not sustainable
- recognition that increasing infrastructure construction will not solve the problem
- discussion about limitations on the use of the car so that demand can be matched to supply
- renewed interest in the environmental consequences of unlimited mobility
- realisation that the only way to improve both environment and congestion is to use the car less

Various transport management strategies are associated with the five stages of the new realism, beginning with increasing the amount of available road space through using existing road space more effectively, shifting demand from car to other modes, restraining the demand for car use and, finally, implementing non transport policies.

Decisions on the development of the transport system and transport activities involve a number of different actors (government, transport planners, business, citizens) and are influenced by factors such as prices and quality of services, the availability of modal choices, travel time and the organisation of economic and social life. Moving towards sustainable mobility requires the right framework of price signals, infrastructure planning and provision, regulations and standards, research and development, information, awareness and shared responsibility and partnerships.

5.2.3 Freight Transport in the Alpine Region

Freight transport through the Alpine region is expected to increase further in coming decades due to developments in CEE countries and current pressure of the EU to abandon regulation in Switzerland and Austria. Large-scale investments are carried out to reduce congestion and to stimulate the modal shift. However, the economic feasibility is limited and new infrastructure will result in larger capacity and hence, more mobility growth.

There are several policy instruments, which may be introduced to reduce mobility growth or stimulate the desired modal shift. Legislative measures may encourage operators to use rail transport. Price measures may be introduced (e.g. tolling, vignettes, road pricing, fuel taxes). Infrastructure provision may favour rail and subsidies can be given to the rail system. The introduction of these measures will often be hard because restrictive measures are opposed by countries that benefit from the transit transport (e.g. Italy, Greece, Germany, and the Netherlands) but on the other hand they have the disadvantages in the form of congestion and pollution.

In the distinct images trade-offs have to be made between the political and social feasibility of measures in the Alpine region (e.g., the construction of new road infrastructure) and objectives like efficiency or regional development. Increases in road transport in this region are likely to lead to public opposition.

5.2.4 The Future of Railways

Europe´s railways have suffered a period of stagnation and decline over the last 25 years. If this trend which continues into the future, the role of railways for sustainable transport will be negligible. Since the mid 1980s different strategies have been discussed and implemented to achieve a ‘renaissance’ of railways, such as the promotion of high speed links and liberalisation.

Railways have been the major form of transport from the second half of the nineteenth century up to the beginning of this century (1930s) and rose to be the primary means of transport in all industrialised countries by the turn of the century: at that time railways were transporting between 80 and 90 percent of all passenger and tonne-kilometres (Grübler and Nakicenovic, 1991).

Since the end of the Second World War the role played by rail in the transport market has been in constant decline for both passenger and freight transport. This loss of market share is to be connected with the symmetrical growth of road transport. In the period between 1970 and 1994 freight transport by rail has decreased from 283 to 220 billion tonne km while the freight market has increased by almost 70 percent and road transport by almost 150 percent, which corresponds to a loss of half the market share (European Commission, 1996).

If one extrapolates the above illustrated trends for the next 25 years and taking account of this decline of market share in connection with the expected growth of transport, the trends are quite alarming for the future of railways. Nevertheless, the available data show that in the different European countries (and also at a intra-

national level) the situation can substantially differ: in some areas rail can still play an important role whereas in some other areas it cannot compete (European Commission, 1996). The reasons for this decline are widely discussed in literature - among the most prominent features:

- changing market requirements, in terms of speed, flexibility and loads, which put the 'mass-transports system' with limited chain-integration potential at disadvantage compared to the flexible, individual transport systems (see for example NEA, 1992; Cerwenka, 1990; Commission of the European Communities, 1992; Baum, 1990);
- limited flexibility of state-owned bureaucracies to meet the new market requirements by an active innovation and modernization policy (e.g. Nijkamp, 1995; Ewers, 1991);
- political decisions, which systematically discriminated against rail in favour of the car, such as infrastructure policies and taxation (see Button, 1992; Wolf, 1987; Heinze, 1992);
- technical and political national fragmentation, which prevented the railways to maximise the increasing international markets (Nijkamp et al., 1994)

It is difficult to find forecasts about the market share rail will have in the coming 25 years. Nevertheless, it is clear that there is potential for an improvement of the position of rail, which cannot be brought about solely through an improvement of railway service. Rail´s future share in the European transport market will also depend on the position road transport will have in the coming years: the internalization of external costs may substantially contribute to improve the competitive position of rail transport.

On the basis of these assertions, the best conditions for the improvement of rail are technical harmonization and standardization, interoperability, optimum use of the existing infrastructure, coordination of new infrastructure projects at the European level, completion of a european high speed train network with key links and, last but not least, increase in price of road transport by means of internalization of external costs. In this case, one can expect an increase in modal share from about 15 percent (1994) to about 20 percent in 2010 and 30 percent in 2020 for long-distance freight transport. For long-distance passenger transport one can expect an increase from 6 percent (1994) to 10 percent in 2000 and 20 percent in 2020 (UIC, 1994). These forecasts are concerned with transport over 80 kilometres, which represents only a limited percentage of the overall transport volume. Another important growth market of railways is transport in and around agglomerations, where public transport may have market shares above 30 percent (Zürich for example – see Bratzel, 1997).

5.2.5 Air Transport

Air transport demand is still growing at a rapid speed, leading to high and rising environmental costs. There have been few restrictions on the growth of air transport to date: it seems that each country is expanding the capacity of airports rapidly in order to attract as many activities as possible. A main problem is that the international character of this sector makes it very hard to introduce measures: every country may act as a 'free rider', not wanting to introduce measures when other countries do not (see also Rienstra

and Nijkamp, 1997). This makes it difficult to introduce unilateral measures such as taxes on fuel.

The main trend in this sector is a large-scale liberalisation and deregulation. In Europe these trends are following behind US-trends. Some lessons may therefore be learned from American experiences. It appears that the impacts of European liberalisation are less significant than was the case in the USA, which is mainly due to differences in market and institutional conditions.

There are few technical options for reducing the environmental impacts of air transport, although current technology certainly can be improved to some extent. A frequently mentioned option is the introduction of liquid hydrogen aeroplanes. Complementary policies are however necessary to achieve a successful introduction because of the high introduction costs. International coordination may cause problems in this respect. Another option is the construction of High Speed Train connections, which may compete with aeroplanes on distances up to 500 kilometres. This option seems however only viable at some connections and depends also very much on the prices of train tickets.

5.3 THE ROLE OF DIFFERENT POLICY MEASURES

The role of policy instruments in achieving the POSSUM targets is assessed in this section. The contribution that technology might make is set out in section 4.1. The potential role of passenger and freight transport policies in achieving the POSSUM targets are considered in sections 4.2 and 4.3 respectively. The role of organisational change and its role are discussed in section 4.4. In order to show the large scope for action in favour of decoupling a distinction between different basic policy orientations may be useful. Under policy orientations we understand the generic rationale which usually can be found behind different policy packages:

- **lifestyle-oriented policies** – policy intervention is only a subsidiary help for the ongoing growth of 'post-material' lifestyles. A basic element of such lifestyles is a changed attitude towards mobility and material consumption. Quality of life aspects play a central role. Part of this is an increasing acceptance of the claims that sustainable development has on lifestyles (which changes the balance between material consumption and resource use and environmental degradation). Public policy intervention is first of all an anti-discrimination policy in favour of such post-material lifestyles. The dynamics might be basically bottom-up. Information policies are an important element of this approach. Knowing the transport effort contained in a product or the transport consequences of a policy decision, helps to reorient behaviour.
- **market-oriented policies** – this approach assumes, that people are willing to change their behaviour or lifestyles, if others do the same and if they have no material disadvantages. So a system of market incentives, i.e. by fiscal reform or changed property rights will change the incentive structure. This approach will have some top-down elements, but it will also have to rely on the general acceptance.
- **regulation-oriented policies** – this approach relies upon technical standards and norms (for instance speed limits, maximum weight of vehicles), on innovative

planning methodology (especially: spatial planning; transport impact assessment) and government reform. The general approach is rationalistic, target and criteria led and top-down.

- **public infrastructure/services** – providing public infrastructure and services is a policy approach that is strongly associated with regulation-oriented polices. The state provides infrastructure such as roads, rail, telecommunication, water supply and services such as research, police, air traffic control etc. The performances offered are not directly linked to cost-covering payments. The actual delivery may be contracted to private companies.

5.3.1 Policy Measures affecting Technology and New Fuels

Four main types of policy strategies are examined: market based instruments, regulation, lifestyle changes and finally research and development and niche vehicles.

Market based instruments

Three categories of market based instruments can be identified. The first category contains fiscally neutral instruments, such as 'feebates' (combinations of fees for fuel intensive cars and rebates for fuel-efficient cars). The second category contains instruments to reduce externalities that can be rapidly reduced (such as sulphur emissions). The third category contains instruments to reduce externalities that can only be reduced slowly (CO_2 emissions for example). Only the latter category of measures is suitable for use in the context of Ecological Tax Reform. With ecological tax reform, other taxes (such as labour taxes) could then be reduced.

These three categories have different impacts on technology and transport volumes. Feebates may improve technology but do not necessarily limit transport volumes, particularly if used as a single measure. Without complementary instruments, feebates may increase transport volumes if fuel costs decrease. The second category of measures mainly affect technology but may limit transport volumes at least in the short term. The third category is likely to strongly affect both technology and transport volumes.

Under the assumption of a perfect market, a CO_2 tax is a very cost-effective instrument for reducing CO_2 emissions. Some considerable market imperfections, however, mean that this instrument needs complementary measures, directed particularly at private vehicle use. A CO_2 tax is likely to affect the development of new vehicles, customer choice among available vehicle types and transport volumes. Studies on customer behaviour, although not unanimous, indicate that customers do not take the whole life cycle fuel costs into account when buying a new vehicle. Typically only the three first years are considered (Eriksson, 1992). Compared to a societal cost-benefit calculation with an interest rate of 6 percent only 35 percent of the (discounted) fuel costs are taken into consideration. To achieve the desired effect from a CO_2 tax would require costs to be two to three times as high as the shadow price. This would lead to unnecessary large adjustments of transport patterns with probably severe distributional effects. Because of this market imperfection it seems appropriate to also include a vehicle purchase tax differentiated according to fuel consumption (and possibly also vehicle weight). It would probably be easier to get

support for such a measure if it were introduced in the form of a feebate. It is difficult to assess the precise levels of CO_2 taxation and feebates on new cars. The gradient of the feebate is dependent on the CO_2 tax.

A high CO_2 tax may result in a rather uneven distribution of mobility. This could be compensated to some extent (but probably not fully) with Ecological Tax Reform if labour taxes were reduced. A general CO_2 tax probably would be included in any policy package, although the levels would differ depending on environmental values and degree of cooperation at the global level.

Vehicle weight reductions is one way of reducing emissions. It may be argued that the most general policy instruments (such as a CO_2 tax) should be used since it is difficult to forecast which technological solutions will be appropriate. The situation regarding vehicle weight is, however, somewhat special. To have great weight differences in the road fleet means, ceteris paribus, that more people are killed or injured. To suddenly introduce a new generation of vehicles that are significantly lighter than the present may therefore be less attractive. If, on the other hand, a gradual development against lighter vehicles is started now the result may be both lower energy use and better safety if the weight span is simultaneously narrowed (which means that focus is on phasing out the heaviest vehicles). The car manufacturers are faced with a 'prisoners dilemma' situation. Safety is apparently an important variable for potential customers. So for the car manufacturer it seems rational to produce cars that are heavier than the cars of theirs competitors. From a societal point of view this is however unwise since the total safety (and the environmental performance) is worsened by this. Policy instruments with a more direct effect on vehicle weight may therefore be needed. These may be economic incentives (a vehicle purchase tax or a yearly tax differentiated according to weight) and/or regulations (such as a maximum car weight).

To encourage the scrapping of old vehicles, economic incentives and regulations may be necessary. Bonuses for scrapping of dirty and heavy cars or a successively increased annual tax may be most appropriate. The former cannot be used continuously but have to be used for a short period (maybe every fourth year or so).

Regulation

CAFE (Corporate Average Fuel Economy) standards have been used in the USA since 1975. They require that the average fuel consumption of cars sold by a company in the USA should not exceed a certain limit. Compared to a carbon dioxide tax this instrument is less cost effective. The use of standards in the USA is the consequence of the political impossibility of high taxes on gasoline. Fuel consumption regulations may allow specific targets to be reached more easily than with CO_2 taxes. A drawback with this type of regulations however is that traffic volumes may increase due to lower fuel costs. In addition, new cars may become more expensive while the cost of driving an old and dirty car is unaffected.

In Germany, a slightly different policy has been proposed in which there is a limit on vehicle emissions of CO_2 per vehicle-kilometres. This is differentiated according to

vehicle weight. The constraints are then gradually lowered. If the limit is exceeded a relatively high penalty fee is incurred.

Emission standards have been the most common way of limiting emissions other than CO_2 (e.g. NO_X), although market based instruments are also possible. Since the negative impact caused by emissions other than CO_2 depends on where they are emitted, road pricing is a more precise instrument than for example an additional fuel tax. In any case, since real world emissions often are much higher than test cycles would suggest, more realistic test cycles are needed. Because of the potential deterioration of exhaust cleaning devices, monitoring and regular control of emissions from old vehicles may be even more important.

Lifestyle changes

Information about the environmental properties of products is important if people are inclined to act more environmentally. Information about fuel consumption and emissions (ideally lifecycle emissions) for cars should be easily accessible. 'Eco labelling' of public transport could also speed up technological development regarding buses, ferries and aircraft. Public support for car rental and car-pooling (possibly in the form of tax rebates) may also indirectly contribute to more fuel-efficient cars.

Research and Development and niche vehicles

Most research and development regarding vehicle technology can be carried out by industry if given the proper incentives (such as a powerful CO_2 tax and tax/rebate on new cars according to fuel consumption etc). In some cases, where research is required for a very long perspective, public funding may be needed. Public actors may be able to play an important role in creating initial markets for new kinds of vehicles. One such way is the purchase of innovative vehicles for their own fleets. They may act as a catalyst for the market. Environmental zones with access only for vehicles with zero or very low emissions may also be used. This could create market niches for battery electric and hybrid vehicles.

Since changes in fuel production patterns have long lead times (longer than for example in the car industry), policy instruments need to be implemented promptly. Market based instruments can be used but are not likely to be sufficient alone. Introduction of alternative fuel vehicles in public fleets may be used in order to create a basic niche for new fuels like methanol. Flexible Fuel Vehicles (FFVs) could be used during a transition period.

Examples of transport policy measures that are likely to affect technology and new fuels are identified in Table 5.1, together with an indication of their impact on the POSSUM targets and the likely timescale of effect.

TABLE 5.1 POSSIBLE TRANSPORT POLICY MEASURES THAT MAY AFFECT TECHNOLOGY AND NEW FUELS

Measure	Strategy/ Sub-strategy	Impact/ Timescale
Life-style oriented:		
• Eco-labelling of cars	fuel consumption emissions	++ medium-term
• Eco-labelling of public transport	fuel consumption emissions	+ medium-term
• Support for car rental and car pooling	transport volumes fuel consumption emissions	++ medium-term
Market oriented:		
• Ecological tax reform charging resource use instead of labour	fuel consumption transport volumes renewable fuels	+++ long-term
• Tax on CO_2	fuel consumption transport volumes renewable fuels	+++ medium-term
• Feebates (or only fees) on new cars according to fuel consumption	fuel consumption	+++ medium-term
• Feebates (or only fees) on new cars according to weight	fuel consumption safety	++ medium-term
• Incentives for scrapping of cars	fuel consumption emissions safety	+ medium-term
• Differentiated road pricing	emissions noise transport volumes	+++ medium-term
Regulation:		
• Standards for average fuel consumption	fuel consumption	+++ medium-term
• Emission standards	emissions	+++ medium-term
• Better control of 'real world' emissions	emissions	+++
• Maximum weight for cars	safety fuel consumption emissions	++ medium-term
Public services:		
• Research and development – vehicle technology	fuel consumption emissions safety renewable fuels	++ medium-term
• Research and development – renewable fuels	renewable fuels	++ medium-term
• Creating environmental zones	emissions noise	++ medium-term
• Public procurement of environmentally friendly vehicles	fuel consumption emissions renewable fuels	++ medium-term

5.3.2 The Role of Passenger Transport Policies

Historically, there has been a strong link between transport growth and GDP, but more recently the growth in travel demand has been greater than the growth in GDP. In the OECD countries, GDP growth 1970 to 1990 was 2.8 percent per annum and traffic growth was 3.3 percent per annum. The extent to which transport growth can be decoupled from economic growth in the next two decades (up to 2020) is discussed. Four main types of strategies for passenger transport are examined: market based instruments, regulation (including spatial planning), information technology (including substitution effects) and lifestyle changes. (Issues concerning freight transport are discussed in section 5.3.3.)

Market Based Instruments

Pricing gives clear messages to users of the transport system about priorities and there is a strong case for internalising the external costs of transport. As a general principle, users should pay according to use of the system, particularly when travel takes place under congested conditions. This means that fuel duty should be substantially increased so that petrol and diesel prices reflect the full environmental costs (including pollution). Drivers would then choose to drive less or more carefully. In the longer term, higher fuel prices would be reflected in purchase decisions on new vehicles and clear indications would be given to industry to provide more fuel efficient vehicles. There would also be an indirect incentive to scrap older vehicles, or 'cash for clunkers'.

Vehicle tax and insurance charges could also be related to the fuel efficiency and the emissions of the vehicle. Some pricing would be linked to the emissions profile, so gas and electric vehicles (including hydrogen cell vehicles) would have a much lower fixed charge (the annual tax charge) than a standard petrol or diesel vehicle. The advantageous position of the airlines should also be reviewed so that the VAT and appropriate environmental taxes are charged on kerosene and other aviation fuels.

Distortions within the system should be eliminated wherever possible. This means that all forms of subsidy to private and public transport should be phased out. In particular, the substantial tax benefits from owning (or leasing) a company car should be abolished as should access to uncharged for private parking at the workplace or shops.

Parking is the one policy option that is easy to influence in the short term. Pricing for parking, along with controls of spaces and type of parking, strongly affects modal choice. As a general rule, parking occupies valuable space and so should be charged for at the appropriate levels for commercial floor space equivalent within that particular area.

In the longer term, road pricing may provide the most appropriate single measure to internalise costs, but there are substantial political and operational problems with its implementation. Acutt and Dodgson (1996) review fifteen policy instruments aimed at reducing the environmental impacts of transport, eleven of which could affect CO_2 emissions (Table 5.2). They have combined pricing and other measures, but the table does give some indication of the options available in the passenger transport sector.

Apart from reducing travel, these policy options have other impacts on air pollution, traffic congestion and on consumer expenditure, equity across groups and public sector finance.

TABLE 5.2 IMPACTS OF ROAD VEHICLE POLICY MEASURES

Policy	CO_2 emissions	Kilometres by car	Equity implications
1. Fuel taxes	Reduction	Reduce total	Problems in rural areas
2. Variable car excise taxes	Reduction	No direct impact	Improvements
3. Scrappage bounties	Reduction	Small reduction	Improvements
4. Road congestion pricing	Reduction	Reduction in priced area, but may increase elsewhere	Ambiguous
5. Vehicle use restrictions	Reduction	Reduction	Ambiguous
6. Parking charges	Reduction unless diversion a problem	Reduction in priced area, but ambiguous in total	Ambiguous
7. Parking controls	Reduction unless diversion a problem	Reduction in controlled area, but may increase elsewhere	Ambiguous
8. Land use planning	Reduction if policy successful	Reduction if policy successful	Possible long term improvement
9. Traffic calming	Possible increase in total	Reduction in residential areas	Improvements possible
10. Public transport subsidies	Small increase	Reduce total, especially urban	Improvements
11. Road construction	Increase	Increase	Could be negative

Source: Acutt and Dodgson (1996).

Many of the policies, such as congestion pricing and traffic restrictions could be used in larger cities where the provision of an efficient and effective public transport alternative is possible. But some measures might not be so appropriate in more remote areas of Europe where a sparse network with low levels of demand is more in evidence. Here, it may be more efficient to travel around in an 'environmentally clean' car, rather than in a public transport vehicle. This means the policies should be seen as forming parts of a package of measures that can then be applied in appropriate contexts.

Regulation

Physical restraint and demand management measures have been extensively used in cities and elsewhere to allocate space to priority users. Promotion of public transport and limitations on car use are common. Environmental objectives can be achieved through these measures, which would supplement pricing strategies. Included here are access control measures, parking restrictions, speed limits, bus lanes and routes, cycle and foot networks, priority to some vehicles at road intersections, high occupancy vehicle lanes and many other proposals. Underlying these measures is the desire to

reallocate road space to the most appropriate user, whether it is the pedestrian, the cyclists, the public transport user or the car driver. In the longer term, clear zones can be designated in cities were no cars would be allowed to enter. This would include city centres, local centres and residential areas. Pedestrianisation and traffic calming are intermediate steps to the complete banning of all cars from environmentally sensitive locations. Only non-polluting vehicles would be admitted (e.g. electric vehicles and bicycles).

The second role that regulations have is ensuring that high standards are maintained through testing, monitoring and benchmarking. Tough targets can be set on acceptable levels of pollution and energy use, with incentives (and penalties) being set for compliance. These measures would ensure the best available technology is being applied, with vehicles being maintained to a high standard.

Land use planning and the spatial development controls can be used to maintain city compactness so that trip lengths can be reduced. The key components of sustainable development concern the location of new development, which should be of a substantial size (over 25,000) or located near to an existing settlement, so that the existing set of local facilities, jobs etc. can be used. Density and intensity of land use be sufficiently high (over 30 to 40 persons per hectare) so that car use is reduced and more opportunities are available for cycle and walk. Mixed-use developments can also help reduce trip lengths and car dependence, as does development which is located near to public transport interchanges and corridors so that high levels of accessibility can be provided.

It has been demonstrated that about 20 to 30 percent of the variation in travel patterns can be attributed to land use and physical characteristics, and the remaining 70 to 80 percent is accounted for by socio-economic characteristics of people, including their ownership patterns. But these two sets of factors are not independent of each other (Banister and Stead, 1997; Gordon, 1997). In summary, land use factors most conducive to low travel distances include:

- High residential population densities;
- Larger settlement sizes;
- Development within short distances of local and regional employment, services and facilities.

If it is assumed that a new development is built according to more sustainable criteria, perhaps 25 percent travel reductions can be achieved in these areas. Assuming that such savings only apply to new developments, the overall effect on travel demand may be of the order of a 5 to 6 percent reduction (since around 75 percent of the built environment will remain the same between now and 2020). More of a reduction in travel demand may be achieved if new development has synergistic effects on existing developments, such as the provision of local facilities in new development which might also be used by residents of neighbouring existing developments. Land use planning and environment policies can also add to the attractiveness of local areas, which may encourage more locally based activities (such as shopping and leisure), rather than at distant (often out of town) locations.

Information Technology

Information technology may allow workers to spend more of the working week at home, thereby reducing commuting distances. Hall (1995) suggests that telecommuting might reduce total vehicle commuting distance by approximately 3-4 percent, which is consistent with the forecast of Koenig (1996) who suggested a 3 percent substitution of commuting trips by information technology to 2010. Himanen et al. (1996) have calculated an example of the potential impacts of telecommuting and teleconferencing. According to a literature review usually 60 percent of employers want to use telecommuting (refer to Himanen et al., 1996). Supposing that one third of them cannot realise it there remain 40 percent of employers for telecommuting. Usually people prefer to telecommute from one to three days per week. Supposing that everybody stays away from the working place two days per week we find that 16 percent of all work trips would disappear. In Finland that would mean 3 to 4 percent of total car kilometres.

The impact of teleconferencing is much more difficult to assess. Substitution of 10 to 20 percent of business trips by teleconferencing in Finland would result in a 1-3 per cent decrease in car kilometres and 7-15 per cent decrease in regular aviation passenger trips (Himanen et al., 1996).

Various technologies may reduce business travel. These include videoconferencing, telephone conferencing and email. Koenig (1996) suggests a 2 percent reduction in business travel through these technologies. Better global communications, however, might also promote additional travel by increasing the number of global business contacts. The evidence is ambivalent here.

Distance learning is of interest for schools, institutes, universities and enterprises. Virtual classes have been established in order to reduce school transportation and also for security reasons. Interactive multimedia systems are widely used in education in companies and also on factory floors for advisory purposes. They are used instead of specially arranged outside training. The future potential for reducing trips is very difficult to assess when I.T. at the same time changes the way of learning and gives new opportunities for many to participate. School trips form typically less than 10 percent of all trips (Salomon et al, 1993) but up to 20 percent of all car journeys during the morning peak are for education purposes. Most of them are made by walking, cycling or by public transport.

Value added I.T. services like banking, consulting (for example in medicine, law, design, engineering, architecture and computing), marketing and giving product and sales information, interactive media, freelance editors and authors, and municipal services (public libraries, taxing, social services, registrars etc.) are all using the advantages of I.T., with consequences for transport demand. The major influence on trips is among customers, who can get services at home or at their work place via I.T. networks. The future potential for reducing trips is very difficult to assess.

I.T. has potential to in helping elderly and disabled people. In this sector I.T. is combined with medicine and the smart home technology. In addition to the human welfare gained, I.T. in human services lessens the burden of the social sector by

diminishing the need of service visits. In Finland a reduction of 36 percent of travel kilometres for social home aids has been noticed (see Himanen et al 1996). The reduction potential when considering the total travelling is, however, rather modest.

Some key factors in influencing teleshopping include:

- network marketing,
- access to technology
- availability of the interactive multimedia systems
- the interplay of local and global production
- population distribution
- land use policy
- trends in urban and rural living
- goods delivery

Shopping trips are typically 20 percent of all trips, but are usually relatively short – around 10 percent of daily distance (Salomon et al, 1993). A reduction of 20 percent in shopping trips would mean 2 percent decrease in total distance. Koenig (1996) suggests that 2 percent of shopping trips might be substituted by technology by 2010. This might include catalogue, telephone and Internet shopping. There is the potential for technology to replace more shopping trips, but it is likely that many people will still prefer face-to-face shopping.

Home theatres are possible with advances in home-based technology. They might be real substitutes for the cinema, when a silver screen is used. I.T. can attract people from some events (e.g. pubs and horse races) to stay at home, especially when technology is interactive and connects players regionally or globally. The speed of the progress of telematic multimedia with interactive digital television is a key factor. Entertainment has been so far the driving force of I.T. and it must be remembered that people are already spending more time watching television than shopping and many other activities. Leisure trips may be as much as half of daily travel (Salomon et al, 1993), which means that even a modest change in travel distance and/or frequency might have large impact on personal travel.

As technology increases the flexibility and range of choices offered to users, the impact may be to increase interaction and travel rather than reduce it. The behavioural response to all types of tele-activities is not well researched or understood. It is likely that the responses will be extremely variable with subtle adaptations in behaviour, rather than large changes. Access to technology is also very variable, but almost universal use of a wide range of new technologies can be assumed between the present and 2020. Possibilities include the networking of companies, the distribution of company activities to the periphery of Europe, the transformation of traditional high street activities, a greater awareness of environmental issues in business. Companies may encourage employees to work at home by providing the necessary infrastructure and by restricting parking at the workplace.

Life Styles and Attitudes

Various aspects of life styles of attitudes may have significant effects on passenger travel demand. Home location is dependent on lifestyles and attitudes, and influenced by land use policies. Local transport supply, home location, and attitudes to various modes all influence mode choice. The availability of alternative modes to the car can be affected through infrastructure policies. The option for employees to compress their working week may also influence work travel demand. Hall (1995) suggests that this could result in a one percent reduction in total distance travelled.

Kitamura et al. (1997) show that pro-environment or pro-public transport attitudes do not necessarily correspond to fewer trips per person – in fact, these attitudes often correspond with higher than average trip frequencies. These attitudes do correspond, however, with higher proportions of non-motorised modes. They also suggest that attitudes affect travel patterns more strongly and perhaps more directly than land use factors (ibid.). A better understanding of attitudes to travel, the formation of these attitudes and the effect of land use on these attitudes are necessary.

More fundamentally, attitudes need to change towards the car, in particular the right to own and use it, often at less than the full social cost. New forms of ownership are important including car pooling, shared ownership and rental cars. There should be no need to own a car in the city. Public support for restrictions on private ownership would allow communal ownership patterns to evolve. This means that the alternatives must be as good as the private car in providing high-quality door-to-door travel. Car free cities together with environmentally benign public transport, which is demand responsive and fully integrated with the passengers having 100 percent accurate real-time information, is possible in which smart cards and personal communicators are much more readily available.

In the passenger sector, the potential policy measures are available to decouple transport growth from economic growth, and to achieve the challenging environmental objectives set out in the three POSSUM Images.

Examples of passenger transport policy measures are identified in Table 5.3, together with an indication of their impact on the POSSUM targets and the likely timescale of effect.

TABLE 5.3 POSSIBLE PASSENGER TRANSPORT POLICY MEASURES

Measure	Strategy/ Sub-strategy	Impact/ Timescale
Life-style oriented:		
• Driver Information Systems	Route planning	+ medium-term
• Commuter Planning	Route planning Mode choice	+ medium-term
• Travel Information	Route planning Mode choice	+ medium-term
• Traffic Calming	Vehicle speed Mode choice	+ medium-term

Measure	Strategy/ Sub-strategy	Impact/ Timescale
• Teleworking / Telecommuting / Teleconferencing	Reducing the need to travel	+ medium-term
• Teleshopping / Telebanking / Telecottages	Reducing the need to travel	+ medium-term
• Telematics / Informatics available locally	Reducing the need to travel	+ medium-term
• Multipurpose personal communicators	Route planning Mode choice Reducing the need to travel	++ long-term
• Transport chaining awareness	Route planning	+ medium-term
Market oriented:		
• Congestion Pricing	Route planning Mode choice	++ medium-term
• Fuel Tax	Vehicle purchase decisions Mode choice	+++ short-term
• Vehicle Purchase Tax	Vehicle purchase decisions Mode choice	++ short-term
• Car Ownership Tax	Vehicle purchase decisions Mode choice	++ short-term
• Parking tariffs	Vehicle purchase decisions Mode choice	+ medium-term
• Excise for aircraft fuels	Mode choice	++ short-term
• Airport charges	Mode choice	++ short-term
• Tradeable Mobility Credits	Vehicle purchase decisions Mode choice	++ medium-term
• CO_2 tax	Vehicle purchase decisions Mode choice	+++ medium-term
• Taxes and feebates based on fuel consumption and weight	Vehicle purchase decisions Mode choice	++ medium-term
• Scrappage bonuses and tax increases	Vehicle purchase decisions Mode choice	+ medium-term
Regulation:		
• Land use planning	Route planning Mode choice	++ long-term
• Parking Restrictions/Control	Mode choice	++ medium-term
• Access Control	Route planning Mode choice	++ medium-term
Public services:		
• Advanced Traffic Management Systems	Route planning	+ medium-term
• Priorities for bus, tram & High Occupancy Vehicles (HOVs)	Mode choice	+ medium-term
• Segregated rights of way for transit	Vehicle purchase decisions Mode choice	+ medium-term
• Cycle priority & roadspace	Vehicle purchase decisions Mode choice	+ medium-term
• Pedestrian priority & roadspace	Vehicle purchase decisions Mode choice	+ medium-term
• Lower speed limits & enforcement	Vehicle purchase decisions Route planning Mode choice	+ medium-term

Measure	Strategy/ Sub-strategy	Impact/ Timescale
• Fare integration & Schedule coordination	Route planning Mode choice	+ medium-term
• Increase rail capacity and speed	Vehicle purchase decisions Route planning Mode choice	+ long-term

5.3.3 The Role of Freight Transport Policies

Four key factors influence the elements of freight transport growth:
- the material intensity of the economy,
- the spatial structure of production and consumption,
- the handling requirements of goods,
- the organisation of transport.

In order to influence these factors three basic strategies can be identified:
- Dematerialisation of the economy,
- Reduction of the spatial range of material flows,
- Optimisation of transport organisation

Most research up to now has concentrated on the last strategy. This section mainly deals with the two previous ones which both are not only linked to material intensity of the economy and the spatial structure, but also to handling requirements and the organisation of transport.
For each of these strategies several sub-strategies will be identified below.

Dematerialisation of the economy

A basic strategy for the 'dematerialisation of the economy' can rely on a series of interesting trends. The following sub-strategies can be identified:
- substitution of material products by services
- increased durability
- miniaturisation

In the last decades a large number of (often expensive) services have been substituted by industrial products (e.g. washing machines, do-it-yourself tools, private cars) which have become affordable for a large public. However, since some years a reverse trend is growing. Leasing equipment of all kinds has become attractive, new kinds of full-service contracts in the fields of heating and cooling, transport, professional clothing have emerged, speeded up with the boom of outsourcing. More efficient use of more durable goods and equipment, modularity concepts etc. are the consequence. 'Post-material' lifestyles, relying less on the visible ownership of all kinds of equipment, are gaining pace.

Also the durability of goods is influenced by very contradictory trends. In private consumption in some fields more expensive high quality is gaining terrain over short fashion cycles. The outsourcing of services makes more durable goods economically

interesting. (e.g. several car producers are planning more durable cars for the rental and leasing business). Miniaturisation is a strong trend in many fields. Especially information technologies have strongly favoured this tendency. Generally, a more mobile society prefers less heavy equipment. Trends in these three fields can be enhanced by different kinds of policy measures belonging to all basic policy orientations.

Lifestyle-oriented policies can have a major impact on the substitution of goods by services. They can comprise all kinds of awareness-raising and advertising less material oriented life-styles. They can also - and that may be most important - encourage such lifestyles by systematically removing disadvantages that persist in tax systems, different kinds of regulations, accessibility of infrastructure, or availability of public services. Durability can also to some extent be influenced through such policies. For miniaturisation it is more difficult.

Market-oriented policies can support all three sub-strategies for dematerialisation. E.g. waste policies which establish a responsibility of producers for the whole product life cycle lead to increased durability and replacement of material consumption by services (e.g. re-use of packaging, modularization of products). Public procurement can utilise its considerable purchasing power for developing markets in this direction.

Regulation-oriented policies can contribute to dematerialisation by replacing old rules. E.g. lighter cars could be introduced if new categories for low-speed areas were created that do not have to meet safety standards for high-speed roads. Changing old standards in the construction industry could save material. Moreover, review of regulations is important in conjunction with life-style oriented policies. However, durability or miniaturisation cannot directly be imposed by regulations.

Public infrastructure/ services may enhance trends in this direction considerably. Public infrastructure expenditures can be shifted from roads to telecommunication. Public Research & Development programs can set other priorities. Subsidies in the structural policies could set some priorities in this direction.

Managing the spatial range of the circulation of material

Reducing the spatial range of the circulation of material is an even more complicated task. The spatial structure of production and consumption is influenced by a large number of factors whose interrelationships are not well known. The transport impacts of business or political decisions are in most cases known to a very limited extent since information is missing.
We can broadly distinguish four sub-strategies:

- Enhancement of regional consumer markets
- Strengthening of regional production networks
- ‘Glocalisation’ of large companies
- Slowing down ‘deterritorialisation’

The strengthening of regional consumer markets is mainly a life-style and marketing issue, on the other hand companies can also be more directly encouraged to produce near to their markets (e.g. by public purchasing). Food and building, the fields in

which such regional markets can most easily be enhanced, make up for a considerable share of the total transport market. Information on the origin of products is an essential prerequisite for such a strategy. Today, such endeavours are often considered to be in contradiction with the internal market. However, in a sense of subsidiarity, enhancing regional markets while maintaining European openness can avoid a narrow regional clientele.

Regional production networks have been important motors of economic growth in the last decades. Industrial districts in which a large series of SMEs co-operate intensely, such as the textile and furniture industry in central Italy or the machine industry in Baden-Württemberg, have been described extensively as most innovative production structures in recent years. Large companies have learned to make use of similar structures by regional sourcing. On the procurement side such spatial production patterns produce less transport than global sourcing concepts. However, on the customer side they are mostly addressing global or European markets.

There are no simple recipes for reducing transport distances in business decision-making since there is a large number of influencing factors and trade-offs, and each business is only one link in a longer chain. Mostly, however, information about the transport impact of decisions is nearly completely lacking. Large potentials for reducing transport are not discovered and used because adequate tools are lacking. Despite the fact that the cost of transportation is of minor influence on business decisions, readily available information about possible, even minor, savings could have a considerable influence, as endeavours for systematically improving logistics within large companies have shown.

The ‘glocalisation’ of large companies follows a similar logic. In the information society material flows loose their importance for holding together large companies. It is the management of information and knowledge that counts. Material flows therefore can be decentralised without jeopardising the cohesion and the essential functions of a European or global company. Impressing examples can be found even in the car industry. (e.g. Polski Fiat).

In the past decades a series of big steps in the liberalisation of trade as well as technological changes have strongly loosened the linkage between material production and a specific territory. The internal market, the GATT/WTO agreements, enormous improvements in telecommunication, strongly decreasing relative costs of transport also largely due to liberalisation, have resulted in larger markets and a steep increase in freight transport. It might be asked whether these trends will continue in such a pace in the future. The EURO may further push intra-European trade and GATT/WTO regulations have not yet fully developed their impact on international markets. However, it seems that the major steps have been accomplished and that further liberalisation might proceed a more moderated pace and may more cautiously try not to push ‘deterritorialisation’ much further.

Life-style policies may be of outmost importance for enhancing regional consumer markets. Providing pertinent information is essential for all sub-strategies. To establish a system by which the ‘transport content’ of all kinds of products is made transparent through a kind of ‘Transport Chain Assessment’ would be essential for

considering transport issues in business and policy decisions. These policies could therefore contribute to the sub-strategies 1, 2 and 3.

Market-oriented policies surely would include all kinds of policies that increase the cost of transport. However, the impact of rising transport costs in spatial patterns of production and consumption would probably be rather limited unless more information is available. In the food sector, transport makes up approximately 8 percent of the total cost, for other products it is much less. Specific incentives for the development of regional markets and typical regional products are conceivable (e.g. through public purchasing). Also, specific forms of encouraging the formation of regional production networks are possible. Today, support by the structural funds is mainly founded on the 'export-base' theory and requires that companies sell beyond regional markets. Therefore market-oriented instruments are available for all sub-strategies but the last one.

Regulation-oriented polices could contribute in a series of details, but can only shape the general framework (e.g. more differentiated rules for public procurement would be needed). A more regional orientation of the Common Agricultural Policy (CAP) would be very important. To require that transport impact assessments are made for all major business and policy decisions could contribute enormously.

Public infrastructure/ services policies could give an important contribution to all sub-strategies. Considerable subsidies for road infrastructure in most countries in the last decades have contributed to increasing road transport speeds and reduced transport costs. Shifting these contributions to other would comply with the sustainability target of efficiency and allow for kick-off investments in other kinds of infrastructure and services such as community development, regional development agencies aimed at building regional networks etc.

Proposing to retard the considerable growth in freight transport often creates fears that this would have negative effects on the economy and the labour market. Analysis shows that there are considerable countervailing trends and that policies aimed at decoupling freight transport from economic growth would mainly mean to accelerate structural change in a certain direction. This change creates winners and losers, acceleration may therefore increase conflicts. The losers represent the old, ripe material-oriented industries, the protagonists of the era of mass production, who still have considerable influence and power. The winners are linked to the rising service and information based industries. The potential of decoupling therefore is mainly limited by political and not by economic difficulties.

The potential of decoupling is in principle very large. However, estimates are very difficult, since knowledge and information is limited in these fields. On the basis of rough guesses for the different sub-strategies one can estimate that the overall potential for decoupling freight transport growth from economic growth could be estimated at 35 to 50 percent compared to present trends. That means, that instead of growing by 80 percent between 1995 and 2020 freight transport might remain at levels similar to those in 1995 if appropriate measures are taken.

Examples of freight transport policy measures are identified in Table 5.4, together with an indication of their impact on the POSSUM targets and the likely timescale of effect.

TABLE 5.4 POSSIBLE FREIGHT TRANSPORT POLICY MEASURES

Measure	Strategy/ Sub-strategy	Impact/ Timescale
Life-style oriented:		
• information systems	spatial patterns	+++
• transport content declaration TCD	dematerialisation	medium-term
• transport chain assessment TCA		
• development of regional markets for agricultural products: marketing	spatial patterns	+++ medium-term
• regional origin declaration	spatial patterns	++ medium-term
• encourage and facilitate car-less life-styles	dematerialisation	+++ medium-term
• facilitate car rental and car sharing	dematerialisation	+ medium-term
Market-oriented:		
• full life-cycle responsibility of producers for their products	dematerialisation	+++ medium-term
• ecological tax reform charging resource use instead of labour	dematerialisation/ service	+++ long-term
• increase taxes and tolls for freight transport	spatial patterns	++ short-term
• use public procurement for regional networking and creation of regional markets	spatial patterns	++ long-term
Regulation-oriented:		
• new category for light cars	dematerialisation / miniaturisation	++ short-term
• concentrate transport-intensive industry along existing infrastructure	spatial patterns	+ long-term
Public infrastructure / services:		
• regional networking agencies	spatial patterns	++ long-term
• shifting structural fund priorities	spatial patterns dematerialisation	++ long-term
• Reduced subsidies for road infrastructure	spatial patterns dematerialisation	++ medium-term
• regional networking agencies	spatial patterns	++ long-term

5.4.4 The Role of Organisational Change

This section discusses appropriate policy instruments to reduce the negative externalities of mobility and transport through the organisation of transport markets and infrastructure. First, the issues concerning infrastructure and the organisation of transport markets will be described. Next, possible policy measures, affecting infrastructure and the organisational aspects of transport markets, will be placed under the headings of the four different policy strategy directions: market based instruments, regulation, information technology and lifestyle and attitudes.

Infrastructure and Transport Markets

Infrastructure is the set of physical facilities that allow the movement of transport, especially immobile capital. The organisation of the transport market has in all countries in the past been the privilege of the public sector, with some involvement of the private sector. Demand was uncritically accepted as given and transport planning was not strongly oriented towards changing an ever increasing rise in private car use. However, the transportation scene has changed drastically. Changes in lifestyles and leisure, globalisation, technology progress, development of telecommunication etc. have lead to an increasing dependency on transport and an increasing mobility. At the same time, policy makers are more and more confronted with the externalities and problems of mobility like environmental issues, congestion and social exclusion. Two major approaches in defence of a public policy interference with the transport sector may be distinguished: the public goods argument (equity considerations and monopolisation objectives are of paramount importance) and the externalities (both positive and negative) argument (OECD/ECMT, 1995).

In recent years we have witnessed a process of devolution reflected in privatisation, deregulation and decentralisation. We also see new forms of transport operation, such as outsourcing and franchising. Furthermore, we observe also that physical transport in a strict sense is only used to lay down the basis of added value operation, where profits are generated in complementary facilities (shopping facilities, cultural amenities). For the future it seems likely that this process of devolution will continue for quite some time. Many countries are just at the beginning of this process and take the UK or New Zealand as a successful example. Thus the future organisation of the transport market provokes the question on institutional regimes for different modalities, with the aim to generate added value from transport and related activities. In addition to an involvement of the private sector, we also observe a trend toward the supply of packages of transport related services (e.g. the logistic operator in freight transport, the tourist operator in tourism).

Negative externalities caused by transport may be affected through the organisation of transport markets and infrastructure. In other words, the supply of transport can affect the demand for transport in general and the demand for certain modes in particular. Policy measures, affecting the organisation of transport markets and infrastructure, should aim at stimulating the use of alternative modes, reducing car and truck use and stimulating the use of capacity of both infrastructure and transport means to a fuller extent.

Passenger transport is more and more tuned to individual needs. The segment of supply that does not function through companies is the private car. The supply is made up of the infrastructure and the individual car. The infrastructure is generally public and often free. The service is, however, provided by the driver itself. The low elasticity demonstrated to taxes and tolls and the relevant elasticity demonstrated in respect of optional income, confirms the high value that the user gives to this form of transport.

Also in freight transport the requirements are more and more in favour of motorised transport. As the average value/weight ratio of goods increases, it becomes economical to utilise the faster modes (road, air) in combination with themselves. Truck combinations or trucks with door-to-door transport are becoming the most feasible solution for much of Europe. The ongoing transformation of production and distribution systems among firms strives to achieve just in time methods, economies of scope and an integrated approach to their economic activities. Future goods transport requires important quality factors. Punctuality and reliability are very important as storage is more or less eliminated in the logistical systems. As average consignment sizes will be reduced, frequency plays a decisive role.

The changes in passenger and freight transport, as described above, demonstrate the growing importance of the improvement of transition possibilities and the improvement of alternative modes (including new modes). In order to meet the requirements of both passenger and freight transport, transport has to be quick, reliable and door to door. So, alternative modes have to be improved and transition has to be possible, cheap and fast. Different strategies are possible:

- Changing ownership structure
- New and upgraded infrastructure
- Integration of different systems
- Land use planning

Possible policy strategies affecting the organisation of transport markets and infrastructure will now be placed under the headings of the four different policy directions, market based instruments, regulation, information technology and life style/attitudes. Infrastructure and the organisation of transport markets mainly concern the supply side, which means that most of the policy measures should be categorised as regulatory measures. Market based instruments play a smaller role and a life style orientation is hardly relevant here.

Market Based Instruments

High levels of risk and uncertainty mean that the private sector has been reluctant to get involved in transport infrastructure investments, despite having the resources available. Arguments in favour of private sector involvement are that the market forces firms to provide the best service at the lowest cost, they will perform better and enhance consumer welfare more than either regulated firms or government owned companies. However, the public sector still has a key role to play concerning accessibility issues, negative externalities, interaction with other sectors or national and international implications. All these roles are essentially passive and therefore, the more important position for the public sector must be to promote a partnership between the public and private sectors. It is in partnership between the private and public sectors where most potential lies. There are several different potential approaches. These possibilities are presented in Table 5.5.

TABLE 5.5 NEW PARTNERSHIP POSSIBILITIES

	PARTNERSHIP POSSIBILITIES

FUNCTION	TRADITIONAL MODEL	1	2	3	PRIVATE SECTOR MODEL
Planning	Public	Public	Public	Public	Private
Design	Public	Public	Private	Private	Private
Construction	Private	Private	Private	Private	Private
Operation	Public	Private	Private	Private	Private
Ownership	Public	Public	Public	Private	Private
Finance	Public	Joint	Joint	Private	Private

Source: Banister et. al. , 1995

Different systems of tendering or franchising can be classified. Total franchises include both the operation and provision of necessary infrastructure. This means that the franchisee is also responsible for capital costs. Operations franchises exist where the franchisee operates the system, but with rolling stock and infrastructure provided by the franchiser, normally a public authority responsible for the planning and financing of public transport. In franchising or tendering systems, companies will be competing for the market instead of in the market. Authorities can control fares and plan an integrated set of services with cross-subsidy, while competition for tenders or franchisees would provide the required pressure on costs. The use of various forms of franchising or tendering will be an effective means of solving the need for further efficiency measures in public transport operations without choosing the most radical alternative: full deregulation.

Changing the regulatory regime for public transport and rail, like different forms of franchising, can influence the performance of the service. In public transport, separation of controlling, maintenance and exploitation will achieve a more effective business operation. It will improve the quality, flexibility and market orientation of the internal business operation through competition and innovation. Competition will result in more efficiency and more demand orientated service. So, by changing ownership structure, a more demand-oriented service can be provided. Basically, this means that prices will reflect the costs of transport to a larger extent and the service will be demand orientated.

Important goal is to improve the performance of public transport. But, in order to guarantee transition possibilities, co-ordination between different exploiters is needed. Also for rail, co-ordination can realise good linkages between different transition points. The danger of privatising (parts of) public transport lies in the physical and social accessibility of tracks. Less profitable tracks need to be exploited to guarantee accessibility and public transport should not be too expensive which would exclude lower income classes.

In order to internalise the external costs of driving road pricing, congestion pricing and parking pricing may be implemented. This will increase the costs of driving, especially when congestion occurs. In order to reach the goal of reducing the use of car these measures would have to be combined with a decrease in the costs of other modalities, especially public transport for passenger transport and rail for freight transport. In combination with pricing, a more demand oriented service might reduce car and truck use.

Changes in the tax system could also influence transport users. In this way, alternatives to traditional car use could be stimulated, like car pooling and car renting. Furthermore, in both freight and passenger transport the use of cleaner vehicles could be rewarded.

Regulation

Restraints and prohibitive measures are typical regulatory measures. Speed limits on roads, public transport priority in cities, access rules in cities, goods traffic constraints, parking restrictions and increasing rights and space for bicycles and pedestrians are all examples of regulatory measures. Also, fare integration and schedule co-ordination in public transport, standards and procedures on inspection and maintenance, standards for emissions, noise and safety are included here. Through these measures, an important part of traffic can be regulated. Important supplementary measures in the form of pricing and improving public transport would have to be implemented as well. Alternatives for the more environmentally polluting transport means should be available. This would also incorporate building distribution centres outside the cities and home delivery services in the city for the distribution of goods. Alternatives in passenger transport could be improved by creating transition points outside of the city (park and ride) and good and fast public transport in the cities.

Through infrastructure policies, the availability of alternative modes to the car can be affected. Building new infrastructure for environmentally friendly modes (new vehicles, bicycles, public transport) will improve the performance of these modes. The high speed train, underground transport means and other new innovations may be introduced if infrastructure is provided, and if introduction is supported by creation of niche markets and made competitive. If new types of vehicles or transportation systems will be able to penetrate the market despite a higher price than established systems, the existence of niche markets for these artefacts may be important. Systems with a potential to improve its performance and reduce its costs will then eventually expand outside the niche. If there are no natural niches, public authorities may help to create them, e.g. by defining environmental zones in urban areas. The expensive development and the effort from the industry to come to a large scale production have to be supported by the (European) government. The industry has to be willing to develop new vehicles and transport systems. Large automobile companies, who have invested to a large extent in production means, will have difficulties supporting this development, except when opportunities in the market are clearly present. Development of new vehicles and transport systems therefore offers chances to companies outside the automobile industry, especially in smaller markets (niche markets). Through investing, subsidising and taxes the development of new vehicles and systems has to be supported. In addition, niche markets, when not existing, have to be created.

When new vehicles and new infrastructure are introduced or when ‘old’ systems are improved, the demand for transport will increase. So, in order to reduce mobility and decrease the external effects, at the same time other measures need to be implemented to ensure that this increase will not occur. The main objective has to be a shift in transport demand and not an increase.

If we look at transport infrastructure a distinction has to be made between the different modes. Building more and more roads has increased the ability for people to travel by car. It has not reduced congestion in peak hours to a large extent. Available road space is quickly filled. Even regions with the most extensive road networks have high congestion levels (OECD/ECMT 1995). So building new infrastructure is not the way to solve congestion problems. Besides, an extensive network of roads would change cities beyond recognition. New and improved infrastructure for bicycle and pedestrians will, to a small extent, reduce car use (on shorter distances) and will facilitate transfer on public transport. Concerning railways, more tracks can increase the accessibility of certain regions and therefore it may reduce car use at certain routes.

Integration of transport networks starts with building appropriate infrastructure, upgrading existing infrastructure and ensure appropriate use of this infrastructure. For road transport, the ability to use the entire road network requires little more than the absence of restrictive legislation. For rail, the organisational issues are far more severe. Road transport generally is too cheap, so measures are needed which will raise its cost. For international rail transport, the need is to find an organisational form that offers the same degree of flexibility in marketing as exists for roads. In order to realise this degree of flexibility in marketing, co-ordination and co-operation between different European rail companies is needed. The resulting integration of the network and fast transhipment will increase the efficiency of rail. Concerning rail infrastructure, the major problems of the European network are the non-standard track different power systems and different signalling and communication systems. Harmonisation of the railways would increase the efficiency and the profitability. For planning new tracks land use conflicts and noise have to be considered.

In order to improve the possibilities for door-to-door transport with other means than just motorised transport, it is important that transition between different transport means for both passenger and freight transport are facilitated. In other words, the possibilities for intermodal transport should be increased. Intermodalities between trucks and planes, or cars and planes, already exist. However, there is close competition between rail, car, bus and the lorry. Over short distances, the railways are capable of competing against air travel only on medium distances by offering high-speed rail services. Favouring intermodality means favouring the railways with organisation, investments and regulation, above and beyond the subsidies that already sustain this mode.

Improving intermodality and creation of transition points play a key role in the regulation measures. Park and ride, stimulation of car pooling, bicycle facilities near stations are included here. For freight transport transition possibilities between ship, rail and truck are important to realise. The integration and harmonisation of railways in Europe, co-operation between different rail companies and the creation of terminals for transhipment are included here. Also stimulating the location of industries near water and rail play a role in this (land use planning). Besides, land use planning can ensure the location of new developments near existing areas of activity in order to guarantee the compactness. In this way, mobility can be reduced.

Information Technology

New developments in the communication and information technology can have an enormous impact on the organisation of transport markets. These developments can affect traffic management and logistical processes in freight transport.

In traffic management we already know the traffic lights and traffic signs. A fairly new instrument is providing information. Information systems can have an enormous impact on the organisation of transport markets. Driver information systems can ensure a more efficient use of existing infrastructure and an optimal use of transport means. Information systems can give information concerning parking space and congestion and on waiting times in public transport. Information can change choice behaviour of transport users and it will improve the quality of travelling and the reliability of public transport. The problem now is that every car can use the infrastructure at any chosen moment. This results in chaotic, unorganised traffic. Information systems can change this. Expectations are that future traffic information systems may lead to a 10 percent reduction in congestion (Bovy, 1995). Another possible application of I.T. systems is a system for automatic road pricing.

In logistics, information and communication technology plays a large role. Due to the developments in technology, production processes have changed and logistics are more and more important. Developments in information and communication technologies influence transport flows because it affects shipments sizes of intermediate and final products, thus requiring a higher effort for economising transport through consolidation in time and space. As the level of flexibility in production and the required techniques of logistical organisation emerge, the necessity for vertical and horizontal co-ordination within the logistical chain will become greater and thus require the transportation sector to cope with a higher standard of service, reliability and performance. This can only be achieved through efficient and high quality information regarding the logistical processes which will effect the choice of location of parts of the logistical chain, the organisation of distribution networks, the frequency of shipments and the utilisation of transport equipment and infrastructure.

Lifestyles and Attitudes

Policies, based on information, could alter attitudes towards environmentally unfriendly modes. The awareness could be increased, which would eventually lead to a changed life style concerning transport use. But, these policies should be supplemented with other measures, which would support the messages given by the public information. Also, life styles and attitudes concerning home and business location could be influenced by land use planning. The quality of the public transport system and other supply of transport and infrastructure could also affect attitudes.

Changing the organisation of the transport market influences life styles and attitudes concerning mode choice. Through infrastructure policies, the availability of alternative modes to car and truck can be affected. The creation of possibilities for transition and improving door-to-door transport could change the decision on the location of firms and houses. Besides, a marketing strategy to promote a certain mode among a specific

target group might have such an impact that this target group will change their attitude towards this specific mode. Technological standards, increases in fuel costs and ownership taxes may change attitudes towards car ownership and the use of new environmentally friendly vehicles.

Concerning infrastructure and the organisation of transport markets, many policy measures are available. Often, an overlap exists with the other potential sections. But, the organisation of transport markets and infrastructure mainly concerns freight management, traffic management and mode management measures. It is quite difficult to give an estimation of the potential reduction in mobility due to these measures, since they affect many actors. Changing the organisation of transport markets will definitely be a structural change with long-term effects.

5.4 POLICY MEASURES

Having identified the hotspots and the potential contribution of different policy measures to the achievement of the POSSUM targets, a comprehensive list of policy measures is constructed in this section. The influence of these measures on each of the hotspots is indicated by means of a matrix (Table 5.6). The matrix is also used to identify:

- The influence of each measure on technology, passenger transport, freight transport and transport organisation;
- The extent to which each of the policy measures might contribute to the three broad types of POSSUM targets (environmental protection, regional development and economic efficiency);
- The policy orientation of each measure (as a way of identifying which policy measures are consistent with each Image of the future); and
- The timescale of effect of the policy measures – whether impacts are likely to be short, medium or long-term.

TABLE 5.6 POTENTIAL POLICY MEASURES FOR INCLUSION IN POLICY PACKAGES AND PATHS

POLICY MEASURES	INFLUENCE ON				POSSUM TARGETS			'HOTSPOTS'					POLICY ORIENTATION				TIMESCALE OF EFFECTS		
	TECHNOLOGY	PASSENGER	FREIGHT	ORGANISATION	ECONOMIC	ENVIRONMENTAL	REGIONAL	GLOBAL	URBAN	FREIGHT	FUTURE	AIR TRANS	LIFESTYLE	MARKET	REGULATION	PUBLIC	SHORT-TERM	MEDIUM-TERM	LONG-TERM
1. Land-Use Planning																			
• Integrated planning		*	*		*	*	*	*	*	*	*		*		*				*
• Regional development policies		*	*			*	*	*	*	*					*				*
• Zoning regulations (single use, mixed use, densities, etc.)		*	*		*	*	*	*	*	*	*				*				*
• Compact mixed land use		*	*		*	*		*	*	*	*		*		*				*
• Development at public & intermodal nodes		*	*		*	*		*	*	*	*				*				*
• Access to transport services		*	*		*	*	*	*	*	*	*				*	*			*
• Pedestrian & cycle friendly developments		*			*	*		*	*		*		*		*				*
• Designated areas for control over the pattern of development		*	*		*	*	*	*	*						*				*
• Fiscal incentives for relocation in designated areas		*	*		*	*	*	*	*					*					*
• Relocation of activities		*	*		*	*	*	*	*	*	*				*				*
• Green belts		*	*				*								*				*
• Regeneration of decaying areas (city centres, inner-city areas)		*	*		*	*	*	*	*	*	*		*	*	*				*
• Improvements to housing and neighbourhood quality/facilities		*	*		*	*	*	*	*	*			*	*					*
• Parking standards for new developments		*				*		*	*	*	*				*				*

TABLE 5.6 POTENTIAL POLICY MEASURES FOR INCLUSION IN POLICY PACKAGES AND PATHS [CONTINUED]

POLICY MEASURES	INFLUENCE ON				POSSUM TARGETS			'HOTSPOTS'					POLICY ORIENTATION				TIMESCALE OF EFFECTS		
	TECHNOLOGY	PASSENGER	FREIGHT	ORGANISATION	ECONOMIC	ENVIRONMENTAL	REGIONAL	GLOBAL	URBAN	FREIGHT	FUTURE	AIRTANS	LIFESTYLE	MARKET	REGULATORY	PUBLIC	SHORT-TERM	MEDIUM-TERM	LONG-TERM
1. Pricing / Taxation																			
• Road tolls for freight			*		*	*		*	*	*				*				*	
• Congestion pricing	*	*	*		*	*		*	*	*	*			*				*	
• Fuel tax	*	*	*		*	*		*	*	*	*			*				*	
• Vehicle Purchase Tax		*	*		*	*		*	*	*	*			*			*		
• Car ownership tax		*	*		*	*		*	*	*	*			*			*		
• Parking tariffs		*			*	*		*	*	*	*			*			*		
• Excise for aircraft fuels		*	*		*	*	-	*	*	*	*			*			*		
• Airport charges		*	*		*	*	-	*	*		*			*			*		
• Restrictions																			
• Parking restrictions/control		*	*		*	*		*	*	*	*				*			*	
• Entry prohibitions/access control/environmental zones	*	*	*		*	*		*	*	*	*				*			*	
• Goods traffic restraint			*		*	*		*	*	*	*				*			*	
• Road capacity restraint/throttling		*			*	*		*	*	*	*				*			*	
• Traffic management																			
• Advanced traffic management systems		*	*		*					*						*		*	
• Driver information systems		*	*		*					*	*					*		*	
• Bypassing sensitive areas		*	*			*	-		*		*				*		*		
• Priorities for bus, tram & high occupancy vehicles (HOVs)		*			*	*		*	*						*			*	
• Segregated rights of way for transit		*			*	*		*	*						*			*	
• Commuter planning		*			*	*		*	*		*				*			*	
• Travel information		*			*	*		*	*	*	*					*		*	
• Traffic calming		*			*	*		*	*						*			*	
• Cycle priority & roadspace		*			*	*		*	*						*			*	
• Pedestrian priority & roadspace		*			*	*			*						*			*	
• Lower speed limits & enforcement		*			*	*			*						*		*		
• Casualty reduction targets	*	*			*	*			*						*			*	

TABLE 5.6 POTENTIAL POLICY MEASURES FOR INCLUSION IN POLICY PACKAGES AND PATHS [CONTINUED]

POLICY MEASURES	INFLUENCE ON				POSSUM TARGETS			'HOTSPOTS'					POLICY ORIENTATION				TIMESCALE OF EFFECTS		
	TECHNOLOGY	PASSENGER	FREIGHT	ORGANISATION	ECONOMIC	ENVIRONMENTAL	REGIONAL	GLOBAL	URBAN	FREIGHT	FUTURE	AIR TRANS	LIFESTYLE	MARKET	REGULATORY	PUBLIC	SHORT-TERM	MEDIUM-TERM	LONG-TERM
1. Infrastructure / Mode Management																			
• Strategic environment assessment of plans and programmes				*		*		*	*	*					*			*	
• Fiscal & regulatory framework and investment for the promotion of environmentally friendly transport modes for passenger and freight transport		*			*	*		*	*	*				*	*			*	
• Intermodality		*	*		*	*		*	*	*	*		*		*	*		*	
• Park & ride		*			*	*		*	*		*		*		*	*		*	
• Improvement of public transport		*			*	*		*	*		*			*	*	*		*	
• Fare integration & schedule coordination		*			*	*		*	*		*				*	*		*	
• Traveller information systems		*			*	*		*	*		*					*		*	
• Deregulation				*	*										*	*		*	
• Subsidies				*		*		*	*		*			*		*		*	
• Concessions		*				*		*	*		*			*		*		*	
• Investment in TENs		*	*			*	*			*	*			*		*		*	
• Increase rail capacity and speed		*	*		*	*	*			*	*					*		*	
• Harmonisation of rail		*	*		*	*	*			*	*				*	*		*	
• New rail freight tracks			*			*	*				*					*		*	

TABLE 5.6 POTENTIAL POLICY MEASURES FOR INCLUSION IN POLICY PACKAGES AND PATHS [CONTINUED]

POLICY MEASURES	INFLUENCE ON				POSSUM TARGETS			'HOTSPOTS'					POLICY ORIENTATION				TIMESCALE OF EFFECTS		
	TECHNOLOGY	PASSENGER	FREIGHT	ORGANISATIONAL	ECONOMIC	ENVIRONMENTAL	REGIONAL	GLOBAL	URBAN	FREIGHT	FUTURE	AIR TRANSPORT	LIFESTYLE	MARKET	REGULATION	PUBLIC	SHORT-TERM	MEDIUM-TERM	LONG-TERM
1. Technical Improvements																			
• Standards for emissions, noise and safety	*					*		*	*		*				*			*	
• Fuel quality standards and alternative fuels	*					*		*	*		*				*			*	
• Efficiency improvement of materials and energy (with a factor four)	*				*	*		*	*					*	*			*	
• Dematerialisation of products/miniaturisation	*		*		*	*		*	*	*					*			*	
• Standards and procedures on inspection and maintenance - test cycles	*			*	*	*		*	*						*			*	
• Enforcement and monitoring	*				*	*		*	*						*		*		
• Research, dissemination and practical application	*				*	*		*	*	*	*				*			*	
2. Telecommunications and Technology																			
• Teleworking / telecommuting / teleconferencing	*	*			*	*	*	*	*				*					*	
• Teleshopping / telebanking / telecottages	*	*	*		*	*	*	*	*	*			*					*	
• Telematics / informatics available locally	*	*			*	*	*	*	*	*			*					*	
• Infrastructure technology	*	*	*		*		*	*	*	*				*				*	
• Vehicle technology - more efficient and/or smaller speed vehicles	*				*	*		*	*					*				*	
• Multipurpose personal communicators	*	*			*	*	*	*	*	*			*					*	
3. Behavioural Patterns																			
• Activity patterns - leisure		*				*		*	*				*				*		
• Changing lifestyle (e.g. not travelling at weekends)		*				*		*	*				*				*		
• Home location		*				*		*	*				*	*			*		
• Job location		*				*		*	*				*	*			*		
• Promotion of local destinations		*				*		*	*				*				*		

TABLE 5.6 POTENTIAL POLICY MEASURES FOR INCLUSION IN POLICY PACKAGES AND PATHS [CONTINUED]

POLICY MEASURES	INFLUENCE ON				POSSUM TARGETS			'HOTSPOTS'					POLICY ORIENTATION				TIMESCALE OF EFFECTS		
	TECHNOLOGY	PASSENGER	FREIGHT	ORGANISATION	ECONOMIC	ENVIRONMENTAL	REGIONAL	GLOBAL	URBAN	FREIGHT	FUTURE	AIRTRANSPORT	LIFESTYLE	MARKET	REGULATION	PUBLIC	SHORT	MEDIUM	LONG
1. Freight Management																			
• Logistic management of firms - increase load factors			*		*	*		*	*	*				*				*	
• Home delivery of goods/services			*		*	*		*	*	*				*				*	
• Freight distribution			*		*	*	*	*	*	*				*				*	
2. Information and Public Awareness																			
• Campaigns for the promotion of environmentally friendly modes		*			*	*		*	*	*	*		*					*	
• Campaigns for reducing private transport externalities		*			*	*		*	*	*	*		*					*	
• Increase awareness of public transport services		*			*	*		*	*		*		*					*	
• Transport chaining awareness		*			*	*		*	*	*			*					*	
• Eco-labelling of vehicles	*				*	*		*	*		*		*					*	
3. General Economic Policies																			
• Ecological tax reform	*			*	*	*	*	*	*	*	*		*	*				*	
• Tradeable mobility credits		*	*		*	*	-	*	*	*	*		*	*				*	
• CO_2 tax	*	*	*		*	*	-	*	*	*	*			*				*	
• Taxes and feebates based on fuel consumption and weight	*	*	*		*	*		*	*	*	*			*				*	
• Scrappage bonuses and tax increases	*	*	*		*	*		*	*	*	*			*				*	

5.5 POLICY PACKAGES

Policy packages are developed by combining sets of policy measures that are likely to work well together (i.e. which create synergies). Each of the policy package is designed to relate to a specific Image of the Future. Policy paths in the POSSUM project are combinations of policy packages that lead from the present to one of the Images of the Future. In order to show the diversity of possible paths it was decided to construct more than one path for Image I and for Image II respectively. However, before paths can be constructed, policy packages are first identified.

5.5.1 Introduction – the Construction of Policy Packages

The construction of the packages in the POSSUM project has been achieved through the combination of two different approaches:

- a more deductive, systematic one on the basis of the framework of the images has helped to define the outline of the packages and paths; and
- a more intuitive, inductive approach starting from the list of measures (developed in section 5.3) has helped to allow for a creative process of inventing new combinations of policies.

Basic attitudes of the responsible policy makers will always shape the course of developments. Therefore it seems reasonable to take the policy orientations introduced in the last section as construction principles for the different paths. In practice these orientations always overlap. In conceiving first drafts of paths it was found that there was a stronger affinity between market and lifestyle oriented policies on the one hand and between regulation and service oriented policies on the other hand. It has therefore been decided to develop four paths which follow the broad systematic shown in Table 5.7. However, the emphasis on one or the other policy orientation may vary.

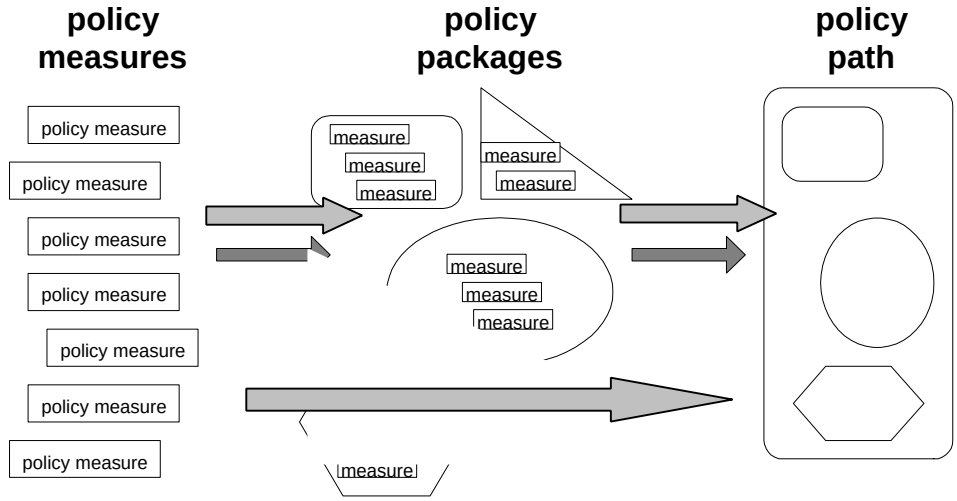
TABLE 5.7 POLICY PATHS AND POLICY PACKAGES

	Image I bottom-up	Image II top-down
market orientation & lifestyle orientation	path 1.1	path 2.1
regulation orientation & service orientation	path 1.2	path 2..2

Paths will contain a large number of policy measures that are needed to attain the targets set in the images. Since it is difficult to conceive and to discuss all aspects at once, a two-step method has been adopted. First, several measures are combined into policy packages covering an issue or addressing a target group. Then, several policy packages are combined to form a path. Figure 5.2 shows this process. Measures within a package and packages within a path are meant to be interrelated. Policy packages can be imagined as a package of measures to be introduced and discussed in a parliament. They have to address a delimited issue, they must give a convincing contribute to the solution of a perceived problem, they have to show a balanced impact on different groups of stakeholders in order to be acceptable and they have to be understandable and convincing as a package. Such a package cannot be designed by a

schematic application of rules, it must be conceived in a creative, iterative process. As in practical politics, it is useful to start from a triggering issue, to begin with a central measure and to add complementary measures so as to form a balanced package which is not too large and has an inner logic. New or modified kinds of measures are likely to be proposed in this process. The conceptual framework of POSSUM can then be used for a more systematic appraisal of this package which may again lead to adjustments.

FIGURE 5.2 METHODOLOGY FOR THE CONSTRUCTION OF POLICY PATHS



Several such packages have then to be combined in a path. A policy path is made up of both policy packages and policy measures. The construction of policy packages and policy paths is an iterative process which could go on over many cycles. Within the POSSUM project it was not possible to go beyond the state described in the following sections. A further development of these packages and paths together with concerned stakeholders would be a challenging further step (see also the chapter on validation). The discussions within the project team and with stakeholders in different countries have shown that the introduction of policy packages has been a most important step in developing this methodology:

- it allows to focus discussions so as to achieve some results within a limited amount of time
- it allows for intuitive creativity in developing new approaches within a more systematic framework

In this section some Policy Packages are presented. This collection of packages is illustrative rather than comprehensive and could be extended or modified. Some of the packages appear in two different variants intended for different Policy Paths. Clustering policy measures into packages appears to be more relevant and entail more synergies regarding decoupling than technology. This is mainly because decoupling involves a deeper transformation of production and consumption patterns. These can only be reached by strategies which go well beyond traditional transport policies and require a cautious balancing of different interests.

These packages are then combined with single measures to form the tentative Paths leading to the respective Images.

5.5.2 Policy Package: Ecological Tax Reform

Construction Logic

The idea behind an Ecological tax reform is the view that externalities, resource use and environmentally harmful activities are taxed too lightly, while labour is taxed too heavily. This Package consists of two variants.

Suitable bases for increased taxes are use of energy and materials and emissions of CO_2. These imply considerable negative externalities but may only be changed slowly. Initially mainly relying on CO_2 as the tax base, one could gradually change over to energy and materials as CO_2 emissions decrease. With such a strategy it is possible to get stable tax revenues, since we will always be using energy and material, although to a lower extent than today. Taxes on emissions that in principle could be cut by 100% (such as sulphur emissions), could be added but they do not form the backbone of an Ecological tax reform.

As we use the concept of an Ecological Tax Reform here, it is presumed to be fiscally neutral considering the whole society. That is, labour taxes should be reduced correspondingly. However, this interpretation does not imply that an Ecological Tax Reform should be fiscally neutral for every sector of society. On the contrary, the transport sector which is rather resource intensive would have to face substantially raised taxes, while labour intensive sectors would get lower taxes.

Variant A: In Image I where cooperation at the global level is not prevalent, there is still some room for shifting taxes from labour to resources at EU and/or national level. In addition the revenues from local road pricing could in some cases be used to lower local labour costs. Although some externalities such as emissions of NO_x could be cut substantially, congestion pricing will probably provide rather stable revenues.

Variant B: This variant is aimed at Image II in which comparatively high taxes could be levied on energy, material and not least CO_2 since there is a global cooperation on these issues. The global (at least the EU, the US and Japan) consensus makes it possible to levy even higher taxes on air transport (compared to Variant A) and to introduce taxes on fuel for shipping. This considerably enhances the base for the CO_2 tax and increases economic efficiency, so that a certain reduction of CO_2 can be accomplished at a much lower cost.

Main measures

- Lowered taxes (compared to present) on labour
- *Variant A*: Increased taxes (compared to present) on energy, materials and CO_2 emissions at national or EU level.
- *Variant A*: Local road pricing.
- *Variant B*: Much increased taxes (compared to present) on energy, materials and CO_2 emissions at national, EU or global level.

Impacts on stakeholders

The type of measures introduced would vary between regions and this may lead to friction or problem migration at the boundaries. On the other hand it is possible that regions or cities could attract qualified labour suitable for the expanding IT sector by offering very good living conditions.

Branches oriented towards IT and services will gain while resource intensive branches will face increased costs and may have to reconsider their strategy. These effects are more pronounced in *Variant B* than in *Variant A*.

Frequent car users would pay more. If labour taxes are decreased especially for low income groups, this could lead to a somewhat more even distribution of mobility/income. People without a car, often those less well off, would gain. If a large part of revenues comes from differentiated local road pricing rural population need not be disadvantaged even if they rely quite heavily on car use.

5.5.3 Policy Package: Liveable Cities

Construction logic

This package aims at making cities more attractive by diminishing the dependence on car travel. Strategic measures are increased accessibility by IT, more space and higher priority for walking, cycling and public transport combined with decreased space for cars and parking. Land-use planning in favour of decentralised concentration is also an important element.

With regard to the process of implementation, the use of IT to replace trips must play a crucial role. Reduced space for cars is hard to accomplish without an alternative way of getting access to the activity requires. If public transport is the alternative, it cannot be fast and reliable if car use is not restrained. A sort of locked position may occur. In this context, emerging IT presents a major opportunity to accomplish an initial decrease of car travel (drawbacks like spontaneous urban sprawl can be counteracted) which could make it possible to increase space for walking, cycling and public transport. Some roadspace is replaced by dedicated lanes for public transport, cycling and walking. The average speed of public transport is much increased through for example dedicated lanes, priority at intersections and payment with smart cards. The advantages are threefold: travel times for users are reduced, fewer drivers and vehicles are needed and fuel consumption and emissions are reduced (due to a smother ride). It also substantially raises the capacity of the public transport system.

Since market mechanisms, such as road pricing, are not the dominating policy orientation in this Policy Package, regulation of car traffic is achieved by improving the substitutes and partly by limiting road and parking space. Environmental zones will be established in central areas which only allow very clean cars, such as battery electric cars or hybrid cars in electric mode with combustion engine turned off. Distribution vehicles (mainly electric) are allowed to use some public transport lanes. The environmental zones also create niche markets for new technologies like fuel cells.

Low speed zones in residential areas make it more attractive and safe to cycle or walk and increases competitiveness of electric vehicles. Furthermore it is safer for children. Lower

speeds and less conventional cars significantly reduces noise. Appropriate land-use planning (such as decentralised concentration and high densities around public transport nodes) enhance the efficiency of public transport and the possibilities to telecommute from tele-offices in local centres. Less space for cars will also help to facilitate higher density development which in turn may help suppress car ownership. Commercial distribution has replaced a large part of shopping travel and load factors are maximised with the help of IT.

Main policy measures

- Possibilities for telecommuting, tele-services and tele-shopping/doorstep delivery are much improved by for example adapting legislation and setting up tele-offices.
- Appropriate land-use planning supporting IT-accessibility and public transport, by for example promoting decentralised concentration.
- Conditions for walking, cycling and public transport improved, by for example dedicated lanes.
- Space for cars is progressively reduced.
- Low speed zones (30-40 km/h) are introduced in residential areas.
- Environmental zones to stimulate very clean niche vehicles.
- Coordinated distribution with very clean vehicles is promoted.

Impact on stakeholders

Urban citizens will get a safer, quieter and cleaner environment. This will be particularly appreciated by families with children, and elderly people. Non car drivers will get both improved IT-accessibility and mobility. Many people can save considerable amounts of time through telecommuting and home delivery services. Frequent car drivers will get significantly impaired accessibility. However, many of those formerly driving to work may now be able to work from nearby tele-offices a couple of days a week.

IT related industries will flourish. Equipment for teleworking, teleshopping and teleservices will be in great demand. The IT industry is likely to remain buoyant as it also benefits from new applications, upgrading of software and hardware, the expansion of tele-activities in other sectors (such as shopping and public services) and new areas for the IT market (such as the Eastern Europe and, later perhaps, less developed countries). Distribution to shops and home delivery services require an extensive use of IT to optimise load factors and route selection. This could also significantly increase economic efficiency. Public transport companies will improve their economic situation because of the increased demand for their services and less cost due to the additional roadspace allocated to them.

5.5.4 Policy Package: Electric City Vehicles

Construction logic

This policy package aims at a better matching of transport demand with type of vehicle used. This could significantly increase resource efficiency.

The present all-purpose car is designed to transport 5 people with luggage at speeds exceeding 100 km/h. The same car is used in city traffic for transporting 1 person at much lower speeds.

To better match performance with demand a new category of Small Low Speed Vehicles (SLSV) is created. These vehicles would typically be small (2-seaters) electric cars with a maximum speed of 50-70 km/h. They would be cheap, easy to handle, very clean and require little parking space. Slots perpendicular to the streets could be used. Elderly and disabled could get increased mobility by using these vehicles. It may also be possible for the young to use them.

However, even these vehicles have an excessive capacity. For one person with little luggage, a bike may be sufficient. Therefore safety and convenience for bikers is of prime importance in order to better adjust transport services to demand. The low speed zones is one measure that improves cycling conditions. The use of electric bikes is facilitated by for example adapting legislation.

High costs for car use, restricted parking space and different types of cars for different uses would raise the attractiveness of car rental and car sharing compared to traditional ownership (additional incentives like a lower sales tax or subsidised parking space for non private cars could also be used). This in turn would lead to a more intense use of equipment and to a more efficient management of the overall car fleet. More durable vehicles (in terms of passenger kilometres), quicker innovation due to shorter life-cycles and less material intensity would also result in beneficial outcomes.

Main measures

- A new category of Small Low Speed Vehicles (SLSV) is introduced.
- Support for car pooling and car rental
- Concerted action to promote very efficient and clean vehicles for taxi-fleets, rental-fleets and public car fleets.
- Dedicated parking space for SLSV with shorter lots and much less parking space for conventional cars.
- Low speed zones in residential areas (30-40 km/h).
- Environmental zones only allowing very clean vehicles in central areas.
- Cycling conditions improved, by for example dedicated cycling lanes and supervised parking.

Impacts on stakeholders

Elderly and disabled people could get improved accessibility by using the cheap and easy-to-handle SLSVs. The same is possible for young people (14-18 year olds). Most people in urban areas would have to get used to not having a car of their own. They would, however, have relatively easy access to a wide range of vehicles for different purposes.

Impact on present car companies is not evident, but depend on their capability to rapidly adjust part of their production to a rather different kind of vehicle – the SLSV. New actors with knowledge of innovative materials, plastic composites for example, may emerge if the inertia of traditional car manufacturers turn out to be too large. Cycle manufacturers would gain from improved cycling conditions. There is a substantial potential for companies such as battery manufacturers and electricity suppliers.

5.5.5 Policy Package: Long Distance Links – Substituting for Air Travel

Construction logic

This package is directed at reducing long-distance passenger travel by substituting highly energy intensive modes with less energy intensive modes and other forms of communication. It also involves the reduction of travel distances.

In Image I the possibilities to internalise externalities connected with international travel are somewhat limited. This is not to say that the EU cannot on its own levy significant taxes on air fuel, but other measures may also be needed to limit growth of air travel.

Some air travel could be rendered unnecessary as a result of teleconferencing. The technology is already at hand, and will improve rapidly without policy measures. What may constitute more of a barrier is facilitating changes in people's habits. Demonstration programmes may therefore be appropriate. Regarding long distance leisure travel, less distant destinations could be promoted. The cities and their surroundings could be made more attractive for leisure purposes.

Faster rail services on existing tracks, such as taking advantage of tilting train technology, could substitute for some air transport particularly within Europe. It is however crucial that this development is accompanied by an increased tax on air fuel as well as a very restrictive policy regarding new airports, railways and roads. Otherwise the only effect may be increased air travel when airport slots are released for longer flights.

Main policy measures

- Moderate, although increased, tax on air fuel, possibly implemented as a minimum level inside the EU.
- Demonstration of teleconferencing facilities.
- Promotion of local destinations for leisure travel.
- Harmonisation of railways.
- Upgrading of existing tracks to allow faster railway services, such as the use of tilting trains.
- Making residential areas and their surroundings more attractive for leisure purposes.
- Restrictive policy regarding building new airports, railways and roads.

Impact on stakeholders

Stakeholders in air transport will resist, but air transport will still grow quite fast. There will be a strong pressure on railways to offer faster and more customer-friendly services. If successful, they could gain a larger market share. Frequent air travellers are offered improved alternatives for access without flying. If these are not utilised they will have to pay more. Strong incentives are required for air companies to invest in new technology engines to reduce noise and energy use.

5.5.6 Policy Package: Fair and Efficient Distribution of Mobility – Tradeable Mobility Credits

Construction logic

All individuals and firms cannot compete equally so some distributional mechanisms are necessary to ensure fair levels of accessibility.

Decoupling passenger transport with market oriented policies requires new approaches. The kinds of taxes used today cannot easily be raised to levels which really would make a difference: the population in the countryside and lower income groups would be considerably disadvantaged in their everyday life. As individual motorised transport is at the same time a basic need and a luxury good, measures to contain it must take into account spatial and social equity considerations. Given widespread car ownership, the tax system should lower the fixed costs and raise the variable costs of car use in order to give incentives to use public transport and to drive less.

All car taxes except energy and CO_2 taxes are replaced by road pricing. Decisions on the price levels should mainly be taken locally. Some general framework is needed. It must be clear where the money goes. The specific emissions of cars must be taken into account: an emission factor attributed to each (type of) car must enter into the calculation of the road fee. In a longer-term perspective real time emissions measured by on-board equipment could be used. A taxometer could show actual cost in each car, not least to stimulate a smooth driving style. Smartcards could be used for payment.

Effective incentives for not further increasing but for decreasing overall mileage cannot be directly coupled with monetary costs because of social reasons. Introducing 'tradeable mobility credits' (TMCs) can solve the social distribution problem: every person gets a limited number of credits for paying road fees and other mobility services at reasonable prices, corresponding to slightly less than present average mileage. Establishing a market for these credits will lead to higher costs for those who travel further and to extra incomes for those driving less. A similar system has been intensively discussed in Switzerland in the 1980ies. Manifold variations concerning the rules for this market and its regulation are conceivable.

Encouraging the use of public transport may be coupled with the same system of 'tradeable mobility credits' (TMCs) as they could also be used for paying public transport services. This would effectively decrease car mileage if public transport is attractive. Technically, smart-cards would present an excellent form for realising a system of TMCs. The cards could easily be sold (or recharged) by public authorities according to the respective personal quota, be used for payment of fees on the car taxometer, be used for payment in public transport and easily be traded between private persons or over electronic systems. With increasing flexibility of working hours and use of IT services, there is a tendency to level off peak hours in transport. Decreasing costs in public transport would be the consequence.

A strong differentiation in taxes (road fees) for vehicles depending on their emissions becomes easy to implement with such a system. However, standard regulations limit innovations in this respect. All cars have to comply with safety requirements conceived for high speed which require considerable size, weight and technical sophistication. A large part of urban transport does not require these features. The creation of a new category of Small Low Speed Vehicles (SLSV) with a maximum speed of 50-70km/h would maintain safety levels and reduce energy consumption (for further details see *Electric City Vehicles).*

High variable costs for car use, widespread use of smart-cards across different transport systems, different kinds of cars for different uses, would raise the attractiveness of car rental and car sharing compared to traditional ownership. This, in turn, would lead to a more intense use of equipment and to a more efficient management of the overall car fleet. More durable vehicles (in terms of passenger kilometres), quicker innovation due to shorter life-cycles (in terms of years) and less material intensity would be the consequence.

Main policy measures

- Tradeable Mobility Credits (TMC).
- Replacing taxes (except energy and CO_2 tax) by differentiated road pricing.
- A new category of Small Low Speed Vehicles (SLSV) is introduced (for further details see Policy Package on *City Vehicles).*

Impact on stakeholders

Similar comments are relevant here to those in the Policy Packages related to *Electric City Vehicles* and *Liveable Cities*. Considerable new markets would be developed in IT, battery transmission and storage, small vehicle production, information systems and urban design. A higher quality environment, less need to own a car and more local travel would result. The distributional consequences are positive, particularly for marginal car users and those who choose not to use the car and use their Personal Mobility Credits (PMCs).

Frequent car and air travellers will get increasing costs and might have to modify their life-style. Low income groups and elderly will in general get lower costs as they can sell some of their Mobility Credits on the open market.

There will emerge huge opportunities for IT industry as the need for road pricing equipment, smart-card systems and other technology increases rapidly. Vehicle industry will face a lower and more differentiated demand. Durable cars with exceptional good environmental properties will be demanded for use in rental, pool or taxi fleets. SLSVs will constitute an increasing market niche.

5.5.7 Policy Package: Promoting Subsidiarity in Freight Flows

Construction logic

One basic strategy for decoupling freight transport from economic growth is to reduce the travel distance of goods. This Package consists of two variants. The differences are outlined in the end of this section after a general description.

A well-known claim in this context is the ‘regionalisation of material flows’. However, as very differentiated approaches including different scales for different products are needed, subsidiarity may be a better term to use. The proposed policies address the spatial patterns of production and consumption. Results are to be expected only in the medium and long term.

Consumers (private, public and commercial) are being addressed through awareness and information campaigns promoting the use of products which come from nearby. Adequate information is essential. Appropriate systems and declaration requirements have to be

developed by public authorities in order to allow for responsible consumer choices. European agricultural policy needs to stop its continued opposition to regionally oriented commercialisation endeavours. The creation of concrete opportunities is also important. Opportunities for purchasing regional products concern the structure of the distribution. An extraordinary concentration has taken place amongst retail companies in the last 30 years, especially in northern Europe and this has strongly contributed to large-scale increases in material flows. This process has been facilitated by land-use planning and urban policies, by technological development, by changing life-styles, by a neglect of local cultures and an ideology of homogenisation in economic polices. Interestingly, in the relevant sectors, distribution is more concentrated than production. Changing the frame conditions in the mentioned policy fields may allow for discovering the advantages of more flexible small-scale structures.

In terms of the production, economic development policies at all levels could encourage regional networking and cooperation of companies and the formation of industrial districts. Sourcing strategies strongly determine the transport input to manufactured goods. As transport has always been as a servicing function, information concerning the transport impact of business and policy decisions is mostly missing. Information systems which trace the transport input of goods over the whole life-cycle could considerably help to make better choices. Likewise, a transport impact analysis of major political decisions could help to avoid errors and to improve our poor understanding of the relationship between transport and development.

Transport will remain as a servicing and disregarded function as long as it stays very cheap compared to other inputs to manufactured goods. Continued subsidy of transport has led (and continues to lead) to inefficient structures. Differentiated pricing of transport according to different regional contexts (by differentiated road pricing for example) may considerably widen the margins of action for attributing real costs.

Public spending plays a very important and mostly underestimated role on many markets. Public procurement may be used very effectively for strengthening subsidiarity in the flow of goods. This must not end up in anti-innovative local or regional protectionism but differentiated approaches in the spirit of a balanced subsidiarity are conceivable.

Variant A: This variant is mainly life-style and market-oriented. Price mechanisms are widely used. In agricultural policy regional marketing is encouraged by a differentiation of subsidies. Differentiated road pricing and an increase in transport costs play a certain role. Structural development programs require a high degree of local sourcing from companies seeking aid. More important than these direct price mechanisms however are endeavours to change lifestyles and consumer preferences through information and campaigning.

V*ariant B:* This variant has a stronger emphasis on regulation and service-oriented policies. Here price mechanisms are not very important. A strong emphasis is put on relatively quick and compulsory introduction of information systems on transport content and regional origin declaration. Also the qualification of public procurement plays an important role.

Main measures

- *Promotion of 'regional' consumer markets*. Governments on all levels may promote regional consumer markets by improving public awareness and information, changes in the Common Agricultural Policy, introducing the notion of flexible subsidiarity in internal market regulations, promoting adequate distribution structures through land use planning.
- *Promotion of company networking and industrial districts*: Networking and local sourcing can be encouraged by development policies at all levels. Incentives, facilitation and the provision of specialised infrastructure (technology and training centres for example) can be combined.
- *Information system on the 'transport contents' of all goods*: Parallel to the introduction of EMAS a European system for tracing and declaring the 'transport contents' (in tkm by different modes) of all goods would be established within 10 years
- *Labels with declaration of regional origin*: Easier to introduce would be a labelling of end consumer products concerning their regional origin. Not all products will have such a 'regional origin'. Such labelling could be made compulsory within five years.
- *Transport impact assessment for major political decisions*: Should be introduced on all political levels.
- *Mainly Variant A*: Differentiated road pricing and increases in road transport costs: This instrument would allow to considerably raise the cost of road freight transport in particularly sensible areas or corridors. An adequate negotiating system would be necessary for equilibrating different interests.
- *Variant B*: Qualification of public procurement: Public procurement rules would be revised in a way that European exchange of knowledge and information is favoured while flows of goods would be contained in the spirit of subsidiarity.

Impacts on Stakeholders

Compared to present trends, populations along long-range transport corridors would be somewhat relieved from freight transport. Urban and rural population would have better access to services and would have to rely less on own cars. Therefore especially elderly, disabled, young and economically weaker parts of the population would have advantages compared to present trends. Even a small price increase would not set off these advantages. However, this trade-off does not seem to be self-evident for all. Large-scale distributors would loose opportunities and will be amongst the strongest opponents of such policies. Structural change will be accelerated in such a direction that traditional material-intensive and mass-production oriented industries will have more difficulties to adapt than flexible high-tech oriented ones. The vehicle industry will tendentially loose and oppose such a policy, while IT industry will discover big new markets in information systems and road-pricing systems. Also new systems for more flexible local logistics may create new opportunities. SMEs will probably have more advantages from such policies than large companies. Generally, entrepreneurship and local employment may be strengthened. The development of agriculture throughout Europe may become more even, less favoured regions in this context may have better opportunities. Areas with high intensity export-oriented agricultural production may oppose such policies. Railways will find it more difficult to compete since long-distance transport of mass-products form their traditional market. *Variant A* which envisages an increase in transport costs may encounter more general political opposition. In V*ariant B*, the fast introduction of compulsory information and declaration systems may encounter lasting and detailed resistance among industry.

5.5.8 Policy Package: Promoting Dematerialisation of the Economy

Construction Logic

Reducing the material throughput of the economy can reduce the necessity for transport. This Package consists of two variants. The differences are outlined in the end of this section after a general description.

Dematerialisation is a current trend which can be observed in many sectors. Three sub-strategies can be used to enhance it: substitution of products by services, increased durability of products and miniaturisation. Generally, dematerialisation of the economy does not only contribute to the solution of transport problems, but also to reducing a wide range of environmental problems. Therefore, joint efforts between different policy fields are conceivable. This policy package addresses all three strategies with different kinds of policies. The general awareness and information concerning the problems caused by material consumption and the opportunities to reduce it can be overcome by appropriate policies at all levels. Appropriate information systems can help to improve transparency for example. The Transport Content Declaration (TCD) or Material Flow Accounting would be very helpful in this context. The effective material consumption for complex products, such as computers, is difficult to estimate for the final customers.

The substitution of products by services can be encouraged by changes in the frame conditions for the economy. Economic and fiscal policies are still strongly oriented towards a hardware-producing and not to a service-oriented economy. Shifting the tax burden from labour to material consumption, shifting development policy priorities away from infrastructure and hardware investments to the improvement of the human and social capital could make a big difference. A series of more specific changes (labour regulations, insurance for borrowed or rented equipment, setting of professional service standards for example) could support a general shift in perception concerning the service dimension of consumption. The internalisation of external environmental costs will generally curb the material intensity of the economy. Therefore, the full life-cycle responsibility of manufacturers for their products are helpful, as introduced into waste policies in some countries. These policies will also tend to increase the durability and stimulate the more intensive use of products. All kinds of sharing and rental of equipment tend to lead to a more intense use, and this may in turn lead to technical development towards more durability.

Miniaturisation in the common understanding can only marginally be influenced by public policies. However, many technical and safety standards prescribe an oversized use of materials which, on a closer investigation and considering new technologies, may be reduced considerably. Especially in the building sector many examples can be found. Also changing the admissible conditions of use, could reduce material consumption. For example, lower speed limits would allow for the construction of lighter vehicles.

Life-styles may not only be influenced by awareness campaigns and information but also by providing opportunities for other ‘genres de vie’. The permanent availability of cars for moving heavy goods and of frequent waste collection inevitably reduces the awareness for ones own material consumption. Encouraging car-less life-styles by improving public transport, facilitating car sharing and rental or providing home delivery services would not only reduce private car circulation and car production (which makes up for up to 10% of total

freight transport) but would also change the attitude towards the everyday consumption of materials.

Strengthening the trends towards dematerialisation would also change the structure of freight transport requirements. Transported goods will diminish in size and increase in specific value. This will reinforce the trend towards more careful and flexible handling and shorter transport times. This in turn may create problems for the railways and intensify the trend towards air transport. Therefore, balancing policies for these two modes will be important in order to avoid additional environmental problems.

V*ariant A:* This variant is mainly market and life-style-oriented, in which tax policy plays a predominant role. Specific incentives are given in this framework.

V*ariant B***:** This variant relies more on regulation and public services. It emphasises manufacturer responsibility for recycling and disposal of goods after use, the introduction of increasingly stringent standards and a shift in structural development policies towards investments into human and social capital .

Main measures

- *Give incentives for rental and sharing of goods and services*: tax and other polices aimed at encouraging hardware investments should be linked to incentives for organisational forms that allow most intensive use of equipment. Legal frameworks for service contracting could be improved.
- *Variant A*: Shift tax burden from labour to materials, energy and emissions of CO_2. Endeavours in this direction can already be observed in different European countries. European coordination in this respect, especially concerning taxes on energy and co-ordinated waste policies could be very helpful.
- *Variant B*: Shift development policy (including structural funds) priorities towards human resources: Improving the capability of mutual learning, of cooperation and of thinking in terms of optimal service delivery would become the main focus of development policies at all levels. To enhance cross-cultural learning in this respect and to pioneer in setting new priorities could be an important contribution of European Structural Funds.
- *Variant B*: Introduce product responsibility of manufacturers for the whole life cycle: Manufacturers of all kinds of end products should be made responsible for all recycling, dismantling or disposal costs of their products also after use. This would lead to more responsible technology development and to more service-oriented marketing strategies.
- *Variant B*: Revise standards which affect material consumption (cars, building)

Impacts on stakeholders

Dematerialisation of the economy is an approach that allows for coalitions with a variety of actors in environmental policy. There are also strong political forces which call for effective policies for reducing unemployment and alliances seem possible to achieve a shift of tax burdens.

However, the consequences of this policy package will be quite different for different sectors of industry. The result amounts to accelerating the pace of important trends of present structural change. Traditional, hardware-oriented industries will be exposed to increased

pressure to reorient themselves. IT and service-oriented industries will gain new opportunities. Losers of an accelerated change towards a more service-oriented economy will oppose dematerialisation policies. The pressure for developing new service-oriented and communication-oriented skills for large parts of the working population will increase. Economies which are advanced in this direction will tend to be more competitive and more stable. However, accelerated change may create political conflicts with those representing and depending on traditional industries. Small and large companies may be equally affected in both directions. A strong shift in tax policy as envisaged in variant A may cause broader political opposition than the regulation-oriented approach which concerns more specific stakeholders.

5.5.9 Policy Package: Minimising Specific Emissions

Construction logic

This package aims at a significant reduction of specific 'real world' emissions from road and air transport. It is in particular intended for Image II where the all purpose car has a strong position. In Image I transport volumes are lower, electric vehicles are more common and walking, cycling and public transport also have high shares in urban areas.

Emission standards are related to specific test cycles. In real traffic deviations from these occur due to high speeds, full throttle accelerations, cold starts, malfunctioning exhaust treatment systems and so on. Real world emissions are thus often much higher than those observed in test cycles. This especially holds for conventional cars. Stricter emission standards will only affect a (decreasing) part of actual emissions and may not necessarily be the most cost-effective measure.

To ensure durability of exhaust treatment systems manufacturers must have a long term responsibility for proper functioning. Regular control of emission levels should be made compulsory. An option may be to use the on-board engine diagnostics which now is common in new cars. Information about the benefits of a smooth driving style should be communicated. Regarding commercial transport, the education of drivers combined with economic incentives for fuel efficient driving could for example give significant benefits both for CO_2 and other emissions.

If diesel engines cannot be made to comply with the strong measures needed to reach the emission targets, they must be phased out from use in city traffic. This does not seem unlikely although it is difficult to predict the technology development in this area. For inter-city freight they may still be used, but not in distribution.

Hybrid vehicles which are less sensitive to driving style could be promoted, by for example more flexible certification levels or by lower sales taxes. All measures leading to reduced driving resistance, such as reduced weight, will also have beneficial effects on emissions. More fuel-efficient engines, however, do not necessarily imply lower emissions. Higher combustion temperatures may decrease fuel consumption but, ceteris paribus, tend to increase emissions of NO_X. This is especially problematic regarding aircraft since after treatment of exhaust gases is not possible.

Finally it is important not to forget the emissions and resource use associated with production of vehicles, fuels and infrastructure as well as maintenance and running of infrastructure. The introduction of electricity and later possibly hydrogen may contribute to a substantial reduction of emissions in urban areas, but overall emission reductions are strongly dependant of how these final fuels are produced.

Main policy measures

- Long term producer responsibility for emission levels.
- Frequent control of real emission levels.
- Information regarding the effect of driving style on emissions and fuel consumption.
- Introduction of more realistic test cycles.
- Hybrid vehicles, which do not have the same problem with off-cycle emissions, are promoted, such as by less tight certification levels or by lower sales taxes.
- Feebates on new cars according to weight and fuel consumption.

Impacts on stakeholders

Car manufacturers might resist a more long-term responsibility for emission levels, but additional costs will probably be rather small. Car owners will be spared the risk of suddenly having to buy a new exhaust cleaning system, although price of new cars may increase slightly.

Freight companies may reduce costs if drivers adopt a more fuel-efficient driving style. Airlines may face increased costs due to more complex engine designs.

5.5.10 Policy Package: Resource Efficient Freight Transport

Construction logic

This Policy Package aims to increase the resource efficiency of freight transport and reduce haul distance. This Package consists of two variants. The differences are outlined in the end of this section after a general description.

This package is mainly intended for Image II. Although freight transport volumes are lower than in the reference case they are considerably higher than both in Image I and compared to 1995. This difference is mainly to be attributed to longer distances rather than increased goods volumes. Longer distances improves the competitiveness of rail, but other measures will also be needed. Technical and organisational harmonisation of railways all over Europe must be strongly promoted. To improve combined transport considerable efforts must be made for introducing European standards and technologies for automatic flexible freight handling and tracing.

Promotion of professional home-delivery could potentially yield significant gains if shopping travel is substituted. Coordination of distribution including home delivery is promoted in order to increase load factors. Emerging IT will strongly contribute to this. Better information may lead to a shorter supply chain.

Variant A: Road pricing for freight is introduced on a European scale. This gives incentives for increasing load factors and modal shift to rail.

Variant B: New freight tracks and intermodal centres are built to improve competitiveness of rail.

Main policy measures

- Standards and technologies for automatic flexible freight handling and tracing are promoted.
- Technical and organisational harmonisation of railways.
- Promotion of professional home-delivery with clean vehicles.
- *Variant A*: Road pricing introduced, in particular for freight transport.
- *Variant B*: Some new freight tracks and intermodal centres are built.

Impact on stakeholders

The freight industry is concerned about the efficiency and reliability of their supply chain. Some companies are already exploring the possibility of localising production processes to eliminate unreliability and reduce costs. In principle, the industry will respond to clear market and regulatory signals. Of greater long-term concern is the move towards customer driven production which tailors goods to individual requirements. This may increase material consumption but technology allows customised production so impacts on resource consumption may be neutral.

Railway companies have historically been reluctant to open up their national monopolies. The necessary harmonisation will increase the market share and possibly the profit for rail transport, although some rail companies might not stand the increased competition on the market.

In conventional distribution load factors will increase. The effect being that fewer vehicles are needed. A new market segment will however appear for freight companies as home-delivery services increase.

5.5.11 Policy Package: Customer Friendly Transport Services

Construction logic

This package aims at making public transport and intermodal travel more convenient. It is mainly aimed at Image II which in part is due to its strong emphasis on technology. Furthermore, in Image I there are other strong measures contributing to competitiveness of public transport.

Technological innovation allows the development of a personal communicator with smart card facilities to allow payment and stored value. Each person will have a dedicated multipurpose personal communicator (MPC) that can be used for all forms of communication and information services. The MPC will have real time information on travel services and facilities, including multimodal travel so that journeys can be planned in advance and modified as circumstances arise. This requires co-operation of all public transport providers so

that journeys from door to door can be booked with a single transaction. Car rental firms should also be integrated into the system. The intention would be to encourage multimodal journeys which are flexible and convenient. Standardisation and full compatibility between functions and locations should be completed by 2010. The MPC has an advisory function in that it can suggest alternatives, in terms of where to go, when to go, special deals, or even linking with other people. The MPC can also be used for individual banking facilities, shopping, booking leisure and other activities. Support infrastructure will be required, and consideration given to the noise nuisance and potential health risks.

Main measures

- Establishing EU standards for the MPC (Multipurpose Personal Communicator) and to commission feasibility research in conjunction with the industry.
- The necessary databases will have to be set up and made accessible remotely so that the full benefits of the MPC can be realised.
- Cooperation of all public transport providers must be promoted so that journeys from door to door can be booked with a single transaction.

Impacts on stakeholders

There are tremendous commercial possibilities and controls may be needed over the major producers to ensure availability and that pricing is competitive. As this is a facilitating technology, care is needed in assessing whether complementary measures are required as more journeys may result. Implementation needs to be matched by other measures to restrict car traffic. As with all new technology there may be distributional consequences as high income computer literate individuals and firms take advantage of it. Other people may find the technology expensive and difficult to use. Measures are needed to safeguard the interests of those less likely to use this technology. It should not replace other forms of communication, but provide an additional source of information and advice.

5.6 POLICY PATHS

5.6.1 Path 1.1: Market and Lifestyle-oriented

This path is directed towards Image I. The dominant policy orientations are market and lifestyle. Characteristic policies include:

- PACKAGE : Ecological Tax Reform -*Variant A*
- PACKAGE: Fair and Efficient Distribution of Mobility - Tradeable Mobility Credits
- Facilitating IT accessibility for work, services and so on, in order to reduce travel.
- PACKAGE: Long Distance Links - Substituting for Air Travel
- PACKAGE: Promoting Subsidiarity in Freight Flows - *Variant A*
- PACKAGE: Promoting Dematerialisation of the Economy - *Variant A*

5.6.2 Path 1.2: Regulation, Public Services and Lifestyle-oriented

This path is directed towards Image I. The dominant policy orientations are regulation and public services. Characteristic policies include:

- PACKAGE: Liveable Cities
- PACKAGE: Electric City Vehicles
- PACKAGE: Long Distance Links - Substituting for Air Travel
- PACKAGE: Promoting Subsidiarity in Freight Flows - *Variant B*
- PACKAGE: Promoting Dematerialisation of the Economy - *Variant B*

5.6.3 Comparison of Paths 1.1 and 1.2 (Image I)

Both Paths 1.1 and 1.2 rely mainly on bottom-up initiatives. This is slightly more pronounced in Path 1.2 where local initiatives on local/city level are crucial, not least to accomplish Liveable cities with diminished reliance on car travel. In Path 1.1 emphasis is on using market incentives, while the dominant policy orientations in Path 1.2 are regulation and public services. In both cases policy is intended to facilitate the environmentally benign lifestyles which in Image I are common.

The more widely used market incentives, such as local road pricing, in Path 1.1 may induce distributional conflicts, if complementary measures are not added. If cars become much cleaner and more fuel efficient it is likely that those worst off, i.e. those with the oldest vehicles, will have to pay the highest fares in a road pricing system. This can, in the context of an ecological tax reform, somewhat be compensated for by the profile of labour tax reductions. Another solution, which we have included, might be to introduce Tradeable Mobility Credits. This could be a very powerful means for making distribution more even. It would, however, probably take some time before such a Package would be accepted by the public.

In Path 1.2, mobility with individual vehicles can partly be adjusted by congestion provided that the vehicles are clean. This means that road space is allocated by time rather than by money. A prerequisite would be that freight distribution could get through, by using some public transport lanes for example.

5.6.4 Policy Path 2.1: Market-oriented

This path is directed towards Image II. The dominant policy orientation is the market. Characteristic policies include:

- PACKAGE: Ecological Tax Reform – *Variant B.*
- Facilitating IT accessibility for work, services and so on, in order to reduce travel.
- Tradeable permits or feebates according to fuel consumption of new cars and aircraft.
- Feebates on new cars according to weight.
- PACKAGE: Customer Friendly Transport Services.
- PACKAGE: Minimising Specific Emissions.
- PACKAGE: Resource Efficient Freight Transport – *Variant A.*
- Introduction of methanol through economic incentives.

5.6.5 Policy Path 2.2: Regulation and Public Services

This path is directed towards Image II. The dominant policy orientations are regulation and public services. Characteristic policies include:

- CAFE standards or uniform reductions of average specific fuel consumption for cars and aircraft (e.g. 25 % for all car manufacturers).
- Facilitating IT accessibility for work, services and so on, in order to reduce travel.
- PACKAGE: Customer Friendly Transport Services.
- PACKAGE: Minimising Specific Emissions.
- PACKAGE: Resource Efficient Freight Transport – *Variant B.*
- Introduction of methanol, by for example funding R&D and by public procurement of methanol vehicles.

5.6.6 Comparison of the Paths 2.1 and 2.2 (Image II)

Path 2.1 and 2.2 are both directed towards Image II. Although some policy elements are similar they have different emphasis regarding policy orientations.

The general potential for decoupling is better in Path 2.1 mainly due to the Ecological tax reform which also affects transport volumes. It is also uncertain whether the same technological progress can be achieved if market mechanisms are not widely used as in Path 2.1. The consequence is that following Path 2.2 it will be impossible to reach the targets without introducing a renewable fuel, such as methanol, on a wide scale (in Path 2.1 there is at least some chance that this step could be postponed). This, however, appears to be a rather costly strategy. As measures for decreased fuel consumption of new cars and aircraft, such as CAFE or uniform relative reductions, are relatively inefficient from an economic point of view, it may be concluded that it will be significantly more costly to follow Path 2.2 compared to Path 2.1.

5.7 COMMENTS ON THE CHOICE OF POLICY SCENARIOS

5.7.1 Revisiting the Construction of Images

In section 4.2, nine alternative scenarios were identified according to the matrix also presented below. Three of them were chosen for elaboration. Image I had a focus on both decoupling and a bottom-up approach. Image II on technology and a top-down approach. Image III is a combination of both top-down/bottom-up and decoupling/technology. Here we will reconsider the basis for the choices of the images of the future.

In the first column (Table 5.8), the emphasis is on decoupling rather than technological improvement. Radical decoupling demands behavioural changes (less transport intensive choices, for example) which in turn probably requires ‘grassroots’ involvement and commitment. This is in line with the first row in the matrix, where local and regional co-operation is prevailing. Hence, our choice from this column is D1 - *EU Co-ordination of Active Citizens (Image I).* In the second column the general strategy emphasises a fast technological evolution and dissemination, while the degree of decoupling is moderate. This strategy seems to require global co-operation on such issues as regulation or taxation of CO_2 emissions. Consequently, we have chosen scenario T2 as the most interesting and internally coherent case in the second column – this is *Global Co-operation for Sustainable Transport (Image II).* Finally, the cases in column three all exhibit a balanced strategy of fast technological development and a considerable degree of decoupling. This is facilitated by cooperation on all levels, as is the case in*TD3, Accord on Sustainability (Image III).*

TABLE 5.8 THE NINE IMAGES OF THE FUTURE OBTAINED FROM COMBINING THE TWO DIMENSIONS

Contextual Elements	**Strategic Elements**		
	Technology+/ Decoupling+++	Technology+++/ Decoupling+	Technology++/ Decoupling++
Local, Regional + EU co-operation (bottom-up)	D1	T1	TD1
Global + EU co-operation (top-down)	D2	T2	TD2
Local-Global co-operation (both bottom-up and top-down)	D3	T3	TD3

The other alternatives cannot be ruled out. However conditions for the policy measures that will have to be implemented are less favourable in these cases. In the case of strong decoupling, when the prevailing situation is in favour of top-down (D2) and not for bottom-up, the policy measures have to be oriented towards pushing citizens and other actors in a decoupling direction. This is a completely different situation compared to the bottom-up case (D1) where policy measures has the role of facilitating a desired development. In the D2 case governmental action will more be oriented towards different general policy measures that will reduce transport volumes by regulation and/or pricing some transports out of the market.

A bottom-up situation that shall push technology (T1) will likely be based on customer preferences at the market. Customers will in this situation push development by demanding energy efficient and environmentally benign vehicles and transport services. Local policy measures, like environmental zones, can also be implemented. Co-ordination within customer groups can be achieved through NGOs. This process is likely to be much slower than the international harmonisation of emission standards. It is therefore more unlikely that this alternative will reach the targets by 2020.

The major conclusion from this discussion is therefore that it is important for the success of a CTP that the prevailing situation regarding top-down or bottom-up is recognised and possibly also influenced over time.

We have not elaborated on policies for Image III in this Chapter. The reason is that they will primarily be a combination of policies for achieving image I and II and the text may to a large extent be repeated from those images. The image III has been chosen as Technology++/ Decoupling++. In a following section we will analyse under what circumstances both Technology and Decoupling can be strongly pushed (i.e. Technology +++/Decoupling +++).

5.7.2 Eligible and ineligible elements

The Policy Paths elaborated on in the previous sections are based on a combination of elements where some can be chosen and other elements cannot be chosen, and the latter thus involves uncertainty (Figure 5.3):

1. The actual and future level of dominant policy making (local, national or international) and the degree of co-operation between these different levels of policy-making are

contextual elements that cannot be chosen. They reflect the way society copes with market failure and public goods and ‘bads’. The level of co-operation can of course be influenced and can change over time, but that will be outside the reach of a CTP.

2. The relative priority between Technology and Decoupling can be chosen. However one of the major conclusions of the POSSUM project is that both of these strategic elements have to be pursued if the set targets are to be reached by 2020. As most of the decoupling measures/packages should be designed so that adjustments can take place (such as land use patterns), a relative long time perspective is needed. Implementation of these kinds of measures/packages can therefore not be postponed. If sustainable mobility should be within reach, decoupling activities have to start as early as possible. The choice is thus not between Technology and Decoupling, but between the relative priority and strength of policy measures.

3. A choice can be made between different policy orientations. The POSSUM project has divided the policy measures into:
   - lifestyle-oriented policies
   - market-oriented policies
   - regulation-oriented policies, and
   - public infrastructure/services

(These four types of policy measures have been outlined in section 5.3). Figure 5.3 shows the different combinations of choices associated with the paths outlined above, together with the different futures which are themselves uncertain.

FIGURE 5.3 THE POLICY PATHS EXAMINED

UNCERTAINTY: different futures

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		Image I: focus on *decoupling*, bottom-up	Image II: focus on *technology*, top-down
CHOICE: different strategies ® ®	market and lifestyle orientation	Path 1.1	Path 2.1
	regulation and service orientation	Path 1.2	Path 2..2

Note that the Policy measures/packages presented in this report are qualitative. We have not had sufficient basic material to determine the quantitative level of different measures, or to identify what level of fuel taxation will be needed to reduce CO_2 emissions to a certain level, or the magnitude of an ecological tax reform. The may suggest that knowledge only can be created through experiments. A gradual implementation of taxes or feebates over time, starting with low levels, can generate the knowledge needed, with subsequent adjustments being made according to the projected achievement of the targets. This is elaborated on in the last section of this Chapter.

5.7.3 The need to combine policies inside and outside the transport sector

In all Policy Paths it is evident that policy measures aimed specifically towards the transport sector are not sufficient. More general policy measures are at least as important. For example, the relationships between tax levels on labour on the one side and energy, materials and emissions on the other side are of prime importance. In other cases, it is more a matter of encouraging the benign parts of a more or less spontaneous development while at the same time suppressing the detrimental ones. The development of IT is a case in point. It has the potential to replace existing transport, often with positive side effects, but it also has the potential to generate substantial amounts of new transport.

The future agricultural policy in the EU is one area of crucial importance for achieving decoupling in freight transport. About one third of all road freight in the EU (measured in tonne-kilometres) is attributable to food and agriculture. This situation still remains despite the fact that freight distances are still quite short, compared to the movement of other goods.

5.7.4 Consequences for Image III – Is Strong Decoupling and Technology Possible?

Introduction

In Image III, co-operation exists on local, European (EU) and the global level. This means that policy instruments in this Image could be a mixture of both bottom-up and top-down policies. The valuation of the environment is high in this Image, as it is in Image I, which means that people to a high degree take responsibility for the common good. Global agreement on targets concerning the environment can count on at least passive support from the population.

It should be noted that the general prospects to achieve the targets in Image III is higher than in the other Images. The introduction of biofuels on a greater scale may be one of the more costly measures in Image III. Since targets in Image III seem to be attained with some margin, an option might be to postpone this introduction and see if (other) technological improvements in combination with decoupling measures are sufficient to push down emissions, until a transport system based on hydrogen and fuel cells can be implemented.

The possibilities to simultaneously accomplish a relatively strong decoupling and much improved vehicle technology are at the centre of this Image. A specific issue is how new technology could be implemented rapidly while traffic volumes are relatively low in the EU. Policies intended to reduce transport intensity and volumes are employed mainly through the use of pricing and taxation (road pricing, ecological tax reform, feebates on new cars according to fuel consumption and weight, for example). Restrictions concerning parking, entry access and goods traffic may also be applied. The production system changes towards more local and glocal production. A strong support exists for decoupling and there are good conditions for technological improvement. Emphasis on the concept of decentralised concentration induces a demand for telecottages and teleshopping facilities. Investments in information technology infrastructure are therefore quite high.

One potential synergy in Image III concerns the introduction of very fuel efficient and clean but expensive cars and the decrease of daily car travel in city areas. If more car use was by car rental, car pooling and taxis, which would increase the niche for expensive cars with low fuel costs. A policy package could for example include tax deductions and cheap parking as long as the cars are used for rental or car-pooling. Clean taxi fleets, which in Image III would increase, are even more suitable for these cars because of yearly mileages often in excess of 100,000 kilometres (a fuel gain of 3 litres per 100 kilometres would then transform into a yearly benefit of about 2,500 ECU). In this case it might suffice just to better co-ordinate the purchases of new taxi cars in order to get these cars out on the market. If a strategy like this was applied not much public funding of research and development would be needed.

A shift towards fewer but more durable and lighter cars would also have some impact on dematerialisation, which for instance could imply less transport in the production process. Increased export of cars (to Asia for example) may to some extent compensate for this.

Regarding renewal of vehicle fleets there might be some difficulties to reach the average fleet technology levels exactly by 2020. The recent development of cars has led to longer life spans not least because of better rust protection. This is of course positive from an economical point of view and may also somewhat enhance dematerialisation. Still, from an environmental point of view this poses a problem since today's cars are not fuel-efficient and could also be cleaner. Furthermore, it seems to be the case that the heaviest and most powerful cars have the best quality and will remain the longest. This extension of cars life span makes it the more urgent to change the incentives regarding fuel consumption of new cars.

In Image III it is assumed that cars will consume on average 40 percent less fuel per kilometre than 1995. This implies that the fuel consumption of new cars in general should be halved by 2020. If this is accomplished without increasing fuel price substantially the consequence may be lower running costs and increased mileage. This may be consistent with Image II but not with Image III due to the strong decoupling emphasis. If fuel prices are increased substantially (more than doubled), old and not so fuel efficient cars will be very expensive to

drive. Since these are often the cars of the poorest people, distribution of mobility will be even more uneven than now. It is very doubtful whether this is politically acceptable. An alternative strategy would certainly include a higher fuel price but would rely much on other measures like improved conditions for walking, cycling and public transport, replacement of trips by information technology and access to cars without having one of your own. The distributive argument could also be used against road pricing in city areas. Besides improving the alternatives to car travel, simple regulation of the remaining car traffic could continue through congestion. A prerequisite would be very low emissions so that 'idling' vehicles standing in queue could be accepted. The apparent risk is that politicians would give way for claims of building new road capacity.

In Image III, information technology is used heavily to replace travel and at the same time the travel generating effects of information technology are counteracted. The increased use of information technology to gain accessibility in combination with more flexible working hours implies a more dispersed traffic over time. This means that very little new road infrastructure would be needed and that much (mainly) public resources could be saved. Because of the very fast expansion of the information technology sector, very little public funding would be needed. It is more a matter of creating a regulatory framework for the use of that technology. More local production of heavy (low value per kg) goods, such as food, fuel and constructing material, will decrease the need for long distance transport by lorry and thus also for inter-city roads. An increase in teleshopping would increase the market for flexible and clean distribution vehicles. Through information technology, the co-ordination of goods flows could be achieved in order to minimise unnecessary vehicle-kilometres. In general it seems that public funding does not have to increase if smart policy actions are taken, possibly with the exception of biofuels. A key factor is that costs for road infrastructure could be substantially cut.

Possibilities of both strong decoupling and technology

Image I was characterised by co-operation on local and regional levels (mainly bottom-up politics). Image II on the other hand was characterised by a good climate for global co-operation (mainly top-down politics). If both these frame conditions materialise, then Image III is a feasible option. Originally (Section 4), it was argued that strong decoupling may not be possible to combine with strong technological development as the costs would be too high. However, under certain conditions outlined below, a 'win-win' situation may be possible, i.e. a focus on both strong decoupling and technology.

It was assumed (in POSSUM Deliverable 2) that the investments needed to both pursue strong decoupling and strong push of technology would be too high. Therefore Image III has a lower level of decoupling and technology than Images I and II respectively. Considering the proposed policy measures/packages earlier in this Chapter, it seem that they do not in general involve high investments. The proposed changes are very different to what can be regarded as business as usual. Therefore an image with Decoupling+++/Technology+++ might be feasible.

Possible constraints

A tentative conclusion is that transport policy measures together with other actions in related sectors (such as land use and the development of industry) can achieve the targets set in the three Images. And there also seems to exist options for an Image IV with both strong

technology and decoupling (Technology+++/Decoupling +++). In this case there is a good base for later achieving more far reaching sustainability goals. To reach such an Image requires a high level of commitment and intervention of decision bodies across all sectors. The capacity for preparing decisions and implementing them is likely to be a bottleneck in realising this Image. Transport policy at the EU level is only one of many competing areas of action.

If the conditions prevail for co-operation on all levels this may, however, be an attractive alternative. The issue addressed in the POSSUM project is sustainable mobility, which is a subset of sustainable development. This deals with the question: how can a social and economic development be possible globally without destroying the ecological systems and depleting natural resources? It can be argued that heading for sustainability before it is too late is not a choice but this is a question that should have high priority.

5.8 CHOOSING INITIAL MEASURES

5.8.1 Some principles

It is not reasonable to work out complete plans for a time-span of 20 years or more. Things will happen that are not possible to foresee, making plans obsolete. The POSSUM scenarios are intended to *guide policy making today*, but with a view to long term goals of sustainability, also considering different possible developments of such contextual factors as values, life-styles and climate for co-operation. The long view of POSSUM will help to widen the scope of options considered, but the aim is to advise short-term policy making.

In this section we will discuss what measures could be implemented today as a first step that paves the way for later decisions and eventual goal attainment. We will not provide a detailed list of concrete measures, but rather discuss principles and give a few examples.

If Governments and the EU commit themselves to the long-term goal of sustainable mobility in Europe, then a persistent policy should be developed aiming at this goal. This policy will have to evolve step by step and continuously be adapted to external factors that are more or less impossible to predict and control. It should be possible to take some measures directly and to prepare later steps. We suggest a few guiding principles for choice of *initial measures* to be included in a start package:

- The measure should not be too controversial today (*principle of acceptability*).
- Measures that are essential to goal fulfilment but will have a delayed effect should be implemented early (*principle of inertia or long lead-times*);
- Measures that will set dynamical processes in motion should be implemented early (*principle of dynamic effects*).
- Measures that tend to retain freedom of action in the future are often to be preferred to measures leading to lock-in solutions (*principle of adaptability*).

Only the first point is (close to) a necessary condition. The others are not really disjunct but have different foci. Measures fulfilling the first principle may be qualified for inclusion in a start package by complying with either of the other principles. These will be discussed in the following sections.

Acceptability

In this study we have assumed that measures that are intended to change peoples travel behaviour, will have to be accepted or at least tolerated by a majority. Now we want to elaborate on the subject of acceptability, by commenting on a few aspects.

1) In the long run a governmental policy generally requires the support of a majority of the general public. Admittedly, though, there are examples to the opposite - the Swedish restrictions on sales of alcohol is a case in point, speed limits in some countries may be another example. In such cases the actual question has generally not been a real issue in political election campaigns, either because it is a minor question or because the political establishment has a common view across party boarder-lines.
2) In many cases, such as the decree to use safety belts in cars, political decisions have actually had an influence on attitudes. Politics is not just about reflecting prevailing preferences but also about forming opinions.
3) Judging from actual travel behaviour, one may be lead to underestimate the support for change. Thus, some commentators have taken a rather pessimistic view on people's willingness to accept restrictions or higher costs on the use of private cars in urban areas. In cases of a conflict between the common good and the interests of the individual (i.e. *social dilemmas*)[1], the latter will win according to this view. The group of idealists will always be small, while the great majority are assumed to act with purely economic interests, always seeking to optimise the benefits[2]. These analysts tend to overlook that there is a possible stand between that of the true idealist, always acting for the common good regardless of what other people do and, on the other hand, that of the selfish economic man who does not care about the common good. People taking the attitude that they want to act according to the common good *if most of the other people do the same* is key to a solution. If this group and the idealists together form a majority, then political initiatives promoting behaviour in accordance with the common good will be tolerated. There are studies indicating that a majority of commuters in some big cities would welcome restrictions on private car use. This attitude also prevailed among those who commuted by car today. The discrepancy between attitudes and actual behaviour may be explained by the logic of social dilemmas.
4) The support or acceptance of a sufficient number of industrial and other interest groups and institutional actors is also required.

Inertia and long lead-times

Inertia and long lead times is the main rationale of taking the long view in planning and decision making. When the greenhouse effect is being perceived as an emerging threat to society, one should start taking actions now, because they will have an effect much later. We cannot wait until the problem is manifest. Because of the long time between decision and desired effect, the policy is also exposed to changing circumstances that are to some extent impossible to foresee. Some measures may also have unexpected effects. This calls for a strategy of flexibility and adaptability. Here we will focus on the long lead times and the need to take actions early. A major change of the built structure (land use) has a potential to

1. See section 2 and Deliverable D2, pp 15 – 17
2. This is the explicit assumption made in a Swedish scenario on sustainable mobility by Naturvårdsverket (the Swedish Environmental Protection Agency) see *Att miljöanpassa Sveriges transportsystem – en scenariostudie* (Adapting the Swedish Transport System to the Environment – a scenario study), SNV report no.4633.

influence travel patterns and mobility much, but will also take a long time to achieve. In 20 years time a considerable effect should be possible, provided that policy measures are taken early. Several studies indicate that a spatial pattern of 'decentralised concentration' would minimise travel. This means a concentration of settlement, services and work places to centres that are nodes in a public transport system. Similarly, decisions taken now on the basis of the locations of new housing, services and facilities will influence travel patterns in the future.

Adaptability to changing contextual circumstances

Decisions today should not unnecessarily restrict the scope for future decisions. That is the meaning of this principle. When the impact of strong measures is hard to predict, a good strategy may be to make piece-meal changes and to test several solutions in small-scale experiments. This will be discussed at the end of this section (see 6.5.3).

To catalyse positive dynamic processes

The most efficient way to achieve a change in, say, settlement patterns may be to trigger a different system dynamics. One example is the introduction of tele-cottages in urban sub-centres, thereby facilitating tele-commuting. When more people stay in the suburb during daytime, the market for local services such as lunch restaurants and shops will grow. This in turn will attract some more tele-commuters and perhaps also new work places. The initial policy measure may be said to *catalyse* an accumulation process that may lead to more self contained sub-centres and less travel.

5.8.2 Discussion

Here we will give a few examples of measures that we think should be implemented early. They are chosen because they seem to have a large potential to contribute to a better environment, while at the same time they are possible to introduce stepwise. To what extent they will eventually be used and at what pace they will be introduced will depend on contextual factors, such as prevailing values in society. The list of measures discussed below is by no means a complete start package, it is just meant as illustrative examples.

Tax reform: A shift of tax base from labour to the use of natural resources would mean a strengthening of incentives for dematerialization and energy conservation. For example, this would tend to favour lighter vehicles and fuel efficiency. In the long run, the volume of freight being transported would also go down. It should be noted, however, that a tax reform concerns politics at large, not just transport policy. Therefore, discussions and mobilisation of stakeholders across different policy-areas is necessary. This may take some time, but the process should be started now. There is also a need to study likely effects of a tax reform in more detail and to work out a concrete design for the reform. The amount of taxation being switched from labour to resource use may be increased step by step depending on the support that can be mobilised. A fast and radical change may hurt traditional branches of industry such as mining and metal manufacturing. At the same time knowledge intensive industries such as IT, medical equipment and pharmaceuticals would gain by the reform. The same holds in general for the service sector. The tax reform would, thus, reinforce the already ongoing structural change of European economies.

The role of the European Commission could be to catalyse policy discussions across policy areas and involving different stakeholder groups. The Commission could also initiate committee work regarding how to design and launch a tax reform, its likely effects. Also, there should be a follow up and evaluation program for the reform.

Experiments with environmental zones. Environmental zones could be introduced in some big cities showing an interest in testing this measure. The idea is to create a niche for cleaner vehicles, such as electric or hybrid cars, where the producers can get experience and gradually cut the costs. The emission levels that are permitted may be lowered gradually in order to stimulate continuous improvements of vehicle technology. This measure is different from the present experiments with new fuels for city buses in that it just defines the goal – low emission levels – and lets the market pick the most efficient solutions. By sponsoring a few good examples the Commission may trigger a cumulative development, where several cities join in. *The role of the Commission* could be to catalyse the process, by establishing a network of interested cities. Also, the Commission could lead an investigation regarding the best model to be applied. A follow up and evaluation program should be established.

Tele-cottages. This could also be launched as an experiment with participation from interested urban regions. The idea is to stimulate tele-commuting and thereby directly diminish passenger travel. Even more important, however, is the intention to catalyse a different dynamics for land use development in large urban areas, which would tend to decrease travel even more – as indicated above (under the heading *To catalyse positive dynamic processes)*. *The role of the Commission* could again be to catalyse a network of interested urban areas and to carry out evaluations and disseminate experiences gained.

Road-pricing. This measure, which is intended to reduce car traffic into city-centres and on heavily overloaded roads, should be employed together with measures that provide alternatives, such as efficient public transport or IT facilities making tele-commuting and tele-shopping easier. Urban areas interested in trying this measure could make a start and hopefully provide good examples to be followed by others. In this sense this policy may be employed step by step. But those cities that go for it should apply efficient levels of taxation from the start, provided that they can simultaneously provide good alternatives to the private car. *The role of the Commission* is again that of an initiator and co-ordinator of urban programmes.

In Table 5.9 below we summarise the discussion of the four examples in terms of the principles for choice of initial measures introduced in the first part of this section.

TABLE 5.9 SUMMARY OF CHARACTERISTICS OF THE POLICY PATHS

	Acceptability (today)	Long lead times	Adaptability	Changed dynamics
Tax-reform	OK, if introduced in a piece-meal manner	Yes	Yes	Yes
Environmental zones	In some cities but not in all	Can be introduced as experimental areas quite quickly	Yes, the critical values of emissions may be increased step by step	Yes, will give incentives for technological Development and market penetration
Tele-cottages	Probably OK	Yes	Yes	Yes
Road-pricing	Varies, but should be possible in some places	Not in principle unless new legislation is introduced	Yes	Yes, if combined with other measures, such as improved public transport

5.8.3 General Conclusions

In some areas the system dynamics governing development is only roughly understood. The predictability is low, at least in the longer term. This holds for the interdependence between travel behaviour, infrastructure development and spatial patterns of production and residential areas. The same is true for the development and dissemination of new technology, such as cleaner and more energy efficient vehicles. Although the economics of knowledge intensive production and the competition between new technological solutions can be clarified, it is generally not possible to foresee the development in the specific case[1]. In other problem areas the system dynamics is simpler and more transparent, lending itself to relatively good predictions.

The potential impact of policy also varies from area to area (and over time). It is very difficult to influence driver behaviour, such as speed by policy measures. There are simply not police resources enough to patrol all roads at every hour. Fast driving has to do with attitudes that are very difficult to influence.

On the other hand economic incentives, city planning and supply of good public transport certainly will have an impact on trips by private cars in urban areas, although it is hard to say how much. Also, there may be unpredictable and unwelcome side effects of the policy. In Table 5.10 the dimensions of uncertainty and potential impact are combined to form a framework for discussing political strategy.

TABLE 5.10 LEVELS OF CERTAINTY AND IMPACT OF POLICIES

	Large uncertainty	*Limited uncertainty*
Potential impact of policy is large	1 Testing &Learning Small scale experiments; Incremental change and frequent follow ups;	2 Find stable solution Lock in to good solution may be acceptable; Retain some adaptability;

1. See for example B. Arthur, Positive Feedbacks in Economy, *Scientific American*, Feb 1990, and B. Arthur, Increasing Returns and the New World of Business, Harvard Business Review, July-August 1996.

	Large uncertainty	*Limited uncertainty*
	Market incentives; A variety of approaches; Retain freedom of action; Avoid early lock-in;	
Potential impact of policy is limited	Learning & safe-guarding Follow development; Safeguarding against bad effects 3	Adapt to trend Plan for adaptation to the expected development; Seek opportunities to benefit from the development 4

Of course, in reality there is a continuum between large uncertainty and little uncertainty as well as between large potential impact and little potential impact. It may, however be clarifying to identify the poles of the strategy field.

In quadrant 2, the dynamics of the relevant system is relatively well known and the development can be predicted within reasonably narrow limits. The impact of policy making is large, and no big unexpected effects are likely. In any broader area of policy, this seems to be a rare situation. However, this is the case where public planning, large investment programs and control may be used. It may be OK to lock-in the development, but usually at least some adaptability must be retained, because one cannot rule out the possibility of surprise all together.

In quadrants 3 and 4 the impact of policy is limited. In the case of large uncertainty, the strategy should be to follow the development, try to learn how the system works and prioritise safeguarding against especially bad effects. In the case of small uncertainty the strategy will be to find the best way to adapt to the expected development and to identify especially favourable options.

As for quadrant 1 we think several issues concerning sustainable mobility belong here. It may even be that the emphasis of the Common Transport Policy should lie in this field. Quadrant 1 is characterised by relatively large uncertainties as regards how the studied system will develop and by that the potential impact of policy measures is relatively large, although the effects may be hard to predict. There may also be undesirable side effects. The four examples of initial measures, which we discussed in the previous section, were chosen to illustrate a strategy for quadrant 1.

Because of the lack of predictability it is important to proceed in small steps and to have frequent follow-up activities. One example is the approach to tax reform discussed above. It is also preferable to try several solutions in order to gain experience and learn, as in the example of environmental zones. Part of the strategy outlined here may be called an *evolutionary* or *Darwinian approach*. The role of public policy is then to promote variety and to set targets that play the role of selection mechanisms. Another element, beside the Darwinian part, is to catalyse a new dynamics that may lead to a more favourable development, as in the example of Tele-cottages in the preceding section.

6. VALIDATION

6.1 THE VALIDATION APPROACH

In the POSSUM methodology for developing actor-oriented policy scenarios, validation plays an important role. As the policy scenarios deal with complex systems and as qualitative estimations and statements play an important role, the involvement of a variety of actors is important for developing coherent scenarios and for identifying the key issues. At the same time the validation process is already part of the dissemination strategy of the project results. Three aspects of the POSSUM project have to be validated (Figure 4.1):

- the framework, including the overall methodology and the Images;
- the policy paths including the technology and decoupling potentials; and
- the overall conclusions and recommendations.

The project has two main results, which must be kept in mind during all validations:

- a methodological framework for developing, discussing and evaluating long-term transport policy strategies; and
- concrete sustainability targets, Images and paths which help to identify key issues and to propose innovative approaches.

6.2 VALIDATION OF THE FRAMEWORK

The framework as described in deliverables 1 and 2, has mainly been validated through a series of meetings with transport experts from the scientific community[1]:

The results of these discussions have been incorporated in the papers concerned. Overall, the POSSUM approach has been considered to be innovative, appropriate and useful. However, the complexity of the scenario construction repeatedly made it difficult to discuss the whole issue in a short amount of time. The main points that emerged from these discussions are the following:

- *Decoupling* is an important concept for future transport policy and considerable efforts in this direction are necessary in order to achieve the targets. However, there is considerable uncertainty about the potential and useful measures. *Technology* developments are difficult to forecast, the use of technology depends on the general conditions and does not always correspond to the original intentions. The *backcasting* approach developed by POSSUM is seen to be a very interesting complement to the more conventional forecasts in other projects. It requires a way of thinking about future situations which is difficult

1. Validation meetings include:
   - validation workshop with 8 experts in Stockholm (8.9.97)
   - presentation and discussion with 21 experts in a workshop in Bad Boll, Germany (1.10.97)
   - joint meeting with the SCENARIOS project, London (27.11.97)
   - validation workshop with 13 experts of the NECTAR network in London (15.1.98)

   In addition among the numerous presentations and discussions of POSSUM papers on various occasions the following have been particularly useful for validation:
   - MISTRA workshop, Amsterdam, December 1996
   - ERSA conference, Rome, August 1997
   - PTRC conference, London, September 1997

and unfamiliar. It is considered to be particularly useful in transport policy where strategic thinking needs to be more developed.

- *The policy scenarios and the targets* should not give the impression of quantitative precision. They can only indicate orders of magnitude, key issues, key trends and key options. The targets could be complemented (e.g. noise and other local impacts, economy). The Images of the Future are considered to be consistent and useful. It must be made clear that they are alternatives reflecting assumed frame conditions: the choice of alternatives lies in the construction of the paths.

On the basis of these discussions a concise and condensed presentation of the framework has been developed and has been presented and discussed[1]. In terms of the research framework, the main results were:

- The backcasting approach and thinking 20 years ahead are rather unfamiliar for most officers responsible for the single policies. However, most of them think that similar approaches are increasingly necessary
- The POSSUM framework could provide a useful support for meeting the growing need for a long-term policy strategy. The basic construction of the framework is consistent and useful. The concept of decoupling proposed by the POSSUM project has meanwhile been introduced in official policy.
- After the political developments in the last two years, the CO_2 target is well above the present official targets. However, decoupling remains necessary nevertheless.
- Decoupling strategies require cooperation of transport policy with other policy fields. This seems to be increasingly an issue. When transport policy ceases to have only a serving function and sets own targets, it needs to have convincing arguments for asking measures in other fields. Backcasting scenarios can be a useful help in argumentation.
- As a management instrument that allows the development of policy strategies the POSSUM framework needs to be flexible in its use. A series of alternative paths would be helpful. To fill the framework with a rich collection of measures, packages in order to provide a kind of toolbox could be a challenging and useful next step.

6.3 VALIDATION OF THE PATHS

The validation of the framework has mainly the role of improving consistency, providing expert information and helping to discover new approaches. The validation of the policy paths also has the purpose to explore more in detail the impact and the acceptability of proposed policies. Therefore at this stage a wide range of stakeholders should be involved. The validation should help to balance policy packages, to minimise implementation difficulties and to understand the differences between different countries and regions.

The number of paths actually constructed in the POSSUM project is rather limited and so is the extent of the validation. As a next step it would be challenging to go further into the iterative process and construct more paths and to validate them with a larger variety of stakeholders in different countries. Within the POSSUM project the validation of the paths consisted of the following:

1. In a workshop with about 20 representatives of DG VII including the director general, Mr. Coleman (27.4.98). A series of one-to-one discussions subsequently took place with 10 officers of DG VII (18. and 19.6.98). These discussions (in which the draft paths were also discussed) gave a very useful insight into the ways in which the European Commission might use the results of the project.

- validation workshop with stakeholders in London (12.6.98)
- one-to-one discussions in Brussels with DG VII officials (18-19.7.98)
- validation workshop with stakeholders in Florence, Italy (20.7.98)

The London workshop among others gathered representatives from the UK Department of the Environment, Transport and the Regions (DETR), the Pedestrians Association, the Office of the Traffic Director for London and the Royal Automobile Club (RAC). It concentrated on the passenger transport in a draft path for Image I. The discussion partners in DGVII of the European Commission included officers responsible for development and analysis of policy, institutional affairs as well as different transport modes. The discussions covered the following questions:

- are the policy paths consistent?
- are the proposed policy packages effective enough for meeting the targets?
- what are the consequences for different stakeholders, which conflicts will arise?
- are the policy measures adequately packaged and timed, are additional / other policies needed?

Besides a series of minor aspects, the following consequences emerged from the discussions in London and Brussels:

- Stakeholders are not used to this type of thinking. Some discussion is needed before a useful assessment of complex policy packages in a longer time horizon becomes possible.
- Discussion of the paths produces interesting insights for both the POSSUM project and for the stakeholders involved.
- It is difficult to assess the impact of longer lists of policy measures, it would be useful to break down the paths in smaller policy packages.
- More differentiated approaches in time and space (urban / rural) would considerably widen the margins of action.
- Air traffic cannot be excluded from the scenarios (as originally decided after budget reduction for POSSUM)
- Participants of the London workshop strongly shared the view that the increase of road transport has to be curbed. Policies acting on costs and on lifestyles were considered to be most promising.

As a consequence of these discussions, the POSSUM team revised the paths and packages. The Florence workshop then was focused on an early version of path 1.1. Hosted by the Regional Government of Tuscany[1], the Florence workshop took place on the background of ongoing institutional reforms in Italy which also in the transport sector will lead to a strong deferral of competencies from the national to the regional level. The 15 high-ranking participants came from the national level (including board members of WWF and the Italian national railway company – FS), from the regional level (several departments and agencies of the regional government), and from the local one (Public transport company and city government of Florence).

Whereas in London the participants liked to focus on concrete policy measures, despite a detailed presentation of path 1.1., the long and intensive discussion in Florence concentrated on basic conceptual and political issues. The backcasting approach was considered to be very useful for discovering new political options and for elaborating strategies. The concept of

1. This was possible thanks to the cooperation with Studio Ricerche Sociali, Florence.

decoupling was considered to be challenging and interesting. However, in the Italian context decoupling was considered to be more a necessary consequence of several intermediate steps than an immediately practicable political strategy. The following key issues emerged from the discussion:

- To find a new way of sharing responsibilities between different government tiers in the spirit of subsidiarity is considered to be essential for a more differentiated and adequate way of governing transport, e.g. in the field of taxes and tariffs. The approach of differentiated taxation as proposed in path 1.1. was welcomed.
- Decoupling is a difficult task in highly interconnected industrial districts which are a characteristic of central Italy. High technology solutions for improved transport organisation and for substitution of transport by IT are considered to be interesting approaches.
- As a consequence of the whole post-war development in Italy, mobility is strongly perceived as an element of freedom and of the quality of life. Therefore decoupling should not be promoted as a limitation to the freedom of movement but more as the discovery of new opportunities for improving the quality of life and the quality of transport. Confronted with a 'culture of mobility' a cultural shift has to be promoted cautiously. Lifestyle-oriented policies are therefore considered to be important.
- Traditional theories concerning transport and economic development are still strongly rooted among the main actors. The emphasis in transport policy is therefore put on the supply side. Demand side policies (tariffs, taxes etc.) are mostly perceived as a mere support for supply strategies. The main actors therefore think that at least in the short term inducing a modal shift by improving public transport – which is considered to be of very low quality –is more important than decoupling.
- The integration of transport issues into other policies is considered to be most important. Decoupling policies cannot be promoted by transport policy alone.
- The internalisation of external costs is considered to be a necessary but insufficient strategy. Given the present cost structure in Italy, a simple internalisation of environmental costs could lead to unwanted effects, e.g. to penalising the railways. It has to be considered that the considerable labour costs in public transport companies are not mainly due to operational necessities but often to the important social function of public enterprises.

6.4 CONCLUSIONS

The POSSUM project has provided a useful framework for structured discussions of a wide variety of future transport issues. It seems to be a logical next step to use the POSSUM results as a basis for discussion and validation with a much larger variety of stakeholders in a series of different European Countries. The limited number of validation meetings that could be carried out within the POSSUM project has shown the difficulties and the promises of such an opening of the scenario building exercise to a much wider circle of participants. It takes considerable effort to convince stakeholders in responsible positions to spend time on discussing such long term questions. Compared to the complexity of the issues, meetings have to be quite short, and the possible depth of discussion is limited. Especially decision-makers which do not perceive themselves as being strongly involved in transport issues are difficult to reach.

The backcasting approach and the concept of decoupling are not familiar to most stakeholders. On one hand this has the disadvantage that it takes a long time to explain and discuss these

concepts before being able to validate more concrete policy packages and policy paths. On the other hand, these concepts encounter much interest, they challenge conventional views of the transport community and, as many participants have said, lead to new insights and innovative ideas that may influence their everyday decisions. Therefore, in each validation exercise an appropriate balance has to be found between the discussion of the general framework and the validation of specific issues to be looked at in more detail.

The reactions to basic concepts and to more specific propositions in the policy packages differ between different European countries and regions. It is evident that a successful transport policy, especially when it is not limited to the transport sector but also relies on other policies, has to take into account national and even regional specificities. The POSSUM packages and paths until now have not been differentiated in this sense.

Validation therefore cannot be conceived as a one-way exercise in which the project only gets input for improving the scenarios. It must also be considered as a kind of dissemination of results. Moreover, these discussions seem to be an interesting part of a transformation process in which views and perspectives concerning European transport issues are changing. However, the POSSUM validation exercise has shown that the development of a common language for discussing endeavours for a sustainable mobility across different European regions, different policy fields and different kinds of stakeholders is a challenging task which will take a longer time. A broad and systematic validation effort of the POSSUM scenarios across different countries and different constituencies could be a viable and helpful effort in this direction.

7. RELEVANCE OF THE IMAGES AND POLICIES TO POLAND & RUSSIA

7.1 POLAND

The relevance of the POSSUM Images of the Future and policy instruments for countries of Central and Eastern Europe (including Baltic Republics) was considered in the course of the project through analysing specific situation in countries such as Czech and Slovak Republic, Hungary and Poland as well as Estonia, Latvia and Lithuania. Poland was selected as a representative of this group of countries. While there are some differences between these countries, conclusions concerning Poland can be considered as valid for the whole region.

In the course of validating the POSSUM Images of the Future and policy instruments, a workshop in Warsaw was held in May 1998 with a group of policy-makers, researchers, experts and NGOs[1]. From this meeting, other conferences concerning the region and earlier POSSUM questionnaire the following conclusions have been formulated:

Generally, there is awareness that all possible efforts have to be made to redirect the present trends in transport, which are not always sustainable. Growing income accompanied with changes in lifestyles have been leading to a rapid shift to road transport in passenger transport. The same is observed in freight transport where railways with extensive networks but low quality and efficiency cannot compete with road transport.

The main project concepts and proposals were positively received. As regards POSSUM Policy Targets for 2020, there were considered as acceptable and relevant, except specific targets concerning CO_2 and NO_X emissions that will be difficult to meet in groups of countries concerned. Taking into account starting level, with relatively lower mobility, it seems sensible that CEEC countries should be allowed to increase their transport volumes more than in the EU countries. Consequently, even with similar technological progress, emission targets should be lower in CEEC/CIS. This may require that a larger reduction of emissions will be required in EU+3 countries if the targets are to be achieved across the area (EU+CEEC+CIS) as a whole.

Diverting the present trends in consumption and behaviour will not be easy. Motorisation in CEEC is growing even more rapidly than incomes and this, is to a very high degree stimulated by the aggressive policy of the automobile and oil EU industry. To control the situation and change current trends, concerted policies of EU and national governments are needed.

In CEEC several cases were noted of political decisions of local governments adopting sustainable transport policies. However, when concrete actions were needed, implementation appeared to be extremely difficult. At the state level, situation is even more complex, as it is illustrated by, for example, a recent decision of the Polish parliament[2] to increase speed limits on motorways and expressways. At the same time, government proposals to reduce speed limit in urban areas from 60 kilometres per hour to 50 kilometres per hour have been rejected.

1. more detailed information on the workshop is contained in Appendix 3.
2. the traffic law was amended in 1997.

As regards specific POSSUM scenarios, there was no strong view on which Image of the Future might be more appropriate for CEEC. At the same time, opinions were expressed with regard to specific measures such as:

- with the present preferences slowing down motorisation growth will be very difficult;
- progress in vehicle technology is possible, but as was stressed above, it will depend on how successful EU countries are in implementing POSSUM targets for industry (e.g., lower average fuel consumption and reduces weight, new fuels etc.);
- fiscal measures such as road/parking pricing would probably be very effective in CEEC; however, it will be very difficult to have them accepted by policy-makers and people in general; nevertheless, they have to be kept on the top of the list;
- maintaining a leading role of public transport is still possible; in particular, better use can be made of existing railway infrastructure and extensive urban tramway systems, but it requires political will; unfortunately, emphasis is placed on few capital intensive projects such as high speed rail;
- land use planning has a long tradition in the CEEC. Unfortunately, in the course of political reforms it was weakened and it will take time before its great potentials may be used to promote transport-effective urban patterns.

To summarise, validation has shown that POSSUM ideas are relevant to CEE countries. However, targets, scenarios and concrete policy measures would have to be further analysed and, perhaps customised taking into account specific conditions in countries in question. Nevertheless, POSSUM ideas and proposals deserve to be widely disseminated in CEEC as they may play a positive role in educating policy-makers, officials, professionals and other actors.

7.2 RUSSIA

The deformation of the price system in the Soviet Union made it possible to transport enormous volumes of freight for long distances. According to Hall (1993), transported tonne-kilometres per unit of GDP in the Soviet Union in the late 1980's were almost six times that of the United States. As a consequence mining, metallurgical and other heavy industries could be established in the Arctic and Far-East regions of Russia. Heavily subsidised air flights served person transport for these areas. During the 1990s transport volumes in Russia have decreased. Nowadays in the railways cargo is 40 percent and passengers 60 percent of the earlier volumes. The corresponding figure for passenger transport in aviation is 40 percent and for cargo in inland waterways 20 percent. Unlike in the other transport modes there has been a significant increase in road traffic, especially in the number of private cars.

The railway network is well developed in Russia - there are 87,000 kilometres of railway lines, which however, suffer from some quality problems. In Russia - outside the western part - roads play a minor role - the length of all highways in Russia is only 53,000 kilometres. The length of inland waterways is 84,000 kilometres. Under the old regime, sea transport played an important role, but it still has a shortcoming - like the other modes of transport - poor transport logistics. Former Baltic ports in the Soviet Union belong now to the Baltic States, which serve import and export flows to/from Russia. The number of airports both for international and domestic traffic is adequate. However, most airports and air traffic control systems are out-of-date and require upgrading, also the fleet is old. In the former Soviet Union urban transport policy was public transport-oriented. During the 1990s, most public transport

systems have been neglected and a lot of former services has been abandoned (see also Himanen, et al. 1995).

Regional issues are a very big problem in Russia. The eastern and northern regions of Russia have nowadays very poor economy and accessibility. The accessibility problems are mostly due to the vanishing of the earlier subsides to the rail and air transport.

Protection of environment has not been a major concern in Russia even though air pollution in major cities is already severe. Even with current volumes of road traffic safety is very poor and about 250 people per million persons are killed on Russian roads annually. Also security problems are actual in freight transport. Border crossings form crucial links in international road transport. Nowadays existing points are overburdened which together with poor management result in long queues and delays for road traffic.

The current economic situation in Russia is still quite unstable and all sectors are under large-scale transition. This has of course implications for transport policy. Because of the current unstable economic situation and the big decrease undergone in transport volumes the POSSUM Images of the Future were not considered to be very relevant in Russia in the short term. However, in the long term almost every measure was considered to be feasible also in Russia. The exceptions were high increases on aviation fuel taxes and very strict emission standards. The reaction on the first one can be understood against the care for the accessibility when considering the wideness of Russia and the length of international links. The last one may mirror the general attitude with only moderate concern on environmental issues.

From the measures in Image I none was considered feasible. However, three measures were considered to be acceptable in a limited scale:

- Promotion of transport saving information technology;
- City planning in favour of public transport; and
- Information about resource use for instance to enable the choice of local products.

Three measures in Image II were considered to be feasible. Those were:

- Upgraded East-West railway links;
- Increased spending on R & D for new vehicle technology; and
- Promotion of combined freight transport through harmonisation of railways and new intermodal centres.

The information from Russia proved that current economic problems and previous abrupt decrease in transport volumes influence strongly current transport policy. Only the measures that improve accessibility were considered to be feasible and actual. However, there was a feeling that in the longer term also environmental issues will get more concern. It is obvious also that sea transport and railways will form the major modes - which is also good from the environmental viewpoint - for the transport of goods between the European Union and Russia.

8. CONCLUSIONS

8.1 INTRODUCTION

The overall goal of the POSSUM project has been to develop a set of alternative policy scenarios to assist in decision making on EU transport policy. In particular, strategies have been developed to make transport policy consistent with sustainable mobility. The scenario building process has been divided into three main stages which the POSSUM consortium consider are essential components of the process:

- Targets
- Images of the Future
- Policy Measures/Packages and Policy Paths

This final report has brought together all these components in the three central Sections (Sections 3, 4 and 5). In this conclusion, we make some detailed comments about the methodology and the broader conclusions form the project.

The overall view has been that the comprehensive scenario building methodology, developed and tested by the POSSUM consortium provides an innovative tool for taking a longer-term perspective of transport policy, particularly within the context of sustainability. It allows imaginative combinations of policies to be adopted to achieve the challenging intermediate targets set for sustainable mobility, within the Images of the Future. The combinations of policies, their packaging, the timing of implementation, the paths from now to 2020, the responsibilities and roles of the different actors can all be included in that process. Throughout the project, considerable effort has been placed in presenting interim results to decision makers and researchers through the validation process as well as numerous conference presentations. The implications for the wider Europe have also been addressed through participation in the consortium and through workshops in Poland and Russia.

8.2 THE SCENARIO BUILDING METHODOLOGY

1. The POSSUM project has used a backcasting approach. This includes setting Targets for sustainable mobility for the year 2020 and analysing the impact that new transport technology can have in that timespan. The forecasts for transport growth still show expectations of continued growth in transport volumes (both passenger and freight). Those expectations are incompatible with the sustainability targets. Three Images of the Future has been outlined that has transport volumes compatible with the targets and alternative assumed levels of average transport technology use in 2020. The strength of the approach is that the magnitude of change relative today or a reference case can be estimated. The second part of the project has been devoted to analysis of different policy measures that can promote a development in the direction required to reach the Images of the Future.

2. The interpretation of sustainable mobility has included three dimensions:
   - Environmental Protection
   - Regional Development, and
   - Economic Efficiency.

In the research, it has been clear that the regional development and economic efficiency dimensions are hard to give a precise interpretation of how the transport sector should be changed to fulfil the assumed targets. There are two reasons behind this conclusion. First, the major influence on these targets comes from developments outside the transport sector. Second, they have more to do with how well a given transport system works, rather than how it is designed. So the environmental protection dimension has had the major impact on the design of the Images of the Future. The environmental dimension is instrumental in achieving sustainable mobility.

3. The key objective of the Common Transport Policy (CTP) is that we should seek to achieve sustainable mobility. At present, sustainable mobility is an example of what is called 'the Tragedy of the Commons', where people share a common ideal but individual over-use of that resource ruins it for everyone. To solve this problem requires co-operation, otherwise there is an overproduction of common 'bads' and an underproduction of common goods. This co-operation can be either on the level of political interventions (top-down) or by 'grassroots' initiatives (bottom-up) - or at both levels. The POSSUM Images of the Future have distinguished between three alternatives, but in all cases co-operation on the EU level is assumed. This assumption is consistent with the basic rationale behind the CTP:
   - Image I - with local, regional and EU cooperation: *EU Coordination of Active Citizens;*
   - Image II - with global and EU cooperation: *Global Cooperation for Sustainable Transport;*
   - Image III - with both local and global cooperation: *Accord on Sustainability.*

   The importance of this contextual dimension must be emphasised, particularly when the implementation of different policy measures is being evaluated. It is often neglected in policy discussions.

4. The outcome of the POSSUM scenario building process are recommendations about what policy decisions need to be taken now in order to reach the assumed targets for sustainable mobility. It is recognised that sustainability is not a definitive end-goal, but it is a direction which policy can head for. Hence the targets used in POSSUM are intermediate ones.

5. POSSUM also gives advice on the roles of these policy decisions in subsequent decisions. But it must be emphasised that the policy measures/packages and paths presented in the final report are not rigid plans for future development. It is a methodology that puts near time decisions in a longer time perspective and based on today's best knowledge. More or less unexpected developments will result in revision of the images of the future and the alternative paths to the images. This calls for flexibility and adaptability.

6. Policy options have usually been tested in isolation under restrictive conditions. Although intuitive policy packaging is already a reality in political decision making, the POSSUM project has explicitly combined policy measures into policy packages, and has then put the policy packages together as paths which is likely to lead to the Targets and Images set for sustainable mobility. The basic argument here is that

combinations of policies are more effective in achieving sustainable mobility objectives than individual measures. Although composite policies make it harder to assess the overall impacts, it does allow the direct and indirect effect of individual measures to be assessed. It also permits the advantages and disadvantages of each measure (individually and as part of a package) to be discussed so that compensating actions can be taken. By introducing packages of measures, policies are less seen to be restrictive or permissive, but are related to achievement of particular objectives (such as sustainable mobility).

In summary, the main methodological contributions made by POSSUM are:

- To further develop the idea of Target setting and backcasting. Putting this concept into operation requires a public discussion on Targets and effective monitoring that requires flexibility in action if intermediate Targets are not achieved;
- To develop a framework of Targets, value orientations, Images, key issues, hot spots, key strategies and policy orientations to facilitate a discussion of these issues;
- To develop an innovative methodology for the construction of the paths in a backcasting framework;
- To propose a means by which the intuitive packaging of policy measures can be combined with a systematic assessment of these packages in a backcasting framework;
- These tools are aimed at supporting a target-oriented management process in transport policy. Such an approach requires a considerable mental, organisational and behavioural effort compared to conventional incremental policies which have proved to be conflict laden and not particularly effective. This is so partly because they often have a too short time perspective. In a longer time perspective, the gains of specific measures will be more clearly visible, and therefore changing the balance between benefits and efforts.

8.3 POLICY CONCLUSIONS

1. **Decoupling**: If transport is to become more sustainable, then positive policy action is required along the two main POSSUM dimensions - technology and decoupling. Even if the strongest priority is given to technology, this is not sufficient on its own to achieve the POSSUM targets or images. This conclusion is based on the notion that transport volumes, both passenger and freight, is expected to continue to grow. Strong decoupling in both the passenger and the freight sectors is therefore also essential to achieve sustainable mobility. This means that a decrease in transport intensity of GDP is needed. The range of measures available and the means to reduce transport intensity have been outlined in this final report (Section 5).

- A wide variety of policies is available for decoupling both passenger and freight transport from economic growth. This seems possible without limiting economic growth (further analysis is however needed), but policies would need to accelerate some existing trends of structural change and lifestyle change. However, as decoupling can be regarded as a shift in the transport paradigm, such changes may result in opposition from those who perceive they may lose from these changes. Accelerated decoupling strategies will bring benefits to the overall economy, but may temporarily increase political conflicts.

- To reduce these political conflicts, two important further actions are required. The nature of decoupling and its pivotal role in achieving sustainable mobility needs to be presented to, and discussed among decision makers at all levels – an information activity. Secondly, the implications of decoupling have to be discussed with the public and business/industry to think through the necessary actions in terms of travel and activity patterns - a public acceptance activity.

2. **Technology**: Technology has a key role to play in moving policy in the direction of sustainable mobility, particularly in the longer term. In the shorter term firm action and direction is required at the EU level to promote best practice and to help push particular technological paths. For example, should research be directed at new technology (hydrogen) or at an intermediate technology (methanol); what should be the role of diesel fuel in urban areas; and how can cleaner technology and fuels be introduced in cities, together with the necessary infrastructure? These actions need to be accompanied by strong decoupling. It may be necessary to protect the market in the short term so that the appropriate conditions for technological innovation are encouraged. In the longer term there should be an open market with pricing and regulation determining which technologies are consistent with sustainable mobility.

3. **Action needed both within and outside CTP**. The analysis of different aspects of decoupling transport volume growth from economic growth clearly shows that a CTP must be supplemented by measures outside the transport sector (and consequently outside the CTP). Some of these non transport policy actions are related to structural changes in society (like the consequences of IT or inceases interest in local-regional markets). Other actions are a matter of more general macro economic policy intervention (like a tax shift from labour to resource use). But also that some developments in line with decoupling will be driven without policy interventions (like the rapid growth in the use of information technology). Here actions may be needed to cope with drawbacks, like increased urban sprawl.

4. **Dynamics and the Time Element**: The POSSUM time horizon is 2020, but this is only an intermediate stage in the process towards sustainability. As decoupling is a necessity and those measures often have a long lead-time (particularly with the use of market based measures), it is important that they start early. Technology will also be important, but measures can be taken stepwise. However, this does not mean that no action should be taken now as clear guidance is required on standards for technology (e.g. on fuel consumption and emissions), and on whether investment should take place in intermediate technology (e.g. methanol) or whether encouragement should be given to 'jump' to the ecotechnology (e.g. hydrogen fuel cells). The uncertainty about changes over time should be recognised so that flexibility permits modifications in measures and Targets.

5. **The Regional Dimension**: Much of the discussion in this final report and at the validation session has concentrated on the city and the urban transport problems. Different problems exist in rural areas and in the peripheral regions of Europe (including the CEEC and CIS countries). The differences in conditions across the EU and wider Europe requires different measures, different processes of implementation and phasing. Uniform policies concerning regulations and taxes do not produce optimal results and can create unnecessary conflicts. Ways must be found to adapt

measures to local conditions while maintaining overall EU Targets and consistency of policies. Differentiated (road) pricing may provide a useful approach to achieve Targets with regionally based policies.

6. **The Trans European Networks**: The TENs form an important component in the achievement of cohesion within Europe, but in terms of sustainable mobility, their role may be more limited. The main purpose of the TENs in the context of POSSUM is to achieve a significant modal shift from road (and air) to rail. If the TENs only increase the supply of transport and encourage more travel overall, then sustainable mobility targets will not be achieved. This means that the TENs must form part of an integrated transport strategy that packages increases in supply of rail with reductions in supply of other modes. The opportunities for the TENs are substantial, particularly if they include the new telecommunications networks which can reduce levels of physical movement. The problems of the TENs extend to the role for freight transfer to rail, and the question of European standardisation and harmonisation in the freight sector. Consideration should also be given to designing more regional and locally based networks that fed into and are complementary to the TENs. This would allow subsidiarity, with local and regional networks being decided at the appropriate decision level.

7. **Air Travel**: The dramatic increase in passenger and freight travel by air (about 6% growth per annum or doubling every 12 years) is a major constraint on the achievement of sustainable mobility targets, as it is both long distance and energy intensive. Although not central to the POSSUM project, this growth makes decoupling much harder. The development of new technology with larger aircraft and later hydrogen powered engines may help to reduce energy use and emissions per passenger kilometre. But the effects of H_2O and NO_x emissions at high altitudes is still not clear. The wolume growth has also to be addressed. At present the air industry benefits from an advantageous tax situation as there is no tax on kerosene. Equal tax treatment would help raise costs and prices in the air sector, particularly on some goods, but more action is required. The low cost of air travel on shorter European routes may also affect the potential for high speed rail. But, if rail takes over from shorter air routes, it may only release more air space for long distance air travel. Achievement of sustainable mobility objectives requires careful consideration of the future of air transport.

8. **Support for Sustainable Mobility**: Throughout the POSSUM project, questions have been raised about the nature and scale of change required to achieve sustainable mobility. It is essential to achieve support both for the principles and for the practice of sustainable mobility. Many people are constrained by current value systems and conventions. In the validation process POSSUM has found strong support for the principles of sustainable mobility but equally strong barriers to real change. POSSUM has also found that there are different views from the EU countries and professions, with no clear commonality. One prerequisite for the implementation of the proposed policy packages is a gradual shift in attitude towards increasing importance of values in line with sustainable development.

9. **Complementary Actions**: Although the primary elements for the policy packages are taken from the transport sector, there are many complementary actions needed in other

sectors. These include the important role that land use and development factors have in reducing transport intensity. It also includes the new technologies within transport (e.g. telematics), new technologies as they impact on transport (e.g. telecommuting), and the possibilities of an ecological tax reform. In addition, the POSSUM project has also found that new institutional and organisational structures may be necessary to achieve sustainable mobility. Included here are partnerships between the public and private sectors to facilitate technological innovation, the development of partnerships at all levels with involved people (including the general public) to gain support for change (and to inform), new means to encourage and disseminate best practice, and the means by which progress can be monitored over time.

10. **Common Elements**: Whatever the starting point of the scenarios or the path to be followed, there are certain common actions necessary. These include consideration of ecological tax reform (coupled with CO_2 tax, fuel, vehicle and car ownership tax reform), emissions standards (including off-cycle performance, long term responsibility, automatic monitoring of emissions etc), actions to provide integrated information systems (including the personal communicator), and the promotion of teleactivities.

11. **Lifestyle Changes**: Over the next 20 years, the amount of time available for leisure activities will dramatically increase, particularly within the demographic context of an ageing population, Much of this new leisure time may involve long distance energy intensive travel as people wish to see the world. The question here is whether there is anything that can (or should) be done to reduce this expected growth as it will again severely impact on sustainable mobility. For much of the year people may be 'sustainable' with local travel being undertaken on low energy modes, but once (or twice) a year may travel round the world, thus negating any overall notion of sustainability. This means that changes in lifestyle are essential to meet sustainable mobility objectives, and that actions in the passenger sector may be harder to achieve than those in the freight sector.

12. **Possibilities of both strong decoupling and technology**: Image I was characterised by co-operation on local and regional levels (mainly bottom-up politics). Image II on the other hand was characterised by a good climate for global co-operation (mainly top-down politics). If both these frame conditions materialise, then Image III is a feasible option. Originally (Section 4), it was argued that strong decoupling may not be possible to combine with strong technological development as the costs would be too high. However, under certain conditions outlined below, a 'win-win' situation may be possible, i.e. a focus on both strong decoupling and technology. Considering the proposed policy measures/packages earlier in this report, it seem that they do not in general involve high investments. The changes proposed are more of the kind that development will take another path compared with what can be regarded as business as usual. Therefore an image IV with Decoupling +++/Technology +++ might be feasible. In this case there is a good base for later achieving more far reaching sustainability goals. To reach such an Image requires a high level of commitment and intervention of decision bodies across all sectors. The capacity for preparing decisions and implementing them is likely to be a bottleneck in realising this Image. Transport policy at the EU level is only one of many competing areas of action.

If the conditions prevail for co-operation on all levels this may, however, be an attractive alternative. The issue addressed in the POSSUM project is sustainable mobility, which is a subset of sustainable development. This deals with the question: how can a social and economic development be possible globally without destroying the ecological systems and depleting natural resources? It can be argued that heading for sustainability before it is too late, is not a choice, but that this question shall have high priority and therefore Image IV makes sense.

13. **Choosing initial measures**. If Governments and the EU commit themselves to the long-term goal of sustainable mobility in Europe, then a persistent policy should be developed aiming at this goal. This policy will have to evolve step by step and continuously be adapted to external factors that are more or less impossible to predict and control. It should be possible to take some measures directly and to prepare later steps. We suggest a few guiding principles for choice of *initial measures* to be included in a start package:
    - The measure should not be too controversial today (*principle of acceptability*).
    - Measures that are essential to goal fulfilment but will have a delayed effect should be implemented early (*principle of inertia or long lead-times*);
    - Measures that will set dynamical processes in motion should be implemented early (*principle of dynamic effects*).
    - Measures that tend to retain freedom of action in the future are often to be preferred to measures leading to lock-in solutions (*principle of adaptability*);

    Only the first point is (close to) a necessary condition. The others are not really disjunct but have different foci. Measures fulfilling the first principle may be qualified for inclusion in a start package by complying with either of the other principles.

14. **Strategies to cope with the lack of knowledge about impact of policy measures**: In some areas the system dynamics governing development is only roughly understood. The predictability is low, at least in the longer term. This holds e.g. for the interdependence between travel behaviour, infrastructure development and spatial patterns of production and residential areas. The same is true for the development and dissemination of new technology, e.g. cleaner and more energy efficient vehicles. Economic incentives, city planning and supply of good public transport certainly will have an impact on trips by private cars in urban areas, although it is hard to say how much. Also, there may be unpredictable and unwelcome side effects of the policy.

    The dimensions of uncertainty and potential impact can be combined to form a framework for discussing political strategy. Several issues concerning sustainable mobility can be characterised by large potential impact of policy and large uncertainties. A testing and learning strategy is then required. A Common Transport Policy should accept this lack of predictability and proceed in small steps and have frequent follow-up activities. It is also preferable to try several solutions in order to gain experience and learn. The role of public policy is then to promote variety and to set targets that play the role of selection mechanisms. It is also to catalyse a new dynamics that may lead to a more favourable development.

15. **Role of Transport**: In the past, transport has mainly been seen as having a serving function for the economy and leisure activities. Where sustainable mobility is a major

policy objective, transport cannot fulfil these demands in an unlimited way. Transport has to be integrated with other policy. Transport is at a turning point, and it is clear that transport interventions alone will not move policy in the direction of sustainability. The role of transport policy among other policies must be given a stronger emphasis, together with the different policy strategies that are required. More emphasis has to be placed in influencing economic, structural, agriculture, tourism and other policies to find the means to decouple transport growth from economic development.

The POSSUM project one that could be repeated at regular intervals in order to identify new and emerging policy issues and responses for the European Commission, particularly as technologies and political priorities change. The value of the work is the contribution that it can make to creative thinking and problem-solving in transport policy action and implementation, particularly in terms of sustainable mobility.

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GLOSSARY

BACKCASTING

A process of identifying actions (e.g. *policy packages* and *policy paths*) that lead from specific point in time to one or more specified future situations.

EXTERNAL SCENARIO

A medium or long term set of assumptions about changes in society that may affect the transport sector in the future. The external scenario describes assumptions about the autonomous development of parameters which are considered crucial for the strategy or policy to be formulated. Alternative external scenarios contain internally consistent sets of future socio-economic and technological parameters which influence the transport sector in some way.

FEEBATE

A combination of charges (fees) and rebates (e.g. higher taxes on polluting vehicles used to fund rebates for energy efficient models).

FORECASTING

A process of constructing projections based on the extrapolation of recent trends (c.f. *backcasting*).

IMAGE OF THE FUTURE

A qualitative and/or quantitative description of a future situation, often forming part of the *backcasting* process.

IMPACT ASSESSMENT

An analysis of the effects on particular areas (e.g. on economic development, spatial distribution of activities, and the environment) derived from developments and initiatives (e.g. new infrastructure projects, road pricing and other policy measures).

INFRASTRUCTURE/TRANSPORT INFRASTRUCTURE

The fixed physical structures and other common facilities serving the operational parts of a transport system.

INTERMODAL (INTERMODALITY)

A route of an individual passenger or goods unit which consists of a combined chain involving at least two different modes. For freight transport in particular, intermodal transport indicates the

transport between two points in which several modes of transport are used in succession without handling of the goods during mode changing operations. One carrier or operator may organise the whole journey.

INTEROPERABILITY

The ability of national and geographically defined transport networks to provide efficient operations and services across national borders and across physical and technical barriers respectively. Interoperability occurs when the rolling stock of a national railway company is able to operate on the whole or part of the trans-European railway network or when two previously separated national networks are being interconnected and able to serve common fleet operations. In telematics, interoperability is the ability of systems to provide services to and accept services from other systems and to use the services so exchanged to enable them to operate effectively together.

MULTIMODAL (MULTIMODALITY)

The situation when passengers or goods are carried by at least two different modes of transport (see also *intermodal* transport). It may also indicate an analysis, an approach or a choice which considers more than one mode (e.g. that passengers and freight consignors are able to choose from among at least two different modes of transport serving the same route, corridor or network).

POLICY ASSESSMENT

The assessment of alternative policy options (e.g. different *policy instruments*) in terms of specific *policy targets* or issues. The assessment includes ex-ante and ex-post *evaluation*.

POLICY GOAL

A broad objective of a policy or set of policies (e.g. the need for higher accessibility or mobility of a certain geographical area, reduction of congestion, increased safety, reduced environmental damage or energy consumption from transport). It may be formulated in either relative or absolute terms and usually has a specific time-frame.

POLICY INSTRUMENT

A specific policy (e.g. the construction of transport infrastructure, the introduction of road pricing).

POLICY ORIENTATION

A category or broad type of *policy instrument* (e.g. policies to internalise external costs, policies for parking restraint).

POLICY PACKAGE

A group of two or more *policy instruments* introduced together (which may introduce *synergies*).

POLICY PATH

A group of two or more *policy packages* which are constructed to achieve *policy targets* at particular points in time. Policy packages are often discussed in terms of implementation issues such as timing, obstacles and barriers, roles and responsibilities.

POLICY SCENARIO (FOR TRANSPORT)

A transport policy option which represents a sequence of deliberately planned *policy instruments* according to a given *external scenario*. Alternative policy scenarios are often presented to decision-makers to make a comparison or choice. In this case, the scenarios are associated with *policy assessment*.

POLICY TARGET

A specific goal of policy which is often formulated in quantifiable terms. It is often used to measure the extent to which a specific *policy instrument* or *policy package* contributes to the goal (e.g. the percentage or number of accidents or casualties reduced, the effect on CO_2 emissions, the average travel time from one region to another, the modal split, etc.).

SCENARIO

A tool that describes a view of the future within a specified framework and under specified assumptions about external factors (see *external scenario*) and *policy instruments*. Scenarios are usually designed to compare and examine alternative futures.

STAKEHOLDERS

Groups who in some way affect and/or are affected by transport policy or the outcomes of policy.

SYNERGY

The complementary effect(s) between instruments in *policy packages* which result in more advantageous outcomes than the combined outcomes of the individual measures if introduced separately.

VALIDATION

Verification of the performance of a research approach, a model or research results through surveys, tests or trials.

ABBREVIATIONS

CEEC

Central and Eastern European Countries

CIS

Commonwealth of Independent States

CTP

Common Transport Policy

APPENDIX 1. ASSUMPTIONS ABOUT VEHICLE ENERGY INTENSITY BY 2020

MODE	IMAGE I	IMAGE II	IMAGE III
Car (fossil)	-30%	-40%	-40%
Car (methanol)		-100% (relative fossil car 1995)	-100% (relative fossil car 1995)
Car (electric)	-70% (relative fossil car 1995)		-70% (relative fossil car 1995)
Aircraft	-35%	-40%	-40%
Lorry (fossil)	-10%	-15%	-15%
Lorry (methanol)		-100% (relative fossil car 1995)	-100% (relative fossil lorry 1995)
Bus	-10%	-10%	-10%
Train	0%	0%	0%

APPENDIX 2. ASSUMPTIONS ABOUT VEHICLE NO_X EMISSIONS BY 2020

MODE	IMAGE I	IMAGE II	IMAGE III
Car (fossil)	-85%	-90%	-85%
Car (methanol)		-90% (relative fossil car 1995)	-85% (relative fossil car 1995)
Car (electric)	-95% (relative fossil car 1995)		-95% (relative fossil car 1995)
Aircraft	-40%	-50%	-40%
Lorry (fossil)	-70%	-75%	-75%
Lorry (methanol)		-85% (relative fossil car 1995)	-85% (relative fossil lorry 1995)
Bus	-75%	-80%	-80%
Train	-50 %	-50%	-50%

APPENDIX 3. POLICY PATHS AND INSTRUMENTS – IMPLICATIONS FOR THE CEEC & CIS

A3.1. BACKGROUND

The transport situation in Central and Eastern European Countries[1] (CEEC) and the Commonwealth of Independent States (CIS) has to be considered within a broad framework of their geo-political situation and the legacies of their old economic system, including their military strategy, which affected the transport system. Major features of the past period were:

- rapid urbanisation and industrialisation,
- state owned means of production,
- emphasis on the heavy industry and energy sectors at the expense of consumer goods and services,
- excessive concentration and specialisation of production,
- ineffective management as well as the lack of market mechanism led to excessive freight transport,
- raw materials, heavy industrial products and agricultural products were main categories of transported goods.

The deformation of the price system made it possible to transport enormous volumes of freight for long distances. According to Hall (1993) transported tonne-kilometres per a unit of GDP in the Soviet Union in the late 1980's were almost six times that of the United States. As a consequence mining, metallurgical and other heavy industries could be established in the Arctic and Far-East regions of Russia. Heavily subsidised air flights served person transport for these areas. In late 80´s air transport carried almost 20 percent of all domestic passenger mileages in the Soviet Union (Himanen et al., 1995).

Even in former times the transport infrastructure and performance of transport system in this huge Euro - Asian region were not a coherent one. The CEE countries, the Baltic States and Western regions of former Soviet Union (FSU) had relatively dense surface transport network. The situation in the Eastern and Arctic regions of the Soviet Union was different - there were only a few main transport corridors and very limited local networks. The efficiency, service level, security and safety of the former transport system were not comparable with those in the Western Europe.

Most of the international freight transport took earlier place between the COMECON countries. Dry and liquid bulk from the Soviet Union comprised the biggest volumes of East-West foreign trade cargo. The import of grain was the main commodity from the West to the Soviet Union. The international passenger transport was limited by regulations. The liberalisation started from the end of 80's. Since then the growth of person traffic between east and west has been massive. In contrast with the international traffic, the volumes of domestic freight and passenger transport started to decrease.

1. This term Central and Eastern European Countries encompasses Bulgaria, Czech and Slovak Republic, Hungary, Poland and Romania, as well as the Baltic Republics (Estonia, Latvia and Lithuania).

Transport issues in CEEC and CIS are discussed in this appendix using Poland and Russia as representing both groups of countries. The appendix also contains an assessment of the implications of POSSUM scenarios based on the results of workshops held in Moscow and Warsaw.

A3.2. GENERAL DESCRIPTION OF THE TRANSPORT SYSTEM

The railway network is well developed in all countries. For instance, the density of railways in Poland (7.5 kilometres per 100 square kilometres) is higher than the average in the EU (6.2 kilometres per 100 square kilometres). In Russia there are 87,000 kilometres of railway lines. However, there are quality problems. In Poland, on the basic network (14.1 thousand kilometres) as much as 25 per cent of the length of tracks are considered to be in unsatisfactory technical condition, the traffic control system is outdated[1] and the quality of the rolling stock is poor. This holds true also in the CIS countries. In Russia it can be assumed that railway stock has deteriorated by 40 percent from the previous condition.

Low quality of material assets in combination with inadequate operational efficiency causes the low quality of service and low economic efficiency. Generally, railways are not competitive in terms of speed, costs or convenience but are still able to carry high volumes of cargo on main lines. This is relevant for all countries of the region. Nevertheless, as an inheritance from the centrally planned economies, railways still - more or less depending on the country - dominate the transport sector.

In the forties and fifties, road transport was considered of secondary importance and private motorization as undesirable. Gradually, the policy of governments changed in response to the revealed preference of the population and needs of the economy. In spite of a relatively low income level, since 1970's the number of private cars rapidly increased. This growth was especially rapid in countries such as Hungary, Poland and former Czechoslovakia,. Cars, goods vehicles and buses were predominantly made in the COMECON countries, they were environmentally unsound and inefficient with regard to fuel consumption.

While the density of roads in most CEE countries and western parts of the CIS is not much lower than in high-income countries (in Poland 109,1 kilometres per 100 square kilometres), these networks have several shortcomings:

- motorways constitute only a very small proportion of roads (except in Lithuania);
- most roads, including international roads, do not have access control and are used by mixed traffic;
- the quality of many sections of main roads is low; this includes geometric design, the riding quality and bearing capacity of the pavement[2], etc.;
- many sections of major intercity roads go through built-up areas, and some through city centres;
- the rates and severity of road traffic accidents are much higher than in EU countries;
- the quality of local road network is very poor.

1. Only 9 per cent of the network is equipped with modern centralised traffic control system
2. Only a limited part of the network is prepared for 10 ton axle load. In Poland in 1994 almost 30% of national roads were in critical state, and less than 20 percent did not need any intervention.

In Russia - outside the western part - roads play a minor role. This can be highlighted by the fact that the length of all highways in Russia is only 53,000 kilometres compared to 87,000 kilometres of railway lines and 84,000 kilometres of inland waterways.

Border crossings form crucial links in international road transport. Nowadays existing points are overburdened which together with poor management result in long queues and delays for road traffic. In 1993 according to a survey (see Himanen, et al., 1995) average waiting times in some major crossing points for lorries were between 2 and 24 hours.

Under the old regime, sea transport played an important role and was in an advantageous position. The structure of production (i.e. a very high proportion of heavy industry), required ports and fleet for bulky cargo. Most of the port infrastructure, facilities and equipment were developed mainly for this kind of cargo. Capacity to serve general cargo and the transport of containers is limited. The most important shortcoming is - as with other modes of transport - poor transport logistics. However, from the beginning of the economic reform, Polish ports have been losing their position, because of the competition of railways and, first of all, road transport. In the Baltic states the situation is different because their ports are still serving import and export flows to/from Russia.

The inland water transport plays an important role in Russia (a total length of waterways - 84,000 kilometres) and in the countries of Danube region. In Poland, the Czech and Slovak Republics inland water transport plays a marginal role, in spite of its generally flat area, extensive network of rivers and high volumes of bulky goods transported. In 1990, in Poland, inland water transport served only 0.3 per cent of all traffic (tonne-kilometres).

There are 315 operators and 756 airports (52 are international) in civil aviation of Russia. During the former SU times the Aeroflot had two functions - to be a civil carrier and to be a part of military logistics in possible war time. That was the reason for high level financing in that time. Aeroflot bought between 300 and 400 new aircraft per year. They got 5 new aircraft in 1997. Nearly three fourths (70 percent) of the fleet is worn out! The safety level for the main international carrier of Russia (Aeroflot) was declared not bad for 1997, but it seems to be very risky for local carriers. The economical situation of air carriers is poor.

As a result of the low income level, in all CEEC/CIS region, air transport is used nowadays less than in the Western Europe. In comparison to the number of passengers, the number of airports both for international and domestic traffic is adequate. However, most airports and air traffic control systems are out-of-date and require upgrading. In the recent years almost the whole - Soviet built - fleet in the CEE countries was replaced with the modern Western planes and many national operators were privatised. The Western investors and air operators have participated in the privatisation of national carriers.

In Russia former Aeroflot has lost its monopoly and numerous new airlines have emerged (see also Barrett, 1993) - many with old float and low reliability. However, with current airline prices former high level of domestic mobility in Russia cannot anymore be obtained.

In contrast to what could be expected in countries with centrally-planned economies, freight transport was not organised as a chain-of-services. Each mode was organised as a public monopoly, with extreme vertical integration. Under these conditions, combined transport was not well developed. Containers were used, but there was a lack of terminals with efficient

handling equipment, especially for 40 foot containers. Very few scheduled combined transport links were in operation.

In all countries of the region, urban transport policy was public transport-oriented. Fares were kept low, and heavy subsidies were accepted. Capital investment, including purchasing of vehicles, was financed from the central budget and, in many cases, operating expenses were covered from the same source. Even though there were shortcomings in the quality of service they were compensated with high density of networks and good frequencies. Clearly, this policy, combined with low car ownership ratio, meant that, for a long time, a very high proportion (85 to 95 per cent) of mechanised trips were made by public transport. In theory, development of urban transport was planned in co-ordination with urban land use plans. In major cities metro systems were planned. In practice, except cities of the former Soviet Union, these plans were only slowly and partially implemented. During the 1990s, urban public transport systems have been neglected and many former services had been abandoned.

A3.3 CURRENT TRENDS

The political and economic reforms in the CEEC/CIS countries have already caused great changes in passenger and goods transport. There is a strong tendency to own and use private cars. In Poland in 1997 there were already 221 cars per 1000 inhabitants. In the Czech Republic, Hungary and Estonia car ownership was even higher. The result of motorization is that the metropolitan regions have now congestion and air pollution problems together with deteriorating public transport services and poor road network. (see also Steen & Suchorzewski, 1994).

There is a shift of transport demand from the products of heavy industries to lighter consumer goods, from low quality services to high quality services, and from international transport between the former COMECON countries to transport between CEEC/CIS countries and EU countries.

In Poland, the following trends are observed:

- a reduction of the amount of goods carried (by about 50 per cent within 15 years);
- a rapid increase of international traffic[1];
- a shift from rail to road; the tonnage of goods carried by rail decreased 55 percent within last 15 years; the decrease of the number of passenger is similar; however, a slow increase of tons carried by rail has been observed since 1992;
- a shift from collective to individual means of passenger transport in urban areas;
- a modest role in domestic transport of modes other than road and rail; in the period 1990-1995, total traffic on national road network has grown by 45 percent.

During the 90´s transport volumes in Russia have decreased as well. Nowadays in the railways cargo is 40 percent and passengers 60 percent of the earlier volumes. The corresponding figure for passenger transport in aviation is 40 percent and for cargo in inland waterways 20 percent. Unlike in the other transport modes there has been a significant increase in road traffic, especially in the number of private cars

1. In 1985, 19.2 million people and ten years later in 1995 crossed the Polish borders by 235 million.

The continuing transition period has kept old monopolies and at the same time brought new enterprises in transport sector. The result of this development is new business environment with several positive and negative changes including security and safety problems.

A3.4 PLANNED SOLUTIONS

A3.4.1 Forecasts

In Russia, because of the current unstable economic situation and abrupt changes in transport volumes all forecasts are very unreliable. In the foreign trade a moderate increase is expected i.e. export will grow from 180 million tonnes in 1996 to 217 million tonnes in 2010 and import from 81 million tonnes in 1996 to 115 million tonnes in 2010. The major modes for international freight transport are by sea, pipelines and railways. What can be considered to be sure is that road transport - both car and lorry - will increase considerably in Russia even though road transports share of foreign trade will remain a minor one.

In Poland, the last years have brought about a remarkable 6-7 per cent growth of GDP. Economic development programme leading Poland to enter into the EU assumes the GDP growth of at least 5.5 percent per year. At the same time it must be remembered that recessions are also possible - especially for the countries with negative foreign trade balance - as has recently happened in the Czech Republic.

The most recent forecasts assume that the international traffic in Poland, the Czech Republic and Hungary will be growing at the rate of 3 to 5 percent per year and that most of this increase will be in road traffic. However, forecasts in the Baltic States for the years 1995 - 2015 assume the growth of freight transport on rail to be more (2 to 3 percent) than on roads (2 percent). When most of freight in the Baltic countries is transit cargo to/from Russia and other CIS countries, its future is uncertain depending on the development in Russia.

Road traffic is enhanced by the estimated growth in car ownership, which may reach 300 to 400 cars per 1000 inhabitants in 2025 in CEEC and the Baltic States. For the time being, average annual mileage is much lower than in the Western Europe. However, it is expected that annual mileage per car will increase with growing income, and that is why road traffic will be increasing even faster than car ownership.

These trends cannot be considered as desirable from the point of view of sustainable development. However, it will be difficult to reverse them, when remembering that reducing differences in mobility is a clear objective of growth and convergence. Increasing traffic means anyhow pressure on underdeveloped transport infrastructure and the environment. A sound balance between development objectives and the protection of the environment has to be found.

A3.4.2 Transport Policies

Proposals concerning transport policies and strategies are related to identified problems of:

- inadequate quality and low efficiency of transport systems;
- the adverse effects of transport on the environment,
- transport safety (with emphasis on roads), and
- transit business in the Baltic states of foreign trade cargo to/from the CIS.

It is generally assumed that CEEC/CIS countries should move progressively to adopt international (EU) quality, technical, safety and environmental standards and should use the best available technologies. However, the cost of full harmonisation in a short time is unbearable for practically all countries under consideration. This issue has to take into account the real costs of adopting a particular standard, the associated social and economic benefits and the opportunity cost of the capital, which in the CEEC and CIS countries is very high.

With limited resources, the main principle of transport policies could be that potentials of existing transport infrastructure are used to the maximum extent possible. Better maintenance, the streamlining of the existing systems, and rehabilitation and modernisation have a higher benefit/cost ratio than investments in new infrastructure. (see also Suchorzewski, 1994). This has been recognised in CEEC. For example, in Poland, in early 1990s, advanced system of roads and bridges maintenance systems (PMS, BMS) have been introduced. The same direction was accepted in the Polish Railways (PKP).

Railways have particularly high potentials to improve service by low-cost measures. With a 'status quo strategy', the share of trips and goods transported by rail will drop further. In order to keep flexibility for the future, it is important that railways reach a sufficiently good service level before road upgrading and developments make road transport even more attractive than it is today. Railway transport should be given a chance to be competitive to road traffic, resulting in a mix of different transport modes - more accessible and less damaging to the environment. Therefore streamlining and modernisation of existing railways in the countries in transition should have top priority.

In many countries there are plans to develop except a network of motorways and expressways also to add some high speed railway lines to the existing railway networks (see also 4.3). However, the planning principles obtained from the Western Europe (see for example Ferlaino & Garosci, 1996) may not be applicable in the regions with long distances and low densities. For example, for corridors such as Moscow-Minsk-Warsaw (740 kilometres) and Moscow - St. Petersburg (540 kilometres) without intermediate urban centres between them, plans of building high-speed railways designed exclusively for passenger traffic do not seem viable. Probably, upgrading of existing lines which can be used for both passenger and freight transport (including combined transport) will have much higher rate of return.

Technical improvements to eliminate bottlenecks on existing roads of regional importance are also needed. The modernisation of main arteries also has high benefit/cost ratios. On major corridors heavy road traffic is predicted. This will justify investing in motorways. At the same time relatively low traffic volumes are predicted on many sections of major roads passing through low density areas. For these sections, the concept of single-carriageway expressways, much used in Scandinavia, can be a viable alternative to full standard motorways[1].

A3.4.3 Transport Policies in Poland

In 1993-1994 the Ministry of Transport and Maritime Economy prepared a document entitled 'Transport policy: programme of transformation of the transport system into a system adopted

1. This was one of the major conclusions of the 'Study of motorway and expressway system for Poland' (1997) which aimed at updating the national road development programme. The Institute of Roads and Bridges of the Warsaw University of Technology prepared the study for the National Road Planning Bureau.

to market economy and new conditions of economic co-operation in Europe'. This document was widely discussed and presented to the Council of Ministers in 1995. According to the document, the highest priorities have been given to actions of high social and economic viability:

- eliminating bottlenecks in the system and improving the quality of services and safety;
- reducing the gap between Poland and EU, first of all through: increasing capacity, increase of speed of through traffic, reducing border crossing time etc.;
- stimulating improvement of efficiency of transport operators, leading to improved services and reduction in the use of fuels and energy;
- increasing of attractiveness of transport sector for private and foreign capital;
- stimulating transfer to Poland of advanced transport technologies; and
- facilitating reduction of emerging environmental and social problems.

Some of actions have already been undertaken. For example, selected railway lines of international importance are modernised to allow speed of 160 kilometres per hour (and 200 kilometres per hour for tilting body trains), and several border crossing points are upgraded. research and development project on road traffic safety, named GAMBIT, was financed by the government in 1994-96. The three-year project, in which several research institutions from EU participated[1], ended up with a draft comprehensive programme for the government.

This programme, containing a list of specific projects and actions, has been criticised by environmentalists for concentrating on economic efficiency and neglecting the last objective, concerning environmental problems. The new government is presently reconsidering it.

A3.4.4 Transport Policies in Russia

The priorities of the Ministry of Railways of Russian Federation are:

- implementation of new information technology
- rehabilitation of communication system
- implementation of multimodality
- renovation of fleet and locomotives.

There are now restrictions for Russian fleet in EU area. The TALGO system (system, developed in Spain, for changing axle spacing in motion) might be one solution. There are two priority corridors, North-South Trunk line and Trans-Siberian (East-West) Trunk line. The North-South transport corridor provides a link between Northern, north-western and Central Regions of Russia and its Southern regions. It also makes approaches to Azov Sea-Black Sea, Caucasus and Caspian Sea. The Trans-Siberian (East-West) corridor has an access to Trans-Siberian Railway. The railway link is very important as intermodal railbridge between Europe and Asia. It has accesses to the Caspian and Black Seas.

The Ministry of Railways expects a small increase in the volumes of both freight and passenger traffic. Some ecological aspects will be implemented on Russian Railways - mainly concerning new types of fleet. Cleaning of the polluted rail is an actual question too. The Russian programme, 'Rehabilitation of the Transport System', will tackle some ecological issues.

1. BASt (D), DSCR (F), INRETS (F), SWOV (NL), SweRoad and VTI (S)

The Russian Traffic Safety improvement programme was prepared with the assistance of Finnish experts. VTI from Sweden has also organised high-level traffic safety training courses. The strategic target is to improve the traffic safety situation in Russia significantly.

In order to pass current transport from the Baltic ports to Russian ports there are plans to build new port facilities in the Gulf of Finland. Also some new border crossing stations will be opened in addition to the current 39 ones and the operation of the old ones will be improved. The process of restructuring inland waterways includes both the network and operations.

Most of international road freight (75 percent) is transported on corridor IX (Helsinki - St. Petersburg - Moscow). The development of terminals is one of the important questions. Most important hub for road transport is Moscow, where the terminal development programme is ongoing. There are number of federal and EU level programmes going on:

- Road traffic safety
- Inland waterways
- Revival of Russian merchant fleet
- Terminals
- Implementation of global navigation systems (Glomass)
- Production of busses and trolley-buses in Russia
- Civil aviation programme

Financing is mostly solved for programmes 1, 2 and 4 (65 to 75 percent comes from the federal budget). For other programmes financing is not as clear. Environmental aspects are not presented in any of the programmes.

A well functioning ferry system in the Baltic Sea is of common importance. To make it more attractive, efficient links with other modes of transport are needed. As transport demand may not be sufficient to utilise fully all planned harbour capacity of the Baltic Sea Area, and in order to make more effective use of investments, international and national consensus about specialisation and investment priorities between the harbours would be beneficial.

A3.4.5 Coordination of National and International Programmes

Co-ordination of plans and actions in Europe in the area of transport has a long history. As regards former socialist countries in divided Europe, the co-ordination was carried out within the Council for Mutual Economic Assistance (COMECON). Fortunately, UN Economic Commission for Europe provided a platform for the Cupertino between Western and Eastern countries and international agreements on main transport networks for railways (AGC), roads (AGR) and combined transport (AGCT) were signed. Even though the density of international networks in the eastern part of Europe remained much lower than in the western part. (see also Suchorzewski, 1997).

During the transition period, a number of new initiatives have been taken by EC, ECMT, OECD and groups of countries (Baltic, Black Sea, Central European Initiative, Mediterranean) to improve international transport and to reduce and, in the longer perspective, eliminate the differences between countries and regions. The 1st, 2nd, and 3rd Pan-European Transport Conferences in Prague, Crete, and Helsinki were of particular importance for strengthening European co-operation in the field of transport.

The concept of supplementing the Trans-European Network (serving the European Union) with so called 'layer 2 priority corridors' serving CEEC/CIS was adopted by the Second Pan-European Transport Conference. The year 2010 was chosen as the time horizon for this programme. The countries concerned, in the framework of the G-24 Transport Working Group and with the assistance of the European Commission and the International Financial Institutions undertook joint efforts to implement the programme. For all corridors, interested countries signed Memoranda of Understanding. (see also CEC, 1996). However, realisation of the programme has been relatively slow as was stated in the Helsinki Conference, where also a need for additional links between some Corridors themselves and improvement of the interaction between the Corridors and national/regional networks was emphasised. It must be remembered that the EU's PHARE and TACIS programs and some projects of the 4th FWP (EUROSIL and CODE-TEN etc.) will elaborate several tools for these activities.

A3.5. VALIDATION OF THE POSSUM SCENARIOS

A3.5.1 Workshop in Moscow

A validation group consisting of public authorities, industrialists and environmentalists was used to test Images I and II and to them related policy paths in Moscow workshop. The venue for the workshop was MADI (Moscow Automobile & Roads Institute in Moscow) on 25 May 1998. Representatives from the POSSUM Consortium were Professor Peter Steen (ESRG, Sweden) and Doctor Vladimir Segercrantz (VTT, Finland). Other participants were as follows:

- Feodor Pehterev, Director of Institute of Transport Economy of Ministry of Railways in Russia
- Professor Valentin Syljanov, Technical University, MADI
- Valeri Shaikin, The Ministry of Transportation of Russian Railways, Head of Department
- Ludmila Kolishkina, Institute of Transport Economy of Ministry of Railways in Russia, Chief of Technology
- Jelena Chistekova, Association of inland shipowners and ports
- Ivan Batishev, Institute of Road Transportation, NIIAT
- Nikolay Antonov, Ministry of Transportation, Assistant Head of Department
- Victor Sabolin, Scientific Centre for Complex Transport Problems, Moscow, Head of Office
- Andrei Zenkin, Scientific Centre for Complex Transport Problems, Moscow, Head of Office
- Alik Chebotaev, Scientific Centre for Complex Transport Problems, Moscow, Head of Department
- Jevgeni Mahlin, Scientific Centre for Complex Transport Problems, Moscow

Peter Steen presented the POSSUM Images of the Future. Vladimir Segercrantz presented the Russian situation in general and the POSSUM approach for the beginning of discussion. Short sectoral presentations from Russian experts were then given.

The main emphasis in testing Scenarios in Russia was put on the validation of the most important policy measures in Images I and II. The assessment concerned mostly the political feasibility of the measures in Russia - both today and tomorrow.

The current economic situation in Russia is still quite unstable and all sectors are still under heavy transition. This has of course implications also for transport policy. Because of the current unstable economic situation and the big decrease undergone in transport volumes the POSSUM Images of the Future were not considered to be very relevant in Russia in the short term. However, in the long term almost every measure was considered to be feasible also in Russia. The exceptions were: i) much increased taxes on aviation fuel and ii) very strict emission standards. The reaction on the first one can be understood against the care for the accessibility when considering the wideness of Russia and the length of international links. The last one may mirror the general attitude with only moderate concern on environmental issues.

From the measures in Image I none was considered feasible and actual. However, three measures were considered to be acceptable in a limited scale:

- Promotion of transport saving information technology,
- City planning in favour of public transport etc. and
- Information about resource use for instance to enable the choice of local products.

In Image II three measures were considered to be both feasible and actual. Those were:

- Upgraded East-West railway links,
- Increased spending on research and development for new vehicle technology and
- Promotion of combined freight transport through harmonisation of railways and new intermodal centres (see also Tables A1 and A2).

TABLE A1. MOST IMPORTANT POLICY MEASURES IN IMAGE I AND THEIR POLITICAL FEASIBILITY

POLICY MEASURE	POLITICAL FEASIBILITY TODAY	POLITICAL FEASIBILITY FUTURE
Tax shift from labour to natural resources and energy (e.g. increased petrol price).	Not feasible	Feasible
Promotion of transport saving information technology (e.g. telecommuting)	Starting in some cases	Feasible
City planning in favour of public transport, pedestrians and cyclists. Space for cars is thus restricted.	Starting very slowly	Feasible
Environmental zones in cities (only very clean vehicles, such as electric cars, are allowed)	Not feasible	Feasible
Information about resource use (e.g. transport input) for instance to enable the choice of local products.	Locally feasible	Feasible
All measures together	Partly feasible	Feasible

TABLE A2. MOST IMPORTANT POLICY MEASURES IN IMAGE II AND THEIR POLITICAL FEASIBILITY

POLICY MEASURE	POLITICAL FEASIBILITY TODAY	POLITICAL FEASIBILITY FUTURE
Promotion of production and distribution of renewable fuels (e.g. methanol).	Not feasible	Feasible
Increased spending on research and development for new vehicle technology.	Feasible and very important (to have access to EU and World market)	More feasible than today
'Feebates' on new cars related to fuel consumption, i.e. taxes on inefficient cars and subsidies to efficient cars.	Not feasible (Pilot project might be possible in some regions)	Feasible
Very strict emission standards regarding NO_X etc.	Not feasible	Partly feasible
Road pricing, especially for freight transport.	Neither feasible nor actual	Feasibility unclear
Promotion of combined freight transport through harmonisation of railways and new intermodal centres.	Feasible and actual	More feasible than today
Much increased taxes on aviation fuel.	Not feasible	Not feasible
Some upgraded East-West links, especially railways.	Feasible and very important	Feasible
All measures together	Partly feasible	Partly feasible

During the workshop, a number of other issues were also discussed.

i) Evolution of the production system in the Eastern Europe

It was very difficult to answer this question and predict future development in Russia. Present situation is very unstable and difficult. There are possibilities in the future, but still it is a very long way to go.

ii) Trends in transport volumes relative to GDP

Transport volumes have been very high in freight transport, but they are lower today. The use of private cars has risen significantly. There are however too many factors influencing (e.g. world markets, social problems in Russia), which makes the comparison difficult.

iii) Conditions for combined transport

The share of combined transport is increasing slowly and conditions are amending. There are good examples like Siberian railbridge and two major programmes: the TACIS project, combined transport in Russia, and a national program, Terminals.

A3.5.2 Workshop in Warsaw

In validation workshop which was held on 29 May 1998 at the Institute of Roads and Bridges of the Warsaw University of Technology, 12 invited participants included one member of the Parliament, 4 officials from the central and local governments, 5 researchers/experts and 2 leading representatives of NGO's:

- Andrzej Bartoszewicz, Department of Technical Supervision of Transport, Ministry of Transport and Maritime Economy.
- Prof. Halina Brdulak,, Institute of International Marketing, Warsaw School of Economics.
- Krzysztof Celiñski, - Director of Railway Department, Ministry of Transport and Maritime Economy.
- Jan Friedberg, Mayor of Krakow representative, responsible for transport strategy.,
- Stanislaw Furman, planner, Warsaw Development Planning Office.
- Ewaryst Hille, Foundation for Effective Use of Energy, Vice President.
- Dr. Andrzej Kassenberg, Institute for Eco-development, Warsaw, President
- Prof.. Boguslaw Liberadzki, Transport Institute in Warsaw, Member of The Parliament.
- Dr. Edward Menes, Road Transport Institute , Head of Research Division.
- Barbara Pawlowska, University of Gdansk, Faculty of Economics.
- Andrzej Siemiñski, Ministry of Environmental Protection and Natural Resources.
- Dr. Jerzy Wronka, Research Institute of Transport Economics, Szczecin.

Professor David Banister (UCL) and Professor Wojciech Suchorzewski (WUT) represented the POSSUM consortium. Professor Banister made introductory presentation describing briefly: methodology, Images of the Future, scenarios and policy instruments. In his presentation Prof. W. Suchorzewski concentrated on aspects of Images of the Future, scenarios and policy measures which, directly or indirectly, relate to specific conditions and problems in countries of Central Europe. He paid attention of participants to the following points:

- With regard to traffic volume forecasts, it can be accepted that the CEEC/CIS countries should be allowed to increase their transport volumes more than in the EU countries.
- According to some findings of POSSUM, „from the point of view of the environment and the utilisation of resources, it may be claimed that faster transport is doubly problematic'.
- *Decoupling transport growth from economic growth* is of a great relevance for the CEE countries.
- In Image I: *EU Coordination of Active Citizens,* in which it was assumed that there will not be a great need for new inter-regional infrastructure, links to CEEC countries were mentioned as the exception. In addition, need for some reorganisation of railways in CEEC was mentioned.
- In Image II: *Global Cooperation for Sustainable Transport,* „new transport links to CEEC countries and peripheral regions (*Regional equity*)' were mentioned as was 'some reorganisation of railways to CEEC/CIS countries'.
- In Image III: *Accord on Sustainability* financial constraints will restrict what is attainable. The targets are agreed at higher levels but regions and municipalities of Europe will choose their own ways in coping with local emissions, congestion etc.
- The fulfilment of targets to a large extent dependent on the degree of *decoupling*. The NO_X target is more demanding than the CO_2 target. It is achieved for EU15+3 in all the Images of the Future, however, it was stated that further cuts may be necessary to allow for increasing transport volumes in CEEC/CIS.

- The efficiency target will be fulfilled, but there are some problems. For example, in Image I: subsidies to public transport and infrastructure connecting CEEC/CIS may be necessary and in Images II and III financing of research and development and infrastructure.
- The most important comments and statements made by invited participants were as follows:
- The development of technology should not be limited to vehicles and fuels. Progress in organisation/automation, transport/traffic management, etc. has great potential to increase effectiveness of transport.
- The model of consumption represents the most important problem. *Individual consumption* is growing while *public consumption* is loosing its position. There is some danger that improved efficiency of transport and decreasing costs may lead to a much higher use of transport with all negative effects.
- According to the Institute for Sustainable Development, *National transport policy* elaborated in 1993-1994 is not sustainable. A*lternative transport policy* was prepared.
- Policy makers have a crucial role to play. Norms and standards for vehicles set up by governments will decide about the future. A clear signal has to be sent to the automobile industry.
- System of taxation and subsidies has to be used to reach goal of sustainable development.
- Perhaps more attention should be devoted in the POSSUM project to accession countries. Countries such as Poland have a little impact on the progress in technology.
- As long as the difference in GDP per capita between EU and CEEC is not reduced, it is not realistic to assume that similar resources (per capita) will be directed to environmental matters in all countries. Consequently, not all ideas and measures proposed in the POSSUM project can be directly applied in countries such as Poland.
- The central location of Poland in Europe is an important factor. The attractiveness of transport markets causes a great competition among the industry and transport service providers.
- Although the quality of the Polish transport system is not satisfactory, a significant progress has been made in the last years. For example, considerable part of truck fleet (28 percent) meets EURO1/EURO2 standards. This is similar to Germany (29 percent) and better than in, for example, Greece (17 percent).
- There is no much chance that the Polish society will resign from using the automobile. Awareness of emerging problems is important, however, 'terrifying' the society does not seem to be a proper strategy.
- Declarative adopting policies do not necessarily mean implementation; sustainable urban transport policies were adopted in recent years by city councils of Krakow, Warsaw, Lodz, Bialystok and other cities, but there are not implemented;
- The opinions expressed in polls are not consistent with behaviour.
- Mass media have a crucial role to play.
- It is possible that it might be easier and more justified to reduce CO_2 emissions in other sectors;
- The improvement of public transport is essential. However, it is the common view that it requires much investment but this does not have to be true, since there is the potential to use existing infrastructure more efficiently. The case of tram improvements in Katowice, Krakow and Lodz illustrate this. Generally, a lot of potentials is in making better use of existing transport infrastructure;
- TINA and TENs programmes and actions are of a great importance and may and should be used as a tool to direct the development of transport systems in CEEC in desirable way.

In summary, on the basis of discussion during the Warsaw workshop, the following conclusions can be formulated. Generally, there is awareness that all possible efforts have to be made to redirect the present trends in transport which are not always sustainable. Growing income accompanied with changes in lifestyles have been leading to a rapid shift to road transport in passenger transport. The same is observed in freight transport where railways with extensive networks but low quality and efficiency cannot compete with road transport. The main project concepts and proposals were positively received. As regards POSSUM policy targets for 2020, there were considered as acceptable and relevant, except specific targets concerning CO_2 and NO_X emissions that will be difficult to meet in the group of countries concerned. Taking into account starting level, with relatively low mobility, it seems sensible that CEEC countries should be allowed to increase their transport volumes more than in the EU countries. Consequently, even with similar technological progress, emission targets should be lower. It may require that higher reduction of emissions will be required in EU15+3 countries.

Diverting the present trends in consumption and behaviour will not be easy. Motorization in CEEC is growing even more rapidly than incomes and this, is to a very high degree stimulated by the aggressive policy of the automobile and oil EU industry. To control the situation and divert the present trends, concerted policies of EU and national governments are needed. In CEEC several cases were noted of political decisions of local governments adopting sustainable transport policies. However, when concrete actions were needed, implementation appeared to be extremely difficult. At the state level, situation is even more complex, as it is illustrated by, for example, a recent decision of the Polish parliament[1] to increase speed limits on motorways and expressways. At the same time, government proposals to reduce speed limit in urban areas from 60 km/h to 50 km/h have been rejected.

As regards specific POSSUM scenarios, there was no strong view on which Image of the Future might be more appropriate for CEEC. At the same time, opinions were expressed with regard to specific measures such as:

- with the present preferences slowing down motorization growth will be very difficult;
- progress in vehicle technology is possible, but - as it was stressed in point 3 - it will depend on how successful EU countries are in implementing POSSUM targets for industry (e.g. lower average fuel consumption and reduces weight, new fuels etc.);
- fiscal measures such as road/parking pricing would probably be very effective in CEEC; however, it will be very difficult to have them accepted by policy-makers and people in general; nevertheless, they have to be kept on the top of the list;
- maintaining a leading role of public transport is still possible; in particular, better use can be made of existing railway infrastructure and extensive urban tramway systems, but it require political will; unfortunately, emphasis is placed on few capital intensive projects such as High Speed Transport (HST);
- land use planning has a long tradition in CEEC; unfortunately, in the course of political reforms it was weakened and it will take time before its great potentials may be used to promote transport-effective urban patterns.

To sum up, validation has shown that POSSUM ideas are relevant to CEE countries. However, targets, scenarios and concrete policy measures would have to be further analysed and, perhaps customised taking into account specific conditions in countries in question.

1. On the occasion of amending traffic law in 1997.

Nevertheless, POSSUM ideas and proposals deserve to be widely disseminated in CEEC as they may play a positive role in educating policy-makers, officials, professionals and other actors.

A3.6 CONCLUSIONS

Three paradigms of transport policy of the CEEC/CIS are apparent:
- Old centralised planning;
- Brave new world planning; and
- Modern realism.

The **old centralised planning paradigm** has to be considered within a broad framework of consequences of the past geo-political situation and economic legacies of the old system of command economy and central planning. Likewise, consideration for the military strategy has had an influence on the transport system.

The deformation of the price system made it possible to transport enormous volumes of freight for long distances. The Western regions of former Soviet Union had relatively dense transport network.

The situation in the Eastern and Arctic regions was different, there were only a few main transport corridors and very limited local network. This is an important issue for regional development. These areas have formed an integral part of the economies of the COMECON countries.

The **brave new world planning** paradigm is set within the political and economic reforms in Russia which have caused great changes in volumes and directions of passenger and goods transport. For the transport sector the most important - when considering future - is the rapid growth of motorisation.

The transport policy measures considered include extensive and expensive plans for new infrastructure (e.g. motorways, high speed rail, and new ports). In some future scenarios the construction of road network in Russia has been considered to be one the biggest works still undone in the world.

Modern realism is a new paradigm to emerge. It has become obvious that it is not possible - at least during the next decades - to invest necessary sums for new infrastructure. A more realistic and cheaper way is to develop maintenance of current infrastructure and the management of transport services. For the time being it does not make sense to win an hour in a new motorway and then loose six hours during a cumbersome border control.

When remembering the relatively dense railway network it is obvious that railways can form the backbone of modern transport policy in Russia. This will also improve the possibilities to achieve environmental goals.

Instead of building new harbours the use of current ones can be improved and the use of the ports in neighbouring countries – such as the Baltic States and Finland - can continue for transport of goods to Russia.

In terms of regional development, the former centralised system - including close cooperation between the COMECON countries - has dispersed. Russia is fighting inter alia with huge disparities between various regions. Current prices of transport do not allow former share of industrial productions. The peripheral regions of Russia with specialised industrial production are in a desperate situation without any obvious solution. Metropolitan areas are suffering from air pollution and congestion while car ownership is increasing and public transport is deteriorating.

There are some good signs from an environmental point of view. Railways still form the backbone of domestic transport in Russia. Previously large transport volumes have dramatically decreased. Rail and sea transport much of the cargo for the overseas market. An alarming trend, however, is the large increase in road traffic. In the CEEC countries, the transport intensity of economies has been reduced as well. However, very rapid growth in motorization and significant changes in economy have brought about a shift from railways and urban public transport to road transport. Fortunately, there is a growing awareness of necessity to redirect transport policies to make them more sustainable.