CENTRAL EUROPEAN INITIATIVE

Towards Sustainable Transport in the CEI Countries

About the CEI

Ministerial Declaration „Towards Sustainable Transport in the CEI-Countries"

Joint Pilot Study on Environmentally Sustainable Transport in the CEI Countries in Transition

CEI SubGroup „Environment and Transport"

Vienna, May 1999

UNEP For Life on Earth

OECD OCDE PARIS

Federal Ministry for Environment, Youth and Family

Foreword

To bring transport in line with sustainability objectives and to reduce environmental pollution and health hazards caused by transport are key challenges for environment and transport policies in Europe. This applies particularly to Central European countries which - at the crossroads of the continent - are expected to experience a high increase in Trans-European transport.

To address these issues Ministers and State Secretaries for Environment of the Central European Initiative (CEI) gathered at the Ministerial Conference on Environment in Graz in1996 have agreed to co-operate closely in the field of environment and transport.

I am pleased to see that this initiative has been further developed by the CEI Sub-Group on Environment and Transport under Austrian chairmanship and has lead to several positive results:

Firstly, the Ministerial Declaration „Towards Sustainable Transport in CEI Countries“ has been adopted and signed, and will provide a basis for the development of future strategies and co-operative actions.

Secondly, fruitful co-operation with UNEP and the OECD has resulted in a forward looking pilot study on „Environmentally Sustainable Transport“ which developed possible images of a sustainable transport future in the CEI countries in transition. The applied „backcasting“ method using long-term criteria and targets has identified measures in the area of transport technology and demand-side management. These will serve as a basis to develop implementation strategies towards sustainable transport.

Last, but not least, specific pilot actions among the CEI countries have been agreed: a series of workshops on sustainable transport in the CEI countries will start with Slovenia, the Slovak Republic and Croatia, and proposals for joint pilot projects for sustainable transport have been elaborated, which should lead to concrete implementation and investment projects supported by the EBRD.

I also would like to give my warmest thanks to the partners in this work: the Delegates of the CEI countries for their high committment, the CEI Executive Secretary and the Secretary for CEI Projects at EBRD with its CEI/ECE-Focal Point for the assistance, and in particular, UNEP Regional Office for Europe and the Environment Directorate of the OECD for their excellent co-operation and financial support.

This brochure summarises the main results achieved so far and provides an overview of ongoing activities. It is an information tool regarding long-term environmental goals, strategies and instruments for the integration of sustainability criteria into transport policies, and the activities of the CEI countries in the field of environment and transport.

We hope that our report will provide useful information for decision-makers as well as interested citizens, and finally, will encourage further joint activities towards sustainable transport in Central Europe and foster fruitful co-operation among CEI countries.

Dr. Martin Bartenstein
Federal Minister for the Environment, Youth and Family

Editorial

Towards Sustainable Transport in the CEI Countries

Prepared on behalf of the Austrian Federal Ministry for Environment, Youth and Family in co-operation with

the Central European Initiative (CEI),
the United Nations Environment Programme (UNEP) and
the Organisation for Economic Co-operation and Development (OECD)

General Conception and Project Management in the Ministry:

Federal Ministry for Environment, Youth and Family (FMEYF),
Division Transport, Mobility, Regional Planning and Noise,
Univ.Lekt. Dipl.-Ing. Robert Thaler,
Division International Affairs,
Renate Nagy

The general CEI introduction was kindly provided by the CEI Executive Secretariat.

The Ministerial Declaration 'Towards Sustainable Transport in the CEI Countries' was elaborated by the CEI Sub Group Environment and Transport following the mandate of the Conference of CEI Environment Ministers which was held on 26/27 September 1996 in Graz. The Declaration was adopted and signed by the CEI Ministers/State Directory/Department for the Environment (except Italy) on occasion of the UN General Assembly Special Session in New York on June 25th, 1997.

The chapter on the Joint Pilot Study 'Environmentally Sustainable Transport' in the CEI Coutnries in Transition is a short version of the full pilot study which was commissioned by United Nations Environment Programme (UNEP), Organisation for Economic Co-operation and Development (OECD) and the Austrian Federal Ministry for Environment, Youth and Family (FMEYF), elaborated by TRAFICO Transport Planning under the Project Management of UNEP, OECD and the FMEYF and under the Steering Committee of the CEI Sub Group Environment and Transport. The detailed list of the project team is listed at the end of this chapter.

The chapter on the report on the activities of the CEI Sub Group Environment and Transport was carried out by Renate Nagy.

Editorial: Univ.Lekt. Dipl.-Ing. Robert Thaler, Dr. Peter Wiederkehr, Renate Nagy

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About the CEI

Contacting the CEI
CEI Executive Secretariat
Via Genova, 9
34132 Trieste, Italy
Tel.: +39 040 778 6777
Fax.: +39 040 36 06 40
E-mail: cei-es@cei-es.org
Home page: http://www.cei-es.org

For enquiries on investment projects:
Secretariat for CEI Projects
European Bank for Reconstruction and Development (EBRD)
One Exchange Square
London EC2A 2EH, U.K.
Tel.: +44 171 338 6152
Fax.: +44 171 338 7472
E-mail: CalogerV@ebrd.com
Home page: http://www.digit.it/ceinet

CEI Background

The Central European Initiative (CEI) brings countries and institutions together in a spirit of flexible and pragmatic regional co-operation. It has created an atmosphere of mutual understanding, in which national projects and transnational programmes can be discussed, planned, studied, financed and implemented.

CEI Member countries are:

Albania
Belarus
Bulgaria
Czech Republic
Italy
Moldova
Romania
Slovenia
Austria
Bosnia and Herzegovina
Croatia
Hungary
Macedonia
Poland
Slovak Republic
Ukraine

CEI Objectives

- strengthening co-operation among and between CEI Member-States;
- strengthening participation of all CEI Member States in the process of European integration;
- strengthening the process of economic transformation of the countries in transition;
- reducing the impact of existing and possible emerging new differences and disparities between CEI Member States, avoiding the creation of new barriers and divisions in Europe;
- orienting future activities particularly towards assistance to the least advanced member countries and those having the greatest need for accelerated economic development or recovery.

CEI Structure

The CEI provides a series of regular fora, involving officials at the highest level and political leaders: Heads of Government Meeting (annual), Ministers of Foreign Affairs (annual), Committee of National Co-ordinators (regularly), meetings of ministers for specific sectors.

The CEI structure is assisted, in all its activities, by the CEI Executive Secretariat located in Trieste.

The CEI maintains a Secretariat for CEI projects at the EBRD, with the main task of assisting the transformation of project ideas into bankable projects.

CEI Working Groups have the task of formulating practical measures, and operate at both ministerial and expert level, meeting as required.

The CEI Working Groups are:

- Agriculture
- Civil Protection
- Culture
- Energy
- Environment with the Sub-Group Environment and Transport
- Fight against Organised Crime
- Human Resource Development and Training
- Information and Media
- Migration
- Minorities
- Rehabilitation of Bosnia, Herzegovina & Croatia
- Science & Technology
- Small & Medium Sized Enterprises
- Statistic
- Tourism
- Transport

CEI Plan of Action

The Plan of Action represents a selection of concrete activities, programmes and projects which contribute to the overall CEI strategy of cohesion and solidarity in Europe. Only the main headings are given below.

I. Strengthening co-operation among and between Member States

- Neighbourhood co-operation initiatives
- Assistance to CEI countries in special need
- Human dimension
- Promotion of Tourism
- Science and Technology
- Cultural co-operation

II. Strengthening the participation of all Member States in the process of European integration

- Integration strategy
- Transport
- Environment
- Encouragement of the process of liberalisation of trade among CEI countries
- Training

III. Strengthening economic transformation of the CEI countries in transition

- Agriculture
- Small and Medium Enterprise Development
- Training

Ministerial Declaration „Towards Sustainable Transport in the CEI-Countries"*

Declaration by the CEI-Ministers/State Directory/Department for the Environment

Preamble

The Ministers and State Directory/Department for the Environment of the CEI member countries

Albania, Austria, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Hungary, Macedonia, Moldavia, Poland, Romania, Slovak Republic, Slovenia, Ukraine

■ concerned about the heavy environmental damage and health hazards caused by transport and the need to reduce them in line with environmental goals and to maintain them within the acceptable limits for environment and health, in particular air pollution, noise and greenhouse gas emissions;

■ aware of the existing advantages of still having a high share of public transport and rail-freight transport in some CEI countries and concerned about the riskful trends of a decrease of the environmentally friendly transport modes; in particular a decrease of rail and public transport and a shift to road and air traffic;

■ aware of the specific situation of the CEI-region as the traffic junction of Europe and the high potential for an increase of transport volumes, in particular transit;

■ considering the interrelations between transport, land use, trade, mobility patterns and the economic and environmental development;

■ concerned about the high externalities of environmental and social costs not yet covered by the polluting transport modes leading to distortions on the transport market and weakening the competitive position of environmentally sound transport modes;

■ taking into account the specific situation of the CEI countries and the big differences between them, in particular the unevenness of environmentally friendly infrastructure and the need of investments and co-operation in improving infrastructure, rolling stock and logistics for environmentally friendly transport

■ convinced of the urgent need for a sustainable development in transport and the need to make transport environmentally responsible;

■ recalling the decisions taken at the UN Conference on Environment and Development in Rio 1992, the Paneuropean Conferences in Lucerne and Sofia, the UN Conference on Human Settlements - Habitat II in Istanbul 1996 and other relevant international decisions in the field of environment and transport;

have decided to closely co-operate in working towards a sustainable transport system in the CEI-region. To this end they have adopted this declaration for highlighting the long term objectives of sustainable transport, underlining the need for measures aiming at a step by step attainment of sustainability in transport and recommending areas for the further co-operation of the CEI member countries.

In accordance with their competencies they will take the necessary steps to:

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A. Bring Transport in line with Sustainable Development by

- integrating the principles of sustainable development into transport policies in particular the Precaution, Prevention, Protection, Polluter and User Pays Principles taking also into account the principle of subsidiarity and taking the Principles for Sustainable Transport (worked out at the OECD Vancouver Conference and within the OECD Environment Sustainable Transport project as cited in the Annex) as a basis;

- establishing common guidelines for the attainment of a sustainable transport system in particular by working out and developing further Environmental Plans in the CEI-region and Strategic Environmental Impact Assessments as important instruments for this integration;

- promoting those means of transport that best contribute to the attainment of sustainable transport, i.e. those that are most environmentally responsible, best protect health and conserve resources, are most energy efficient and least land consuming, have the lowest externalities, are socially acceptable and the safest;

B. Develop and establish environmental goals and standards for transport by

- working out further standards and limit values for ambient air quality (e.g. threshold values for particulates and benzene), water pollution, soil contamination and noise (related to land use and zoning), which are oriented on WHO guidelines and based on critical loads and levels;

- defining risk levels for cancerogenics, based on the latest scientific research and WHO guidelines;

- elaborating criteria for energy efficiency and other non-renewable resource consumption;

- implementing environmental standards for vehicles for reducing exhaust fumes emissions, energy consumption and noise as well as for fuel quality and infrastructure based on the best available technologies and the environmental quality standards and goals;

- defining reduction targets for emissions of air pollutants, greenhouse gases (specially CO_2), water and soil pollution, resource consumption and noise.

C. Develop, promote and implement strategies and measures towards sustainable passenger and freight transport by

- making transport and infrastructure concepts, spatial and land use planning programs environmentally responsible and give priority to those infrastructural investments, which will produce environmental benefits:
  * assessments of the environmental, economic and social impacts of these plans; concepts and programs and if necessary their adaptation;
  * implementation of environmental criteria within the relevant planning and financing procedures;

- planning and realising research programs and pilot projects focusing on measures and instruments for sustainable transport and co-ordination of national activities in that field:
  * pilot projects in the field of transport demand management, mobility behaviour, economic instruments;
  * technologies, infrastructure and logistics for public transport, cycling, walking and intermodal transport networks;
  * technologies, infrastructure and logistics for environmentally freight transport by rail, maritime and inland waterways and combined transport;

- reducing the demand for motorised transport by:
  * adaptation of land-use planning for shortening transport distances and avoidance of urban sprawl;
  * measures to raise the load-factor of lorries and the occupancy rates of cars

- improving transport efficiency
  * shifting traffic volumes to modes of transport with lower specific emissions or lower specific energy consumption;
  * making a fuller use of existing transport capacities;

- organisation of transport in an environmentally sound way
  * raising attractiveness of services, timetables and rolling stock of rail, bus and public transport on international, interregional and local connections;
  * raising attractiveness of services of rail and combined transport, improving interoperability and intermodal transport chains;
  * developing and improving the network, infrastructure and logistics with priority for rail and public transport, combined transport, coastal

shipping and inland waterways with attention to environment protection;
* improving the infrastructure for cycling and walking and broad implementation of measures of traffic calming;
* ensuring the elaboration and implementation of measures for protection of residents and environment while planning, building and operating of transport corridors and roads;

- encouraging the application of the „best available technologies“
  * facilitating the upgrading and replacement of vehicles and rolling stock in order to satisfy environmental criteria and raising the environmental and technical level of vehicles and rolling stock;
  * substantially reducing the specific emissions of exhaust fumes, noise and fuel consumption of vehicles and working out the most environmentally progressive emission and fuel standards according to best available technologies
  * ensuring the conformity of the vehicle fleet to these standards as soon as possible;
  * fostering the use of renewable energy technologies;
  * phasing out of leaded fuels as fast as possible and promoting less polluting fuels, with substantial reduction of carcinogenic compounds, like benzene;

- making transport pay its full costs
  * bringing the transport costs in relation to the mileage, particularly through area-wide implementing of road pricing;
  * working out and internalising the transport related external costs; in particular of traffic accidents, environmental damage and health hazards on an international level;
  * supporting the use of economic instruments, e.g.: the implementation of parking charges, road pricing, etc;.

- raising public awareness for environmental friendly mobility behaviour by
  * starting information campaigns for raising awareness and projecting a positive image of rail, public transport, cycling and walking;
  * integrating the environmental aspects into traffic education;
  * realizing transport demand management e.g. for enterprises;
  * promoting public participation in transport related decision making processes;

D. Have special focus on environmentally sound transport development in particular

- **in sensitive areas by:**
  * developing and introducing additional and stricter measures to keep the health and environmental impacts below acceptable limits, where the ecosystems are particularly sensitive, where critical loads and levels are exceeded, where the geographical conditions and the topography may intensify pollution and noise or where unique natural resources and features exist;
  * adapting and developing further environmental quality standards to the special conditions in sensitive regions to conclude specific emission reductions targets in the field of air pollutants, noise, water pollution, soil contamination and land consumption;
  * faster and intensive improving and extending of the infrastructure, logistics and competitiveness of rail and combined transport for achieving the highest possible shift away from road transport;
  * fostering the development and introduction of methodologies, economic instruments and measures, which reflect the higher external costs of transport in these areas;
  * promoting the development and introduction of traffic management systems and measures to restrict traffic for environmental, health and safety reasons linked with requirements and incentives for the use of transport modes and vehicles with ultra-low emissions, noise levels and energy consumption;
  * implementing measures for reducing and limiting the environmental impacts of transport infrastructure;

- **in urban areas by:**
  * maintaining the high share of public transport in the cities of CEI countries in transition by improving the infrastructure of tram, underground and bus systems, the facilities and rolling stock and realizing attractive services and demand oriented public transport;
  * using the environmental and passenger friendliest technology for rolling stock;
  * adapting urban planning and zoning in line with the principles of short trips, avoiding urban sprawl and reducing the dependency on car use, minimize land and energy consumption;
  * orienting city development and land use planning on the needs of effective public transport and good conditions for cycling and walking;
  * traffic calming and redesigning urban streets in a cycling and pedestrian friendly way

∗ promoting cycling and walking and improving their situation and infrastructure
∗ reducing the environmental damage and health hazards by limiting and reducing car and truck traffic;
∗ encouraging reductions in the use of private cars by best available instruments;
∗ making public relation and awareness campaigning for public transport, cycling and walking, foster traffic education and driver training;

- **in transit corridors by:**
  ∗ setting priorities for the development of rail and combined transport networks in the identified major international transit corridors, improving the interoperabilities and removing obstacles, extending rail and combined transport logistics and infrastructures, international co-operation in realizing multimodal transport chains,
  ∗ accelerating border crossings and improvements of terminals;

- **in post-war areas by**
  ensuring that reconstruction of destroyed transport networks and systems takes place in an environmentally, socially and spatially responsible way; in particular by promoting the reconstruction of rail and public transport networks and services and by taking measures to reduce the negative environmental and safety impacts of road infrastructure.

E. Co-operation and joint activities in the field of

- implementation of environmental criteria, standards and targets into transport, spatial strategies and land use planning;

- developing further joint strategic environmental instruments, e.g. Environmental Plans, Strategic Environmental Impact Assessments etc. and integrating transport issues;

- transboundary and multilateral and interregional environmental and spatial planning and control of pollution;

- developing instruments for the implementation of the strategies and measures listed in Chapter C and D;

- adapting infrastructural investments on the basis of the assessment of environmental and economic impacts;

- developing, promoting and realizing joint pilot projects and research programs as concrete impulses for moving towards sustainable transport;

- joint public awareness and information campaigns for promoting a more sustainable mobility behaviour;

- co-operation within international bodies to achieve sustainable transport solutions for specific CEI-transport problems;

- co-operation of authorities and organisations acting in the field of environmentally friendly transport within the CEI countries by exchanging information and best practices, developing guidelines, measures and programmes for joint activities and further scientific research;

The Ministers and State Directory/Department for the Environment of the CEI member countries have decided to mandate the Sub Group for Environment and Transport with the further developing, co-ordinating and evaluating of the implementation of this declaration in the CEI-region.

ANNEX

I Vancouver Principles for Sustainable Transport:

(Recommended by the OECD Conference Towards Sustainable Transport March 1996 in Vancouver, revised and accepted by the OECD PPCG Task Force on Transport)

- Access: People are entitled to reasonable access to other people, places, goods and services.
- Equity: In meeting the basic transport-related needs of all people, including women, the poor, the rural, the disabled, and children, nation, states and the transport community must strive to ensure social, interregional and inter-generational equity. Developed economies must work in partnership with developing economies in fostering practices of sustainable transport.
- Individual and Community Responsibility: All individuals and communities have a responsibility to act as stewards of the natural environment, undertaking to make sustainable choices with regard to personal movement and consumption.
- Health and Safety: Transport systems should be designed and operated in a way that protects the health (physical, mental and social well-being) and safety of all people, and enhances the quality of life in communities.
- Education and Public Participation: People and communities need to be fully engaged in the decision-making process about sustainable transport, and empowered to participate.
- Integrated Planning: Transport decision makers have a responsibility to pursue more integrated approaches to planning. They must involve partners from relevant sectors such as environmental, health, energy, financial, urban design, etc.
- Land and Resource Use: Transport systems must make efficient use of land and other natural resources while preserving vital habitats and maintaining biodiversity.
- Pollution Prevention: Transport needs must be met without generating emissions that threaten public health, global climate, biological diversity or the integrity of essential ecological processes.
- Economic well-being: Taxation and economic policies should work for, and not against, sustainable transport. Market mechanisms must account for the full social, economic and environmental costs, both present and future, in order to ensure users pay an equitable share of costs.

II Definition of Environmentally Sustainable Transport

The definition of 'Environmentally Sustainable Transport' worked out within the OECD and accepted by the CEI sub Group for environment and transport at their 3rd meeting on 10th March 1997 in Vienna.:[2]

Transport that does not endanger public health or ecosystems and meets mobility needs consistent with (a) use of renewable resources at below their rates of regeneration and (b) use of non-renewable resources at below the rates of development of renewable substitutes.

[2] OECD (1996), Second Draft Report on Phase 1 of a Project on Environmentally Sustainable Transportation, Paris.

Joint Pilot Study on Environmentally Sustainable Transport in the CEI Countries in Transition*

Publisher's Foreword

Transport - and in particular access for people to communication, services and goods - has been one of the principal factors in this century's economic and social development. However, transport is also recognised as a problem sector for the numerous impacts it has on health and the environmental. Present mobility patterns in passenger and freight transport do not correspond with the objectives of sustainable development. This applies also to Central and Eastern Europe, where a tremendous increase in freight transport by road and rising car traffic has been recorded in the last decade while non-motorised modes, such as walking, bicycling, public transport and rail freight transport experienced a substantial decrease.

To help address these problems, the pilot study „Environmentally Sustainable Transport in the CEI Transition Countries" was initiated by the United Nations Environment Programme (UNEP), the Organisation for Economic Co-operation and Development (OECD) and the Republic of Austria (Federal Ministry for the Environment, Youth and Family).

The CEI SubGroup „Environment and Transport" acted as the steering committee for this project, provided guidance to the development of the study, its scope and objectives, structure and content, and supported the collection of data and background information on transport and environment in the various CEI countries. Some countries also provided examples for good practices for environmentally sound transport which are included as special information boxes in this study section. A lot of thanks have to be expressed to the delegates of this CEI SubGroup for their kind co-operation.

The pilot study examines current trends in transport volume and mode choice and their likely impacts on the environment. It analyses possibilities to reduce the environmental effects of transport by modelling three different „environmentally sustainable transportation scenarios", based respectively on technological improvements, transport demand management and a combination of both. Due to problems of data availability, lack of statistics, open methodological questions and budget constraints this pilot study has to focus on the quantifiable criteria for sustainable transport, i.e. priority on emissions of carbon dioxide (CO_2), nitrogen oxides (NOx), volatile organic compounds (VOC), and particulate matter (PM). Noise and land use issues could only be described qualitatively and further work and investigations are therefore needed in this field. This is also true for the problem of fine particles as well as for the impacts of aviation on attaining or not attaining sustainable transport.

The study concludes on strategies and measures for achieving „Environmentally Sustainable Transport" (EST), taking account the specific situation in the countries in transition, and therefore, suggests a diversified approach.

This pilot study provides a scientific basis for the work of the CEI SubGroup on „Environment and Transport" to implement the „Ministerial Declaration towards Sustainable Transport in the CEI countries". It will also serve as a basis for further national or regional pilot studies on Environmentally Sustainable Transport (EST) in the future.

*The chapter on the Joint Pilot Study 'Environmentally Sustainable Transport' in the CEI Coutnries in Transition is a short version of the full pilot study which was commissioned by United Nations Environment Programme (UNEP), Organisation for Economic Co-operation and Development (OECD) and the Austrian Federal Ministry for Environment, Youth and Family (FMEYF), elaborated by TRAFICO Transport Planning under the Project Management of UNEP, OECD and the FMEYF and under the Steering Committee of the CEI Sub Group Environment and Transport. The detailed list of the project team is listed at the end of this chapter.

Contents

Introduction

Across the last one hundred years, railways, automobiles and air transport have changed the shape of our world. By facilitating travel and increasing access to goods and services, modern forms of transportation have improved personal mobility in many ways and made freight transport across vast distances an everyday affair. Beyond the new forms of leisure and commerce modern transportation makes possible, the transport industry is one of the pillars of modern economies.

For all of these reasons, consumption of transport has long been thought of as being directly linked to economic growth. Yet along with the remarkable contributions they have made to improving the quality of life, new modes of transportation have also brought with them new problems. As the automobile became a part of life, so did the auto accident. With the expansion of transport and in particular the big increase of road and air transport came increased air pollution, noise and other negative impacts on health and the environment. In our time, phenomena such as accidents, smog and traffic congestion have become familiar, as unpleasant features of the modern cityscape. Other recently understood effects of motor vehicle pollution, including health threats like the emission of carcinogens, or regional or global environmental damage like acidification or climate change, are more discreet but just as harmful in the long term.

Transport: going where?

In spite of the increasing conspicuousness of the environmental problems related to motor vehicle use, however, the world's vehicle fleet and the distances that they travel continue to grow at an unprecedented rate. Under current conditions, the growth expected in the consumption of transport across the next few decades promises to further exacerbate current environmental problems and leave future generations with a disturbing legacy, if no measures are taken. Not only does transport contribute to a variety of environmental problems, in several cases, it is the predominant cause of those problems. Accordingly, it is not hard to see that present mobility patterns in passenger and freight transport are not environmentally sustainable in the long run[2]. Modern forms of transport have changed the world in many ways. To ensure that they do not end up changing it for the worse, thus offsetting the many benefits they have brought to modern life, current trends in transport consumption and vehicle design must be altered with a view to protecting human health and the environment across the long term.

Central and Eastern Europe

This is particularly true for the countries of Central and Eastern Europe. While air travel, shipping and rail all have impacts on human health and the environment, motor vehicle use is responsible for the lion's share of the negative environmental effects of transport[3]. Thus, as the share of road transport increases, so do the environmental impacts of the sector as a whole. The current trends in the Central and Eastern European countries show a tremendous movement away from comparatively „clean" forms of transport such as trams, subways, rail freight and non-motorised transportation towards private car and truck use. Although transport's share of environmental pollution in the region is still considerably lower than in Western Europe or North America, this trend represents a potential for vastly increased automobile emissions and other negative environmental effects over the next decade.

A Head Start for Cleaner Transport

Fortunately, these countries have a special advantage in the fight against motor vehicle pollution. Today, most CEI transition countries face a legacy of severe environmental problems linked to very pollution-intensive energy and industrial sectors and inadequate enforcement of environmental policies under former central planning. On the other hand, in contrast to the EU countries, the transport system in Central and Eastern Europe has historically been dominated by the more environmentally friendly forms of transport. Public transport, rail freight and even walking and cycling still play a much greater role in moving people and goods than in EU countries or North America.
A series of informationboxes presented throughout this brochure focus on some exemplary good practices in some of the CEI countries[4].
Many of the Central and Eastern European countries still show high market shares of public transport in

their cities, but a push of investments in comfortable rolling stock and improved public transport and rail networks is needed for maintaining this higher market share of environmentally sound transport.

In regions such as North America or the European Union, where to varying degrees, the automobile was long promoted as the ideal mobility solution, governments now face serious barriers to significantly changing the transportation modal split in favour of cleaner forms such as rail or public transport. Over the years, commerce and other activities have gradually adapted to a heavily motorised population, and support for private motor vehicles is deeply embedded in public policy. The rise of the automobile has led to fundamental changes in land use policies and the shape of population centres. In particular, private motor travel has greatly contributed to the phenomenon of urban sprawl. Since such widely distributed, low-density areas are difficult to service efficiently with public transport and rail, the automobile has become almost indispensable to the ever-increasing number of residents and businesses in these areas. Subsequently the fuel consumption for mobility per capita in such urban sprawl areas and automobile oriented agglomerations is substantially higher than in more densely areas mixed with areas where public transport, cycling and walking can form the backbone network of mobility.

Beside the more technical aspects, the private automobile has become an object of culture and a symbol of personal status.

In Central and Eastern Europe, low car-motorization, land-use patterns and rail and public transport oriented mobility habits favoured environmentally sound modes of transport. It is true that the first years of the transition have seen a dramatic decrease in the share of these transport modes in some countries of the region. The opening of trade barriers and the development of new consumer markets in these countries have been accompanied by a rapid change from rail to road freight transport. At the same time, the private car is sought after both as a convenience and a symbol of the higher standard of living enjoyed in the European Union. For the moment, however, the extensive, if sometimes poorly maintained rail and public transport infrastructure is still in place and population centres in Central and Eastern European countries are still demographically adapted to public transport axes. The profound changes in the urban and suburban fabric wrought by the proliferation of the automobile in EU countries and elsewhere will only occur over time, but they will occur inevitably, if the current shift towards private motor vehicles continues. This will make a future transition towards cleaner forms of transport much more costly and difficult. For this reason, the present moment offers a rare opportunity to help ensure the sustainability of future transport systems in Central and Eastern Europe. The current transportation modal split in these countries offers a „head start“ on the way to sustainable transport. If it can be preserved and consolidated, the prospects for achieving an environmentally and economically sound transport system will be much brighter.

Other questions are equally important. Central and Eastern European countries have seen a surge in road freight transport in recent years. Happily, most of the new segments of the heavy-duty vehicle fleet are modern, potentially low-emitting vehicles. However, large variations in the quality of diesel fuel available in these countries, and poor fuel quality overall make engine optimisation for low emissions and the installation of after treatment devices (such as trap filters) very difficult or impossible. Similarly, a large segment of the passenger car fleet in the region lack environmental modifications (such as catalytic converters). Accordingly, the environmental impacts per passenger or freight unit transported in Central and Eastern Europe are in some cases higher than in the European Union. This has substantially contributed to severe urban air quality problems in Central and Eastern European cities, where traffic is dense and exhaust emissions are high.

Environmentally Sustainable Transport (EST)

To ensure that mobility in the next century does not endanger human welfare, governments must go beyond conventional approaches and introduce a new generation of integrated policy and technology solutions. Many novel suggestions have been made and research is underway - but time is pressing. As stressed in UNCED's Agenda 21, the key word for future transport development must be sustainability [5].

Cleaner transport practices: Focus on the Czech Republic

Urban public transport in the Czech Republic serves the needs of 3 million people per year. 22% of the passengers are transported by metro, 32% by trams, 8% by trolley buses and 38% by diesel buses. The Prague metro network with its three main lines has been extended continuously during the past 20 years. This made it possible to reduce or even eliminate car traffic in the most congested parts of the city and to implement pedestrian zones. Further development of the tramway networks is planned in many cities.

Trolley bus services operate in 12 Czech cities today. Network extensions or creation is planned in 16 cities.

Modern tramway in Prague

Twenty container-reloading yards are operating in the Czech Republic and efforts are being made to increase their capacity and enable them to serve other forms of combined hauling (i.e. vertical reloading of trucks, RO-RO systems).

Combined transport terminal in the Czech Republic

Environmentally sustainable transport is the expression of sustainable development within the transport sector. The concept of sustainable development was first proposed by the Brundtland Commission in its 1987 report „Our Common Future“ and is defined as „development that meets the needs of the present without compromising the ability of future generations to meet their own needs“ [6]. By analogy, sustainable transport (or sustainable mobility) is transport that meets the needs of the present without compromising the ability of future generations to meet their own needs.

A sustainable transport system is one where i) generally accepted objectives for health and environmental quality (e.g. such as those set forward by the World Health Organization concerning air pollutants and noise) are met, ii) where ecosystem integrity is not significantly threatened and iii) where potentially adverse global phenomena such as climate change and stratospheric ozone depletion are not aggravated[7].

In this context, a brief definition of ‘Environmentally Sustainable Transport’ has been proposed by the OECD:
Transport that does not endanger public health or ecosystems and meets mobility needs consistent with (a) use of renewable resources at below their rates of regeneration and (b) use of non-renewable resources at below the rates of development of renewable substitutes.

Furthermore, the OECD Conference Towards Sustainable Transport in Vancouver in 1996 recommended the „Vancouver Principles for Sustainable Transport“ highlighting the ecological, economic and social key principles for sustainable development in transport.

The „Ministerial Declaration Towards Sustainable Transport in the CEI Countries“

Objectives, strategies and actions towards sustainable transport are the heart of the „Declaration Towards Sustainable Transport in the CEI Countries“[8], which was signed by the Environment Ministers of the Central European Initiative (CEI) countries (except Italy) in June 1997 [9].

The Declaration includes the „Vancouver Principles for Sustainable Transport“ as well as the definition of „Environmentally Sustainable Transport“ elaborated and recommended within the OECD.

The CEI Declaration recommends the following strategies and measures:

- Integration of the principles of sustainable development into transport policies and establishment of common guidelines for the attainment of a sustainable transport system.
- Development and adoption of environmental goals and standards for the transport system.
- Development, promotion and implementation of strategies and measures towards sustainable passenger and freight transport including assessments of the environmental, social and economic impacts of transport and infrastructure programmes; strategies should distinguish between reducing the demand for motorised transport, inducing modal shifts towards less polluting transport modes, and finally, applying the best available technology. Fair and efficient pricing including internalisation of externalities should also be a pillar of these strategies and last but not least raising public awareness for sustainable transport.
- Special focus on sustainable solutions for transport problems in particularly sensitive areas, urban areas, transit corridors and post war areas; and
- International co-operation, joint actions and pilot projects, especially for promoting environmentally sound transport and the implementation of measures moving towards sustainable transport within the CEI countries.

Another important step in this direction took place when during the UNECE's 1997 Regional Conference on Transport and the Environment, the „Vienna Declaration and Programme of Joint Action on Transport and Environment“ was signed by the Transport and Environment Ministers of most European countries. It stated inter alia that transport sector development must be pursued within the framework of sustainable development.

The Pilot Study's Scope and Objectives

How can environmentally sustainable transport become a practical reality in Central and Eastern Europe? What are the likely risks to human health and the environment if nothing is done? In an effort to help answer these questions, this brochure presents for the results of a recent study assessing present and future transport patterns in the transition countries of the CEI. The study sought to evaluate current and probable future trends in transport and its environmental impacts in a region comprising several countries (Albania, Belarus, Bosnia-Herzegovina, Bulgaria, Croatia, the Czech Republic, FYROM, Hungary, Moldova, Poland, Romania, the Slovak Republic, Slovenia and Ukraine). Scenarios assuming the application of different types of measures to reduce the environmental impacts were modelled, with the goal of identifying key opportunities for pursuing sustainable transport.

More specifically, the project's objectives were:

- to provide a survey and an analysis of the situation in the past and present regarding environment and transport as well as of environment and transport policies;
- to provide an outlook up to 2010 and beyond on transport and its impacts on the environment for the CEI region;
- to determine the key features of sustainable development in transport in CEI countries and their policy implications, in the context of the CEI Declaration;
- to develop and model environmentally sustainable transport (EST) scenarios using key indicators, principles and approaches elaborated within OECD and UNEP;
- to underpin and develop further policy conclusions and recommendations towards realisation of environmentally sustainable transport in CEI countries;
- to provide the scientific basis for future work of the CEI SubGroup on „Environment and Transport“ to implement the CEI Declaration; and
- to create the basis for national and regional case studies and pilot actions.

A detailed survey of transport and environment policies in the study area was carried out. Road, rail and public transport were examined for passenger transportation, whereas road, rail and inland waterways have been considered for freight transport. Due to lack of data and methodological uncertainties, aviation, coastal shipping and pipelines could not be taken into account.

Socio-economic Situation and Transport Trends in the CEI Countries

Socio-Economic Situation

The CEI countries under study make up a highly heterogeneous group, with markedly different historical, geographic, political and economic profiles. Some countries, like the Czech Republic and Poland are highly industrialised and have recently been enjoying economic growth, others such as Albania, are agricultural nations, while countries like Bosnia-Herzegovina are in the midst of a painful reconstruction following war.

The difference in per capita income among the countries is considerable: as high as 1 to 20, in the case of Bosnia-Herzegovina or Albania as compared to Slovenia. In some countries, agriculture still plays a very important role in the economy. In Albania, agriculture contributed 56% to the GDP in 1995, in Moldova 27% (1994) and in Romania 21%. In contrast, in Belarus, Ukraine, FYROM and Moldova, the industrial sector had a share of 50% or more of the GDP. Unemployment is high in many countries, especially in the war-torn Balkans. According to unofficial estimations, the unemployment rate in Bosnia-Herzegovina is 80%. In general, the early euphoria regarding overall economic progress in the transition countries has given way to a more realistic assessment (Table 1).

Figure 1:

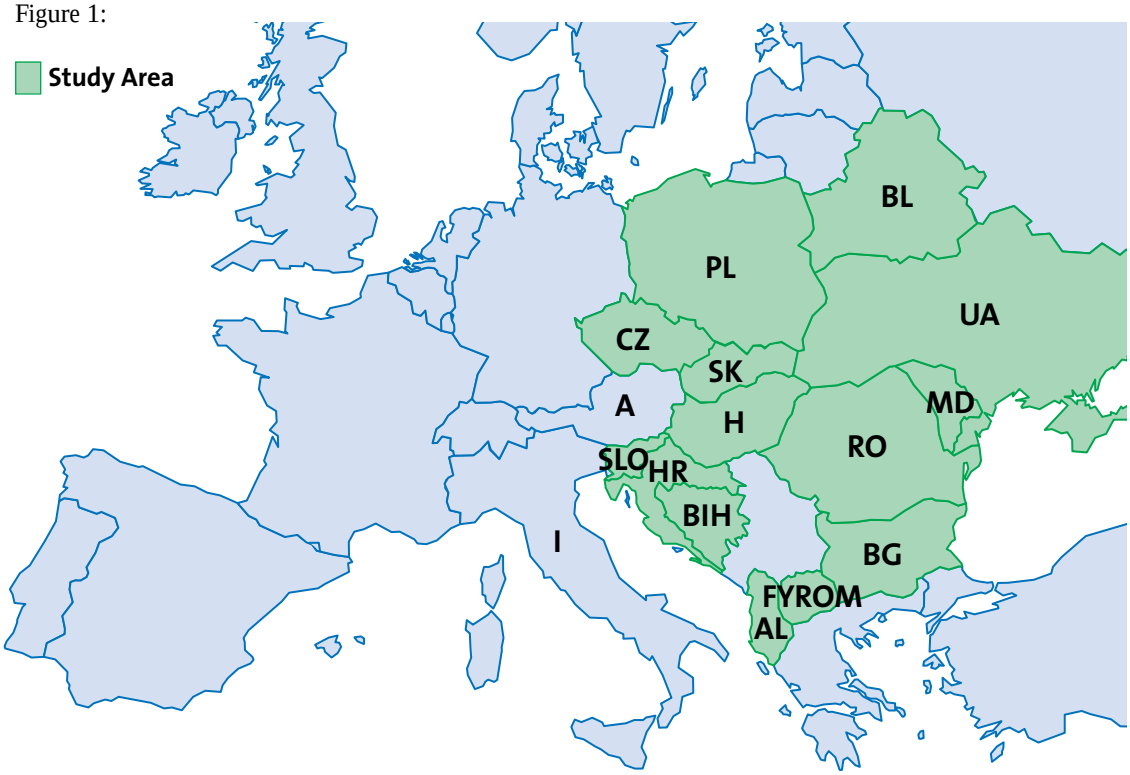


Table 1:

Socio-Economic Parameters of the CEI Transition Countries

Country	Inhabitants 1994 [million]	GDP per Capita 1994, [USD]	GDP at PPP 1994 [USD/ Capita]	Agricultural Share of GDP 1994 in %	Industrial Share of GDP 1994 in %	Unemployment Rate 1995 in %
Albania	3,41	360	n.a.	56	22	16
Belarus	10,16	2.160	4.320	** 8	** 65	3 (20)
Bosnia-Herzegovina	3,50	* 350	n.a.	n.a.	n.a.	(80)
Bulgaria	8,18	1.198	4.380	12	38	11
Croatia	4,78	2.530	3.975	13	25	14,5
Czech Republic	10,30	3.210	8.890	6	39	3
FYROM	2,09	790	n.a.	18	49	(50)
Hungary	10,16	3.840	6.080	7	33	11
Moldova	4,42	870	n.a.	** 27	** 48	6
Poland	38,34	2.470	5.480	6	40	15
Romania	22,74	1.230	4.055	21	33	15
Slovak Republic	5,33	2.230	6.836	7	36	13
Slovenia	2,00	7.140	10.007	5	38	15
Ukraine	51,47	1.570	2.620	** 19	** 50	1

Source: Der Fischer Weltalmanach 1997, Frankfurt am Main 1996, WIIW.
PPP = Purchasing Power Parity, * value of 1995, ** value of 1993, Terms in brackets: unofficial estimations, n.a.: data not available.

Transport Trends

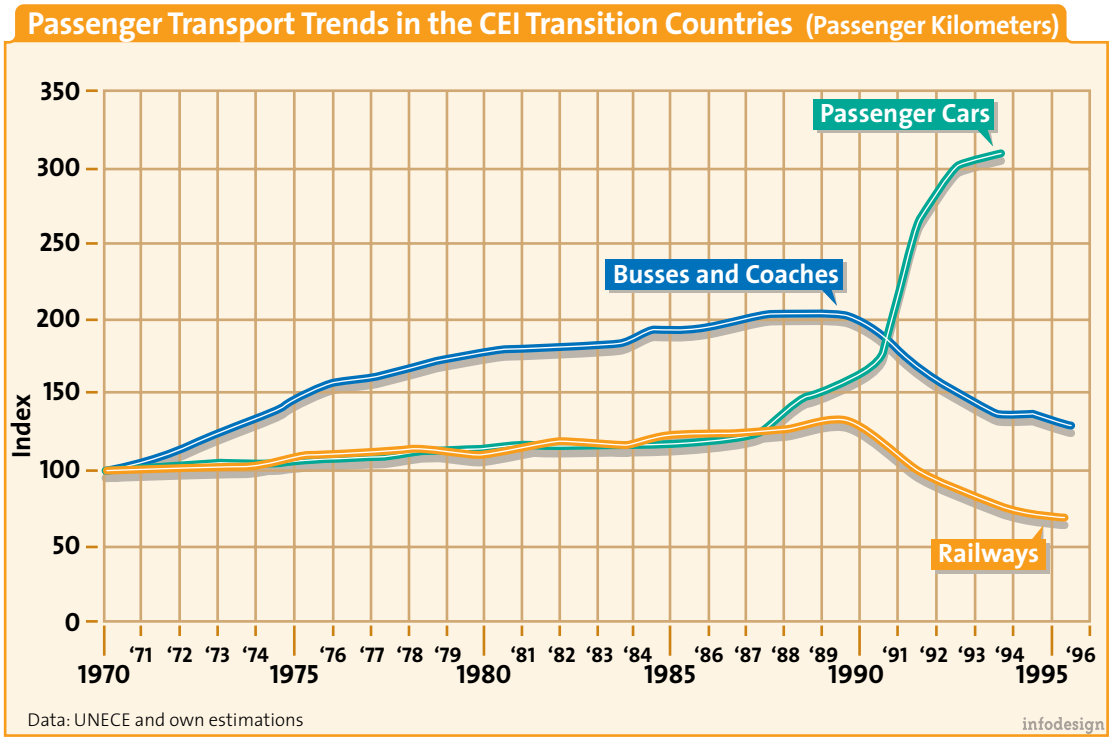
Transport volume in the CEI transition countries increased continuously throughout the 1970s and 1980s. After 1989, this increase was followed by a tremendous decline due to political changes and a dramatic economic recession. In the recent past, strong growth in transport occurred in several areas. At the same time fundamental changes took place in the transportation modal split: road transport increased while rail and public transport declined or remained more or less stable. As growth returns to more of the transition countries, this trend is likely to become more pronounced. In the „Declaration Towards Sustainable Transport in the CEI Countries“, ministers recognised that the strategic position of the region as the „traffic junction of Europe“ implies a high potential for increases in transport volumes, particularly road transport and therefore an urgent need for setting the policies towards a sustainable development in transport.

Passenger Transport

Due to a lack of data on the historical development of passenger transport by private cars, statistics for most of the countries can only be supplied for passenger transport by rail and buses. An estimation of the changes in car traffic was only possible in the case of Hungary and Poland. Since 1989, rail has lost more than 46% of its passenger transport volume (passenger-km) (Figure 2). While the number of rail passenger-km increased only in the three countries Croatia, Slovenia and the Czech Republic, it decreased significantly in Moldova, Bulgaria and Poland. This can be attributed to the considerable increase in train fares and to the greater competition from private cars.

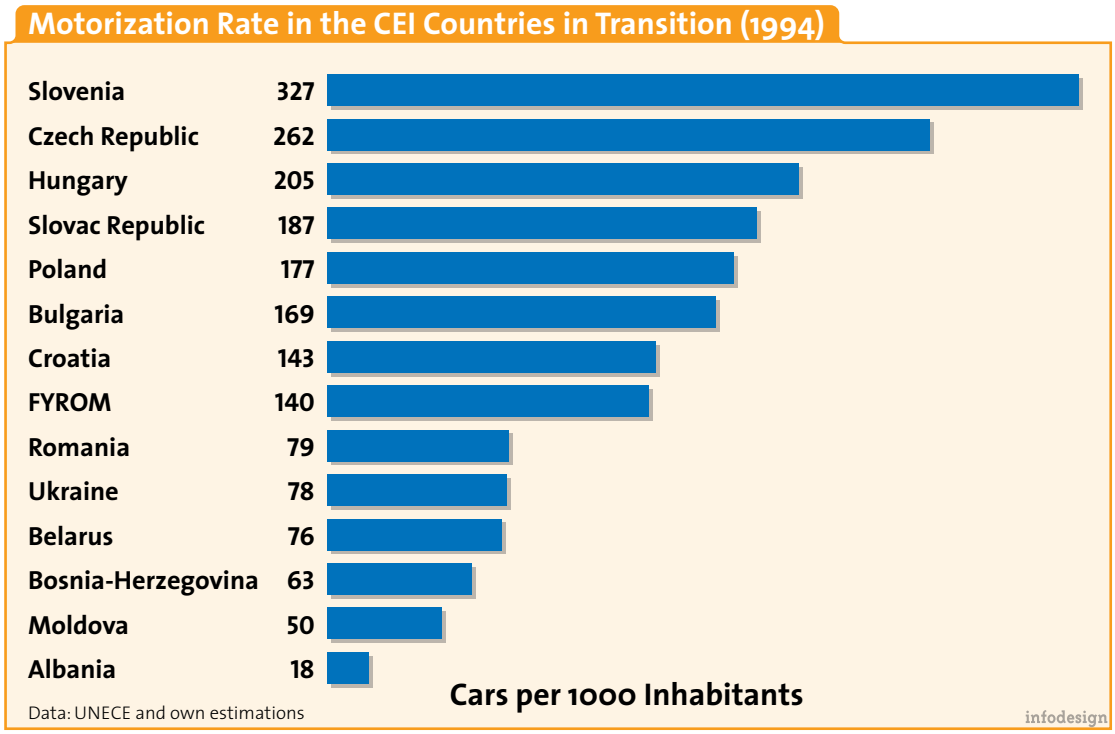
The greater competition from private cars is also reflected in the development of motorization (cars per 1.000 inhabitants). In all CEI countries, except in those involved in war, the number of cars per 1.000 inhabitants grew in the last 10 years. The road vehicle fleet in the CEI countries ranges from 18 passenger cars per thousand inhabitants in Albania in 1994/1995 to 327 passenger cars per thousand inhabitants in Slovenia in 1994/1995 (see Figure 3).
The environmental effects of air traffic (e.g. noise, emissions of CO_2, VOC, NOx and water vapour at high altitude), are significant even if its share is still low in the CEI transition countries. It should be

Figure 2:



Data: ECMT and own estimations, Railways, Buses and coaches: 11 countries (BG, CZ, EST, H, HR, LT, LV, PL, RO, SK, SLO), Index 1970=100, Passenger cars: 2 countries (H, PL), Index 1970=100, own design.

Figure 3:



Data: UNECE and own estimations; own design.

noted that aviation is a rapidly growing segment of the world transport market; the CEI countries are no exception (Table 2).

As shown in Figure 4, passenger traffic per capita varies considerably among the CEI transition countries. Slovenia has by far the highest car traffic volume per capita. On the other hand, passenger rail transport has declined substantially in Slovenia, whereas public transport and rail passenger transport is still more important than car traffic in most of the CEI countries.

Freight Transport

A more complete picture of past trends can be drawn for freight transport. With the onset of the economic recession in 1989, overall transport volume decreased considerably. After 1993, roadways and the fuel distribution network were expanded, leading to growth in traffic. Future changes in transport volume will depend on economic development and transport policy. Expressed as a percentage, freight transport by road and by pipeline has grown much faster than freight transport by rail and inland waterways (Figure 5). When comparing the proportional shifts between freight transport modes, it should be noted that traffic volumes in the different modes often vary substantially among countries.

Although rail still accounts for the largest part of the freight transport market (66% of transport volume [tkm] in 1994), the share of freight transport by road increased from 29% in 1990 to 32% in 1994. From an environmental standpoint, it should be stressed that a shift towards more pollution-intensive transport modes has taken place. Transport intensity, expressed as tonne-kilometres per unit of GDP, is an indicator of the relationship between transport demand and economic activity. In addition to reflecting the quantity of transport consumed for a given amount of economic production, transport intensity is also a register of a country's surface area and other factors, such as:

- The importance of the service sector in the economy. Since the service sector requires less goods transport and delivery, the stronger the service share of the economy, the lower transport intensity is.

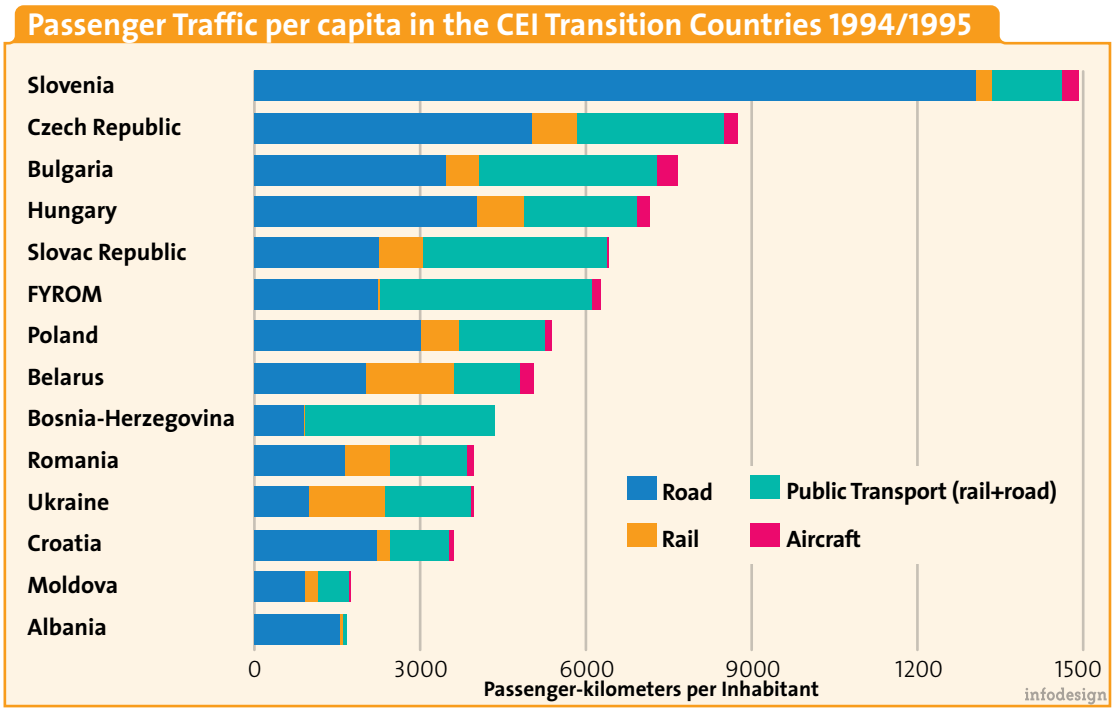
Table 2:

Passenger Traffic in the CEI Transition Countries in 1994/1995

Country	Road passenger traffic [mil. pkm]	Rail passenger traffic [mil. pkm]	Public Transport (rail + road) [mil. pkm]	Civil aviation [mil. pkm]
Albania	5.273	215	197	4
Belarus	20.600	16.063	12.126	2.604
Bosnia-Herzegovina	3.157	28	12.012	0
Bulgaria	29.048	5.059	27.007	3.105
Croatia	10.606	1.139	113	443
Czech Republic	51.700	8.481	27.328	2.640
FYROM	4.696	65	8.000	350
Hungary	41.175	8.508	20.934	2.396
Moldova	4.062	1.019	2.408	228
Poland	114.225	26.635	58.916	4.412
Romania	36.941	18.880	31.574	2.674
Slovak Republic	12.049	4.202	17.778	144
Slovenia	25.883	595	2.507	614
Ukraine	50.270	70.882	79.646	2.820

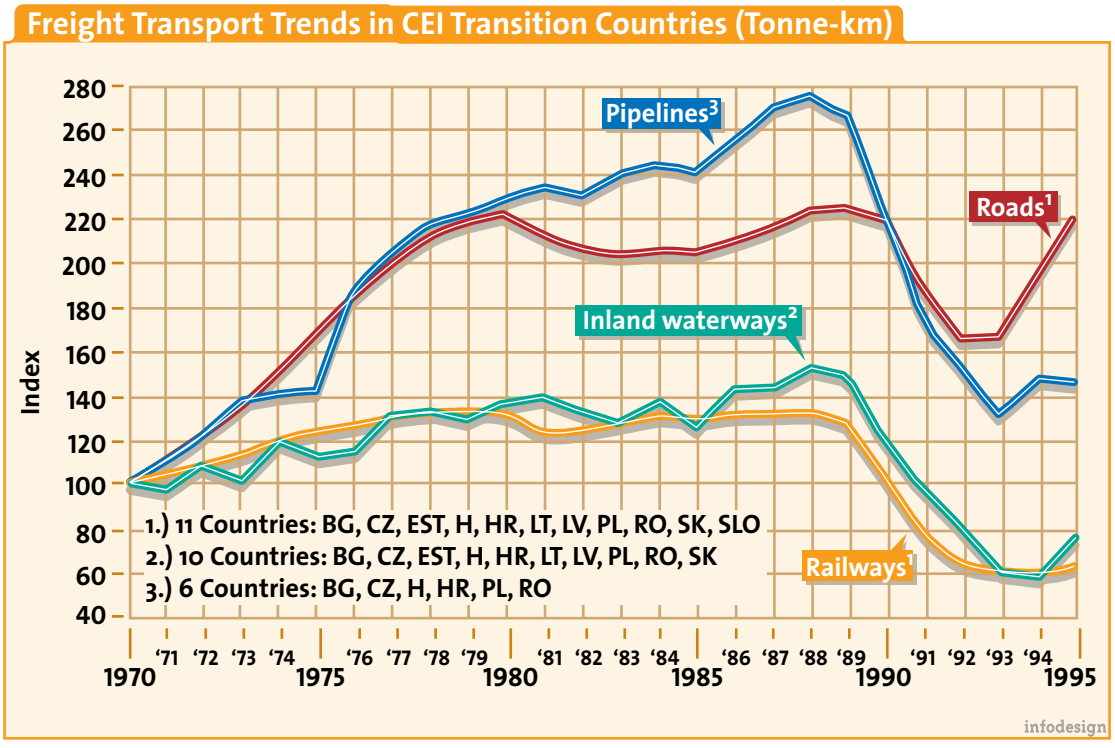
Source: own survey and estimations, UNECE, WIIW, UIC.
Public Transport = tram, metro, bus, trolley-bus, pkm = passenger kilometers

Figure 4:



Data: ECMT and own estimations; own design.

Figure 5:



Source: ECMT (1997): Trends in the transport sector 1970-1995, Paris, Index 1970 = 100

Table 3:

Freight Transport in CEI Transition Countries 1994/1995

Country	Road Freight Transport [mil. tkm]	Rail Freight Transport [mil. tkm]	Inland Waterways Freight Transport [mil. tkm]	Air Freight Transport [mil. tkm]
Albania	486	53	n.a.	0
Belarus	12.478	25.510	133	2
Bosnia-Herzegovina	1.529	16[1)]	n.a.	0
Bulgaria	13.274	7.774	360	121
Croatia	7.514	1.975	33	5
Czech Republic	29.800	24.390	1.186	55
FYROM	1.870	169	0	1
Hungary	11.280	8.421	1.454	93
Moldova	2.115	3.145	1	2
Poland	46.095	69.116	876	82
Romania	17.441	27.179	3.107	33
Slovak Republic	3.967	13.674	1.468	9
Slovenia	2.747	3.076	0	27
Ukraine	31.513	195.760	5.611	168

Source: own survey and estimations, UNECE, WIIW, UIC, ICAO.
Notes: [1)] Data from 1993. tkm = tonnekilometers

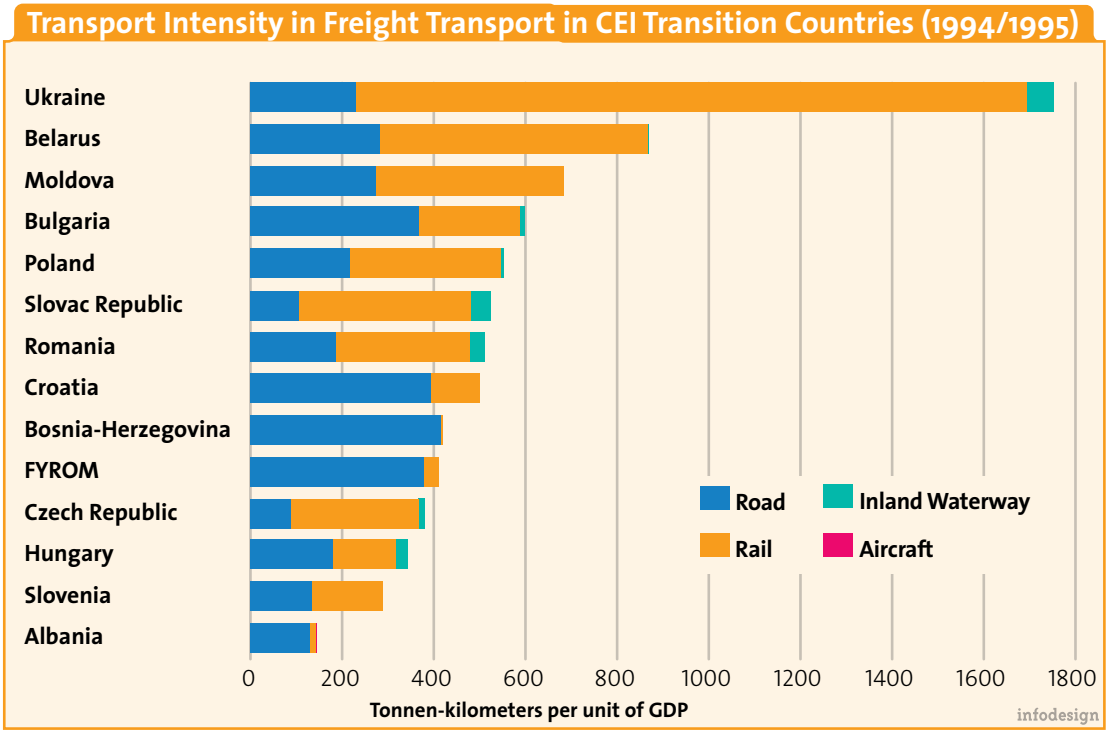
- The regional structure of the economy. Countries with a high number of small and medium-sized economic centres consume less freight transport than countries where concentrated urban centres are few and diffuse rural or residential centres are common.

- The share of low-wage- and low-tech-products.

- Economic concentration. Where many small enterprises supply regional markets, transport demand is lower than in the case of concentrated bases of large enterprises using economies of scale[10].

Figure 6 shows transport intensity in the CEI countries in terms of tonne-kilometres per unit of GDP. The high transport intensities in the Ukraine, Belarus, and the Czech and the Slovak Republics, are linked to the high industrial shares of the GDP and strong regional concentration in those countries. In contrast, Moldova and FYROM have low transport intensities in spite of a high share of industry in GDP. This is likely a reflection of the severe economic recession both countries experienced in the 1990S. In general, low transport intensity is also characteristic of countries with a high agricultural share of GDP, as can be seen in the case of Albania or Romania.

Figure 6:



Infrastructure Investments

Numerous measures or planned measures concerning construction or reconstruction of transport infrastructure in transition countries have been elaborated by national and international bodies including UNECE, ECMT, EC, CEI and CEC. Estimations suggest that all countries together will spend approximately Euro 500 million per year for new transport infrastructure. The „Crete Transport Corridors“ programme adopted at the Pan-European conference of transport ministers in Crete in 1995 and revised in Helsinki in 1997 can be regarded as the broadest approach to the transport network of Central and Eastern Europe. It seems likely that investments of approximately Euro 50 billion will be required for the development of the ten corridors identified during the conference.[11] While the ensemble of the projects is still under review concerning their economic viability, a steady increase in the investment volume for transport infrastructure is expected. The development of the transport infrastructure network in Central and Eastern European Countries is carried out under the TINA process („Transport Infrastructure Needs Assessment“ (TINA)).

Since the beginning of the transition process (between 1990 and end of 1996), international financial institutions (IFIs) have provided Euro 2.6 billion for transport infrastructure investments. By the end of 1996, the EIB had provided loans totalling almost Euro 4.8 billion to eleven countries in Central and Eastern Europe (Albania, Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovenia and the Slovak Republic). Out of this amount, Euro 1.8 billion was lent by the EIB for transport projects in 10 Central and Eastern European countries; four-fifths of the EIB-loans were allocated to the Crete Corridors. The bank's lending activities in transport concentrated mainly on roads (Euro 862 million or 46%). Euro 683 million (36%) went to rail, Euro 215 million (12%) to air, Euro 69 million (4%) to maritime transport and Euro 40 million (2%) to urban transport (Table 4).

Across 1997-1999, the EIB is scheduled to provide a further Euro 3.52 billion for transport development in these countries.

The European Bank for Reconstruction and Development (EBRD) began to granting loans to the transport sector in Central and Eastern

Table 4:

EIB Financing in CEE Countries

EIB Financing (1996) in CEE countries in Transport in mil. ECU						
	Mode of Transport					
Country	**AIR**	**ROAD**	**RAIL**	**MARITIME**	**URBAN**	**Total**
Albania		24		5		29
Bulgaria	60	81				141
Czech Republic		60	325			385
Estonia	20		16	15		51
Hungary	20	217				237
Latvia						0
Lithuania	10	20	22	14		66
Poland	50	225	260			535
Romania	40	135		35	40	250
Slovak Republic	15	10				25
Slovenia		90	60			150
Total	**215**	**862**	**683**	**69**	**40**	**1.869**
In %	11,5	46,1	36,5	3,7	2,1	100,0

Source: EIB Financing in Central and Eastern Europe, Luxembourg 1997, EIB Lending Activity for Transport in Central and Eastern European Countries, Helsinki 1997.

European countries in 1992. The main purpose of EBRD financing is to facilitate the transition of the formerly centrally planned economies in Eastern Europe towards market-oriented policies and to promote private and entrepreneurial initiative as well as environmentally sound and sustainable development[12]. EBRD has invested more than Euro 1.2 billion in transport infrastructure, representing about 16% of the Bank's overall portfolio. EBRD has also provided a wide range of technical co-operation to prepare investments and optimise project effectiveness and transition impact. Between 1992 and 1996, EBRD financing to road and motorway projects represented 53% and railway projects 26% of its total financing to transport infrastructure development.

The EIB and the EBRD, however, are only two of several IFIs currently involved in the region; it would exceed the scope of the study to list all of the relevant IFIs and detail their projects here. Yet, it appears that IFIs focus too much attention on sectoral road transport projects[13]. Observers of the investment decisions in CEE countries have stated that this concentration on road transport projects is „the result of the emphasis on short term economic returns (...) at the expense of longer term environmental or social costs"[14]. To promote sustainable development in transport it is evident that more investment efforts need to be put on the environmentally friendly modes of transport. To this end investment activities of the IFIs should have a special focus on investments for the reconstruction, modernisation and extension of railway systems, combined transport, inland waterways and in particular on investments in the public transport in the CEI agglomeration areas.

Health and Environmental Impacts of Transport

How serious are the risks posed by current trends in transport consumption? The diffuse, decentralised nature of the transport sector often makes its impacts on human health and the environment less obvious than those of other sectors, such as industry or energy production. Within transport, this is especially true of motor vehicle use. Just as the high mortality resulting annually from road accidents is generally overshadowed in the media by more spectacular events such as air disasters or large scale industrial accidents, motor vehicle pollution also tends to be less perceptible than pollution from industrial operations or other point sources. While some effects, such as noise and trophospheric ozone (smog) are relatively well known, the majority of motor vehicle pollution's threats to health and the environment are less evident. This is not, however, because they do not pose immediate dangers. Any serious assessment of the impact of road transport on human welfare must thus go beyond immediate nuisances and examine the health and environmental risks associated with long-term exposure to the various pollutants emitted by motor vehicles.

The health and environmental effects of transport are numerous and diverse and extend to every environmental media (air, land, water). Apart from familiar phenomena such as photochemical smog and accidents, motor vehicle use contributes to a host of less obvious threats to human well being such as the emission of carcinogens and contributions to acid deposition. The environmental consequences of transport also occur within several different time frames. Some effects, like pollution through exhaust emissions or noise, are immediate and direct. Other effects only become apparent over relatively long periods of time. This is true, for example, of acidification or the emission of so-called „greenhouse gases" implicated in global climate change, but also for the transformation of land use patterns or the isolation and subdivision of natural areas by roadway. Finally, whether one looks at petroleum refining, military expenditures for energy security, asphalt and concrete production, vehicle manufacture or the multitude of other activities which make today's transport habits possible, it is clear that transport is also responsible in an indirect fashion for many other health and environmental effects.

The following sections attempt to identify the key impacts of transport on human health and the environment. The effects of transport-related air pollution, accidents and noise are reviewed in detail, and transport's impact on land use patterns is also analysed. For the purposes of this study, however, other types of transport-related impacts could not be taken into consideration. These principally concern transport's direct and indirect contribution to water pollution, including but not limited to:

- the use of de-icers on roadways and airports (salt is the most concentrated contaminant in drains during the winter months);
- contamination of rainwater gutters by fuel or motor oil
- maritime fuel tank flushing.

These impacts are not insignificant, but the current study had to focus on the most pressing environmental problems at this stage. Nevertheless, a brief analysis of the external costs of these problems is made further along.

Air Pollution from Transport

Road vehicles are by far the largest contributors to transport-related environmental pollution. While motor vehicles also contribute to pollution of waterways and soil, the vast majority of these impacts are caused by the deposition of pollutants initially released into the atmosphere. In turn, air pollution from motor vehicles predominantly results from burning petrochemical fuels in combustion engines, or to a lesser degree, from the evaporation of fuel during operation, resting or refuelling of vehicles.

Internal combustion engines have been used in cars, trucks, locomotives and other motorised machinery for approximately 100 years. Engine exhaust contains thousands of gaseous and particulate substances. The major gaseous products of both diesel and gasoline-fuelled engines are carbon dioxide (CO_2) and water. However, significant amounts of carbon monoxide (CO), sulphur dioxide (SO_2) and nitrogen oxides (NOx) are also formed. Finally, incomplete combustion results in substantial amounts of volatile hydrocarbons (VOC) and particulate matter their derivatives in

exhaust. Particulate emissions from traffic are also caused by abrasion of tires, brakes and road surface, and through secondary processes such as the condensation of sulphates and nitrates. Internal combustion engines thus produce a complex mixture of pollutants, making precise analysis and measurement of motor emissions difficult. The exact composition of a motor vehicle's emissions depends on many factors, including motor characteristics (engine design, maintenance), driving behaviour (speed, gear), road condition (congestion, grade, road category) and fuel composition (additives, aromatic content, volatility, sulphur content). Where hydrocarbons are concerned, not only exhaust emissions are relevant: between 30% and 50% of overall hydrocarbons (also referred to as volatile organic compounds) released from motor vehicles are due to fuel evaporation during vehicle use, parking or refuelling.

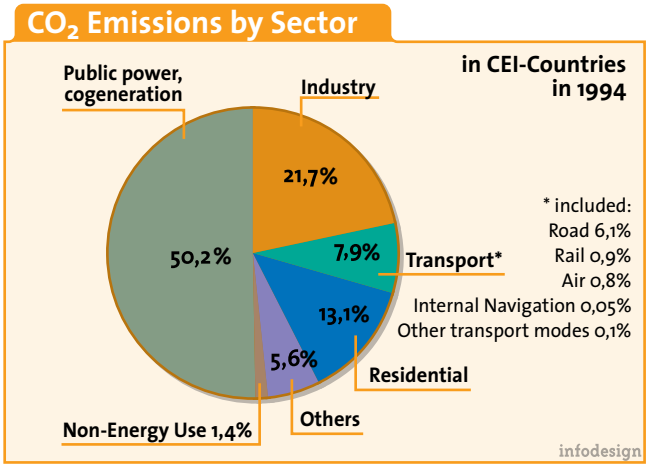
In addition to the emission of CO, NOx, VOC and CO_2, motor vehicles are also an important source of other hazardous air pollutants. These are emitted in considerably smaller or even trace amounts, yet still pose significant risks to human health. Certain of these substances, including lead, cadmium and some organochlorine compounds, are particularly resistant to reduction or elimination through natural means („persistent pollutants"), and accumulate in the atmosphere or the media in which they are deposited.

Emission Shares of Transport-Related Pollutants

In the European Union, motor vehicles are the single greatest source category of several major air pollutants, including CO, NOx and VOC[15]. Figures 7 through 9 show the shares of major source categories to emissions of CO_2, NOx, CO and VOC in the CEI transition countries. Due to differences in economic structure – in particular, a higher share of heavy industry – transport-related shares of these pollutants in CEI transition countries are at present lower (while still important) than in the EU. However, as motor vehicle use increases, the transport shares of such emissions will also rise.

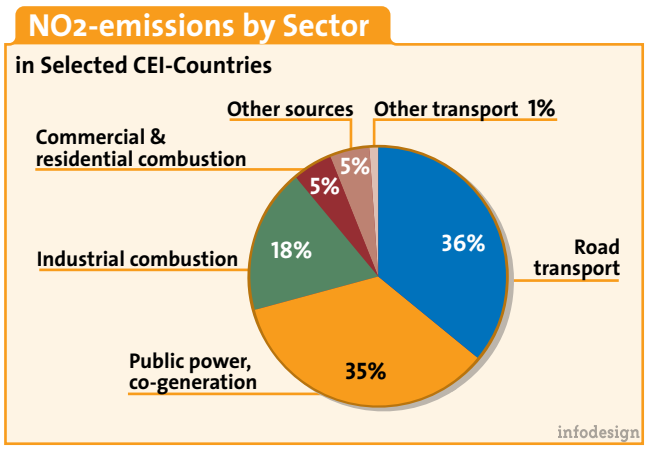
Transport is a major and rapidly increasing contributor to CO_2 emissions. In 1994, transport's share of total CO_2 emissions in the European Union was 26%, while in the CEI countries, this share was only 8%. However, since the transport sector (and road traffic in particular) grew significantly in the CEI countries in the recent past, it is obvious that transport-related CO_2 emissions have also risen in the same proportion. A closer look at the transport sector shows the contribution of the different transport modes to CO_2 emissions (Figure 7). Because motor vehicle use generates so much more CO_2 compared to other modes, road traffic's share of CO_2 emissions from transport (77%) is far higher than its share of passenger and tonne kilometres.

Figure 7:



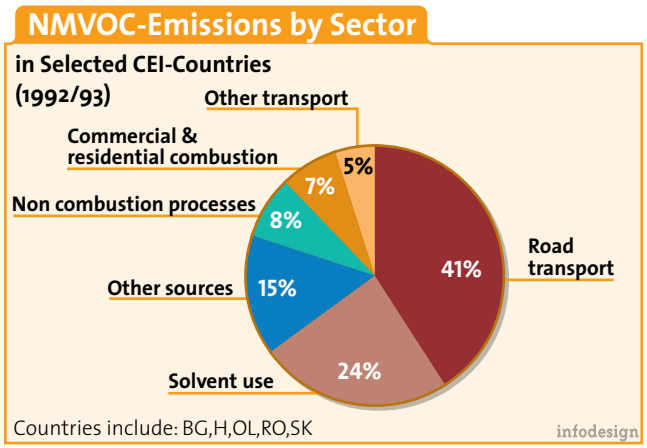
Source: IEA, OECD, Energy Statistics and Balances of Non-OECD Countries, 1993-1994, 1996; own calculation.

Figure 8:



Note: countries include BG, H, PL, RO, SK, SLO.
Source: UNECE, Strategies and Policies for Air Pollution Abatement, New York, Geneva, 1995.

Figure 9:



Note: Countries include: BG, H, PL, RO, SK.
Source: UNECE, Strategies and Policies for Air Pollution Abatement, New York, Geneva, 1995.

Local effects of motor-vehicle related air pollution

Local effects of air pollution, that is, effects produced close to emission sources and connected with poor ambient air quality are among the most noticeable and immediate. Ambient air quality is usually defined in terms of maximum yearly, daily and hourly average concentrations of specified pollutants, sometimes also as a maximum concentration for shorter time periods. Ambient air quality standards are based on criteria, which take into account health or environmental effects of the pollution in question. Concern over transport-related air pollution is usually focused on ambient air quality in urban areas. Urban air quality is poor in the CEI transition countries. Levels of several motor vehicle related pollutants, including NO_2 and NMVOC (particularly benzene and particulate matter) commonly exceed the limit values established as safe for human health and materials by international bodies such as the World Health Organization[16]. In city streets with heavy traffic, the local air quality standards are exceeded by a very large margin[17].

Particulate Matter

According to the United Nations, dangerous urban levels of suspended particulate matter (SPM) is the most severe air pollution problem affecting the world's largest cities as a group[18]. Particles with a diameter larger than 10 µm mainly originate from natural sources such as erosion or pollen. When the share of transport in total particulate emissions is higher, the size of particles drops. Most particles resulting from incomplete combustion measure less than 10 µm in diameter.

Dust particles with a diameter of less than 10 µm (also known as PM10) are easily inhaled, penetrating deep into the lung. These particles cause respiratory problems and often contain known or suspected carcinogens. A closer look at the particles originating from incomplete combustion shows that the major part (90%) is composed of carbon. Approximately 75% of the total carbon are elemental carbon[19]. Other components are heterocyclics, hydrocarbons, inorganic sulphates and nitrates, metals and polycyclic aromatic hydrocarbons. Particles produced by gasoline engines primarily contain metallic compounds (especially lead, if present in the fuel), elemental carbon and adsorbed organic material. Diesel engines account for the major share of particulate emissions. Already in 1989 the International Agency for Research on Cancer (IARC) had concluded that diesel engine exhaust is „probably carcinogenic to humans", while gasoline engine exhaust was classified as „possibly carcinogenic to humans".[20] In 1998 the California Air Ressource Board identified diesel exhaust as a „Toxic Air Contaminant" based on a review of animal and epidemiological studies, which strongly suggest a causal relationship between occupational diesel exhaust exposure and lung cancer.

Nitrogen oxides (NOx)

NOx emissions from vehicles and other sources cause a variety of adverse health and environmental effects. Once in the atmosphere, NOx emissions also react chemically with other pollutants to form tropospheric ozone (the primary component of photochemical smog) and other highly toxic pollutants. After sulphur dioxide, nitrogen oxides are the most important contributors to the formation of acid rain and acid deposition. Exposure to nitrogen dioxide emissions is linked to increased susceptibility to respiratory infection, increased airway resistance in asthmatics, and decreased pulmonary function. Short-term exposures to NO_2 have been associated with a

wide-ranging group of respiratory problems in school children (cough, runny nose and sore throat are among the most common) and an increased sensitivity to urban dust and pollen in asthmatics. Nitrogen oxides have also been shown to adversely affect vegetation. This adverse effect is even more pronounced when nitrogen dioxide and sulphur dioxide are present in the atmosphere simultaneously.

Carbon monoxide (CO)

Carbon monoxide is a highly toxic gas that interferes with the organism's ability to absorb oxygen. By bonding to haemoglobin, the blood's oxygen carrier, it reduces the ability of the blood to absorb oxygen from the lungs and prevents the transport of oxygen from the blood into the tissues. Carbon monoxide also adversely affects weak hearts and the circulatory and the nervous system. In urban areas, motor vehicle exhaust is the primary source of carbon monoxide emissions.

Table 5:

Summary of Environmental Damage by Air Pollution

Pollutant	Source /Cause	Impact on:			
		Humans	Vegetation	Global Climate	Materials
Carbon monoxide (CO)	incomplete combustion	inadequate oxygen supply; heart, circulatory, nervous system		indirect effect through ozone formation	
Carbon dioxide (CO_2)	combustion			major greenhouse gas	
Hydrocarbons (HC - VOC + methane, isopentane, etc.)	incomplete combustion, carburetion, evaporation	some are carcinogenic; ozone precursor	accumulation in soil, feed, food crops	methane has high greenhouse potential, leads to ozone formation	
Nitrogen oxides (NOx)	oxidation of N2- and N-compounds in fuels	respiratory irritation and other problems	acidification of soil and water, overfertilising	NO_2 has high greenhouse potential, leads to ozone formation	weathering, erosion
Particulates, diesel soot	incomplete combustion, road dust	respiratory damage, various toxic content; may be carcinogenic	reduced assimilation		dirt
Ozone (formed by interaction of other pollutants)	photochemical oxidation with NOx and HC	respiratory irritation, ageing of lungs	risk of leaf and root damage, lower crop yields	high greenhouse potential	decomposition of polymers

Source: OECD, 1996.

Non-methane volatile organic compounds (NMVOC)

Volatile organic compounds are released through fuel evaporation during vehicle use, from parked vehicles or during refuelling. The composition of NMVOC emissions varies widely depending on fuel quality (fuel components, additives). Many individual NMVOCs are known or suspected to have direct toxic effects on humans ranging from carcinogenesis to neurotoxicity. For some pollutants such as benzene, the concentration in urban areas may be 1.000 times higher than in rural regions, thus substantially increasing cancer risk for city dwellers. In urban areas, NMVOC emissions of motor vehicles represent one of the largest „single" sources. Since most types of NMVOC are photochemically reactive, some of them intensely so (e.g. formaldehyde, ethylene and xylenes) NMVOC emissions are a major factor in ozone formation.

To give an overview of transport-related emissions and their effects, the table below summarises the major pollutants emitted by internal combustion vehicles, their sources and the impact on humans, ecosystems, global climate and property (buildings and materials). Most of these pollutants are emitted by practically all forms of transportation.[21]

Lead

Use of leaded fuel is a prominent transport-related environmental issue in CEE countries. Most of the CEI transition countries have stated their intentions to improve of fuel quality and phase out leaded gasoline. Nevertheless, avoiding the use of lead in gasoline remains a priority issue. Leaded fuel causes high direct risks to health (lead is known as a neurotoxin that affects the neurological development of young children and causes cardiovascular problems for adults even at low exposure levels). Use of leaded gasoline also makes catalytic converters ineffective, thus potentially contributing to increased emissions of other pollutants indirectly.

Regional effects

Large amounts of pollution generated by urban traffic is transported in the atmosphere and deposited in across vast rural areas around cities and beyond. Environmental scientists use the concept of „critical loads" (deposited pollutants) or „critical levels" (e.g. airborne pollution) to define the maximum safe level of one or several pollutants in a sensitive ecosystem. Precise figures for critical loads or levels of nitrogen compounds, sulphur and ozone have been defined by the World Health Organization. In other words, the critical load for a given area expresses the maximum exposure to one or more pollutant substances that the site can tolerate without harmful effects. Unfortunately, in the CEI transition countries, the concentrations of many pollutants – deposited nitrogen in particular – already substantially exceed critical loads or levels.

Major regional environmental problems linked to motor vehicle pollution include trophospheric ozone concentrations and acid deposition. Tropospheric ozone is the main component of photochemical smog, and is the most pervasive air pollution problem in areas with temperate climates. It occurs as a result of the reaction of NOx and VOC in the presence of sunlight. A harmful irritant, ozone can cause respiratory discomfort, headaches, eye irritation, upper respiratory illness and asthma attacks. Particularly vulnerable individuals can suffer fatal consequences from ozone exposure. At ground level, ozone has been shown to seriously affect plant and crop growth and inflict damage on e.g. forest ecosystems.

Emissions of sulphur and nitrogen compounds (e.g. NOx) play a central role in the problems of acid rain and dry acid deposition. Acidification of soils has a high potential of durably damaging ecosystems over the long term. Soil fertility is reduced and a higher number of toxic metals are set free, which hurts plant growth and causes changes in soil structure. Acid deposition also is implicated in serious damage to materials such as metals, stone and polymers.

Assessing the problem: Focus on Poland

In 1997 Poland completed its ambient air quality assessment project for urban areas. The primary purpose was to define methodologies and information for the impact assessment of motor-vehicle exhaust. On the one hand, a prototype for such a system had to be found, on the other hand the project focused on knowledge transfer. Pollutants monitored included nitrogen oxides, carbon monoxide, hydrocarbons and total suspended particles. The model was tested in the Polish town of Torun and is to serve as a prototype for a global methodology.

Critical levels of these pollutants, particularly ground level ozone on a regional scale, and deposited nitrogen or sulphur on a national scale, are frequently exceeded in CEI transition countries. Ground level ozone often reaches concentrations at which plant and crop growth is affected (accumulated ozone of 40 ppb), and human health is endangered (i.e. beyond the guideline value of 60 ppb /8-hour average). If no action is taken, projections suggest that this already unacceptable situation will worsen considerably[22]. If economic development is to proceed in an environmentally sustainable manner, large reductions of sulphur and nitrogen emissions need to be achieved.

Global effects

Greenhouse gas emissions and climate change

As scientific knowledge of the long-term effects of certain pollutant emissions has increased over the last decade or so, concern over the possibility of durable human-influenced changes to the global climate has grown. Briefly, by trapping heat in the atmosphere, concentrations of so-called „greenhouse gases“ (GHG) could contribute to long-term changes in climate that would in turn raise sea levels and dramatically affect world weather patterns and agriculture. Carbon dioxide (CO_2) is the most significant of the greenhouse gases, in terms of the quantity of annual emissions. However, transport related emissions of many other substances, such as nitrogen oxides and volatile organic compounds, directly or indirectly contribute to climate change. Some VOCs, like methane, are themselves important greenhouse gases, while others contribute chemically to increased concentrations of greenhouse gases such as ozone.

CO_2 emissions are directly linked to the consumption of carbon-containing fuels. Since no technology exists to remove carbon from exhaust, the relationship is simple: the more fuel consumed, the more CO_2 produced. The only technological fix is to switch to fuels with lower carbon for the same energy content, or to reduce fuel consumption by substantially improving energy efficiency.

Transport is a substantial and growing contributor to emissions of a variety of greenhouse gases, particularly carbon dioxide (CO_2). This concern has given rise to important international conventions on the reduction of GHG emissions. The United Nations Framework Convention on Climate Change entered into force in March 1994. The First Conference of Parties to the Convention held in Berlin in 1995 initiated a process to strengthen the Parties' commitment to stabilise and reduce CO_2 emissions beyond the year 2000. The convention was ratified by 171 countries, including virtually all of the countries in the CEI region. According to the most recent Protocol, adopted by the Third Conference of the Parties at Kyoto, Japan, in December 1997, the signatories will seek to realise „the stabilisation of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interferences with the climate system“. To achieve this, the Convention elaborates a number of legally binding commitments. Among other commitments, the Ukraine and the Russian Federation are to stabilise greenhouse gas emissions at or below 1990 levels by the period 2008-2012. Poland and Hungary must keep emissions 6% below 1990 levels, while other Central European countries agreed to keep emissions below 8%. The governments of these countries are aware of the responsibility to combat global warming by implementing measures that will help make sustainable development a reality. Progress towards recently established targets has been slow till now. Current trends in CO_2 emissions from transport, which has proven a particularly difficult sector to address, appear to contravene the emissions' reduction or stabilisation objectives established[23].

Noise

Transport, in particular road traffic, is the main cause of human exposure to noise. The term „noise“ describes a sound pressure level, which is experienced as a personal annoyance when it meets the human ear. Sound pressure is measured in decibels (A) and calculated according to a logarithmic function. The (A) stands for an evaluation of the sound pressure level reflecting the auditory sensation to the human ear. Some mathematical peculiarities result from the log scale. A decrease in the sound pressure level by 10 dB (A) is generally experienced as a division of loudness by half. It should be taken into account that reducing traffic by half does not result in reducing the loudness by half, as this corresponds to a

reduction of the sound pressure level by 3 dB (A) only. In the same way, two cars of the same noise level are not twice as loud, but only cause an increase in the sound pressure level by 3 dB (A). The auditory sensation area of the human ear ranges from zero dB (A) (hearing threshold level) to 130 dB (A) (threshold of noise pain).

Permanent high noise levels can cause health problems (insomnia and poor concentration, stress, hypertension and ischaemic heart diseases). The World Health Organization (WHO) therefore recommends stringent limits to permanent noise levels: e.g. for residential areas 55 dB (A) during the day and 45 dB (A) during the night.[24]

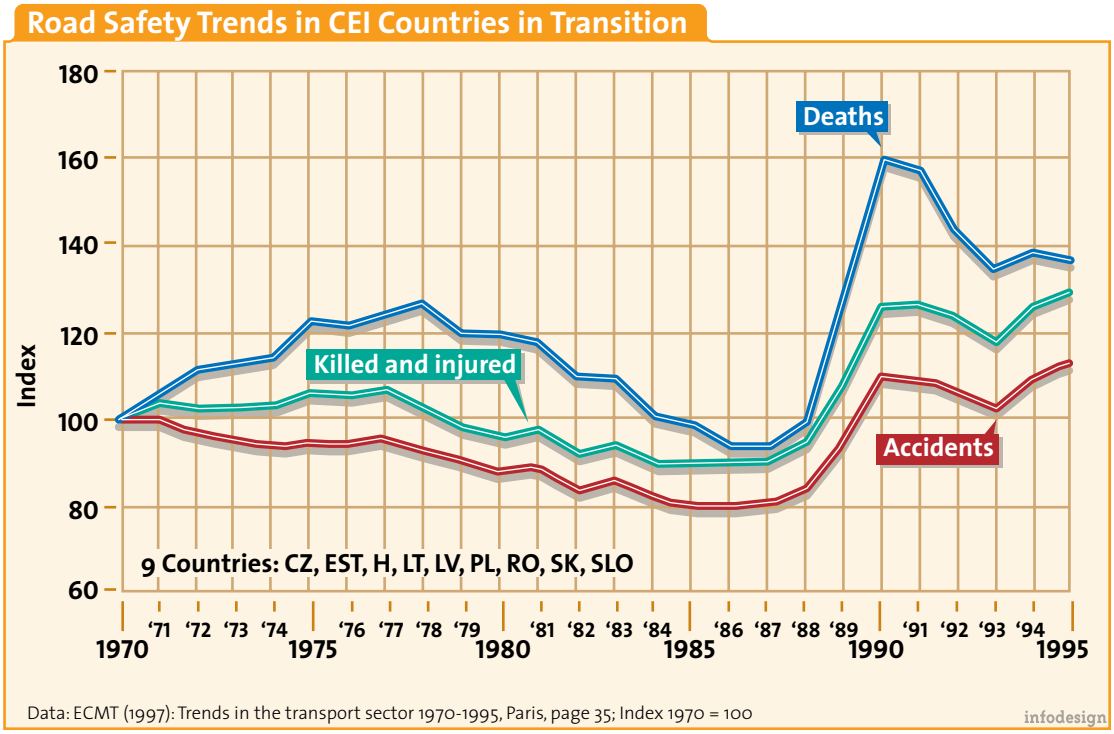
On roads with high traffic loads, however, these limits are often greatly exceeded. Beside road traffic, also aviation and rail transport are responsible for noise nuisance. The comparison between rail and road transport noise, however, shows that from a permanent sound level of approx. 50 dB (A) upwards, road transport noise is subjectively perceived as substantially more annoying[25].

Land use

To be strictly accurate, land is not „used“ by transport, but withdrawn from other uses. It is divided and polluted by noise. The soil is compressed, contaminated (e.g. by heavy metals) and sealed. The use of land therefore does not only refer to the transport infrastructure itself, but also to the areas impaired by their use for transport facilities and by the actual transportation using the facilities. Thus, even if the direct land use of a four-lane motorway requires approximately 2.5 ha/km, the average overall land use amounts up to 8 ha/km. This includes space for noise protection and embankments, interchanges, motorway junctions and service areas. In addition to this, an affected area (impact zones of noise and pollution or required compensation and substitution areas) of 50 to 80 m along both sides of the road can make land use up to 20 ha/km necessary.[26]

Depending on its density, transport infrastructure can divide homogeneous areas into „islands“ and can isolate sensitive ecological areas (e.g. wetlands), thus restricting the functionality of the habitat and impeding the movement of the fauna within it. Both direct and indirect land requirements for the

Figure 10:



Source: ECMT (1997): Trends in the transport sector 1970-1995, P?aris

transport system must be taken into account. Therefore it is very important to incorporate the principles of sustainable development also into land use plans and transport infrastructure as well as to take account of the needs of public transport, walking and cycling within regional and local development and zoning plans.

Road Safety

Following a slight but steady decrease in the years before 1990, a massive increase of accidents, injuries and traffic mortalities was recorded by 1993 in the countries in transition. After this tremendous increase in the number of road accidents, severe measures to improve road safety taken in several countries managed to bring the accident statistics down (Figure 10). However, the only countries with a decrease in the number of accidents in 1995 compared with the previous year were Hungary (-4,4%), Romania (-2,8%), Croatia (-0,7%) and Slovenia (-0,7%). Overall, the number of casualties resulting from road accidents in Central and Eastern European countries rose by 2.9% in 1995. The number of fatal road accidents in CEE countries as a whole has risen by over 37 per cent since 1988. In Poland (+2,3%), Hungary (+1,7%), Slovak Republic (+1,2%) and Moldova (+0,6%), this trend continued through 1995.

Not only does this disturbing trend reflect the wider access to car ownership enjoyed by consumers and the shortage of suitable infrastructure, above all, it emphasises the need for further action to improve road safety in countries where accident prevention policies are still insufficiently developed or implemented.[27]

External Costs

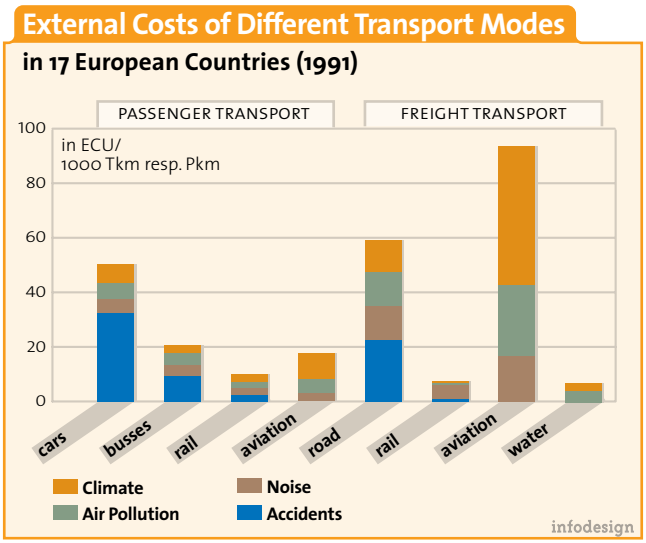
The health and environmental impacts of transport can also be expressed in monetary terms. Basically, the cost estimation is done by calculating one or more of the following:

- direct monetary costs such as medical costs for injured persons or costs of restoring destroyed vegetation;
- indirect monetary costs, e.g. loss of output due to illness or fatalities or harvest and growth losses in forests;
- avoidance costs, e.g. costs for catalytic converters or investments in road safety; or,
- „willingness to pay“, e.g. payments to avoid nuisance or a specific type of damage.

Most of these costs are not paid by the transport user, which is in particular true for road transport. Instead, they are paid by the general taxpayer regardless of his or her utilisation of transport. This situation gives rise to what is often called the „free rider“ phenomenon; that is, subsidies from the general public are offered to the transport consumer.

In most studies attempting to estimate the external costs of transport, such costs comprise external costs of infrastructure (the share of construction and maintenance costs not covered by vehicle or petrol taxes), of noise, of air pollution (mainly NOx, VOC, SO_2), of accidents and of climate change (focusing on CO_2 emissions).[28] In the European Union, Switzerland and Norway, studies have placed the external costs of transport at 3-5% of GDP.[29] To compare the external costs caused by different transport modes, the costs are calculated per transport unit (e.g. Euro/pkm or Euro/tkm). The results clearly show that road and air have the highest external costs, and rail by far the lowest external costs per transport unit (Figure 11).

Figure 11:



Source: Mauch, S., Rothengatter, W. (1995); the 17 European countries include the 15 countries of the EU, Norway and Switzerland.

It is also evident that there is a relationship between air pollution and the mortality of exposed populations. The annual number of premature deaths caused by transport-related air pollution is estimated to be at least as high as the number of persons killed in accidents. A recent study in Switzerland showed that 2.100 premature deaths result annually from transport-related air pollutants.[30]

Health costs and the loss of output due to illness or premature mortality related to air pollution have not yet been estimated on an European scale, but recent studies[31] indicate that estimated external costs will double, reaching 6-10% of the GDP, when these health costs are taken into consideration.

Transport and Environment Outlook 2010 - 2030

Current Efforts Towards Reducing the Environmental Impacts of Transport

The environmental cost of transport activity in the Central European Initiative (CEI) transition countries will likely be extremely high if existing trends towards rising motorization in the transport sector continue. Expressing concern over the heavy environmental damage and health hazards associated with transport, the Environment Ministers of the CEI also recognised the need to reduce emissions in line with environmental goals and maintain them within the limits necessary to protect environmental quality and human health.

Most CEI countries are presently in the process of bringing their national regulations concerning transport and environment into accordance with UN or EU standards. An increasing number of countries have begun incorporating international environmental standards into their national legislation, such as EU emission standards for vehicles and fuel quality regulatives or the obligations of the protocols of the Convention on Long-range Transboundary Air Pollution. This Convention went into force in 1983, and its protocols on the Reduction of Sulphur Emissions, the Control of Emissions of Nitrogen Oxides or Volatile Organic Compounds have been signed or ratified by most transition countries (except Albania and FYROM). Many countries have developed action plans or long-term programmes to implement their strategies, as in the case of the National Environmental Action Plan (NEAP) of the FYROM.

Fuel quality remains a crucial issue. Eliminating leaded gasoline has been a priority in several CEI countries in recent years. In 1996, seven out of 37 European countries, including the Slovak Republic and Albania, eliminated leaded petrol completely, and in 16 countries, market shares of leaded petrol were below 25%[32]. In 1998 the Århus Declaration on the Phase-Out of Added Lead in Petrol was adopted at the UN-ECE Environment Ministerial Conference. Yet the quality of unleaded gasoline and especially of diesel fuel remains low. Bringing the quality of these fuels in CEI countries up to the best European Union standards remains a pressing task.

For diesel vehicles, sulphur content is particularly important. Use of low sulphur diesel (<0.05% S by weight), already widely available in some EU countries, lowers particulate emissions and most importantly, permits the use of trap filters to further reduce pollutant emissions. So far, low sulphur diesel is only commonly available and attractively priced in a few CEI countries such as the Czech Republic. Fuel homogeneity is another issue: while the surge in freight traffic in the CEI region has meant that the majority of the heavy-duty vehicle fleet is relatively new, with modern, potentially low-emitting engines, the wide variation in fuel quality makes engine optimisation for low emissions very difficult.

In the survey carried out for the study presented here, several countries (Belarus, Bosnia Herzegovina, Croatia, Hungary, Poland, Romania, Slovenia and Ukraine) mentioned as priorities the improvement of vehicle maintenance and fleet renewal, enforced catalytic converter use, regulations for the import of vehicles or stricter control of running vehicles. Some countries (Bulgaria, Croatia, Hungary, Poland, Romania, Slovak Republic, Slovenia and Ukraine) plan to devote resources to the improvement of infrastructure for cleaner transport modes, such as rail, public transport and non-motorised transport. Croatia, Slovenia, Romania and Ukraine mentioned the implementation of pedestrian zones. Other countries, such as Croatia and FYROM, plan to implement ambient air quality monitoring systems, an important first step towards reducing air pollution. FYROM, Poland and Slovenia are

developing policies which use the polluter pays principle (internalisation of external costs) as a guiding concept. Noise abatement, the introduction of electric vehicles and driving bans in problem areas are being considered by the Ukraine. Romania referred to the use of environmental impact assessments for transport infrastructure. Croatia and Slovenia regard the improvement of combined transport as an important topic.

Supporting cleaner mobility: Focus on the Slovak Republic

Banská Bystrica is a city of 85.000 inhabitants in the centre of Slovakia. During the last years the historic square in the centre of the city has been revitalised by the implementation of a pedestrian zone.

The Pedestrian Zone in Banská Bystrica

An efficient trolley-bus system connects the centre of the city with the suburbs. The first city bus line in Slovakia operates with low-emission-vehicles in the city centre.

City bus in Banská Bystrica

A green asphalt surface marks the lane of the city bus in the pedestrian zone. A development plan for the community has been elaborated, and includes transport and environment measures. An express train connection is being built between Banská Bystrica and the neighbouring city of Zvolen.

The most advanced economies are also elaborating and implementing concepts for a sustainable transport system. In Slovenia such a concept is already under consideration including a land use planing campaign designed to help induces changes in transport habits and a public awareness campaign to help sensitise the population to transport and environmental issues.

Projections of Current Transport Trends in CEI Countries (Business-as-usual - BAU)

The study presented here undertook a number of modelling exercises to evaluate the health and environmental impacts of various policies. The starting point was a projection into the future of current trends in the transport sector, in order to assess the probable consequences of the anticipated shift towards greatly increased road traffic. Anticipated growth in the transport sector was based on macroeconomic projections, which assumed moderate but steady increases in GDP for CEI transition countries.

The transport trend projections included estimations of future transport volumes by mode and an analysis of the key environmental impacts related to increases in road traffic. The main focus was on those emissions of air pollutants most relevant to human health and the environment (NOx, VOC, particulate matter). Greenhouse gas emissions (CO_2) and the impacts of noise and land use were also among the main elements of the analysis. Due to a lack of reliable data, some speculation was required in the case of the impact of noise and land use.

The projections for transport volumes and related emissions (CO_2 , NOx, VOC, particulate matter) for 2010 and 2030 were made on the basis of calculations for the year 1994. The trend projections integrated assumptions on economic development, future population and income structure, future transport patterns and the environmental performance of the transport system. One key assumption in the analysis was that in 2030, transport patterns in the study area will be more or less similar to those observed in EU countries in 1990. This assumption is based on current trends. It must be borne in mind that all data and assumptions refer to the study area as a whole. Looking at current differences among the different national transport systems in the CEI

transition countries, it is likely that these differences will prevail in one way or another until 2030.

Figure 12 shows the results of the projections of business-as-usual. The trend projections from 1994 to 2030 show a tremendous growth in road traffic: car traffic would be tripled and freight transport would be four times as high as in 1994. On the other hand, public transport would be only slightly higher than in 1994, but below the 1989 level!

Technological progress assumed in the trend projections, especially for road vehicles results in a reduction of emissions of VOC and particulate matter. On the contrary, CO_2 emissions from transport in 2030 will be doubled, even NOx emissions in 2030 will be still higher than in 1994.

From 1994 to 2030, the private car share (modal split) of passenger transport will rise from 46 to 69%. Freight transport by trucks (heavy-duty and light-duty vehicles) will increase from 32 to 64%. The average distance travelled per capita and per year will increase from 5.000 to about 10.000 km (i.e. to the current standard level in OECD and EU countries) from 1994 to 2030. A profound increase in air traffic is expected, especially for long distance flights.

Environmental and Health Criteria for a Sustainable Transport Future

„Business-as-usual“ growth of pollution-intensive forms of transport are unacceptable in light of the determination expressed by CEI Environment Ministers in the CEI Declaration. To protect human health and ecosystems in the long-term, measures need to be taken to improve air quality, prevent climate change, preserve arable land and protect sensitive ecosystems. Consequently, significantly actions need to address local, regional and global concerns simultaneously. According to the definition of environmentally sustainable transport and the approach adopted in the CEI Declaration, environmental and health criteria need to be established and where possible quantified using available international guidelines, limit values or recommendations (e.g. WHO air quality guidelines on critical levels and loads) (see Table 6).

Figure 12:

Trend Projections of Transport Volume and Transport Related Emissions

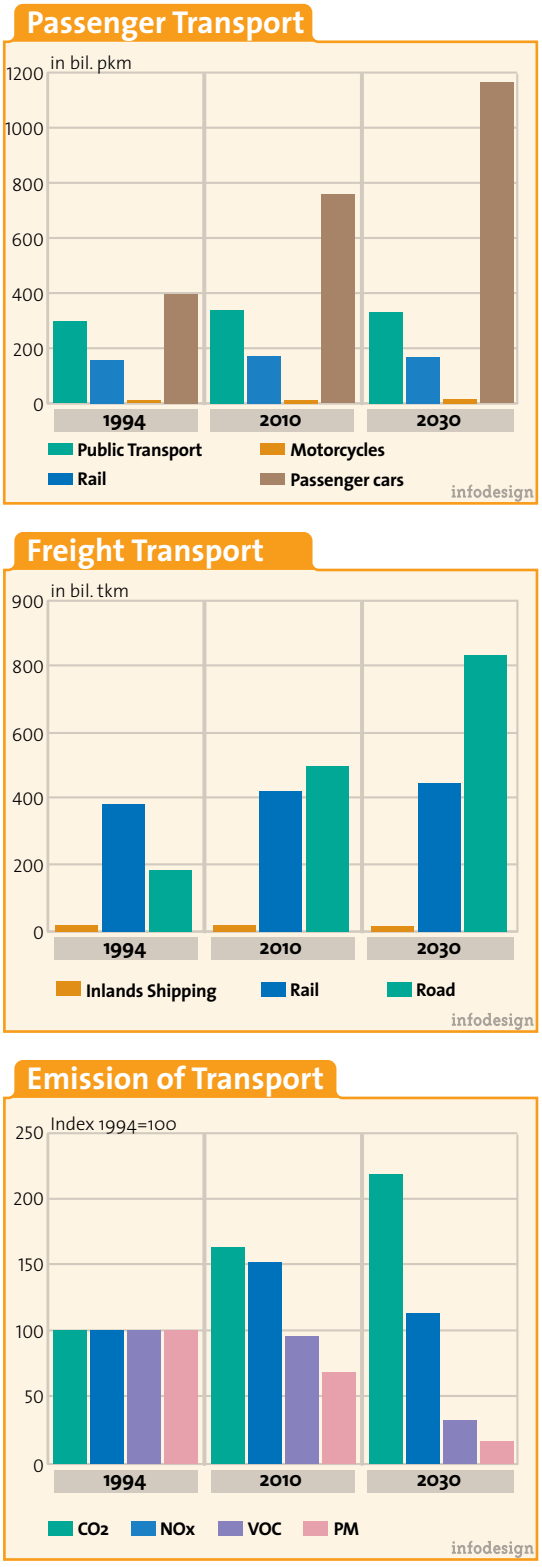


Table 6:

Quantification of Environmental and Health Criteria

Environmental and Health Features	Protection Criteria
Noise	– attainment of WHO recommended levels
Air Quality	– attainment of WHO Guidelines for NO_2, PM – critical levels for ozone not exceeded
Acidification	– critical loads for deposited acid precursors (NOx, SOx) not exceeded
Climate Protection	– stabilisation of global CO_2 concentrations

To fulfill these protection criteria for human health and the environment, measures need to be taken at the source (e.g. limiting polluting emissions, noise, land take). The amount of improvement needed is determined by comparing the actual ambient levels (e.g. air quality, noise exposure, etc.) with the recommended limit or guideline values assuring the protection of human health and ecosystems. Such an assessment will be used to define reduction goals and targets for polluting emissions, noise, land consumption, etc. that will attain these ambient levels.

For the purpose of this study six criteria representing local, regional and global concerns have been selected and therefore, targets have to be set to:

- achieve acceptable local air quality levels by limiting emissions of NOx, VOC and particulate matter;
- prevent the formation of smog and acidification by limiting NOx and VOC emissions;
- ensure climate protection by limiting emissions of CO_2 ;
- reduce noise exposure of the population by limiting noise sources; and
- preserve land use in order to protect ecosystems and limit severance.

Therefore, the derived emission or exposure reduction targets should be based on defined critical loads or levels of motor-vehicle related pollutants. The OECD Project on Environmentally Sustainable Transport had used a set of six criteria as a minimum required to address the ensemble of transport impacts. A similar set of criteria has been used for this pilot study and adapted to the different conditions in CEI countries. An EST system for this region will therefore have to meet all these criteria by 2030.

- **The CO_2 Criterion**

Climate change is prevented by reducing carbon dioxide emissions from all sources, including transport, so that atmospheric concentrations of CO_2 are stabilised at or below their 1990 levels.

The results from the scenarios developed by the Intergovernmental Panel on Climate Change suggest that, in order to stabilise global CO_2 concentrations in the atmosphere, global CO_2 emissions need to be reduced by 50%, and those of OECD Member countries (with the exception of the new Central European Members[33]) should be reduced by 80%, compared to 1990 values. These chosen reduction rates do take into consideration the idea that the relative reductions of CO_2 emissions required in OECD countries ought to be higher than in non-OECD-countries in order to allow for further economic development. Therefore, in CEI transition countries, the global target value has been chosen as the criterion; i.e., CO_2 emissions should be reduced by 50% relative to 1994 levels.

- **The NOx and VOC Criteria**

NOx, VOC and ozone pollution should be considerably reduced, in order to meet WHO Air Quality Guidelines for human health and ecotoxicity. The motor-vehicle related precursors of ozone formation are NOx and VOC. Emissions of these pollutants should be brought below the

defined critical loads and levels of ozone; i.e., emissions from these pollutants need to be reduced at least by 80%. The criteria chosen is that the total NOx and VOC from transport in 2030 should therefore not exceed 10% of total transport-related emissions for these substances emitted in 1994.

- **The Particulate Matter Criterion**

The setting of concrete targets for fine particles appears to be a complex task: current WHO Air Quality Guidelines indicate that there are no safe threshold values for PM, and consequently, particulate emissions should be reduced to the lowest possible level. Furthermore current calculations of PM emissions are based on PM10 and are mass-related. Due to lack of monitoring data and research, the problem of fine and ultrafine particulates could not be sufficiently addressed within this study; in particular, the problem of size, frequency, number and composition, factors that are highly relevant for their health impacts. Therefore, only a preliminary target for PM10 has been set. The criterion chosen is that the level for PM10 in 2030 should not exceed 10% of the emissions in 1994.

This target value is very preliminary and will have to be reviewed in a further project step in the light of new research on health effects, and taking into account further developments of WHO Guidelines about the health risks of fine and ultra-fine particulates. Also new findings, and yet to be confirmed research, about the number and composition of PM and their health impacts will have to be taken into account.

- **The Noise Criterion**

Traffic has been identified as one of the main sources of noise pollution. The noise exposure target level for sustainable transport should be below the risk of impairment of health or serious nuisance. The World Health Organization (WHO) suggests in its forthcoming noise guidelines a set of targets related to land use and settlement structures[34]. For residential areas the outdoor noise levels should not exceed 55 dB(A) during daytime and 45 dB(A) during night-time. Attaining such levels will require significant reductions in traffic activity on the one hand, and development of noise protection measures on the other.

- **The Land Use Criterion**

Development of transport infrastructure is often directly linked to the expansion of urban areas which, in turn, increases the demand for transportation. In urban areas, the amount of land used for transportation is in the range of 25 to 35%, while in suburbs surrounding conurbations this share is even higher.

Given the relationship between regional and interregional development, cohesion and integration of regions, urban sprawl tendencies and the demand for transportation, it is of crucial importance to use more efficiently existing infrastructures, and plan and build new infrastructure with the least possible land consumption. Moreover, urban planning should be co-ordinated with public transport, pedestrian and cycling planning and should go „hand-in-hand“ with the development of new mixed-use structures and commercial centres. The main activity centres (residential, business, and commercial areas) should be reachable within short distances of each other and should be connected by adequate, environmentally sound means of transport. In general, infrastructure will have to be developed in such a way that local and regional objectives for air, water and ecosystem protection are met.

The EST scenarios presented in the following chapter explore the means that might be used to meet these criteria and quantitative conditions by 2030.

Designing an Environmentally Sustainable Transport Scenario (EST Scenario)

Methodology of the Backcasting Approach

The EST scenarios created for this study were elaborated using the backcasting method, which identifies the measures necessary to achieve previously defined targets. In many attempts to explore the likely environmental impacts of transport or other activities, a traditional forecasting approach based on the extrapolation of current trends is still used. However, this approach may not be suitable for assessing the sustainability of highly complex activities. Discontinuities and changes in trends are likely to occur. For this reason, the backcasting approach is an interesting alternative. Backcasting is a term introduced by Robinson, and is defined as follows: *„The major distinguishing characteristic of backcasting analysis is a concern, not with what futures are likely to happen, but with how desirable futures can be attained. It is thus explicitly normative, involving working backwards from a particular desirable future end-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.“* [35]

According to Dreborg „backcasting studies typically aim at providing policy makers and an interested general public with images of the future as a background for opinion forming and decisions.“[36] The major new aspect of backcasting studies is their general approach and the underlying perspective. It can promote creativity, by shifting emphasis from present conditions to a situation sufficiently far off in the future to permit radical change.

The results of backcasting studies are alternative visions of the future, thoroughly analysed as to their feasibility and consequences. These visions are meant to serve as well worked out examples of what sustainability may be like, with the aim of widening perceptions of possible solutions among various actors.

For the present study, three EST scenarios have been elaborated, one based solely on technological improvements (EST 1), another solely on transport demand management (EST 2) and a third based on a combined approach (EST 3). The EST criteria listed at the end of the last chapter structure each of the scenarios. Each scenario attempts to determine what measures and what implementation schedule would be necessary to comply with the criteria by 2030. The calculation of transport volumes and the emissions of CO_2 , NOx, VOC and particulate matter have been based on these parameters.

It needs to be stressed that at this stage EST scenarios are focussing on air pollution and CO_2 emissions while noise and land use could not be treated in a similar manner due to lack of data and methodological and budgetary constraints.

The High Technology Scenario (EST 1)

The main purpose of the EST 1 scenario is to investigate how EST could be attained by means of reducing transport's environmental impacts through technological measures alone. The scenario uses the same assumptions about the socio-economic context of transport and the development of transport volumes as the „business-as-usual“ trend projections. The technology-based EST-efforts will focus on the key categories:

- technological changes in road vehicle design and equipment, using best available technology;
- a shift from the conventional motor vehicle technology assumed in the trend projections towards new technologies; and
- cleaner fuels with very low sulphur content (10 ppm) and broad use of alternative fuels like LPG, CNG and hydrogen.

Meeting the criteria through technical means, as in the EST 1 scenario, seems only feasible if a transition is made from the current petroleum-based transport system to one based on energy produced in a sustainable way. Thus, in the EST 1 scenario, it was assumed that large segments of the vehicle fleet will be replaced by „ultra low emission vehicles“ (ULEV) and „zero emission vehicles“ (ZEV) driven by electricity or other alternative energy sources. Electric cars, mainly using electricity generated in a sustainable manner, and fuel-cell powered cars gain high market shares. Hybrid cars with LPG combustion engines will be introduced at a large scale. Light and heavy-duty vehicles will run on gas or hydrogen or will be equipped with improved diesel technology. Where conventional fuels like diesel are still used, fuel quality (e.g. sulphur content) will be improved.

The rail system also has to be improved technologically by implementing recuperation, improved aerodynamics and shunting technologies and more efficient rail management systems. Power plants will become more energy efficient, thus reducing CO_2 emissions. The electricity generation mix will incorporate large shares of wind power plants and improved hydro power plants. Ships will be equipped with fuel cells using hydrogen, which has been produced in an environmentally sustainable manner.

The Travel Demand Management Scenario (EST 2)

The EST 2 scenario requires the attainment of EST by means based only on optimising mobility management focussing on changes on the transport demand and the supply side with two main characteristics:

- a significant reduction of transport demand for motorised traffic; and
- a substantial modal shift to the environmentally most friendly transport modes.

The main objective for passenger transport is the reduction of transport demand for motorised transport in daily life through changes in land use and mobility patterns. To cover the remaining passenger mobility, non-motorised modes (walking, cycling) and a significantly improved public transport system will be used. To attain EST the modal split of motorised transport in 2030 will be 30 per cent cars and 70 per cent public transport and rail. Cars will need to have an occupancy rate of 2 persons in 2030 in order to conform to the criteria set in the backcasting exercise.

A reduction in the demand for freight transport is also needed to meet the criteria, it will require:

- changes in the regional organisation (increased use of local products) and in production and consumption patterns; and
- changes in freight logistics and industrial location policies.

Remaining freight transport volumes must be shifted towards environmentally-friendly modes and become more environmentally efficient. To this end, measures will have to include:

- a substantial shift from road transport to rail, inland and coastal shipping as well as the broad use of combined transport;
- the use of pipelines for suitable commodity groups; and
- an increase in load factors and reduction of empty trips for all transport modes.
- the development and introduction of demand-management schemes for road freight (e.g. similar to the „eco-point“ system used for heavy lorries passing through Austria).

The modal split for freight transport in 2030 should be 20% road, 77% rail and 3% inland shipping in order to satisfy the criteria guiding the EST 2 scenario.

Internalisation of the externalities will be required for both passenger and freight transport.

The Combination Scenario (EST 3)

The basic task in elaborating the EST 3 scenario, which combines both a technological and a transport demand management approach, was determining the optimal mix of measures capable of attaining EST. In the EST 3 scenario, technological measures contribute about 55% to reducing the environmental impacts of transport, while transport demand measures are required to close the gap.

The main strategies and measures in the EST 3 scenario are:

- decoupling economic growth from transport consumption and related environmental impacts;
- a reduction of transport demand by changes in land use and mobility patterns as well as production and consumption patterns, a more efficient use of vehicles and infrastructure as well as broader use of telematics;
- a significant shift of passenger transport towards non-motorised transport, rail and public transport and of freight transport towards rail, inland and coastal shipping and combined transport;
- a considerable improvement of fuel quality and the technology of road vehicles towards ultra low

emission vehicles (ULEV) and partly towards zero emission vehicles (ZEV) based on sustainably produced hydrogen fuel cells; and

- a positive development in rail technology and rail management and logistics towards higher efficiency and an improvement of power plants for rail electricity generation.

The combination scenario is the most realistic scenario combining more or less balanced measures in technology and in transport demand management. Figure 14 shows the results of the EST 3 scenario.

A sustainable passenger transport requires a substantial increase of public transport (+71% from 1994 to 2030) and more than a doubling of rail transport (+128%). Due to the significant technological progress and the still low share of car traffic in most of the CEI countries in transition compared to Western Europe in 1994, the use of passenger cars can increase overall by 54% until 2030 without compromising the EST-goals!

A sustainable development in freight transport shows similar requirements. The transport volumes by rail freight and inland shipping will have to be nearly doubled from 1994 to 2030 (+80% resp. +71%), while through technological progress, also for road freight a growth of 51% is still possible. This also relates to the low baseline of overall freight transport in the CEI countries in transition in 1994.

Modal split in 2030 will consist of 42% cars and 58% public transport and rail compared to the present mobility pattern of 47% car / 53% public transport and rail (1994). Cars will have an occupancy rate of 1,8 persons.

In freight transport a general reduction in transport demand is required. Modal split for freight transport in 2030 (28% road, 69,5% rail and 2,5% inland shipping) will remain more or less the same as in 1994 (32% road, 66% rail and 2% inland shipping).

The best available technology must be used for the remaining freight transport, especially for road transport. In order to reach the reduction goals, a partial technological shift from fossil-fuel powered vehicles to a system relying on energy produced in a sustainable way, for example by using ultra low emission vehicles (ULEV) and zero emission vehicles (ZEV), will be necessary.

Different types of new passenger cars will be gradually introduced by 2030:

- Hybrid cars with LPG and hydrogen fuel cells. the hybrid cars based on LPG fuel cells will be introduced earlier than those based on hydrogen fuel cells. In 2030 a share of approx. 67% of hybrid cars with LPG fuel cells and a share of approx. 3% of hybrid cars with hydrogen fuel cells is estimated.

- Conventional technology will reach in 2030 a share of approx. 30%. The fleet of cars will consist of improved technology fulfilling the emission standards for vehicles of EURO IV and beyond.

A change to new technology, however, will not take place before 2015. In fact, substantial changes are not expected before 2025. Nevertheless it is assumed that emission controls and introduction of less polluting road vehicles will be enforced and therefore most road vehicles will already meet advanced technological standards by 2015 (e.g. EURO IV emission standards). Gasoline and diesel fuel quality will be substantially improved.

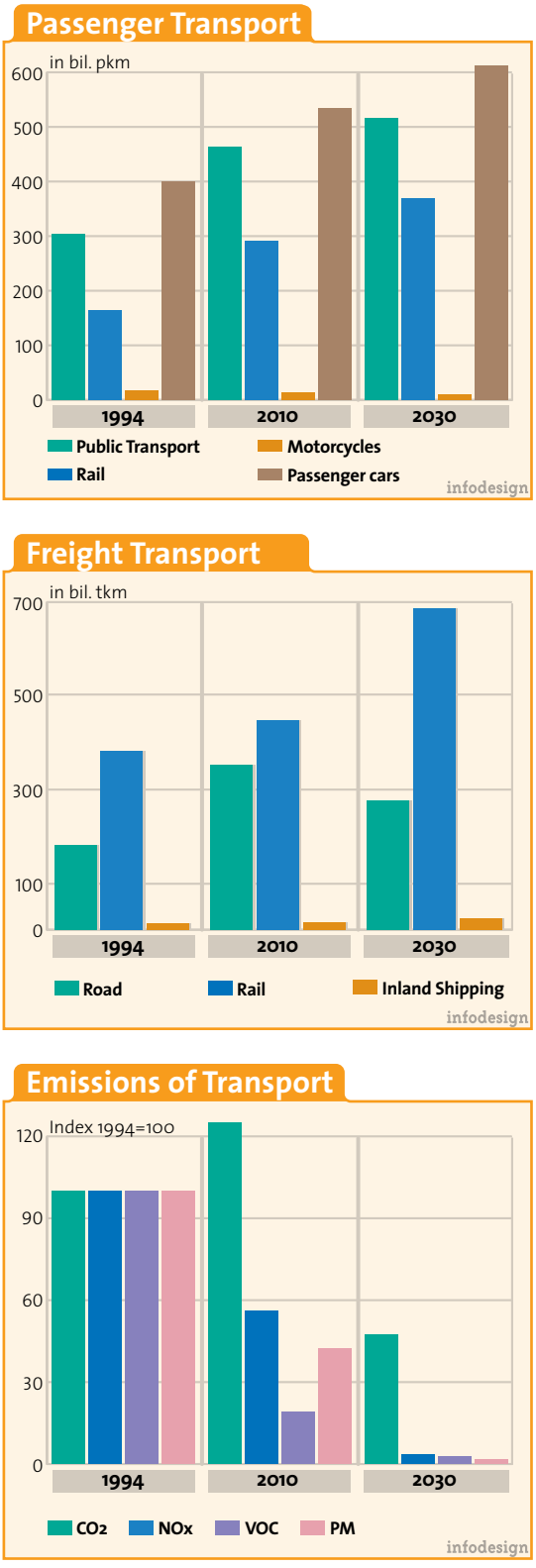
Electric buses will be used for urban transport and hybrid buses with LPG, CNG or methanol combustion engines for inter-city transport. The most important technical improvements for vehicles are the use of light construction materials, better engines, the re-use of brake energy and fuel efficiency improvements.

Light and heavy-duty vehicles will be gas or hydrogen powered or equipped with improved diesel technology. Remaining supplies of diesel fuel will have very low sulphur and will be of improved quality (e.g. homogeneity, volatility, cetane, aromatics). In the long run, hydrogen can be produced by utilising various renewable energy sources for water electrolysis or by gasifying of biomass. It should to be taken into account that the production of secondary energy such as hydrogen causes high energy losses. In the long term the infrastructure for hydrogen requires a pipeline system for distribution as the low energy content of hydrogen makes a distribution by road or railway less effective.

The rail system will be more efficient due to improved recuperation, tracks, aerodynamics and shunting technologies and new rail management systems. Thermal power plants will reach a higher

Figure 13:

Environmentally Sustainable Transport EST Scenario



productivity, causing less CO_2-emissions, portions of electric energy will be supplied by wind power plants or improved hydro power plants.

Open Questions:

Due to the fact that the availability of data was only sufficient for air pollutants and greenhouse gases this pilot study had to focus on CO_2, NOx, VOC and PM as easily quantifiable indicators for sustainability. In the case of particles the PM indicators used are mass-related as sufficient data about their number and composition of particles, which may be more health relevant indicators, is not yet available. Due to this fact the particle target is preliminary and needs to be reviewed in the light of new scientific research results.

Air pollutants of course do not paint the whole picture of EST. It has to be emphasised that the noise and land use criteria appear as crucial additional indicators of sustainability. Due to data, time and budgetary constraints these issues could not be covered fully in this pilot study. As the scope of this study is a more global one viewing the CEI-countries as a whole, it seems to be somehow reasonable to focus also on more global indicators, while noise and land use issues are of a more local nature. Nevertheless, further investigation efforts are necessary to develop also noise and land use indicators. This is particularly true, if EST scenarios are relating to a national or even regional or local level.

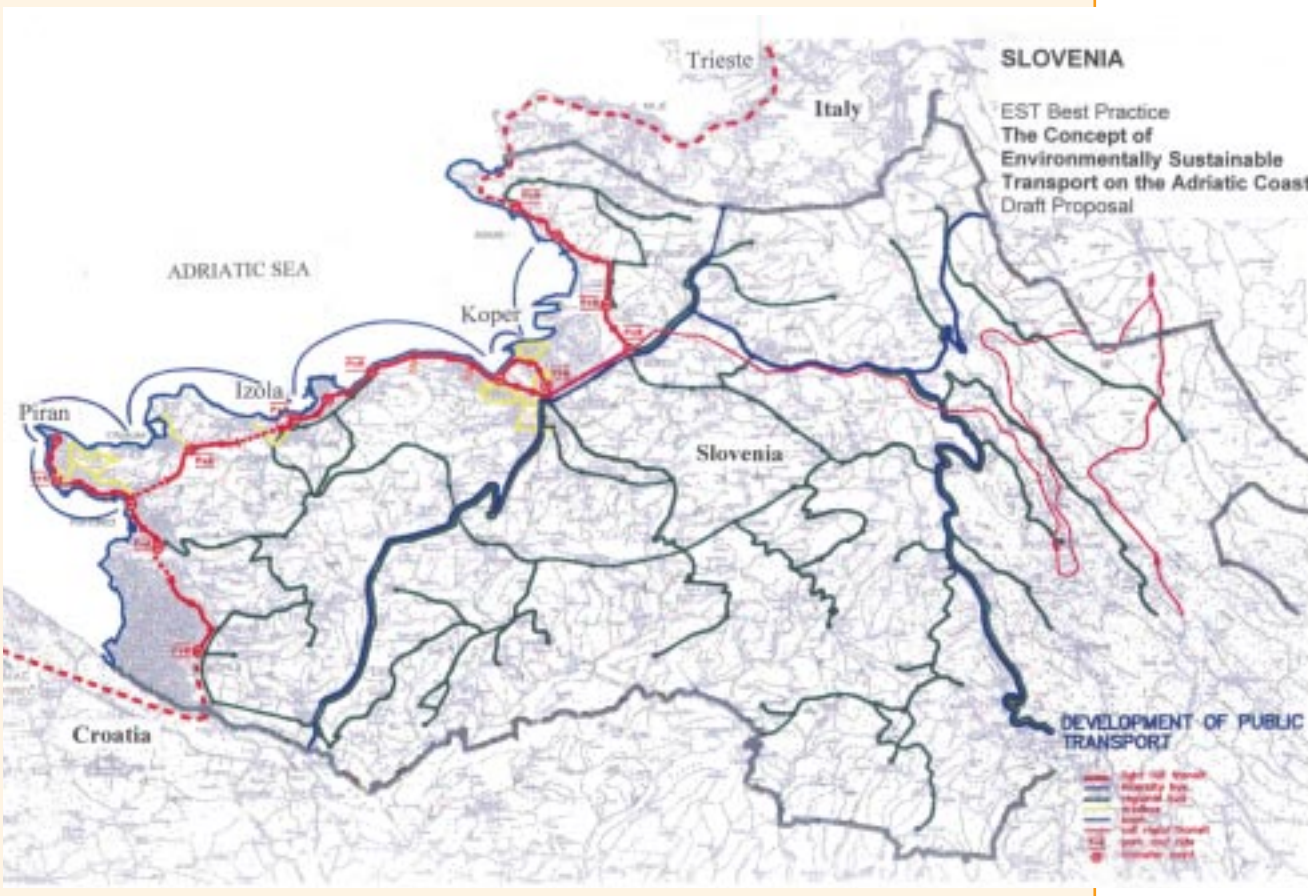
Aviation could not yet be considered in this study. It must nevertheless be noted that the anticipated high growth of passenger air traffic might cause considerable environmental problems. Reducing air travel may thus be critical for achieving environmentally sustainable transport and should therefore be analysed in a special study.

Planning for a sustainable future: Focus on Slovenia

Slovenia has about 46 kilometres of coast between the Italian and the Croatian borders. The attractions of this short stretch of coastline favoured the emergence of three urban centres, and the coastal strip became the focus for nearly all the settlements, enterprises and tourism in the area. Today, Koper, Izola and Piran constitute a conurbation of 80.000 people and represents 26.000 jobs. 71% of the inhabitants have settled along the 2 km wide coastal strip.

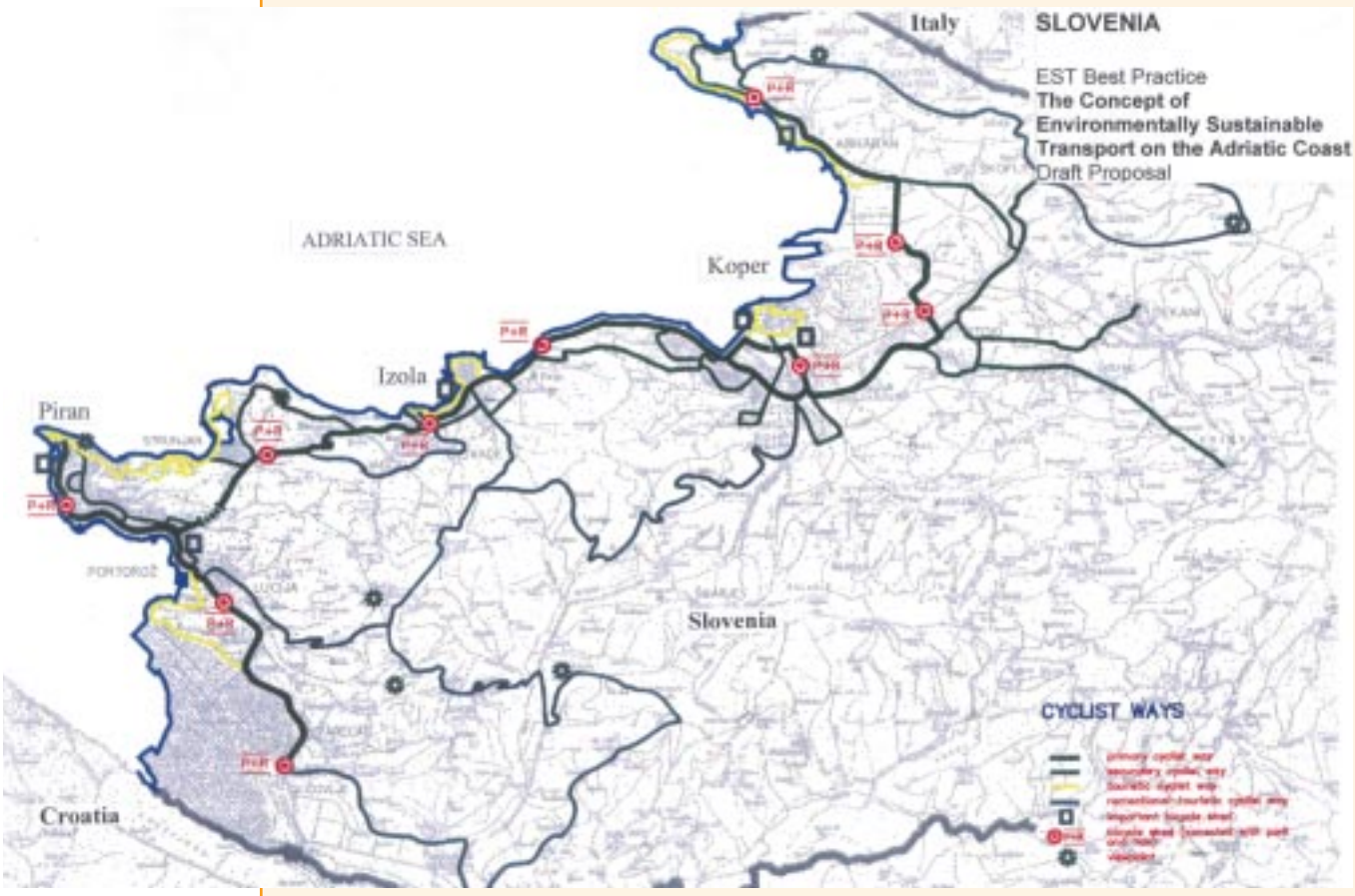
Due to the dense settlements and the high attractiveness of the area for tourists, the traffic volume of the area is considerable. Car use is higher in this area than the Slovenian average and affects living and working conditions adversely. In 1995, 51% of all trips were made by car, 37% by foot or bicycle and only 10% by public transport. The public transport system at present is not sufficient and the number of passengers in buses has been declining.

The Slovenian Ministry of the Environment and Physical Planning has therefore elaborated a project to solve the existing problems by increasing accessibility to all sectors of the population, creating a better selection of transport modes and decreasing dependence on the car, thus reducing negative environmental impacts and improving traffic safety.



Source: PNZ Projekt nizke zgradbe, d.o.o.

The Slovenian Concept of Environmentally Sustainable Transport on the Adriatic Coast - cyclist routes



Source: PNZ Projekt nizke zgradbe, d.o.o.

According to this concept, urban public transport technology will allow for a high level of service, so making public transport an attractive alternative to private cars, at least in the main coastal development axis. Measures include the construction of a (sub) urban light railway, suburban feeder buses and the introduction of park and ride systems. Auxiliary carriers are town minibuses, sea transport, railway and inter-city buses. The (sub) urban light railway will be 32 km in length, with 39 stations, 15 of which are important transfer points. 96% of all job locations and 94% of all inhabitants will be able to reach the public transport system within 5 minutes.

The Slovenian Ministry of the Environment and Physical Planning calculated that this strategy, despite higher investment costs, will be economically feasible, reducing the amount of new parking spaces needed in urban areas in the next 25 years from 7.800 to only 1.200. This represents only 55% of what would be needed in the region in a business-as-usual strategy. Later on, the (sub) urban light railway could be extended to Trieste and Poreè (Pula, Croatia), contributing to a balanced and environmentally sustainable development of the entire coastal area.

Conclusions

Looking Forward

Across the last century, transport innovations and improved mobility for people and goods have aided economic growth and raised the standard of living throughout the world. In recent years, as air and road traffic volumes continue to grow at ever more rapid rates, adverse impacts on human health and the environment linked to transport have become more and more serious.

The high levels of air pollution, noise and CO_2-emissions resulting from current patterns in transport consumption are the most prominent of these issues. At present, transport, in particular road traffic, is one of the major contributors to air and noise pollution as well as CO_2 worldwide. Motor vehicle pollution is not just a nuisance, but already poses serious large-scale threats to human health, damages ecosystems and materials, and is a major contributor to potentially dramatic long-term environmental problems such as global climate change.

In many countries, emissions of NOx and VOC have been greatly reduced in recent years due to technical innovations like the catalytic converter. However, the tremendous increase of the number of vehicles on the road and the growth in the distances that individual vehicles travel have made it clear that these accomplishments may be temporary in the long run unless significantly new approaches are developed and implemented.

In addition, transport in general and motor vehicle use in particular are associated with many other negative impacts such as traffic accidents, congestion, pollution to other environmental media (water, soils), elimination of or damage to natural areas and the proliferation of environmentally harmful or otherwise unsustainable land-use patterns.

All of these costs must be taken into account as we look towards the transport policies of next century. Current serious transport-related problems will only multiply and their causes become more difficult to address unless something changes.

Happily, there are a number of different solutions available. Achieving an environmentally sustainable transport system does not need to mean renouncing the high degree of mobility enjoyed in many parts of the world today. Despite the increasing polarisation of our transport systems in favour of private motor vehicles, there are still many ways of getting from point A to point B. Moreover, many of these modes – rail and public transport are the most obvious examples – are considerably less harmful to human health and the environment than cars.

Ensuring that environmentally sound modes play an increased role in tomorrow's mobility patterns is a key policy issue. Technology can go a long way in making even motor vehicles and air traffic friendlier to the environment. On the horizon, cleaner transportation energy sources such as hydrogen or „clean" electricity have a remarkable potential to make motor vehicle use less polluting. Even measures designed to do things as simple as ensuring that cars and trucks are properly maintained and fuelled with cleaner, better quality petroleum fuels can make a big difference. But improved technology cannot provide all the answers. Ultimately, if growth in the transport sector is to proceed in an environmentally sustainable fashion, policy makers will also have to make re-balancing the transport modal split in favour of cleaner transport modes a central project.

Projections for CEI Transition Countries

In Central and Eastern Europe, more sustainable modes of transportation already play a much more important role in mobility than in EU countries or North America. This study has sought to highlight this advantage in the context of achieving sustainable development in the transport sector. It is an advantage that will be rapidly eroded, however, if the current shift towards car use and road freight transport continues. As CEI Environment Ministers have recognised, there is currently „high potential for an increase of transport volumes, in particular transit" in their countries. The trend projections discussed earlier clearly show that under the present conditions, an unsustainable transformation of the transport system in the CEI transition countries will take place by 2030. This will notably involve a marked decline in current high shares of rail and public transport.

The trend projections show a substantial increase of CO_2 emissions, and a slight increase of NOx emissions until 2030. VOC and particulate emissions should decrease noticeably through 2030. However the environmental criteria for an environmentally sustainable transportation system are not achieved.

On the way to sustainable transport between Austria and Hungary

To improve rail transport the railway-line Vienna-Budapest has been upgraded for higher speed and for visitors of Budapest a all-inclusive ticket combining rail-travelling and public transport in Budapest (viceversa for visitors of Vienna) is offered.

A second good example for bilateral cooperation in the field of environmentally sound transport is illustrated by the Györ-Sopron-Ebenfurth Railway. On its main line from Györ via Sopron in Hungary to Ebenfurth in Austria international rail freight trains and rapid train services from Györ to Sopron and from Sopron to Vienna are operating. The branch-line from Fertö-Szent-Miklos to Neusiedl am See in Austria offers access to Vienna on the one hand and to the Austrian-Hungarian Fertö/Neusiedlersee National Park on the other.
Upgrading of the rail tracks, electrification of the main line and the extension of the combined transport terminal in Sopron, which was co-financed by Austria have initiated a positive development of rail freight.

Improved railway lines, new comfortable rolling stock and attractive passenger services with fixed time-tables financially supported by the Austrian Province of Burgenland have increased rail commuting and tourist travelling by train, e.g. bike and rail.

The implementation of unconventional instruments might also give an incentive for a modal shift of transport activities. A good example in this sense is the 1993 Action Programme of Hungary, where a cheque for public transport tickets has been given in exchange for scrapping old cars.

Improved combined transport like the extended Sopron Terminal offer a environmentally sound solution for freight.

Comfortable railcar-services provide a alternative for commuters and tourists

The gap between projected CO_2 and NOx emissions and the EST criteria seem to be the most serious.

The impacts on health and the environment connected to these developments will still be considerable, and noise and undesirable land use patterns will also be consequences. The latter factors have not yet been quantified due to lack of data. Health and environmental effects create high external costs. Additionally, massive investments in infrastructure need to be taken into consideration, as a substantial extension of the road infrastructure is necessary to cope with the emerging road transport volumes in a business-as-usual scenario.
CEI Environment Ministers have expressed concern over these trends in the Declaration „Towards Sustainable Transport in the CEI Countries“. The need for an environmentally-oriented transport policy is evident. As set out in the Declaration, for a successful environmental transport policy,

concrete environmental targets need to be established, including quantified reduction goals for key pollutants such as carbon dioxide (CO_2), nitrogen oxides (NOx), volatile organic compounds (VOC) and particulate matter.

The Potential of a Diversified Approach to Environmentally Sustainable Transport EST

In the CEI Declaration, the Vancouver Principles for Sustainable Transport and the quantitative criteria set forth within the OECD EST Project were considered to be used as a basis to bring transport in line with sustainable development. Backcasting scenarios inspired by the above principles and criteria were presented on the preceding pages. Three approaches to reduce the environmental impacts of transport and attain sustainable transport in CEI countries in transition were considered: EST 1: the application of advanced technology for reduced emissions and increased fuel efficiency and the development of vehicles running on new, cleaner fuels; EST 2: optimising mobility management and significantly reducing the demand for transport; and EST 3: a combined scenario, using a balanced approach of technology-based and demand management oriented measures to attain sustainable transport.

The combined approach, which relies both on technology and transport demand measures is the most realistic, and would allow substantial emissions

reductions to be achieved while leaving room for growth in transport volumes. Retaining a balanced transport modal split, with high shares of rail and public transport, was a vital assumption of the EST 3 scenario. These assumptions are in line with the expressed will of CEI Environment Ministers in the Declaration to „maintain the high share of public transport in the cities of CEI countries in transition“ and otherwise preserve the existing advantages of the high share of environmentally-friendly modes of passenger and freight transport present in many CEI countries. The scenarios demonstrate that preserving the CEI transition countries „head start“ on the path to environmentally sustainable transport is a vital issue.

Figures 14 and 15 compare the transportation modal split likely to occur in CEI countries by 2030 if no significant action is taken to that possible through policies similar to those assumed

Figure 14:

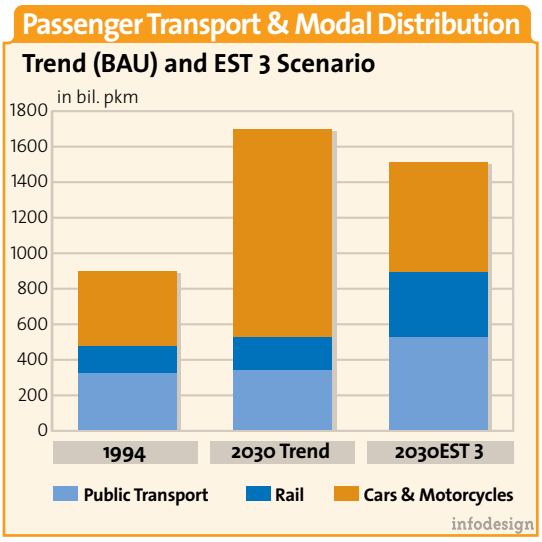
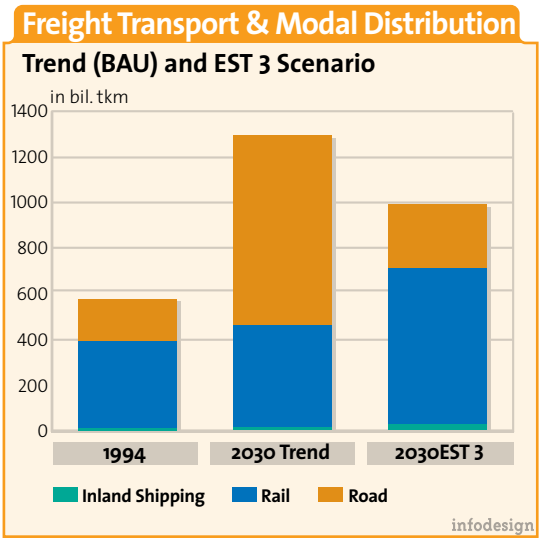


Figure 15:



in the combined scenario (EST 3). A healthy balance between the major passenger and freight transport modes could be preserved in CEI countries through a combination of technological and transport demand management measures. This would allow the growth anticipated for transport in this region to occur in a safe, sustainable manner. It should be noted that while the assumptions for the EST 3 scenario did include implementation of measures to reduce overall transport volume, the projections left considerable room for growth. The key issue is managing this transport growth so that it takes place without threatening human health or environmental quality. The combined scenario suggests that this can be

accomplished by a strategy that can pursue several objectives simultaneously, thus accumulating environmental benefits in a number of different areas. On the most general level, this means i) ensuring that cleaner, more sustainable modes such as rail and public transport absorb a larger share of increasing mobility demand in CEI countries, and ii) ensuring that more pollution-intensive modes (e.g. private cars) are equipped with the best available technical solutions capable of reducing their health and environmental impacts. Far from being an attempt to radically change current mobility habits, one of the main objectives of the combined scenario was to preserve and enhance the environmentally favourable modal split which already exists in most CEI transition countries.

Taking Action: Strategies and Measures for Achieving EST

The strategies and measures necessary to make the combination scenario (EST 3) a reality can be roughly divided into three categories:

i. measures to reduce the overall transport volume in passenger and freight transport (change of mobility and land use patterns, change of the system of industrial production and location);

ii. measures to influence modal shift towards less harmful modes (promotion of non-motorised traffic and public transport for passengers, rail and inland waterways for freight transport);

iii. measures to reduce the negative impacts of „conventional“ vehicles (encouraging the implementation of the best available technology and strict emission standards, increasing the occupancy rates and load factors of vehicles).

The implementation of these strategies and measures requires the application of a set of instruments including:

- economic instruments for fair and efficient pricing aiming at a variabilization of costs and an internalisation of external costs (e.g. environmentally oriented financial, fiscal and pricing policy such as area-wide road pricing and parking charges);
- regulatory instruments (e.g. stringent standards for vehicles and fuels, the use of infrastructure and strategic environmental impact assessments (EIA, SEA));
- regulations and restrictions (e.g. night-time ban for trucks, speed limits, parking regulations);
- adjustment of investment policy (e.g. shifting investments towards more environmentally friendly transport such as rail, public transport, walking and cycling);
- adjustment of technology policy (e.g. emphasis on improvements in technologies and techniques with high environmental impacts, encouraging clean, fuel efficient technologies);
- transport demand management programmes (e.g. incentives for higher load factors and to reduce travel needs);
- integrated transport, urban and regional planning (e.g. land use and zoning, industrial location, transport infrastructure);
- programmes for raising public awareness (information, public relations, training and education).

In order to implement EST it will be essential to apply a package of measures. It will be necessary to discourage more polluting transport means and to strengthen the use of more environmentally friendly transport. As the CEI Ministers mentioned in the Declaration, this will first of all require raising the attractiveness of public transport services and rail, improving timetables and upgrading international and local connections and promoting a positive image of these modes in the mind of the public.

Similarly, the public should be properly informed about the health and environmental impacts and their full costs of transport via awareness programmes and other communication efforts and, where appropriate, through plainly legible environmentally-based pricing policies. Health and the protection of the rights of future generations to a clean environment are popular issues, but unless the link between transport activities and the related health and environmental effects can be effectively communicated to the public, it will be difficult to generate the political will necessary to take action.

Last but not least, direct investment and resources made available by international financial institutions

need to give priority to environmentally sound transport modes like improvement of the rail network and inland waterways. Their policies should be co-ordinated with domestic efforts to preserve or improve the environmental performance of national transport systems. Countries should develop their own mechanisms to make investment in cleaner transport modes or fuels, pollution control technology or fuel efficiency more attractive, and ensure that the fiscal and legal frameworks surrounding investment and international borrowing are in line with established national environmental objectives.

The Path to Environmentally Sustainable Transport

A transition to an environmentally sustainable transport system will require action from several different parts of society on international, national, regional and local level, including politicians, authorities, scientists, NGOs, the private sector and individual citizens. Implementation of a successful, environmentally sound transport policy could consist of three phases:

1. Acceptance phase: Discussion of criteria, goals and measures in order to attain EST. Development and adaptation of strategy and argumentation. Information on long-term goals, health and environmental effects of transport and their economical implications is an important instrument. Additionally, a wide range of measures are needed to encourage and motivate people to resolve transport problems in an environmentally sustainable way. Initial measures, such as the introduction of the „polluter pays principle“ should start in the middle of the acceptance phase. CEI Environment Ministers have affirmed the necessity of these steps in the Declaration, and have pledged to closely co-operate in developing initial policies to realise EST.

2. Adaptation phase: Adjustment of current policies towards a more environmentally friendly transport policy. In the adaptation phase, various instruments will be implemented, such as economic instruments, standards and regulations, or a changes in planning philosophy. Suitable combinations or packages of measures and instruments should be applied, taking into account the interdependence of the different measures and instruments. The implementation of measures has to follow a step-by-step approach taking account of the specific situation in the different countries.

3. Implementation phase: Integration of the principles and goals of sustainable development into transport and transport-relevant sectors. Realisation of environmental and transport policy in order to reach the goals of environmentally sustainable transport.

The major task of policy stake holders for the future will be to develop tailor-made step-by-step implementation plans focussing on policy actions to implement the strategies and measures towards EST agreed in the „Ministerial Declaration Towards Sustainable Transport in CEI Countries“ as well as in the UNECE Vienna Declaration on Transport and Environment and the forthcoming WHO Charter on Transport, Environment and Health.

Open Questions and Outlook on Further Steps

The pilot project „Environmentally Sustainable Transport in the CEI Transition Countries“ sought to give an overall analysis of the current situation of transport and environment in the CEI transition countries in Europe. It also shows probable general trends and means to avoid an unsustainable development of the transport system. Usually, such kind of analysis must be based on comprehensive and reliable data. In most of the CEI transition countries available data was not sufficient or not reliable. Therefore, many factors of the analysis depended on estimations. The improvement and harmonisation of data bases and statistics will be an important task for the future.

Due to the more global scope of this pilot study, but also due to data constraints the focus of the study lies on air pollution and CO_2 emissions. But even for air pollution open questions remain, e.g. the impacts of particle emissions. The particle emissions could only be tackled by considering the particle mass, as sufficient research results on the number and composition of fine and ultra-fine particles and their health risks are not yet available. So the mass-related particle indicator and target have to be seen as preliminary and should be reviewed in the light of new findings.

Noise and land use issues, which are also crucial

indicators for sustainable transport, need more in-depth analysis in the future and further investigations. Therefore noise and landuse indicators should be considered in depth when realising EST projects on national, regional or local level.

Last but not least, air transport, which could not be covered in this study due to budget and data constraints, but which is also a crucial factor for sustainability in pan-European transport development, should be the focus of a future study task.

The study results paint a bird-eye picture of the trends and environmentally sustainable transport scenarios taking the CEI countries in transition as a whole. This more general approach was preferred by the steering comittee - the CEI SubGroup on „Environment and Transport“ because of pragmatic reasons due to availability of data and resources on the one hand and with a view to provide a good basis document upon which further elaborations and investigations with a more diversified national and regional approach could be built in the future.

This study intends to be the first in a number of projects on environmentally sustainable transport. It should serve as the basis for national, regional and local pilot projects dealing with the implementation of the concept for environmentally sustainable transport.

Austrian examples towards sustainable transport

Austria has introduced strict exhaust emission limits for vehicles requiring the use of catalytic converters in 1987. Unleaded petrol was already introduced in 1985 prohibited in general 1993. The content of benzene in petrol was limited to a maximum of 3 Vol.% since 1990 and will be further reduced to 1 Vol% by 2000.

In 1989 a night ban for not ‘noise-reduced’ lorries on transit routes was introduced and extended throughout Austria in 1995. As a result low-noise technologies for lorries rapidly appeared on the market.

New technologies for public transport are implemented offering environmental soundness together with friendliness to passengers by using Ultra-Low-Floor technology for tramways and buses combined with ultra-low emission driving systems based on electricity and alternative fuels, like LPG (Liquid Petroleum Gas) and CNG (Compressed Natural Gas). Vienna has the most environmental friendly bus fleet worldwide: Nearly 80% are LPG driven buses, of which about 94% are equipped with a three-way catalytic converter.

In most parts of Austria integrated systems of public transport have been introduced. An investment programme for the improvement of the railway system is implemented. Siding tracks for enterprises, and Combined Transport are promoted by the Ministry of Science and Transport.

Many Austrian cities (for instance Vienna) have introduced parking management systems including chargeable short-term parking and chargeable parking permits for local residents. Several communities have implemented measures for traffic calming including speed limits of 30 km/h to promote traffic safety and measures to promote pedestrian traffic and cycling. These measures have lead to an enormous decrease of severe injuries and fatalities. For making bordering of passengers safe and comfortable Vienna is running a programme for widening up the pavements to the tram tracks and bus lanes at stops.

Pilot projects for sustainable transport have been launched
e.g. ‘Transport Demand Management for Companies’ has been started by the Ministry for Environment, Youth and Family and for ‘Sustainable Mobility in Tourism’ by the Ministries for Environment, Transport and Economic Affairs together with the Province of Salzburg in the two model villages Bad Hofgastein and Werfenweng.

The new Ultra-Low-Floor Viennese trams: No more steps for bordering passengers - a big step forward

2 OECD Environment Directorate (1997), „Project on Environmentally Sustainable Transport“, OECD, Paris.

3 OECD (1997), Freight and the Environment: Effects of Trade Liberalisation and Transport Sector Reforms, Paris; and MOLITOR. R., et al. (1997), Environmental Balance of Transport, Austria 1950-1996, Federal Ministry for the Environment, Youth and Family (Ed.), Vienna.

4 Documents of examples for Best Practice of Environmentally Sustainable Transport were prepared and distributed by the deputies of the Czech Republic, Poland, Slovenia and the Slovak Republic.

5 UNEP (1993), „Transport and the Environment“, in: Industry and Environment, January - June 1993, p. 3.

6 World Commission on Environment and Development (1987), Our Common Future; OECD (1996), „Towards clean transport - Fuel efficient and clean motor vehicles“, OECD, Paris.

7 OECD Environment Directorate: Flyer: „Project on Environmentally Sustainable Transport“, Paris.

8 The „Declaration Towards Sustainable Transport in the CEI Countries“ was elaborated by the „Environment and Transport“ group of the CEI under the chairmanship of Mr. Robert Thaler, Austria, following the mandate of the CEI-Environment Ministerial Conference in Graz 1996. The Declaration was signed by the CEI Environment Ministers (except Italy) on occasion of the UN General Assembly Special Session in June 1997. The Declaration is enclosed in this brochure.

9 The CEI consists of 16 member states in Central and Eastern Europe and serves as a forum for regional co-operation and as an element of stability and co-operation in Europe. Its major objectives are to strengthen the process of integration in Europe and to promote co-operation among CEI countries.

10 Hey, C. et al., ibid.

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List of Abbreviations

The continental system has been used for decimals appearing throughout the report (e.g. 0,5).

AL	Albania
BAU	Business-as-usual
BG	Bulgaria
bil.	(1.000.000.000) billion
BIH	Bosnia-Herzegovina
BY	Belarus
CEC	Central European Conference
CEEC	Central and Eastern European Countries
CEI	Central European Initiative (former Pentagonale)
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CZ	Czech Republic
EBRD	European Bank for Reconstruction and Development
ECMT/ CEMT	European Conference of Ministers of Transport
ECU	European Currency Unit
EIB	European Investment Bank
EST	Environmentally Sustainable Transport
EST	Estonia
EU	European Union
FYROM	Former Yugoslav Republic of Macedonia
GDP	Gross Domestic Product
H	Hungary
HDV	Heavy Duty Vehicle
HR	Croatia
IFI	International Financial Institution
IPCC	Intergovernmental Panel on Climate Change
km	kilometre
km^2	square kilometre
l	litre
LDV	Light Duty Vehicle
LPG	Liquefied Petroleum Gas
LT	Lithuania
LV	Latvia
MD	Moldova
mil.	(1.000.000) million
n.a.	data not available
NMVOC	Non-methane volatile organic compounds
NO_2	Nitrogen Dioxide
NOx	Nitrogen Oxides
OECD	Organisation of Economic Co-operation and Development
pkm	passenger-kilometres
pass.	passenger
PM	particulate matter
PPP	Purchasing Power Parity
PL	Poland
Rep.	Republic
RO	Romania
SK	Slovak Republic
SLO	Slovenia
t	tonne
tkm	tonne-kilometres
tsd.	(1.000) thousand
UA	Ukraine
ULEV	Ultra-Low Emission Vehicle
UNCED	United Nations Conference on Environment and Development
UN-ECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
USD	US Dollar
veh.	vehicle
veh. km	vehicle-kilometre
VOC	Volatile Organic Compounds
WHO	World Health Organization
WIIW	Vienna Institute for Comparative Economic Studies
ZEV	Zero Emission Vehicle

Project Management and Elaborating Experts

Joint pilot study commissioned by

United Nations Environment Programme (UNEP)

Organisation for Economic Co-operation and Development (OECD)

Federal Ministry for Environment, Youth and Family, Austria

Steering Committee

The CEI SubGroup on „Environment and Transport“

Project management:

Françoise Belmont (UNEP),
Dr. Peter Wiederkehr (OECD Environment Directorate),
Robert Thaler (Federal Ministry for Environment, Youth and Family, Division for Transport, Mobility, Regional Planning and Noise, Austria)

Project co-ordination:

Andreas KÄFER
Dr. Romain MOLITOR

Project elaboration:

Eva BURIAN
Andreas KÄFER
Dr. Romain MOLITOR
Ulrike STOCKER
Stefan Wiederin

TRAFICO Verkehrsplanung

A-1060 Wien, Fillgradergasse 6/2
Phone: +43 (1) 586 41 81
Fax: +43 (1) 586 41 81 10
e-mail: trafico.wien@magnet.at

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The present chapter is a short version of the joint pilot study and has been written by Romain MOLITOR and Eva BURIAN. Draft edited by Ruth OESTERREICH. Final edition by Robert THALER and Peter WIEDERKEHR.

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CEI SubGroup „Environment and Transport"*

Report on the Activities

The Environment Ministers of the CEI Countries decided at the CEI-Meeting of Environment Ministers on 26/27 September 1998 in Graz, Austria, to found the CEI Sub-Group „Environment and Transport" within the CEI Working Group on Environment and to mandate this group with the elaboration of:

- a CEI Declaration on Sustainable Transport in the CEI Countries
- an action programme for the development of an environmentally benign transport system, especially in the field of public transport logistics and rolling stock technology
- identifying an action programme for pilot projects on sustainable transport development
- finding environmental friendly solutions for the common problem of transit.

In a very friendly and co-operative atmosphere 10 Meetings of the sub-group - consisted of representatives of the Ministries for Environment, the Ministries of Transport and other relevant ministries of the CEI Countries and of international organisations as observers (e.g. UNEP, OECD, REC, etc), additional scientific experts as well as experts in the field of environment and transport - have taken place so far in Vienna.

As the first main topic the CEI-Declaration „Towards Sustainable Transport in the CEI Countries" has been elaborated by the sub-group. The Declaration has been signed by the Environment Ministers of the CEI countries (except for Italy) in the frame of the UNGASS (United Nations General Assembly Special Session) on 25 June 1997 in New York.

With their signature the CEI Environment Ministers agreed - in accordance with their competencies - to take the necessary steps to:

- bring transport in line with sustainable development
- develop and establish environmental goals and standards for transport
- develop, promote and implement strategies and measures towards sustainable passenger and freight transport
- have special focus on environmentally sound transport development in particular in sensitive areas, in urban areas, in transit corridors and in post-war areas
- co-operation and joint activities in some specified topics in the field of environmentally transport.

The CEI SubGroup Environment and Transport has been founded by the Heads of Delegations at the CEI Meeting on Environment Ministers, 1996, Graz, Austria

The Environment Ministers of the CEI member countries also decided to mandate the Sub Group for Environment and Transport with the further developing, co-ordinating and evaluating of the implementation of this declaration in the CEI region. This point is one of the main topics of the ongoing work of the sub-group.

* Chaired by Mr. Robert Thaler, Head of Division for Transport, Mobility, Regional Planning and Noise of the Austrian Federal Ministry of Environment, Youth and Famliy, assisted by Ms. Renate Nagy. The chapter on the report was provided by Renate Nagy

As a second main task the sub-group acted as steering committee of the Joint Pilot Study „Environmentally Sustainable Transport (EST) in the CEI Countries in Transition“, supported by the OECD (Organisation for Economic Co-operation and Development) the UNEP (United Nations Environment Programme) and the Republic of Austria (Federal Ministry for Environment, Youth and Family).

The Pilot Study gives and overview of the present and future situation with regard to the environmental impacts of transport in the CEI countries in transition and analyses the possibilities of reducing the environmental effects of transport by using three different „environmental transportation scenarios“ based on technological improvements, transport demand management and a combination of both. The results of this joint project are presented in this brochure „Towards Sustainable Transport in the CEI Countries“. To disseminate the results and follow up this project series of workshops on EST that will be hosted by volunteered CEI countries are planned. The series will start with workshops in Slovenia, the Slovak Republic and Croatia. The results of the Pilot Study will also act as the scientific background of the ongoing work of the Sub-group.

Following up the CEI-Declaration the ongoing activities of the group for the next future (CEI Plan of Action 2000 - 2001) focus now on the preparation and implementation of a Pilot Project Programme on Sustainable Transport in the CEI Counntries, dealing with specific topics of the Declaration.

In a first step the following proposals have been worked out for concrete pilot projects:

- Environmentally Sustainable Transport for the Slovenian Adriatic coast region (initiated and coordinated by Slovenia)
- Environmentally Sustainable Freight Transport (ESFT) (initiated and coordinated by Croatia)
- Ultra Low Emission Vehicles in public transport (initiated and coordinated by Croatia)
- Strategic Environmental Assessment - Methodology for CEI Activities (initiated and coordintated by Croatia)
- Strategic Enviromental Impact Assessment Danube Corridor (initiated and coordinated by Austria)

Austrian Federal Minister for Environment, Youth and Family, Mr. Martin Bartenstein, chairing the CEI Meeting on Environment Ministers, 1996, Graz, Austria

The next steps will concentrate on the practical implementation and allocation of financial resources with close co-operation and support of the CEI Executive Secretariat in Trieste and the CEI/ECE Focal Point of the EBRD.

The Sub-Groupe closely cooperates with other international processes and organisations like

- relevant activities on transport and environment in the EU
- the follow-up of the UNECE Ministerial Conference on Transport and Environment in Vienna 1997
- the preparation and follow-up of the WHO Charter on Transport, Environment and Health, London 1999
- the United Nations Environment Programme (UNEP)
- the Organisation of Economic Cooperation and Development (OECD)

Further Cooperations regarding the Steering Committee of the Phare Multi Country Transport Programme and the Transport Infrastructure Needs Assessment (TINA) Group.

The activities of the Sub Group for Environment and Transport support the overall strategy of the CEI as follows:

- strengthening of the co-operation among the countries with regard to sustainable environment and transport as well as regarding the common elaboration of problem identification, measures and proposals for implementation
- support of the EU integration of the CEI countries
- strengthening of the co-operation between the CEI countries and other international organisations (EU, UNEP, OECD, UN ECE, WHO, etc.)
- support of the transformation process especially by the preparation and the realisation of pilot projects

ANNEX:

Central European Initiative Sub-Group „Environment and Transport“

Chairperson:

Mr. Robert THALER
Ministry for Environment, Youth and Family
Division for Transport, Mobility, Regional Planning and Noise
Stubenbastei 5, A-1010 Vienna, Phone: 0043 1 51522-0; Fax: 0043 1 51522/7208

assisted by
Ms. Renate Nagy
Ministry for Environment, Youth and Family
Department for International Affairs
Stubenbastei 5, A-1010 Vienna, Phone: 0043 1 51522-0, Fax: 0043 1 51522/7626

Ministerial Representatives:

ALBANIA:
Ministry of Environment

AUSTRIA:
Ministry for Foreign Affairs, Ballhausplatz 2, 1014 Vienna, Mr. Franz Irbinger, Ambassador, CEI-National Coordinator for Austria

Ministry of Science and Transport, Radetzkystraße 2, 1030 Wien, Mr. Ernst Lung

BELARUS:
Ministry for Natural Resources and Environment Protection, Ulica Kollektornaya 10, 220048 Minsk, Mr. Alyaxandr Rachevski, Head of Division for International Affairs,

BULGARIA:
Ministry of Environment, 67, W. Gladstone St., 1000 Sofia, Mrs. Albena Karadjova, Head of the „International Relations“ Department

BOSNIA AND HERZEGOVINA:
Ministry for the Environment, Omladinska Str. 2, Sarajewo, Bosnia-Herzegovina, Mrs. Filomena Primorac-Nikolic

CROATIA:
State Directorate for Environment, Ulica Grade Vukovara, 10000 Zagreb, Mrs. Branka Motusic
Ministry of Maritime Affairs, Transport and Communications, Prisavlje 14, 1000 Zagreb, Mr. Nenad Dujmovic

Ministry of Physical Planning, Republike Austrije 20, 10 000 Zagreb, Mr. Velimir Dumicic

CZECH REPUBLIC:
Ministry for the Environment, Vrsovicka 65, 10010 Praha 10, Mrs. Alexandra Orliková, Head of the Department for International Relations

Ministry of Transport and Communications, Nabr. Ludvika Svobody 12, 110 15 Prag 1, Mr. Jiri Matejovic

HUNGARY:
Ministry for Environment and Regional Policy, Fö u.44-50, 1011 Budapest, Mrs. Szuszanna Arokhati, Mrs. Zsuzsanna Bibók

Ministry for Transport, Communication and Water Management, H-1400 Budapest Pb.: 87, Mr. Andras Hardy, Head of the Main Department for International Relations, Mr. Miklós Szoboszlay

ITALY:
Ministry of the Environment, Piazza Venezia 11, 00186 Rome, Mr. M. Borle-Talpaekt, and Via Della Ferratella in Caterano, 33, I-00184 Rome, Mrs. Marina Penna/Mrs. Gloria Visconti

Ministry of Transport, Roma, Mr. Salvatore Ferrante

MACEDONIA:
Ministry of Environment, Department of Internatinal Co-operation, Drezdeuska 52, 91000 Skopje

MOLDOVA:
Ministry of Environment, Boulevard Stefan ccel Mare Nr. 73, 2001 Chilsinau, Mrs. Ludmila Munteanu, Head of International Department

POLAND:
Ministry of Environment Protection, Natural Resources and Forestry, Wawelska Street 52/54, 00-922 Warsaw, Mr Andrzey Sieminski

ROMANIA:
Ministry of Waters, Forestry and Environmental Protection, Bd. Libertatii nr. 12, Sect. 5, Bucharest, Mrs. Lucia Ceuca, Director of the International and Public Relations Office, Mr. Silviu Stoica

Ministry of Transport, GD for European Integration and International Relations, Mrs. Dana Constantinescu

SLOVAK REPUBLIC:
Ministry of Environment, Hlboka 2, 812 35 Bratislava, Mr. Jan Janiga

SLOVENIA:
Ministry of the Environment and Physical Planning, Sl-1000 Ljubljana, Zupanciceva 6, Mrs. Thea Glazar, Mr. Ales Sarec

Ministry of Transport and Communication, Preuernova 23, Sl-1535 Ljubljana, Mrs. Gabriela Navotnik

UKRAINE:
Ministry for Environmental Protection and Nuclear Safety, 5, Khreshchatyk Street, Kiew, Ukraine 25260, Mr.Viacheslav Magmedov, Head of the International Relations Department

CEI-Bodies:

C.E.I.-Executive Sekretariate,
Via Genova 9, I-34100 Trieste,
Mr. Director Paul Hartig, Mrs. Paola Plancher

Secretariat for CEI Projects, EBRD,
One Exchange Square, London EC2A 2EH, U.K.,
Mr. Vincenzo Calogero, Programme Manager

CEI Focal Point at the UN/ECE,
Palais des Nations, CH-1211 Geneva 10,
Mr. Gianluca Sambucini, Technical Adviser

Observers:

Environment Directorate of the OECD,
2, Rue André-Pascal, 75775 Paris cedex 16, Mr. Peter Wiederkehr

Regional Office for Europe, UNEP,
15, Chemin des Anémones, CH-1210 Chatelaine, Genève, Mrs. Francoise Belmont, Deputy Director

Regional Environmental Center, REC
Senovazna 2, Praha 1, 11000, Mr. Jiri Dusik

Transport and Environment, T&E
Boulevard de Waterloo, 34, B1000 Bruxelles

TINA-Secretariat,
Auerspergstraße 15, 1080 Vienna,

If required additional experts in the field of environment and transport (eg. Technical Universities, Companies, Agencies, NGO's, etc.) will be invited.