

# Environmentally Sustainable Transport in the CEI Countries

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EJTIR, 4, no. 1 (2004), pp. 99-120

*Received: September 2003*

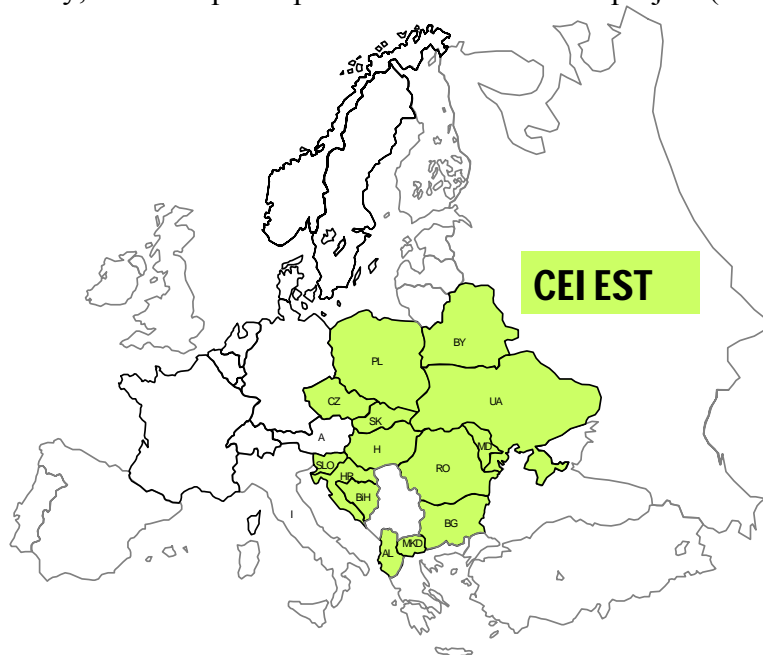
*Accepted: August 2004*

*Moving people and freight in an environmentally sustainable manner that reduces environmental pollution and health hazards is a key challenge for transport and environment policies in Europe. Present mobility patterns of passenger and freight transport in Central and Eastern Europe do not correspond to the objectives of sustainable development. This paper presents the results of a transport futures study for the CEI region as a whole using backcasting methodology with long-term sustainability criteria to be met by 2030. Achieving environmentally sustainable transport (EST) doesn't mean less transport and mobility than we have today, but it means primarily maintaining a balanced modal split that results in less environmental and health impacts than it would be under projected future trends. Rail, trams, busses and new forms of flexible inter-modal public transport mobility would have to take a large share and rail transport for passenger and freight as well as inland shipping would have to be nearly doubled by 2030 while road freight could still increase if it is based on alternative fuels reducing its impacts. Technological advancements for passenger cars and lorries, fuels and infrastructure will play an important part to achieve EST, but also 'smart' mobility management (e.g. transport avoidance, increasing load factors and modal shift), innovative mobility services and freight logistics would be critical. The implementation of these policies and strategies will require coherent and comprehensive packages of instruments and measures, including: economic instruments, regulatory instruments, changes in infrastructure investment, mobility management, information and education programmes as well as better integration of land use, transport and environment policies. Realising EST*

*will provide new opportunities for businesses to develop and invest in innovative solutions for passenger and freight transport. Overall, achieving EST would constitute a net benefit for the environment and for quality of life in general.*

## 1. Introduction

Efficient transport – and in particular access for people to jobs, goods and services - is a prerequisite for economic and social development. However, transport is also responsible for a number of impacts it has on human health and the environment. Present mobility patterns of passenger and freight transport do not correspond to the objectives of sustainable development. This is also the case for Central and Eastern Europe, where freight transport by road and rising car traffic and their health and environmental impacts, notably from accidents, pollution, noise and greenhouse gas emissions have tremendously increased in the last decade. The Central and Eastern European Initiative (CEI) includes the following countries in Central and Eastern Europe (Figure 1): Albania, Bulgaria, Bosnia-Herzegovina, Belarus, Croatia, the Czech Republic, Macedonia, Hungary, Moldova, Poland, Romania, the Slovak Republic, Slovenia and Ukraine. The study was carried out before the accession of the State Union of Serbia and Montenegro and therefore could not take into account data from these countries. While Austria and Italy are also part of the CEI, they are not included in this study, but have participated in the OECD EST project (see references).



*Figure 1 . Study area of the CEI countries*

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 industrialized and have recently enjoyed economic growth, others such as Albania, are agricultural nations, while countries like Bosnia-Herzegovina are in the midst of a painful reconstruction following war.

In most of the CEI countries, except those involved in armed conflicts, the number of cars per 1000 inhabitants grew in the last years. In the mid 1990's the road vehicle fleet in the CEI countries varied from 18 passenger cars per thousand inhabitants (Albania) to 327 passenger cars per thousand inhabitants (Slovenia). In contrast, walking, public transport and rail freight transport experienced a substantial decrease. Since 1989, rail has lost more than 46% of its passenger transport volume.

Transport volume in the CEI countries increased continuously throughout the 1970s and 1980s. After 1989, this increase was followed by a substantial 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 1997, Ministers recognised in the "Declaration "Towards Sustainable Transport in the CEI Countries", the strategic position of the region as the "traffic junction of Europe" suggesting a high potential for increases in transport volumes, particularly road transport, and therefore, an urgent need for developing policies towards sustainable transport. To help address these problems and develop alternative transport futures, the pilot study "Environmentally Sustainable Transport (EST) in the CEI Countries in Transition" was initiated under the auspices of the CEI Sub-Group on Environment and Transport the based on the OECD's EST project (OECD, UNEP, Austrian Federal Ministry of Environment, Youth and Family Affairs, 1999).

## 2. Current and projected transport trends are unsustainable

Developments in the 1990's showed a continuing strong shift towards road transport (+63% increase of the car stock; +73% in road freight), while rail transport decreased by some 36%. Car ownership in the year 1999 had reached an average level of 230 cars per 1000 inhabitants and continued to increase. The study undertook a number of modelling exercises to estimate future trends and the modal structure of the transport system for a time horizon of 2030 with an intermediate time line of 2010. These projections have been made using a number of socio-economic indicators, such as population (UN data), gross domestic product (GDP) and transport activity (OECD/UNEP/Austria, 2002). The economic outlook for region projects considerable growth of GDP and international trade over the next decades, and consequently increased transport activity, primarily for road transport and aviation. The transport effects of these developments have been estimated by assuming elasticity between transport activity and GDP of 0.9 for passenger and 1.1 for freight transport (similar to that experienced in the EU over the past 20 years). Total transport activity has been calculated using total fuel consumption for the transport sector in the region (IEA, 2000). Table 1 provides an overview of the most relevant indicators for the CEI region as a whole.

**Table 1. Socio-economic and other indicators assumed for the study**

| Indicator  | Base year<br>1994 | Period<br>1994-2010 | Period<br>2010-2030 |
|------------|-------------------|---------------------|---------------------|
| Population | 176.874 million   | constant            | 5% less by 2030     |

|                                    |  |   |  |
|------------------------------------|--|---|--|
| GDP growth                         | 1.5%   | 1.5% until 2001<br>3.5% thereafter                    | 2% until 2020<br>1% thereafter                     |
| Occupancy rate                     | 2.00   | 2.00  | 1.65   |
| Truck load factor                  | 3 t/vehicle                                      | 3 t/vehicle   | 4 t/vehicle  |
| Fuel consumption<br>(litres/100km) | cars:8.1<br>light trucks: 13.0                   | 6.6 by 2010<br>10.5 by 2010                           | 5.6 by 2030<br>7.3 by 2010                         |
| Modal split:                       | cars & motos: 47%                                | cars & motos: 59%                                     | cars & motos: 70%                                  |
| Passenger transport                | PT & rail: 53%<br>aviation: <0.5%                | PT & rail: 40%<br>aviation: <1%                       | PT & rail: 29%<br>aviation: 1%                     |
| Modal split: Freight<br>transport  | road: 31.6%<br>rail: 66%<br>inland shipping 2.4% | road: 52.0%<br>rail: 46.0%<br>inland shipping<br>2.0% | road: 64.5%<br>rail: 34.5%<br>inland shipping 1.0% |

The projections for transport activity and related emissions for 2010 and 2030 were made on the basis of calculations for the year 1994. One key assumption for the study was that in 2030 transport patterns in the CEI region would be similar to those observed in EU countries in 1990. This assumption is corroborated by the analysis of current trends in the CEI. The transport implications of these growth projections are that car traffic (in terms of passenger km) would have tripled and freight transport (in terms of tonne km) would increase four times by 2030. On the other hand, public transport would be only slightly higher than in the mid-1990s, but below the 1989 level (Figures 2 and 3).

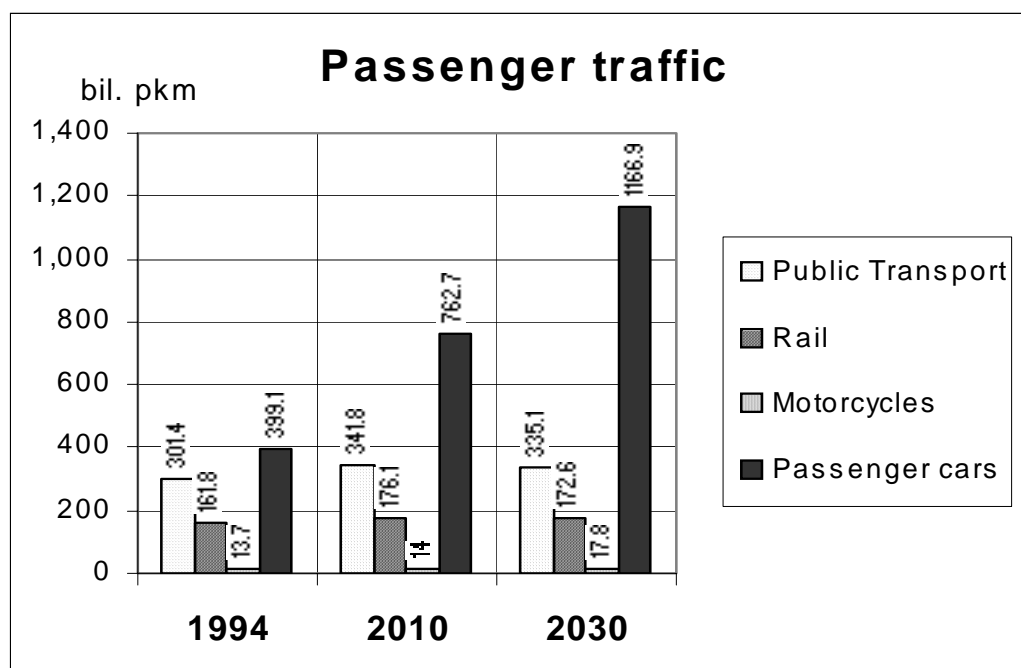


Figure 2. Current and projected modal split for passenger transport in the CEI region

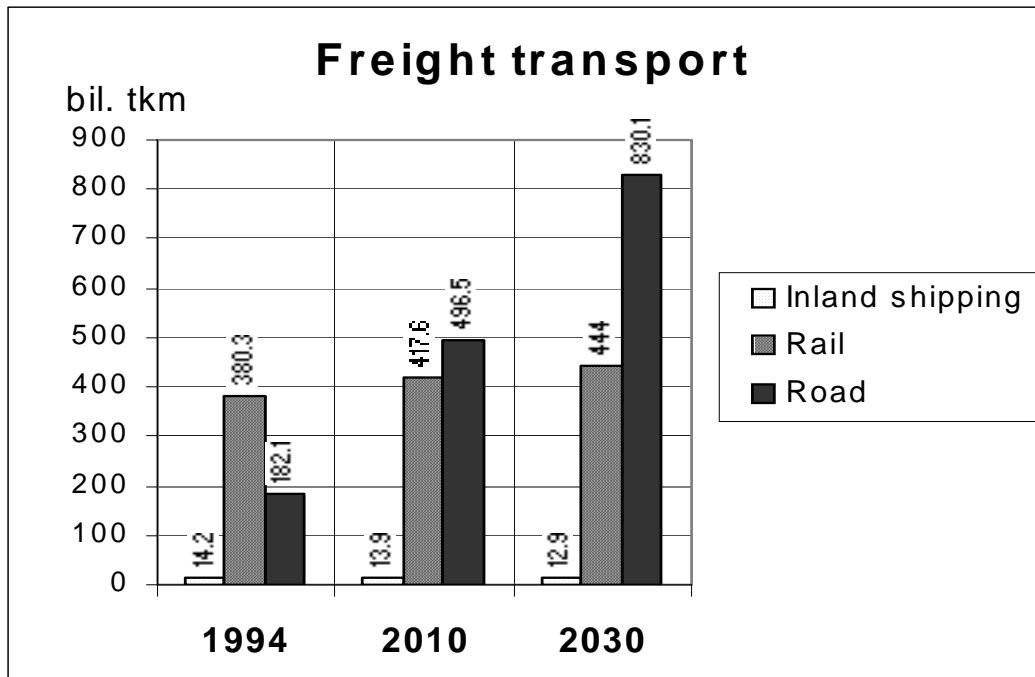


Figure 3. Current and projected modal split for freight transport in the CEI region

As a result of these trends, modal share of private cars in passenger transport would rise from 46% to 69% from 1994 to 2030. The share of road freight (light- duty and heavy-duty trucks) in overall freight transport by might increase from 32% to 65%. The average distance travelled per capita and per year would increase from 5000 t about 10000 km; i.e., the current average level in EU countries. Also a large increase in air traffic is expected, especially for long-distance flights.

Technological progress assumed in the trend projections, especially for road vehicles, will result in an increase of NO<sub>x</sub> and VOC emissions over the next decade, but thereafter, in a reduction of emissions of volatile organic compounds and fine particulate matter in the mid- and long-term. On the contrary, CO<sub>2</sub> emissions from transport in 2030 would have doubled due to strong growth projected and no significant reduction in fuel use. NO<sub>x</sub> emissions would remain higher than in 1995 over the entire period (see Figure 4).

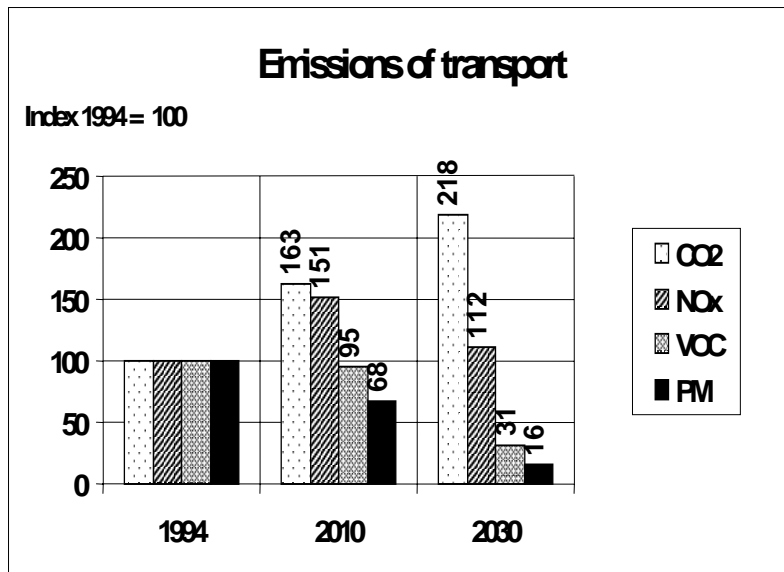


Figure 4: Current and projected emission trends in the CEI region

### 3. The need for Environmentally Sustainable Transport in the CEI: Selection and quantification of EST criteria

In the 1997 Declaration “Towards Sustainable Transport in the CEI Countries”, economic and environment ministers of the CEI recognised the urgent need for developing policies towards sustainable transport. “Business-as-usual” growth trends of pollution-intensive forms of transport are unacceptable in light of the determination expressed by Ministers in the CEI Declaration, and alternative transport futures need to be developed. To this end, the pilot study “Environmentally Sustainable Transport in the CEI Countries in Transition” was initiated (OECD/UNEP/Austria, 2002). A new target-oriented approach based on “backcasting” methodology with sustainability goals was considered necessary that places environment and health issues high on the transport policy agenda and thus, ensures full integration of environmental concerns into the transport sector.

The EST study for the CEI was based on the concept and approach of OECD’s Working Group on Transport recently concluded project on Environmentally Sustainable Transport (OECD/BMLFUW, 2000; OECD 2002) and the EST Guidelines (OECD, 2002) endorsed by OECD Environment Ministers in 2001. The EST project involved a dozen of OECD countries in a search for a new approach to help solve today’s transport environmental problems. The project concluded that there exists a new way towards a sustainable transport future based on backcasting methodology that uses long-term sustainability targets. This involves defining what is meant by environmentally sustainable transport, developing a vision, and then working out how to realise it. It also implies an assessment of the economic and social implications of EST and the measures adopted (a full economic assessment has been performed in the OECD EST study, while for the CEI study it was assumed that growth and investment under the EST scenario would generate considerable economic and social benefits, especially by considerably reducing external costs).

### **Definition of Environmentally Sustainable Transport (EST)**

A sustainable transport system is one that (i) provides for safe, economically viable and socially acceptable access to people, places, goods and services; (ii) meets generally accepted objectives for health and environmental quality (e.g. those set forward by the World Health Organization for air pollutants and noise); (iii) protects ecosystems by avoiding exceedence of critical loads and levels for ecosystem integrity (e.g. those defined by the UNECE for acidification, eutrophication, and ground-level ozone; and (iv) does not aggravate adverse global phenomena such as climate change and stratospheric ozone depletion and the spread of persistent organic pollutants. Therefore, an EST system is one where

*transportation does not endanger public health or ecosystems and meets needs for access consistent with (a) use of renewable resources below their rates of regeneration, and (b) use of non-renewable resources below the rates of development of renewable substitutes.*

Internationally agreed goals, guidelines or standards (such as critical levels and loads defined by the World Health Organization (WHO air quality and noise protection guidelines), the UNECE Convention on Long-range Transboundary Air Pollution (UNECE CLRTAP), or in the UN Framework Convention on Climate Change (UNFCCC)) have been used to operationalise this definition and to develop operational targets to reduce environmental pressures from transport. Sustainability criteria would have to be defined so that local, regional and global environmental quality goals can be achieved.

### **Identification of quantifiable criteria and action targets**

To protect human health and ecosystems on a long-term basis, measures need to be adopted to reduce air pollution, prevent climate change, preserve arable land and protect sensitive natural ecosystems. Policies would have to simultaneously address local, regional and global concerns. According to the definition of environmentally sustainable transport and the approach adopted in the CEI Declaration, quantifiable criteria and targets, based e.g. on defined critical loads or levels, need to be defined and used when developing policies and measures towards EST.

To fulfil the protection criteria for human health and the environment, measures need to be taken at the source (e.g. limiting polluting emissions, noise, land take), especially regarding motor-vehicle related pollutants. 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 is needed to define reduction goals and targets for polluting emissions, noise, land consumption, etc. and that will ensure the attainment of the health and environmental quality objectives.

The OECD Project on Environmentally Sustainable Transport defined a set of six criteria as a minimum required to address the wide range of health and environmental impacts from transport. These criteria are reflected in the definition of the “environmentally sustainable” objectives that are to be met by the transport sector in 2030; notably:

- achieving acceptable local air quality levels by limiting emissions of NO<sub>x</sub>, VOC and particulate matter;

- preventing the formation of harmful photochemical smog, acidification and eutrophication by limiting NO<sub>x</sub> and VOC emissions;
- ensuring climate protection by limiting emissions of CO<sub>2</sub>;
- reduce noise exposure of the population by limiting noise emissions; and
- preserve land use in order to protect ecosystems and limit habitat fragmentation.

Emission reduction targets can be derived from these defined environmental standards, critical loads and levels regarding motor-vehicle related pollutants. Based on the criteria agreed for the OECD'EST Project, a similar set of criteria has been used for this pilot study and adapted to the different conditions in CEI countries (Table 2). An EST system for the CEI region would therefore have to meet all these criteria by 2030.

**Table 2: Quantification of environmental criteria for EST**

| Environmental Feature                       | Criteria and goals  | Operational targets   |
|---|---|---|
| Noise                                       | Attainment of WHO recommended levels  | Reduction of emission sources   |
| Ambient Air Quality (urban and rural areas) | Attainment of WHO Guidelines for NO <sub>2</sub> , PM, and carcinogenic VOCs<br>Critical levels for tropospheric ozone not exceeded (WHO) | Reductions of 90% NO <sub>x</sub> , VOC, and PM emissions                 |
| Acidification Eutrophication                | Critical loads for deposited acid precursors (NO <sub>x</sub> , SO <sub>x</sub> ) and nitrogen deposition not exceeded (UNECE LRTAP)      | Reductions of 70% to 80% of NO <sub>x</sub> and SO <sub>x</sub> emissions |
| Climate Protection                          | Stabilisation of atmospheric CO <sub>2</sub> concentrations (UNFCCC)  | Reduction of 50% of CO <sub>2</sub> emissions                             |

The criteria selected are similar to the other EST studies for the OECD countries, except for CO<sub>2</sub> which is briefly explained here. The results from the scenarios developed by the Intergovernmental Panel on Climate Change (IPCC) suggest to prevent negative impacts on the global climate system, CO<sub>2</sub> concentrations in the atmosphere need to be stabilised and thus, global emission to be reduced by 50%. Emissions of OECD countries with the exception of those in Central Eastern Europe would have to be reduced by 80%, compared to 1990 levels to achieve the climate protection objective. These higher reduction targets for OECD countries take into account the concern that global equality of emission per capita is respected and economic growth with likely increases in emissions in non-OECD countries would possible. Thus, the global reduction target of 50% per cent was chosen for the CEI region.

#### **4. The EST backcasting methodology and scenarios: Challenges for clean technologies and resource saving modal split**

The methodology adopted for the EST scenarios is backcasting, which consists of identifying the measures for achieving pre-defined (long-term) goals and targets. Trend projections and forecasts are based on prevailing trends, whereas the backcasting approach is based on the analysis how a desirable future, for which criteria have been defined, can be attained. It is



thus explicitly normative, involving working backwards from a desirable future to the present state for exploring the feasibility of the approach and identifying the measures to reach that future state.

The result of a backcasting study is alternative images of the future, thoroughly analysed as to their feasibility and consequences. The studies are addressed to many actors, i.e. there is not one single, well-defined decision maker. The images of the future 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. It is essential that the studies provide alternative images of the future. In this way each alternative must appear as coherent and the analysis of consequences for social life etc. must be credible.

Given the very different development state of countries in the study area, the possibility of grouping countries into clusters with similar socio-economic conditions was considered when applying the backcasting method. A number of general indicators, like GDP per capita [or GDP per capita at power purchase parity (PPP)], passenger cars per capita, inhabitants per km<sup>2</sup>, total primary energy use in transport per capita, and the contribution of industry and agriculture to the GDP were calculated with a view to using them for various possible clusters. Two clusters with more or less similar indicators could be retained that divided the study area in a Western and an Eastern part: the Western part was composed of Poland, the Czech Republic, the Slovak Republic, Hungary, Slovenia and Croatia (mainly Accession countries to the European Union), while the Eastern part included Belarus, Ukraine, Moldova, Romania, Bulgaria, Bosnia-Herzegovina, Macedonia and Albania.

Apart from the difficulty to find an adequate method for defining the clusters in the study area, this approach implied the setting of separate criteria and action targets for each cluster. The criteria were defined so that ambient air quality levels below harmful levels for man and nature could be reached and the risk of global warming (CO<sub>2</sub>) was minimised.

Regarding NO<sub>x</sub>-emissions (and also VOCs) in the study area, the application of different criteria among countries didn't seem a suitable way, as ambient NO<sub>x</sub> levels were more or less of the same magnitude in the different countries. Only a different reduction goal for CO<sub>2</sub> emissions could be reasonably justified. In the end, clustering was not used for the study, and therefore, the same goals and targets have been applied for the whole area.

### **The EST scenarios**

Three EST scenarios for achieving the long-term targets have been elaborated: one was based solely on advanced technological solutions (EST1), the second one solely on transport demand management (EST2) and finally a combination scenario (EST3) using both likely technological improvements and transport demand management. Each EST scenario attempted to determine the type of measures and implementation schedule that would be necessary to meet the EST criteria by 2030. All scenarios used the same assumptions about the socio-economic context and the development of the transport sector as the “business-as-usual” trend projections.

The *High Technology Scenario (EST1)* focused on three main categories of technological measures:

- technological changes in road vehicle design and equipment, using best available technology;

- a shift from conventional motor vehicle technology towards new clean and zero emission technologies; and
- cleaner fuels with very low sulphur content (10 ppm) and broad use of alternative fuels like LPG, CNG and – in a long term – hydrogen.

Meeting the criteria through technical means, as in the EST1 scenario, seems only feasible, if a transition is made from the current oil-based transport system to one that is based on energy produced in a sustainable way. Thus, in the EST1 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 would gain a high market share. Hybrid cars with LPG combustion engines will be introduced at a large scale. Light and heavy-duty vehicles would run on gas or hydrogen fuel cells or will be equipped with advanced diesel technology. Where conventional fuels like diesel are still used, fuel quality (e.g. sulphur content) would be dramatically improved.

The rail system would also have to be improved technologically by implementing energy recuperation, improved aerodynamics and shunting technologies and more efficient rail management systems. Power plants would have to be more energy efficient and less polluting, thus reducing CO<sub>2</sub> emissions. Electricity generation would include large wind power plants and improved hydro power plants. Ships would be equipped with fuel cells using hydrogen, which would have to be produced in an environmentally sustainable manner. Overall, the costs of this extreme scenario were considered far too high due to the high demands on advanced technologies, and thus, the EST1 scenario was not considered a realistic option.

The ***Transport Demand Management Scenario (EST2)*** required the attainment of EST by means mobility management focussing on drastic changes on the demand and the supply side with two main characteristics:

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

The focus for passenger transport would be 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 would be used. The modal split of motorised transport of the EST2 scenario in 2030 would be 30 per cent for cars and 70 per cent of public transport and rail. Passenger cars would have to have an occupancy factor of 2 in 2030.

A reduction in the demand for freight transport would also be required to meet the criteria, including:

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

Remaining freight transport volumes would have to be shifted towards environmentally-friendly transport modes and become less environmentally harmful. This would 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 resulting modal split for freight transport in 2030 would be 20 per cent for road, 77 per cent of rail and 3 per cent of inland shipping in order to satisfy the criteria guiding the scenario. Internalisation of externalities will be required for both passenger and freight transport through taxes and charge systems.

Overall, the social consequences of this extreme scenario were considered too dramatic and the changes too drastic to be acceptable, and thus, the EST2 scenario was also not considered a realistic option.

The main task in elaborating the *Combination Scenario (EST3)*, which included likely technological developments and socially acceptable transport demand management approaches, was to determine the modal split and mix of measures capable of attaining the EST criteria. In the EST3 scenario, technological measures contribute about 48 per cent to achieving the targets, while transport demand measures are required to close the gap.

A sustainable passenger transport will require 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 could increase overall by 54% until 2030 without compromising the EST goals. The modal split in 2030 would consist of 42% road and 58% public transport and rail compared to the mobility pattern in the mid-1990s of 47% for cars and 53% for public transport and rail. Cars would have to have an average occupancy of 1.8 persons.

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

Best available technology will have to 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 would be gradually introduced by 2030:

- Hybrid cars with LPG and hydrogen fuel cells. the hybrid cars based on LPG fuel cells would have to 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 in 2030 would have to reach a share of approx. 30%. The fleet of cars would consist of improved technology fulfilling the emission standards for vehicles of EURO IV and beyond.

A change to new technology, however, will not need to 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 introduced with a delay of at least five years compared to the EU). Gasoline and diesel fuel quality will be substantially improved.

Electric buses will be used for urban transport and hybrid buses with LPG 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 gasification of biomass. It should 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 productivity, causing less CO<sub>2</sub> emissions, portions of electric energy will be supplied by wind power plants or improved hydro power plants.

Figures 5 and 6 show the modal split of transport activity in 1995, and in 2030 for the EST scenario, while Figure 7 shows the respective emissions. An EST system would require for passenger transport a substantial increase of public transport, including innovative mobility services with access to car-based mobility and more than a doubling of rail passenger transport. Due to the significant technological progress and the rather low share of car traffic in most of the CEI countries compared to Western Europe, the use of passenger cars could increase by more than 50 per cent until 2030 without compromising the EST criteria.

Achieving EST would require that freight transport volumes by rail and inland shipping would have to be nearly doubled from 1995 to 2030, while through technological progress growth for road freight of more than 50 per cent is anticipated. On average the modal split for EST in 2030 for passenger and freight transport would be similar to that of the mid-1990s.

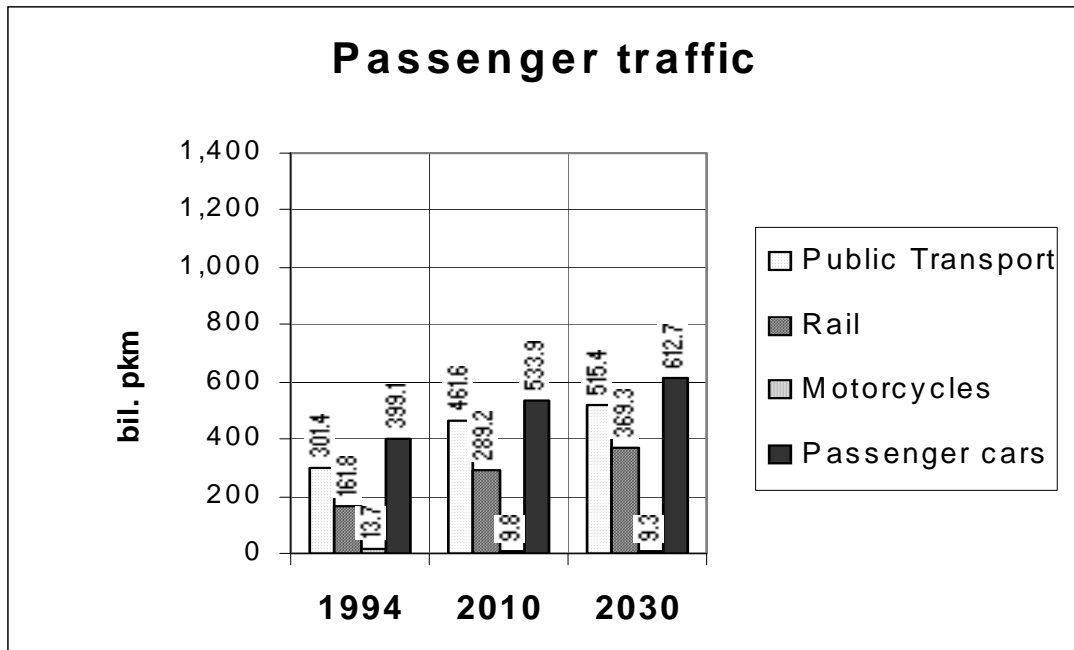


Figure 5. Modal split for passenger transport under the Environmentally Sustainable Transport scenario (EST3) for the CEI region

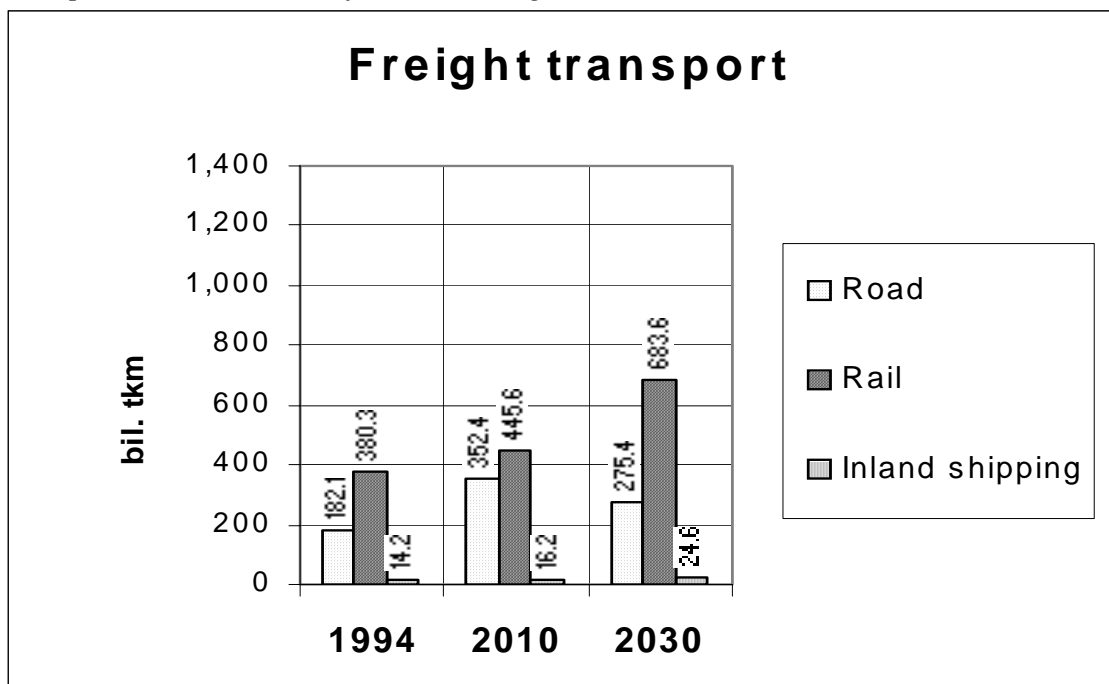


Figure 6. Modal split for freight transport under the Environmentally Sustainable Transport scenario (EST3) for the CEI region

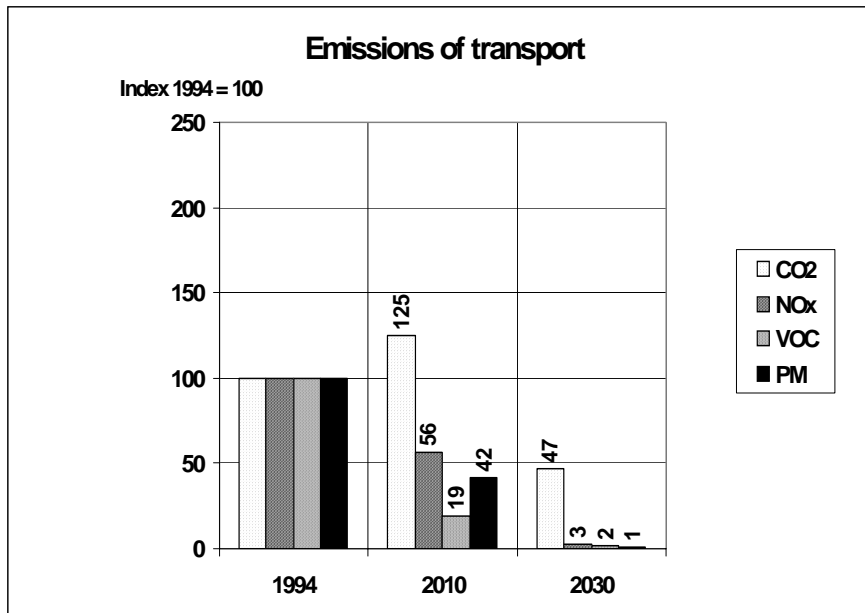


Figure 7. Current and projected emissions from transport under the Environmentally Sustainable Transport scenario for the CEI region

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 EST3 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.

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 EST3 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 the environment. The combined scenario suggests that this can be accomplished by a strategy that would pursue several objectives simultaneously, thus harnessing environmental benefits in a number of different areas. Basically, this would imply:

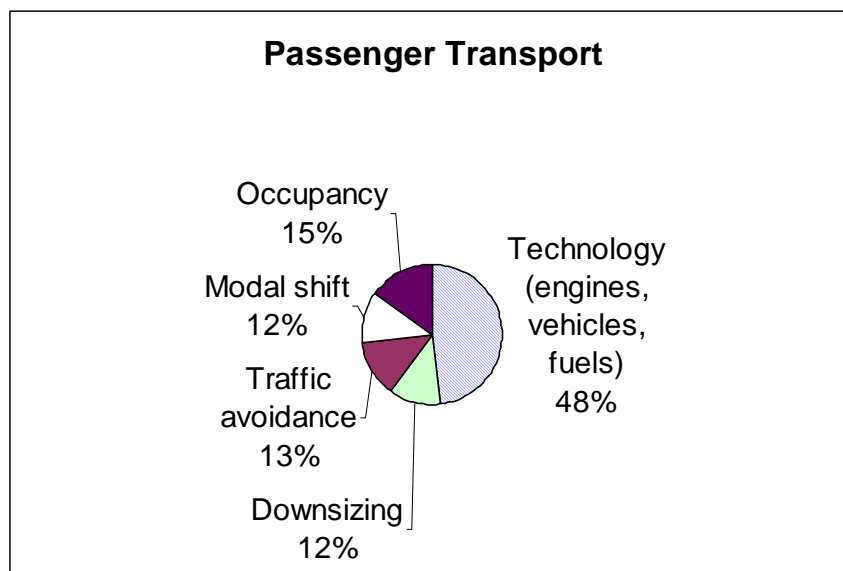
1. ensuring that cleaner, more sustainable modes such as rail and public transport take a larger share of increasing mobility demand in CEI countries; and
2. ensuring that pollution-intensive modes (e.g. private cars and trucks) are equipped with the best available technology capable of reducing the health and environmental impacts.

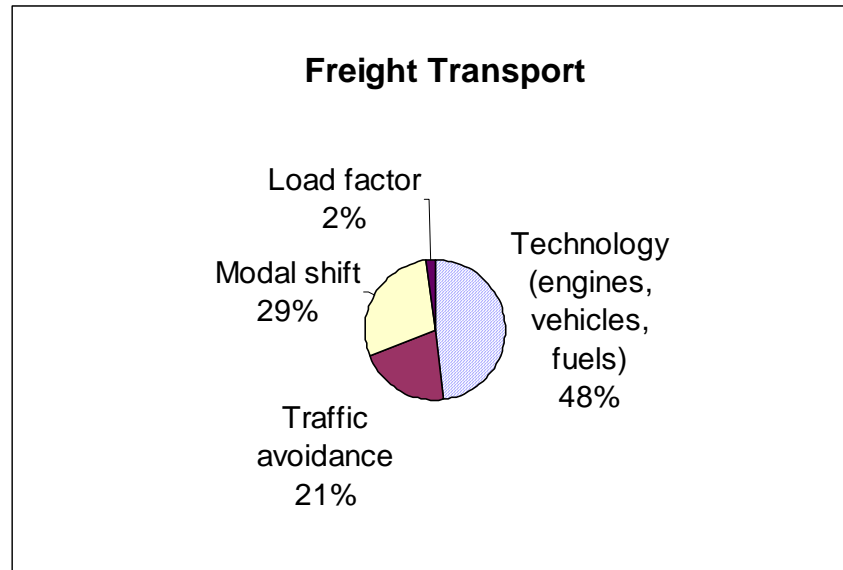
Far from being an attempt to radically change current mobility habits, one of the main objectives of the combined scenario was to preserve and enhance the environmentally favourable modal split which already exists in most CEI transition countries.

Achieving environmentally sustainable transport doesn't mean less motorised transport and mobility than we have today, but it certainly means different transport than it would be under projected trends.

## 5. Measures for achieving EST

Regarding the various measures to be deployed to meet the EST criteria, the analysis was performed for the EST 3 scenario meeting the CO<sub>2</sub> criteria by 2030 - the most stringent of the criteria used. The result was that less than half of the effort towards achieving EST would come from technological advancements for vehicles (improved fuel efficiency for passenger cars and trucks as well as hybrid and fuel-cell vehicles) and the use of clean, low carbon fuels and alternative fuels such as biofuels, natural gas and sustainably produced hydrogen (Figure 8). The other half to meet the goal of 50% CO<sub>2</sub> reduction would come from making transport 'smarter' through mobility management (e.g. transport avoidance, increasing load factors and modal shift) as well as from innovative mobility services and freight logistics that significantly reduce fuel use, even with increased mobility. It was assumed that achieving the most stringent criteria would ensure that the other more easily achievable goals could also be met.





*Figure 8: Impact of Measures to achieve the EST criteria*

If EST is to be achieved in the CEI region over the next three decades, policies and measures would have to be adopted that will result in transport in 2030 with the following characteristics:

- A significant change in the type of passenger transport provided. Many passenger vehicles would be running much more fuel efficient conventional engines meeting most advanced emission standards, hybrid-electric engines, or electric engines (e.g. powered by methanol or hydrogen fuel cells).
- A significant improvement of the infrastructure together with supportive planning and facilities of walking and cycling in urban areas would stimulate their modal share in particular in short distance trips. Public awareness campaign would be needed to increase the “status” and image of human powered mobility
- A significant improvement of public transport, its infrastructure, rolling stock and services, including new forms of integrated public and individual motorised transport such as bike & ride, "public cars" and car-sharing systems would increasingly provide integrated mobility. Buses would run on low emission fuels in urban areas.
- Significantly more efficient longer distance freight movements due to increasing load factors, better logistics and increased use of rail and inter-modal freight transport chains. In road freight natural gas and hydrogen would be used as a fuel both directly and in fuel cells as well as clean diesel technology for conventional engines.
- Rail infrastructure, rolling stock and services would be much improved and almost all rail transport would be electric, with increases in high speed modes, efficiency and capacity, especially for freight movements.
- More efficient and less polluting inland and coastal shipping vessels would be used; hydrogen may also be used as a fuel.
- Air travel for business purposes would become unattractive due to particularly advanced information technology used for communication instead and shorter distances would be

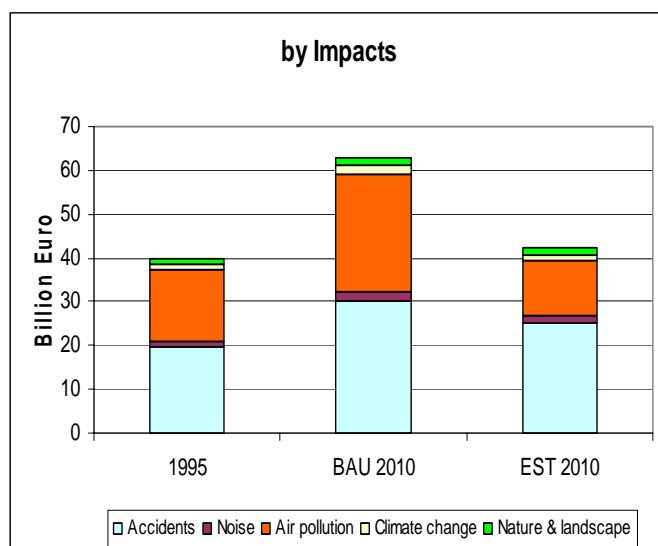


served by high-speed rail. Multi-modal freight logistic solutions would reduce considerably air freight movements, and air planes would be much more fuel-efficient.

A major change to new technology, however, would not take place before 2015. In fact, technological breakthroughs are not expected before 2025. Nevertheless, it is assumed that stringent emission controls and introduction of low emission road vehicles will be accelerated, and therefore, most road vehicles will already meet advanced technological standards by 2015 (e.g. Euro IV emission standards). Gasoline and diesel fuel quality requirements will be substantially enhanced to allow the use of very low emission engine technology.

## 6. Reduced external costs under EST

Realising EST would lead to considerably lower health and environmental costs of transport compared to the BAU trends. The health and environmental externalities (i.e., the unpaid costs of transport users) for the BAU trend and the EST scenario were estimated for the base year 1995 and the year 2010 (Figure 9). The monetary effects of a number of significant impact categories, such as accidents, noise, air pollution, climate change as well as nature and landscape effects (but excluding congestion costs) were valued for the various transport modes making use of a recent study for Western Europe (INFRAS/IWWW, 2000) and applying a value transfer methodology of cost factors based on GDP/capita for each impact category and mode (Austria/CEI/OECD/UNEP, 2003).



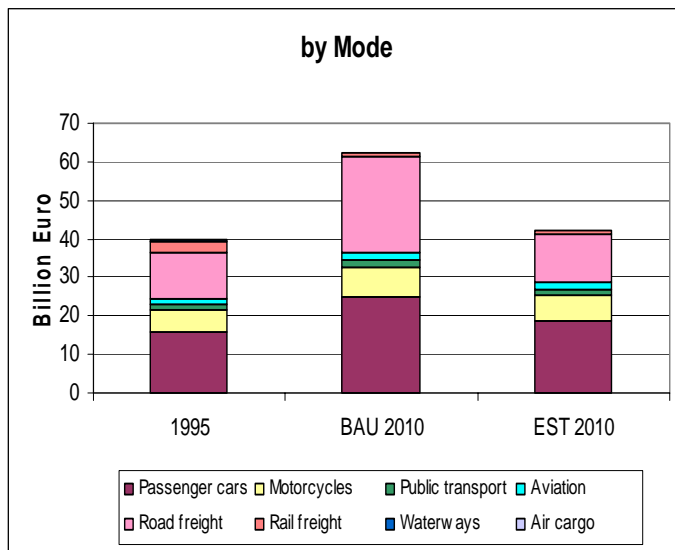


Figure 9. External Costs of Transport in the CEI Region for BAU and EST

The dominant impacts are accidents, followed by air pollution, noise and climate change effects; road passenger and road freight dominate the overall costs. Total external costs, excluding congestion costs, amounted to 40 billion euro in the base year 1995 (see Figure 9). They would rise by some 60 per cent to more than 62 billion euro in 2010 in the case of the BAU trend, could be maintained at about present levels in the case of EST. The external costs of transport in the CEI countries represent approximately 14 per cent of total GDP in 1995 and in 2010 under the BAU scenario, but less than 10 per cent of GDP under the EST scenario, assuming a 60 per cent growth in GDP during the period 1995 to 2010.ref.6

## 7. Conclusion: emerging trends (BAU) and strategies for EST

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 has to be highlighted as an 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 recognized, there is currently "high potential for an increase of transport volumes, in particular "transit" through their countries. The trend projections discussed earlier clearly showed that under the present conditions, an unsustainable transformation of the transport system in the CEI transition countries will take place by 2030. BAU trends will notably involve a marked decline in current high shares of rail and public transport.

The trend projections show a substantial increase of CO<sub>2</sub> emissions, and a slight increase of NO<sub>x</sub> emissions until 2030. VOC and particulate emissions should decrease noticeably through 2030. However the environmental criteria for an environmentally sustainable transportation system will not be achieved. The gap between projected CO<sub>2</sub> and NO<sub>x</sub> emissions and the EST criteria seem to be the most serious.

The impacts on health and the environment connected to BAU trends 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, but overall health and environmental effects generate 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.

The main strategies and measures towards EST highlighted in the study are:

- decoupling economic growth and transport demand 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 information technology;
- a significant shift of passenger transport towards human powered modes for short distances, towards rail-based passenger and public transport, and towards rail freight, inland and coastal shipping and combined transport;
- a considerable improvement of fuel quality and the technology for road vehicles towards ultra low emission vehicles (ULEV) and partly towards zero emission vehicles (ZEV) based on sustainably produced hydrogen for fuel cells; and
- focusing investment on rail and public transport and infrastructure to foster a positive development in rail and public transport technology, operation and management, supportive and improved logistics with higher efficiency as well as improvements in electricity generation from power plants.

The implementation of these strategies and measures will require the implementation of a coherent and comprehensive package of policies including: *economic instruments* for fair and efficient pricing aiming at a variabilisation of costs and an internalisation of social and environmental externalities; *regulatory instruments* (e.g. standards for vehicles, emissions and fuels); bans and restrictions (e.g. use of hazardous components in fuels and materials); *adjustment of investment policy* for different transport modes (in particular for rail, human powered modes and public transport); *changes of technology policy* to accelerate development and market deployment of environmentally friendly technologies; introduction of *transport demand and mobility management* programmes; development of *integrated transport, urban and regional planning*; and programmes for *raising public awareness* and education on environmental matters, in particular on the need and the benefits of EST.

The implementation of a package of measures will have to be carefully tailored to the specific geographic and socio-economic situation of the country. Also the use of polluting transport means will have to be discouraged, while more environmentally friendly transport is to be promoted. As the CEI Ministers mentioned in the Declaration, this will first of all require raising the attractiveness and performance of public transport and rail services, improving timetables and upgrading international and local connections and promoting a positive image of these modes to the public.

Last but not least, foreign 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.

The outcome of the EST project for CEI countries reinforces the conclusion that EST would constitute a net benefit for the environment and for quality of life in general. More important, it follows from the estimated reduction in externalities under EST that some public costs could be significantly lower. The net benefits could be transferred to key areas of the economy including consumption, saving and investment. Overall, this reduction in externalities could lead to a significant improvement in social well-being. EST will also provide new opportunities for businesses to develop and invest in innovative solutions for passenger and freight transport.

## **8. Encouraging good practices toward EST**

The follow-up to the CEI-EST pilot study as well as the implementation of the study results has been developed under the auspices of the CEI Working Group on Environment and its Task Force on Environment and Transport, with support from the CEI Executive Secretariat, OECD Environment Directorate, UNEP and the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management. These parties agreed to promote further the implementation of the EST methodology in Central and Eastern Europe within the “EST goes EAST” Initiative (Austria/CEI/OECD, 2002)

The follow-up of the joint pilot study therefore has taken the form of promoting “demonstration projects” which develop and implement the OECD EST methodology in various ways, ranging from studies on national strategies, to regional transport corridor strategic environmental assessments, to development of best-practice guidelines for regional EST projects and promoting urban public transport vehicle fleets using LPG and other low-emission fuels.

The following projects have been proposed for implementation (Austria/CEI/OECD, 2002)

- Development of the Strategic Evaluation of Environmental Impacts of Transport and Transport Infrastructure (Montenegro)
- Strategic Environmental Assessment of Adriatic-Ionian Corridor (Croatia)
- Strategic Environmental Assessment of Danube Corridor (Hungary)
- Czech Pilot Study of Sensitive Boarder Areas (Czech Republic)
- Guidelines for Implementation of Alternately-fuelled Buses (Hungary)
- Non-motorised Passenger Intermodality (Czech Republic)

In addition to the substantive projects themselves, the results of the EST CEI pilot study as well as the additional study on the external costs were published as brochures and broadly disseminated to the relevant stakeholders in the CEI countries. UNEP’s regional office for Europe with support of Austria is also planning to assist the long-term implementation of these activities and increasing use of the EST approach by developing an EST Information Clearing-House focusing on the needs of Central and Eastern Europe. This will involve the development of a network of governmental and expert stakeholders, an up-to-date of case-studies of EST best practices with relevance to the transport situation in Eastern Europe, and an information response service to handle enquiries regarding the EST approach.

## Acknowledgements

The authors of this article want to warmly thank Mrs Renate Nagy, Federal Ministry of Agriculture, Forestry, Environment and Water Management, Assistant, Division Transport, Mobility, Human Settlement and Noise for her kind assistance and editorial support.

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