Commission Expert Group on Transport and Environment

WORKING GROUP I

Defining an Environmentally Sustainable Transport System

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EXPERTS LIST of WG I

NAME	ORGANISATION	COUNTRY
Aguirre, Miguel	Ministerio de Medio Ambiente	Spain
Andersson, Stefan	Swedish Environmental Protection Agency	Sweden
Basoli, Gian Paolo	Ministero dei Trasporti e della Navigazione	Italy
Delache, Xavier	Ministère de l'aménagement du territoire et de l'environnement	France
Friedrich, Axel	Umweltbundesamt	Germany
Palchetti, Saverio	Ministero dell'Ambiente	Italy
Rasmussen, Ulla K.	Ministry of Transport Planning Division	Denmark
Roxo, Margarida	Direcção-Geral de Transportes Terrestes	Portugal
Thaler, Robert	Federal Ministry of Agriculture, Forestry, Environment and Water Management	Austria
Verron, Hedwig	Umweltbundesamt	Germany

The Group was chaired by Saverio Palchetti

NOTE

This document reflects the opinion of the majority of the members of Working Group 1.

It should not be considered either as an official statement of the position of the European Commission or of the expert's member states.

Not all experts necessarily share all the views expressed in this report.

PREFACE

At the meeting of February 25th, 2000, the Expert Group on Transport and Environment was requested to submit, among others, a document on *"Defining an Environmentally Sustainable Transport System"*. With this aim the Working Group I was constituted and its main objective was to analyse different possibilities of defining the meaning of an environmentally sustainable transport system in order to make the strategy of integration more operational. The following issues were initially addressed:

- propose as concrete as possible the definition of an environmentally sustainable transport system on a community level and how to stepwise improve such a definition,
- analyse different possibilities to define an EST; including the use of sector specific targets,
- analyse existing sector specific environmental targets - relevant for the transport sector – on a national as well as on the Community level,
- discuss institutional implications of using the concept of sector integration on a community level as well as on a national/local level.

Working Group "I" had two meetings: 28th March and 16th May 2000.

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1. Making the definition of EST operational

1.1 Definitions of EST

During the 1990's several attempts have been made to define what is meant by sustainable transport. Most of them have been based on the general definition of sustainable development introduced by the Brundtland Commission in the late 1980's namely " a development that meets the needs of the present generation without compromising the ability for future generations to meet their needs".

Generally speaking a sustainable transport system must contribute to economic and social welfare without depleting natural resources, destroying the environment or harming human health. There is still, however, no strict definition of sustainable transport. In 1999 the joint expert group on transport and environment defined a sustainable transport system[1] as a system that:

allows the basic access needs and development of individuals, companies and societies to be met safely and in a manner consistent with human and ecosystem health, and promotes equity within and between generations;

is affordable, operates efficiently, offers choice of transport mode, and supports a vibrant economy, and regional development;

limits emissions and waste within the planet's ability to absorb them, uses renewable resources at or below their rates of generation, and, uses non-renewable resources at or below the rates of development of renewable substitutes and minimises the use of land and the generation of noise".

The definition proposed by the expert group is an extension of the definition of environmentally sustainable transport that has been carried out by the OECD project on EST.

According to the OECD project an EST could be defined as a transport system that does not endanger public health or ecosystems and meets needs for access consistent with :

the use of renewable resources at or below their rates of regeneration, and

the use of non-renewable resources at or below the rates of development of renewable substitutes."

The qualitative definitions referred to here give a general picture of what is meant by EST. However, in order to guide the transport sector in its endeavour for EST a more quantitative definition is needed.

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[1] Integrating the Environmental Dimension. A strategy for the Transport Sector. A status report. Oct. 1999.

The Working Group has, therefore, not tried to develop the qualitative definitions further. The focus has instead been on how a more operational definition of an environmentally sustainable transport system could be developed.

1.2 Environmental impacts linked to transport

Environmental sustainability implies that certain environmental qualities can be preserved or attained. This is also reflected in the qualitative definitions of EST. Some of these qualities are now in danger or threatened by different activities in the society, among others the transport of people and goods. When developing a more operative definition of EST it seems appropriate to start looking at today's transport system and determine, as concrete as possible, what needs to be done by the transport sector in order to reach environmental sustainability for the society as a whole.

Today's transport system contributes significantly to many of the environmental problems we know today. Box 1 summarises the main environmental impacts linked to the transport system.

Environmental impacts	**Contribution from the transport sector**
Climate change	CO2
Ozone depletion	ODS
Acidification	SOx, Nox
Eutrophication	NOx, NH3
Ground level ozone	NOx, VOC
Air pollution in urban areas causing health impacts like increased breathing resistance, cancer, acute fatalities	NO2, PM, PAH, benzene, etc.
Noise	Noise levels, L_{Aeq}, L_{Amax}
Impact on the landscape like land take, fragmentation, barriers, accessibility to parkland and natural areas	
Ecocycle adaptation	

Box 1. Environmental parameters that could be used as a basis for defining environmentally sustainable transport.

To be operative the definition must indicate a maximum impact that the transport system can have on the environment. Operational definitions can be expressed as the amount of emissions and waste that could be emitted, how much natural resources that can be used, how much noise that can be generated and how the land can be used.

1.3 Environmental quality objectives the basis

For many of the problems listed in table 1 there is a wide gap to sustainability. For instance, in order to eliminate all kind of damages on the vegetation and effects on human health caused by tropospheric ozon, the emissions of the ozone precursors NOx and VOC need to be reduced in the order of 90% in Europe. The basis for this kind of estimations are **environmentally quality objectives** that describes how the quality of air, water, soil, landscape etc. has to be constituted in order to attain environmental sustainability. The environmental quality objectives should primarily only reflect environmental needs. Economic and social considerations could be taken into account by discussing and, if appropriate, extend the timeframe for attainment.

> For acidification an environmental quality objective could be formulated as follows: "*The acidifying effects of acid depositions and land use must not exceed the limits that can be tolerated by land and water. Depositions of acidifying substances must not increase the corrosion rate of materials."*
> This overall objective could be determined further by formulating environmental quality targets. For acidification so called critical loads stating how much deposition (in kg/ha) of acidifying compounds nature can tolerate in the long-term in different parts of the European Union.

Another example is the objective and targets for climate change: *The concentration of greenhouse gasses in the atmosphere must, in accordance with the UN Framework Convention on Climate Change, be stabilised at a level at which human activities will not have a harmful effect on climate system. And the target that the concentration of carbon dioxide in the atmosphere should be stabilised at levels below 550 ppm and that the levels of other greenhouse gasses in the atmosphere should not increase.*

1.4 Targets for action

Environmental quality objectives are, however, not so well tailored to serve as a basis for action. From the environmental quality objectives more operative objectives and targets have to be derived. Such targets could express a desired change, e.g. a reduction of a load or concentration of pollutants. Counting backwards further will, for some parameters, lead to an estimated need for emissions reductions. One example where such a methodology has been used is in the preparations for the EU-directive on National Emission Ceilings. However, these "targets for action" normally don't tell us how much action that should be taken in a specific sector of society.

1.5 Sector specific targets allocate responsibility

We can be fairly convinced that we have to make use of both improved technology and non-technical measures to attain an environmentally sustainable transport system (EST). A transformation to an EST will therefore require a commitment from many actors. Virtually all groups in the society have an important role to play. Policy makers, companies, individuals and many others have to integrate an environmental dimension in their decisions.

In order to allow all these actors to pull in the same direction management by objectives provides an opportunity. The objectives are a way to communicate a desired outcome and a gauge which progress towards sustainability can be measured against. True objectives and targets also provide flexibility for the stakeholders to choose the most efficient measures given a desired outcome.

In general terms the role of sector specific objectives and targets are:

- They help to focus and facilitate the integration process
- They clarify what needs to be achieved and what is required of the transport sector
- They can be used to assess the desirability of proposed measures
- They can help to focus responsibilities
- They can influence different players and stakeholders.

1.5.1 Long-term targets

Long-term targets are needed to point out a direction and the desired changes in broad terms. These targets should be focused on "what" needs to be done rather than "how" or "when". The long-term targets should be based on present knowledge of what man and nature can tolerate – the environmental quality objectives" – and therefore express environmental sustainability.

1.5.2 Intermediate targets

In most cases the long-term targets needs to be supplemented by short to medium-term targets indicating suitable steps towards the long-term targets. The intermediate targets should form the basis for planning and implementation of measures, see figure 1. Follow-up and new findings may lead to a modification of the intermediate targets.

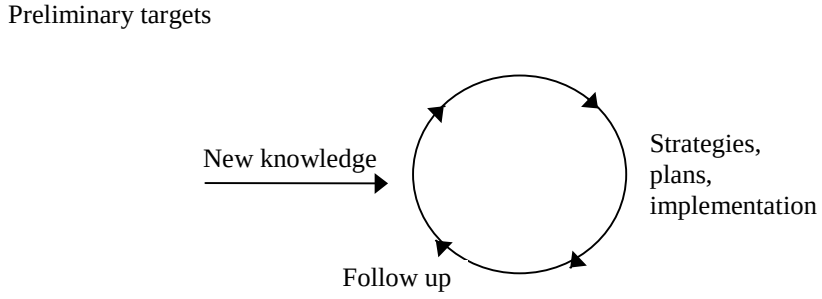


Figure 1. The use of intermediate targets as a basis for action programmes.

Of course there are uncertainties about the consequences of meeting a certain target within a certain time limit. To handle these situations, the intermediate targets should be preliminary and used in order to analyse possible strategies to reach the targets, also taking into account social and economic objectives that have to be met within the transport sector. Sector specific objectives and targets could also be used as benchmarks in decision making.

1.6 Application of targets on an EU-level

The European Union has adopted objectives and targets for environmental quality in order to ensure all citizens of the union good environmental conditions. The EU has also agreed upon "reduction targets" for the union as a whole, e.g the Kyoto-commitment. Sector-specific targets however, are still very much of an uncharted territory for the EU-level despite that most member countries have already adopted some kind of objectives and targets specific for the transport sector.

Due to subsidiarity reasons, applications of objectives and targets that will bind member states to commitments at the sectoral level are unlikely to be agreed and are therefore not discussed further in this report.

In the following a number of possible applications are described. These applications have been divided into two categories:

Analysis of policy options

Political commitments

For each application the following questions are addressed: What should be the role of the sector-specific targets? How could the targets be formulated? In which kind of decision-making processes could sector-specific targets be of added value? Which institution should decide about the targets?

Analysis of policy options

This application has already been used in different situations, for example the Auto-Oil programme or research programmes like POSSUM. The sector specific targets are used as a basis for analysis of different policy options. It's possible to analyse alternative strategies to attain the targets and compare the costs and feasibility of different strategies. If a similar approach is taken in other sectors a comparison of costs and feasibility across different sectors would be possible. One important result of this kind of analysis is that policy instruments, like regulations (e.g. limit values) or pricing instruments (e.g. taxes,charges) can be designed in a more cost-efficient way.

The formulation of the targets will of course be different depending on the type of analysis that is carried out. For example the targets could express a reduction of emissions in x % or in transport terms like a desirable market share for railways. As the targets are to be used as a basis for analysis the decision about the targets also has to be decided on from case to case.

Political commitments

By taking a political decision about the targets, the firmness of them will be strengthened, however, still not legally binding. One example on where this type of targets could be applied is the Common Transport Policy (CTP). Another example could be the TEN-Guidelines.

The targets could be formulated in different ways, in qualitative as well as quantitative terms. A qualitative target could for example be as follows, the emissions of VOC from the transport sector should not harm human health or ecosystems. Both qualitative and quantitative targets could be formulated in environmental terms or transport terms. An example of the previous kind is; emissions of NOx from the transport sector should be reduced by x% to 2010 compared to the levels 1995. In "transport terms" a target could also aim for clean technology stipulating for example that y % of new vehicles sold on the EU-market a certain year meets the requirements for EEV (Environmentally Enhanced Vehicles). Another type of target in transport terms is, for example, the market share of the railway in the EU should increase to x %.

Political commitments like this should be taken by the Council, and if appropriate by co-decision with the Parliament. The range of the decision will of course be within the jurisdiction of the Community. The addressee for the targets can be the transport sector as a whole or if responsibility needs to be allocated more precise, a certain group like the aviation sector, the car manufacturers etc.

> The political commitments are ultimately a basis for different kind of decisions taken on Community level. Strategic Environmental Assessment (SEA) provides a mean to use the sector specific targets as benchmarks in decision-making processes. A major role for SEA is to show how different strategic choices in a plan or programme influence the possibilities to attain the environmental objectives.

2. Possible long-term targets defining an EST on EU-level

2.1 The role of long-term-targets

The long-term targets – which will define environmentally sustainable transport- should be derived from the environmental quality objectives and the long-term needs for action. Hence, the long-term targets will primarily reflect the environmental needs. Economic and social considerations could be taken into account when the time frame for attainment is under consideration.

Long-term targets will always be more or less preliminary. For some aspects, it may not yet be possible to define what is meant by environmental sustainability. For example, the scientific knowledge may not yet be sufficient. Similarly, there may be no safe level of a particular pollutant, thus rendering any objective prone to reconsiderations when new knowledge is presented.

When several sectors are contributing to an environmental problem, e.g. acidification of soil and water, a preliminary long-term target for a specific sector would be possible to set after quite rough estimations. It doesn't seem meaningful to make analyses of the cost-effectiveness when the attainment of the target is far ahead in the future and the gap to the targets is wide and we hence don't know what kind of measures that will be needed in order to reach the target. In many cases it would probably be sufficient to use the same preliminary long-term target for all sectors.

2.2 The development of long-term targets

The sector specific targets for the transport sector should address all relevant environmental effects related to the sector. Table 1 in chapter 1 gives a net list on what kind of parameters that could be used as a basis for the development of long-term targets.

For every environmental impact long-term transport specific targets should be developed. For each impact the long-term environmental quality objective should be identified, taking into account the relevant expert knowledge. Given the current situation an assessment, on a global level, of the action needed in order to attain the environmental quality targets should be done. From these "targets for action" an assessment should be done in order to evaluate the requirements on the transport sector in the long run. The last step should take into account factors like:

The contribution of the transport sector to the problem today and future trends

The feasibility to meet the targets in different sectors of society

An example of this process is given in Box 2.

Defining Long-term Targets

Box 2

Example: Emissions of CO_2:

Environmental quality objective:
The concentration of greenhouse gasses in the atmosphere must, in accordance with the UN Framework Convention on Climate Change, be stabilised at a level at which human activities will not have a harmful effect on climate system.
The target for climate change states that the concentration of carbon dioxide in the atmosphere should be stabilised at levels below 550 ppm and that the levels of other greenhouse gasses in the atmosphere should not increase

Target for action on a global level:
The environmentally quality targets implies that the emissions of CO_2 need to be reduced by 50-80% compared to the levels of 1990. Many argues that industrialised countries have to reduce their emissions in the upper part of the interval in order to allow for increases in developing countries that are presently responsible for low levels of emissions.
A preliminary long-term target for the EU as a whole could be as follows: Emissions of CO_2 should be reduced in the order of 50-80 % compared to the levels of 1990.

Target specific for the transport sector
In 1996 the transport sector accounted for about 26% of the emissions of CO_2 in the EU. The contribution from transport is growing, 1985 the contribution was about 20%. Given the growing contribution of CO_2-emissions from the transport sector it's hard to see how a reduction of CO_2-emissions by 50-80 % could be achieved at all without reducing transport emissions significantly.

Thus a preliminary long-term targets for the transport sector could be a reduction of CO_2-emissions by 50-80 % compared to 1990.

With the time available it hasn't been possible for the Working Group to analyse all relevant environmental parameters with the proposed method. The group has therefore decided not to present long-term targets expressed in figures. In the absence of such targets the group propose that the six criteria developed by the OECD project on EST, may serve as an indication about the order of magnitude for the long-term targets, see Box 3. However, the group is willing to continue its work on this issue during the autumn of 2000, see also chapter 5.

OECD EST Targets **Box 3**

In the OECD EST Project (with A, CH, F, I, D, N, NL, S Can as participating countries) the following environmental quality criteria were elaborated and in a second step translated to quantitative emission related targets as far it was possible: (see OECD EST Phase 3 Report 2000).

CO_2

Climate change is prevented by reducing carbon-dioxide emissions from transport such that atmospheric concentrations of CO_2 are stabilised at or below their 1990 levels. Accordingly, **total emissions of CO_2 should not exceed 20% of total CO_2 emissions in 1990**.

NO_x

Damage from ambient NO_2 and ozone levels and nitrogen deposition is greatly reduced meeting WHO Air Quality Guidelines for human health and eco-toxicity. **Total emissions of NO_x from transport should not exceed 10% of total transport-related NO_x emissions in 1990.**

VOCs

Damage from carcinogenic VOCs and ozone is greatly reduced meeting WHO Air Quality Guidelines for human health and ecotoxicity. **Total emissions of transport-related VOCs should not exceed 10% (or less for extremely toxic VOCs) of total transport-related VOC emissions in 1990**.

Particulates

Harmful ambient air levels are avoided by reduced emissions of fine particulates (especially those less than 10 microns in size). **Depending on local and regional conditions, this may entail a reduction of 55% to 99% of fine particulate (PM_{10}) emissions from transport.**

Noise

Noise caused by transport no longer results in outdoor noise levels which present a health concern or serious nuisance. Depending on local and regional conditions, this may entail a reduction of transport noise to no more than a maximum of **55-70 decibels during the day and 45 decibels at night and indoors.**

Land-Use/Land Take

Infrastructure for the movement, maintenance, and storage of all transport vehicles is developed in such a way that local and regional objectives for air, water and eco-system protection are met. **Compared to 1990 levels, this is likely to entail a smaller proportion of urban land devoted to transport infrastructure.**

3. Possible intermediate targets

3.1 Setting up sector specific targets

Overall non-binding and informative targets for the transport sector can be useful, to point out what abatement strategies should lead to. Non binding sector specific objectives may ease the social acceptability of policy instruments (pricing, regulations, etc), by highlighting what is the expected contribution from the transport sector to the reduction of the environmental impact.

Long term objectives and targets are mainly derived from maximum « critic » concentrations of pollutants assessed by scientific present knowledge, or by the application of the precautionary principle (see chapter 2 above). However, the cost of reaching the long-term targets may be difficult to assess, so that it is not possible to recommend how these objectives and targets should be achieved by policy instruments. In this context, intermediate objectives and targets have to be proposed. In this process uncertainties of several kinds must be handled.

3.2 Uncertainties

When designing targets, and, then, instruments, policy markers are facing uncertainty about the environmental benefits and economic costs of reducing damages, and especially about the distribution of mitigating costs among economic actors and sectors.

This implies that the measures and policy instruments needed to achieve the targets is not fully known when the targets are set up.

The critical question is; what degree of uncertainty, in the evaluation of the environmental impact and the estimation of mitigating costs, can be tolerated when setting up sector specific intermediate or short-term targets? Two main uncertainties should be considered. Knowledge gaps about the costs of reducing the environmental impact and the timeframe in which the short-term targets should be reached.

It is not possible to formulate a scientific solution to this kind of uncertainties. To a high degree a statement about a desired outcome in terms of environmental impact is a value judgement. The answer to the question lies to large extent in the hands of the stakeholders. It is dependent on how we apprehend the nature of a target and on the process that generates the targets.

A target can be seen as an assumption of what can or ought to be done in the short term for the purpose of attaining a long-term objective. To some extent a target is preliminary in nature. The iterative character of the work with objectives and targets implies that a target should be revised if new findings show that either, man and nature are more/less sensitive than previous thought or, that the abatement costs are higher/lower than expected. This relationship is illustrated in figure 1 in chapter 1.

If we are to come up with sector specific targets that can be endorsed by the stakeholders we must envisage a process to generate the targets were the stakeholders are deeply involved. The firmness of the targets will be dependent on where and by whom the targets are decided. Certainly, a high precision in the analysis is needed if the targets were to be binding. Other more plausible possibilities are that targets can be seen as:

- political commitments,
- allocation of responsibility to an actor,
- agreements between actors or just
- a basis for further analysis of policies and measures by means of backcasting technique.

3.3 Objectives and the relation to pricing

When designing intermediate targets, two main types of approaches appear to be available. *Quantitative targets*, generally by sectors, e.g. allocating an overall maximum emission level to different sectors or sub-sectors. *Price targets*, which set an implicit price of the reduction of emissions, giving a « benchmark » to the economic cost of all measures in all sectors (generally economic instruments, e.g. pricing, project appraisal or subsidies).

Uncertainty about the distribution of costs of reduction of impacts throughout different sectors would, at a first glance, lead to recommend the use of “price targets” to be compatible with cost-efficiency.

Some external effects (congestion, security) have in many countries been valued in monetary terms. Often this is done based on different willingness-to-pay studies. The cost of the environmental impacts are often more difficult to calculate, especially damages on health and biodiversity. Estimated values for emission can be further differentiated depending on the location of the emission (higher in urban areas, lower in rural areas). The values can provide an estimation of the external cost. In theoretical terms, this value of external costs should be the “price targets” of measures for mitigating emissions in all sectors. This principle can be applied for all modes of transport.

> However, values derived from willingness-to-pay studies will probably be quite low and hence not represent a substantial step towards the long-term targets. One reason for that is a lack of information about the environmental situation among the respondents. This is not, however, a distrust of the public opinion. All major changes in the society have to be based on public acceptance and political legitimacy.

Another approach that can be taken is therefore to base the “price targets” on previous political decisions and the costs they imply. The monetary value can be estimated from the inferred cost of attaining a certain transport sector specific environmental target. *The next sentence is difficult to understand for me, should it be rephrased or could it be excluded?* (In this case, an « implicit » value of damages can be derived from overall targets on environmental quality, using business-as-usual emission trends and price-

elasticity of pollutant emissions.) This value may not be the « true » value of external costs, but it at least ensure that all individual and public measures to reduce emissions are achieved at the same cost, which matches the cost-efficiency criteria. As long as the estimations are based on historical data there is a similar risk, as mentioned above, that the values will not create so much momentum towards the long-term targets.

This train of thought opens a possibility for setting prices for the external costs of pollutants, as a target. These pricing targets could in turn be implemented in pricing policies and project appraisal. In this way, pricing targets ensure that mitigating measures taken by actors (public and private) show the same cost-efficiency.

However, these pricing targets may in some cases be difficult to implement for economic feasibility or social acceptability. In this case, sectoral quantitative targets could be set up to point out what « burden » is put on each sector, in order to allocate responsibility to stakeholders and to ease evaluation of targets one against the others (cf. supra on governance).

Sectoral targets may, on theoretical grounds, seem to go against cost-efficiency. This shouldn't, however, be a risk as long as the targets are non-binding and just provide necessary guidance for the actors and ease the acceptance of instruments more specifically designed for a given sector (cf. infra on instruments). It is the means, the instruments, that should be cost-efficient not the targets as such.

As a conclusion, quantitative and price targets appear to be complementary instruments. Quantitative targets, generally not binding, ease proper governance of public policies, involving stakeholders to participate efficiently in the « burden sharing » negotiation of long term objectives. Price targets could ease the implementation of quantitative targets between sectors or actors, because they generally ensure cost efficiency. To ensure compatibility between the two approaches the price targets should, preferably, be based on the estimated cost of attaining the intermediate quantitative targets.

3.4 Objectives and the relation to designing instruments

Whatever quantitative or pricing intermediate targets might be set to a given sector, the question remains on what instruments should be used to implement these targets.

The guidelines to assess the adequacy of instruments to a given environmental damage may be based on the following criteria:

Knowledge or uncertainty on damages

Time scale

Cost efficiency

Social acceptability of the instruments

Effects of the instruments on emissions or impacts

Uncertainty on costs and benefits of mitigating damages is an important parameter in designing instruments, as it is when choosing between quantitative or pricing targets. A

high uncertainty about costs of mitigating damages and the fear that those costs could lead to irreversible economic or social effects, would lead to recommend to use economic instruments, where the value of mitigating costs is given, whereas the level of environmental damages is difficult to assess. On the other hand, damages that are highly unknown, with fear of irreversible damages, especially on health and biodiversity, would require more regulatory-type instruments, where costs of abatement are uncertain, but level of emissions are easy to assess.

If we have an environmental problem that is caused by emissions from several sectors (e.g. climate change or ozone) and is well correlated with a specific substance (CO2 or NOx or VOC) a general economic instrument (tax) would on theoretical grounds be the preferred instrument. In this case sectoral targets would seem unnecessary. If we on the other hand think that a range of measures is needed, induced by a package of policy instruments directed towards many actors it is more likely that a distinct target will strengthen the process of identifying cost efficient policy packages by the actors themselves. Such a package may include directed regulatory measures as well as general economic instruments such as a carbon tax.

The time factor is an important parameter in designing instruments. Economic and social behaviours might be slow to adapt to new instruments in the transport sector. Elasticities of transport behaviours and environmental impacts are much higher in the long term than in the short term. This leads to focus on « information and commitment » instruments, i.e. instruments that are predictable by agents, who can adapt their behaviour to them. This gives an important role to objectives, considered as public « information » about the direction of move intended to achieve a certain level of sustainability of transport.

Cost-efficiency requires that the limitation or reduction of impacts should be achieved at minimum costs. This leads to focus first on sectors, firms or individuals that show the lowest cost of abatement. The best way to achieve this goal is, especially when actors are numerous, to use economic instruments, e.g. pricing, that ensure that all players whose abatement cost is below the price-signal will achieve reduction of emissions. Even when pricing is not used as an instrument, cost efficiency should be beared in mind. In this case, cost of abatement should be monitored and targets should be phased, so that gathering information on abatement costs can lead to an adjustment of the targets.

Social acceptability is an important factor of success of the instruments. Social acceptability is more likely to be achieved when the perception of environmental damages is high and the costs of reduction are seen as low. Social acceptability is also improved when policies show positive distributional effects. In this perspective, effects on low-income households should be systematically assessed especially when those households are bound to some kind of transport modes or « techniques » (e.g. public transport or used cars). Social acceptability is certainly eased by improved information on damages and costs, public debate on this information, phased instruments and the virtue of example given by policy makers (e.g. demonstration programs or subsidies to more environmentally friendly modes or techniques).

The « efficiency » of various instruments in reducing emissions or impacts has to be taken into account, especially when critic damages have to be addressed. On this criterion, end of pipe individual emission targets (e.g. vehicles pollution and noise regulation) are generally considered as the most efficient. However, some other instruments may prove to be efficient, when emission targets need time to be efficient (e.g. when setting targets on vehicles emissions despite low turnover of vehicles stock) : in this case, targets on inputs (e.g. fuel) might be preferable. Sometimes, actions on demand (i.e. traffic) may be more efficient as end of pipe or input instruments, e.g. when emissions per unit of demand are very rigid, especially in the short term.

4. Implications for actors involved

4.1 Integrating environmental concerns into transport policy[2]

4.1.1 Policy-making by objectives and targets

Making policy guided by objectives ensuring a sustainable future and implementing the policy by the means of targets is very different from traditional policy-making. Traditional policy-making does not automatically imply consulting the stakeholders (for instance the groups, which will be affected by the regulative measures) nor does it aim at achieving an overall future goal. Traditional policy-making often results in end-of-pipe regulation, which has proven itself insufficient in order to achieve a sustainable development. Policy-making by objectives and targets is a time-consuming process, as it is imperative that the regulative measures do actually contribute to achieving the target and thereby also in the course of time to achieving the objective of a sustainable development.

In order to set the environmental objectives, it is necessary to involve the relevant scientists to ensure as objective objectives as possible, thereby limiting the potential political controversies about them. When translating the objectives into targets and the targets into regulative measures, it is important to ensure that these measures are not only effective but also economically, socially and politically feasible. One way of ensuring this is to involve the stakeholders or target groups. Involving or consulting the stakeholders thus seems to be a cost-effective way of integrating environmental concerns into sector politics. The degree of involvement of target groups or focal actors will vary according to issue and administrative level. The focal actors to be involved can at an early stage be the relevant ministries or governmental agencies, e.g. making sure to involve the proper transport expertise from the Ministry of Transport, whereas they on a later stage can be transport organisations or even specific transport operators.

The potential risk of involving stakeholders such as transport organisations directly lies in the degree of power over politics that they might get. One could argue that by involving target groups, the administrative organisation runs the risk of distributing excessive benefits to the involved group, thereby jeopardising the democracy and the ability to ensure societal benefits rather than benefits for certain groups. However, as long as the two following conditions are fulfilled, the risk is limited considering the potential benefits of ensuring effective and feasible regulation by involving and committing the stakeholders or target groups. First of all, it is imperative that the objective - according to which the targets will be set – is not negotiable, but remains the guiding end goal. Secondly, the administrative organisations have to have some measures to threaten to use. For instance, additional taxes might be the result if the

[2] Based on “TERM-0”, “Integrating the Environmental Dimension” – WG1 1999 and “Integrating Environment in Transport Policies” by ERM, Swedish EPA report no 5083.

transport organisations do not contribute to finding an alternative way of living up to the target. As part of setting the environmental objectives, states often work out a national political plan on integration of environmental concerns in sector politics. This national plan will then frame the work of translating the objectives into targets and regulative measures.

As stated in section 1.6 applications of objectives and targets that will bind member states to commitments at the sectoral level are unlikely to be agreed and are therefore not discussed in this report.

4.1.2 Institutional structures posing obstacles to sector integration

When advocating sector integration and involvement of the affected actors, one must be aware of the institutional difficulties, which often hinders this process in succeeding. The different administrative organisations dealing with transport or environment to a great extent have different cultural characteristics. This is due to their historical development, the very nature of the issues they are dealing with as well as the profile of the employees, that is their education, motivation and their experience. The different cultural characteristics often create mistrust between the organisations and lead to difficulties in communicating openly and thus hampers co-operation. Furthermore, the goals of the transport and the environment administrative organisations tend to be seen as adversarial although being lead by ministers in the same government. Thus, even when ministers proclaim that co-operation is needed, the organisations itself might be slightly more static and unable to truly integrate the issues. This also mirrors the fact that few organisations like to give away working areas and resources, which makes a profound integration of environmental concerns into the transport administrative organisations difficult.

Research has shown, that political culture (e.g. consensus-oriented or adversarial) do not necessarily affect the results of the policy-making. Thus, one cannot assume that countries used to seeking consensus in policy-making will be better at sector integration.[3]

The previous WG1 concluded that the integration of the environment amongst other issues requires overcoming the obstacles originating in the institutional structures of the administrative organisations at all levels of policy-making. That is, institutional change has to take place in international (EU, OECD, UN etc.) as well as national, regional and local administrative organisations. As with all organisational change, this will not happen over night. Therefore following activities to promote the necessary institutional change were recommended:

- To develop processes ensuring good co-operation between the different areas of expertise involved.

[3] "Integrating the Environmental Dimension" – WG1 1999, pp. 29

- To improve the co-operation between the EU and international organisations active in the field of transport and environment, including OECD, ECMT, UN-ECE, WHO, ICAO, IMO and CEI

- To strengthen the institutional capacity by means of bringing in non-transport specialists into transport organisations, promoting informal and formal networks between transport and environment officials, establishing strong co-ordination and co-operation structures and making institutional arrangements to ensure that environmental concerns are taken into account in transport action.

- To build up institutional structures (not the least within the Commission) that ensure that environmental consequences of transport are taken into account when sector policies are developed.

4.1.3 Traditional institutional steps on national level

As stated above, the cultural characteristics of the administrative organisations are often rooted in their historical development. The traditional first step on the way to integrating environmental concerns in transport policies can be said to be the establishment of a ministry of environment. This establishment began in Western Europe in the 1970s, whereby the ministries did not necessarily contain a section or unit for transport issues, as these were seen as environmentally problematic issues. Following increased knowledge about the environmental effects of transport, the next step has been to establish a transport unit in the ministry for the environment. For a substantial period of time, these units have been working independently of the transport ministries and have often been considered more as an opponent than a partner with which to co-operate. Supplementary to the increase in knowledge, the public has become more aware of the environmental effects of transport. This development has lead most ministries of transport to establish some kind of environmental unit. In the cause of time, these environmental units in the transport ministries have consolidated their status and are often doing work similar to the work of the transport units in the environmental ministries or are co-operating closely with these units.

The final goal for the integration of environmental concerns into transport policy must be to integrate environmental concerns in all the different units of the ministries of transport similar to the way that economic and social concerns have been integrated in every transport issue. This would to a substantial extent change the role of the transports units of the ministers of environment, which would benefit from rethinking their role and redefining their mission as early as possible.

4.1.4 Making political plans that integrates environment into transport policy

In order to set the environmental objectives and targets, some countries have found it useful to work out national political plans on integration of environmental concerns in

sector politics. A new study undertaken by ERM[4] found that most EU countries have engaged in some form of environmental integration in the transport policy-making, but that the range of approaches and the degree of integration at the highest political levels vary significantly across Europe. A similarity to the different types of institutional integration can be recognised in the plans as they can be separated into four broad types of integration strategy:

- n integrated transport strategy
- An environmental section contained in a wider transport strategy
- A transport section contained in a wider sustainability strategy
- Other – a range of specific actions and documents which also deal with environment and transport

Only seven member states have adopted or plan to adopt a fully integrated transport strategy, whereas most member states have adopted or planned to adopt more than one of the above types of plans. The main themes, which have been considered in the process of integration, are:

- Transport demand management – including modal split
- Modal shift and transport behaviour patterns
- Transport demand reduction
- Addressing CO_2 emissions

The institutional integration has been a very important dimension in formulating the plans. The definition of the strategies has often required the creation or strengthening of formal or informal links between the transport and the environment ministries and it has often required additional resources (funding as well as expertise). Positive results of the process can be expected when there is a clear and transparent distribution of responsibilities amongst the administrative organisations and when specific measures for implementation have been identified. Furthermore, consultation with other administrative units as well as with wider stakeholders or target groups is becoming a common feature throughout Europe.

The study also found a general agreement in principle that objectives supported by quantified targets provide a measurable and tangible means of defining, assessing and illustrating progress with integration. Most countries seem to have adopted a mixture of generic objectives and some specific targets to guide the integration of environmental concerns into transport policy-making. The targets are only being adopted very slowly among the Member States and mainly in relation to selected areas with a great degree of uncontroversial knowledge, such as some types of air pollution. Some of the countries, which have used targets for several years, are now reviewing this policy and often end

[4] "Integrating Environment in Transport Policies" by Environmental Resources Management, Swedish EPA report no 5083.

up by reducing the number of targets and instead focus on more flexible objectives. This reflects the increasing need for flexibility to ensure that the objectives remain challenging and continue to act as a driving force for change.

Furthermore, there is an increasing tendency to set broad objectives at national level and much more quantified targets at regional or local level. The starting points for developing objectives and targets at national level are mainly international sources such as the Kyoto Protocol and European or national legislation. The objectives are generally based on a combination of technical knowledge and environmental goals sometimes aiming to balance what is environmentally and socio-economically ideal with what is technically possible. The ministries of transport in co-operation with the ministries of environment have in several cases set the objectives.

4.1.5 Future challenges

Although most member states have begun to integrate environmental concerns into the transport policy, much can still be done. The member states could benefit from considering the making of national political plans to support the integration. If the integration will follow the path outlined above, there is a need to rethink the future role of the ministries of environment.

If the ministries of transport take over much of the environmental work, one might foresee a new allocation of financial resources for environmental issues. This would force the transport units in the ministries for environment to change character to either a watchdog making sure that the development goes in the right direction or as initiator to keep pushing for more environmental concerns to be taken in the transport policy. However, the basis for these two roles will always be the role as a contact point to ensure up-to-date state of the art environmental information in the transport policy making will probably be the basis. After all, the main expertise about the environment itself will always remain within the environment ministries/authorities, whereas the expertise within the transport ministries will be about how to fulfil the environmental goals by sector-specific action.

A big challenge is to ensure that the environmental issues are taken truly seriously in the Ministry for Transport. This implies changing tradition and creating new institutions and cultures.

4.2. Steps to be taken by the actors involved

The section above has outlined some of the problems with integration of environmental concerns by the means of objectives and targets. It has furthermore presented how it has already been done in many of the member states. On the basis of this, the following section will present ideas as to the implications for the actors involved, that is, what these actors could undertake to assist the integration.

4.2.1 The Council Strategy

In 1999, the ”Transport” Council submitted “The Council Strategy on the integration of environment and sustainable development into the transport policy” to the European Council of Helsinki.[5] The strategy takes its starting point in article 6 of the Treaty establishing the European Community, in which it is stated that environmental protection requirements must be integrated into the definitions and implementation of the Community policies and activities with a view to promoting sustainable development. Furthermore, the strategy reaffirms the conclusions of the Joint Environment and Transport Council of 17 June 1998, which contained a framework for the integration of environment and sustainable development into the transport sector,. Among other items the invitation to the Commission “to contribute further to the development of a Community strategy on how to achieve environmentally sustainable transport based on relevant intermediate and long term environmental objectives. It also confirms the Council’s report to the Vienna European Council and takes note of the UN/ECE Vienna Declaration of 1997, the Programme of Joint Action annexed to it, the UN/WHO Charter on Transport, Environment and health of 1999 as well as the work on Environmentally Sustainable Transport done by OECD.

Listing all these documents, it is clear that some sort of framework for management by objectives and targets is already existing in the EU context. The Council in the strategy did also recognise this, as well as the fact that the Community and Member States have achieved substantial progress in decreasing certain impacts of transport on the environment. The Council invited the Member States to strengthen their efforts to develop integrated strategies based on intermediate and long-term environmental objectives to promote sustainable transport. Additionally, the Council invited the Commission to promote the environmental objectives and actions within the international organisations dealing with transport (e.g. UN/ECE, IMO and ICAO) and continue to work on, to update and review the Council Strategy.

With regard to the involvement of stakeholders the Council underlines that there is a need for policy packages drawn up in consultation with the actors concerned. Furthermore, appropriate measures to promote awareness among the general public, the vehicle drivers as well as the industry were called for.

4.2.2 The Commission

Since the Commission has been called on to continue to work on, to update and review the Council Strategy, it is clear that it has to be guided by objectives to reach a sustainable development. However, this might call for institutional changes or institutional inventions. The Joint Expert Group on Transport and Environment is one example of such institutional inventions. The expert group does not only bring national expert together, it also promotes co-operation between the DG for transport (DG TREN) and the DG for Environment (DG ENV). The institutional changes are necessary, because the DGs as other administrative organisations have special cultural

[5] Council Strategy on the integration of environment and sustainable development into the transport policy, 1999

characteristics, which are often different from one DG to the other. Thus, the financial resources, the personal capacities of the employees (education, experience and commitment) as well as the relative power ranking of the DG (vis-à-vis other DGs) determines, which DG will be the lead actor concerning environmental integration in transport policy.

Whether it will be DG TREN or DG ENV, which will be dealing with integration of environmental issues in transport policy in the Commission, a lot will depend on the internal organisation of the DG. That is, the institutional placement of environmental issues, the tradition of the organisation, the intra-organisational relative power of the unit dealing with environmental concerns, the unit's financial resources and the capacities of its employees (education, experience and commitment).

In the course of time, the co-operation of DG TREN and DG ENV may have the same result as previously described on national level, namely leading to a necessary rethinking of the role of the administrative organisation dealing with environment.

4.2.3 Parliamentary Committees under the European Parliament

In order to ensure profound integration of environmental concerns in the EU, it is important that the political level, that is the European Parliament, also integrates the environmental concerns in the sector policies. Thus, the parliamentary committee dealing with transport issues should also take the environmental issues into consideration. Whether the environmental concerns will be able to gain enough weight to be taken seriously depends on the organisation and compositions of the parliamentary committees on transport/ environment issues plus the personal competencies of the members (education, experience and enthusiasm).

4.2.4 Monitoring on the European level

Following a Council mandate, the European Environment Agency and the Commission (DG TREN, DG ENV and EUROSTAT) together has developed TERM (transport and environment reporting mechanism), which will be the basis for such a mechanism. The first report from TERM – TERM 2000- was published in the spring of 2000. TERM implies that every country will have to develop their data collecting procedures to be able collect the relevant data. These extended procedures might also lead to more environmental awareness in the affected agencies.

4.2.5 Ministries and agencies

The typical development to integrate environmental concerns into transport policy on a national level has already been described. Important for the choice of lead actor is the relative power/influence of the transport ministry vis-à-vis the environmental ministry and environmental agencies. This power or influence stems from the availability of financial resources, of the personal capacities of the employees (education, experience and enthusiasm) as well as the reputation/esteem of the ministry. On the road to profound integration of environmental concerns in the transport ministries a great deal

of cross-ministerial work on transport/environment issues will be needed. Therefore, the ministry's relations to the stakeholders, be they other ministries or interest organisations, are important. The relations have to do with the type of involvement (consultation, dialogue or co-operation) as well as the regularity of the involvement. If the ministry stands in good contact to the relevant stakeholder, the chances of committing them to contribute to meeting the targets will be better than if the ministry has to build up new relationships to the stakeholders from.

Which ministry (or agency) will end up being the lead actor of environmental integration also has to do with the internal organisation of the administrative institutions. Of great importance is the institutional placement of environmental issues, the tradition of the organisation and the relative power of the unit dealing with environmental issues, that is, its financial resources and the personal capacities of the employees of the unit (their education, experience and enthusiasm).

Additionally, to ensure that the targets and measures are actually leading towards the objectives, it is necessary to establish or refine a national monitoring system. To avoid double work, this system should be able to provide TERM with the national information needed.

4.2.6 Transport Organisations

If the transport organisations are to take part in defining the targets and committing to live up to them, they also have to change institutionally - externally as well as internally. Externally, the transport organisations should seek to establish regular contact with the relevant ministry (of transport or of environment). If the contact is well established and within a climate of co-operation rather than fighting over adversary goals, the ministries will probably be more prone to involve the organisations on as early a stage in the policy-making as possible. However, if the ministries are to take the environmental integration efforts of the transport organisations seriously, the organisations have to establish some sort of environmental unit. Furthermore, they should encourage their members (transport companies, chauffeurs) to integrate environmental issues in the work processes. Applying environmental management systems such as EMAS or ISO 15001 might do this, but it might also be on less ambitious but more economically feasible levels.

5. Proposals for further work

The time available for this work has been extremely short given the complex issues that are addressed in the terms of reference. The Working Group is, however, convinced that the issue needs further attention and work by the Commission and the Member States.

The Working Group has identified the following areas that needs further work.:

In order to develop long-term targets defining an EST on an EU-level, a systematic survey of all environmental problems linked to the European transport system should be done identifying

environmental quality objectives and targets based on scientific knowledge
– the need for action on a European level in the long-term and
– the requirements it implies for the transport sector

This should be done in close co-operation with the concerned stakeholders from the field of environment and transport.

How and where transport specific targets could be formulated and applied on an EU-level needs further thinking. For example which institutions should take decisions about different kinds of targets.

Further analysis on relationship between a management-by-objective approach and cost-efficiency.

Appendix

Possibilities to build targets or objectives from TERM indicator list

Group	**Indicators**	**Possibility to serve as a basis to objectives or targets**
TRANSPORT AND ENVIRONMENT PERFORMANCE		
ENVIRONMENTAL CONSEQUENCES OF TRANSPORT	Transport final energy consumption and primary energy consumption, and share in total (fossil, nuclear, renewable) by mode	Doesn't seam possible for targets. For objectives, may be to state that renewable energy share should be as high as possible. May be only for national level. May be the slopes of the "curbs" could be useful.
	Transport emissions and share in total emissions for CO_2, NO_x, $NMVOC_s$, PM_{10}, SO_x, by mode	It seams possible to fix targets for transport emissions and also for the share in total emissions but the values are not to be compared from country to country. For CO_2 one connected indicator like emissions per capita or per GDP, could be of more use.
	Exceedances of air-quality objectives	Seams possible, but not for the transport sector. Only for global air quality parameters. At local level, may be indicators like "number of days per year with exceedant values" could enable targets.
	Exposure to and annoyance by traffic noise	Seams possible, once having defined the indicator
	Infrastructure influence on ecosystems and habitats (´fragmentation´) and proximity of transport infrastructure to designated areas	Not at the present stage.
	Land take by transport infrastructure	Could be possible, may be as an objective expressed in a % of the territory's area
	Number of transport accidents, fatalities, injured, polluting accidents (land, air and maritime)	Seams possible, but departing from composite indicators - it would be necessary to make the connection with the number of cars /trains and the extension of roads/rails. Possible also for local level
TRANSPORT DEMAND AND INTENSITY	Passenger transport (by mode and purpose): Total passengers Total passenger-km Passenger-km per capita Passenger-km per GDP	Possible for "pass.Km per capita" and "pass.km per GDP" but difficult to understand the use of such a target. Perhaps only as an objective, based on the share of certain modes. Difficult to obtain the share of individual road transport in the total road transport.

Group	Indicators	Possibility to serve as a basis to objectives or targets
	Freight transport (by mode and group of goods) Total tonnes Total tonne-km Tonne-km per capita Tonne-km per GDP	Possible for "tonne.Km per capita" and "tonne.km per GDP" but difficult to understand the use of such a target. Perhaps only as an objective, based on the share of certain modes.
DETERMINANTS OF THE TRANSPORT/ENVIRONMENT SYSTEM		
SPATIAL PLANNING AND ACCESSIBILITY	Average passenger journey time and length per mode, purpose (commuting, shopping, leisure) and territory (urban/rural)	Doesn't seam useful for targets or objectives.
	Access to transport services, e.g.: number of motor vehicles per household % of persons in a territory having access to a public transport station within 500 metres	Seams possible to build an objective (national level?) based on the % of persons in a territory having access to a public transport station within 500 metres.
TRANSPORT SUPPLY	Capacity of transport infrastructure networks, by mode and by type of infrastructure (e.g. motorway, national road, municipal road etc.)	?Needs further thinking...
	Investments in transport infrastructure/capita and by mode	The relations between investments for the different modes could be a basis for objectives. Should be connected with the existent "capacity of transport infrastructure networks"
PRICE SIGNALS	Real passenger and freight transport price by mode	Not at the present stage.
	Fuel price	Doesn't seam possible as so. Composite indicator relating to the average income of families could be interesting for objectives.
	Taxes	Same observation as above.
	Subsidies	Not at the present stage
	Expenditure for personal mobility per person by income group	Doesn't seam useful for objectives or targets.
	Proportion of infrastructure and environmental costs (including congestion costs) covered by price	Not at the present stage. Interesting for objectives once solved the practical problems of the indicator availability
TECHNOLOGY AND UTILISATION EFFICIENCY	Overall energy efficiency for passenger and freight transport (per passenger-km and per tonne-km and by mode)	Interesting for objectives or even targets once solved the practical problems of the indicator availability.

Group	Indicators	Possibility to serve as a basis to objectives or targets
	Emissions per passenger-km and emissions per tonne-km for CO_2, NO_X, $NMVOC_S$, PM_{10}, SO_X by mode	Interesting for objectives or even targets once solved the practical problems of the indicator availability.
	Occupancy rates of passenger vehicles	Interesting for objectives or even targets once solved the practical problems of the indicator availability.
	Load factors for road freight transport (LDV, HDV)	Interesting for objectives or even targets once solved the practical problems of the indicator availability.
	Uptake of cleaner fuels (unleaded petrol, electric, alternative fuels) and numbers of alternative-fuelled vehicles	Seams possible and useful.
	Vehicle fleet size and average age	Seams possible for "average age" of fleets.
	Proportion of vehicle fleet meeting certain air and noise emission standards (by mode)	Interesting for objectives or even targets once solved the practical problems of the indicator availability.
MANAGEMENT INTEGRATION	Number of Member States that implement and integrated transport strategy	Seams possible and useful.
	Number of Member States with national transport and environment monitoring system	Seams possible and useful.
	Uptake of strategic environmental assessment in the transport sector	Seams possible and useful, for objective's purposes.
	Uptake of environmental management systems by transport companies	Seams possible and useful, for objective's purposes.
	Public awareness and behaviour	Seams possible, once having defined the indicator

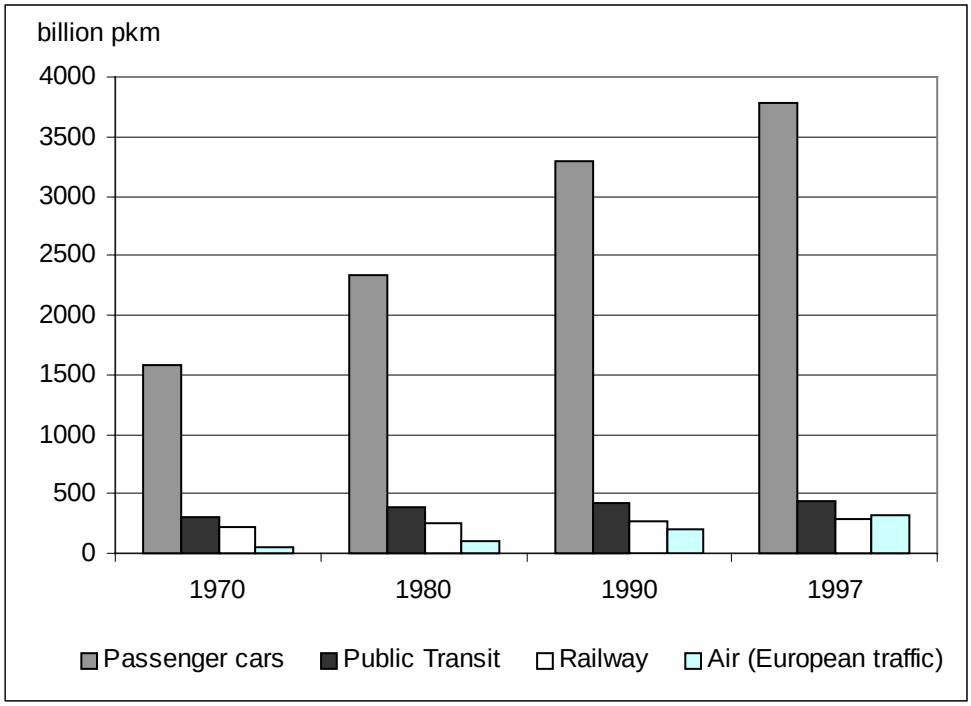
TRANSPORT – ENVIRONMENT STATE

1. Transport activity

In all industrialised countries tremendous growth of transport activity is to be observed. This holds for personal as well as goods transport. During 1970 to 1997 total passenger kilometres in the EU increased by 112 %. Growth is different for different modes. While passenger kilometres travelled by train rose by 30 %, car traffic rose by 140%, and air traffic even by 650 %.[6] Within about the same period cycling and walking almost stagnated.

In the same period motorization in EU countries increased by 147%. In 1997 motorization amounted to 454 passenger cars per 1000 inhabitants.

FIG. 1 PASSENGER TRANSPORT IN THE EU. PERFORMANCE BY MODE



Total freight transport increased by 102 % over the period 1970 to 1997. Total tonne-km by road transport rose by 192 %, while rail transport decreased by 16 %. Transports by ship increased by 127 %, mainly due to sea transports (+138%), while transports via inland waterways only rose by 15 %.

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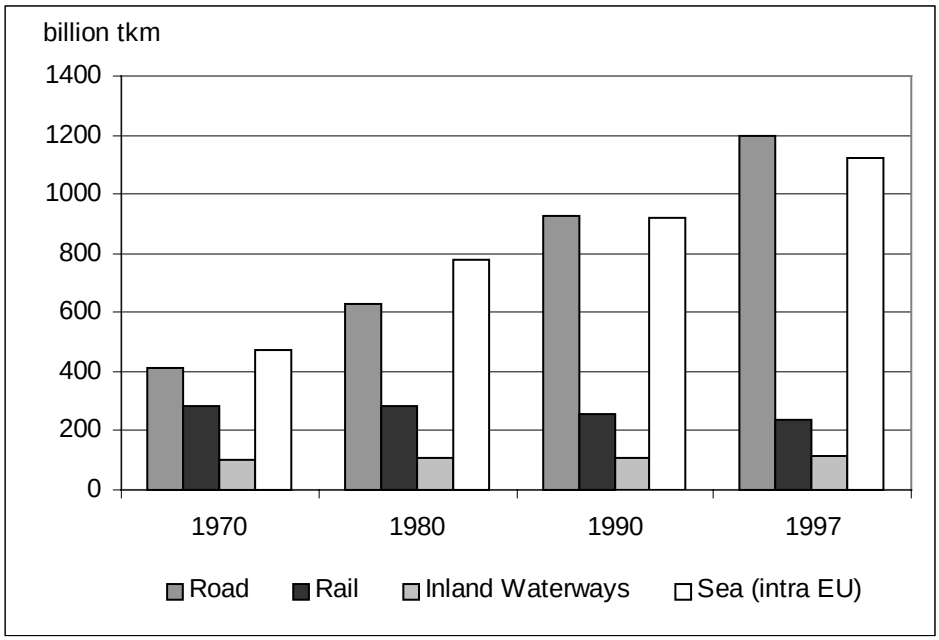
[6] European Environment Agency (1999): Are we moving in the right direction ? Indicators on transport environment integration in the EU.

The European Commission: Transport in Figures. 4/2000

FIG. 2 GOODS TRANSPORT IN EU15. PERFORMANCE BY MODE



For passenger transport in the period 1970 to 1997 the average annual growth rate was 2.8%, for good transport 2.6%. The average annual growth rate of GDP in the 15 countries during this period was 2.5%. Thus transport intensity has been growing over the past 27 years.

The growing trends are expected to continue. In the 9 countries comprising the AOPII base case[7] vehicle km driven by cars are rising by 47 % until 2020 compared to 1995, vehicle km driven by trucks even by 55 % in the same period.

Of all modes of transport aviation is expected to show the highest growth rates. According to the results of the Centre for Energy Conservation and Environmental Technology in Delft[8] passenger kilometres from EU aviation by 2025 will rise by 363 % compared to 1992, while CO_2 emissions from aviation will rise only by 190 % during this period, and CO_2 emissions per passenger kilometre will drop by 37 %.

[7] Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, UK

[8] Centre for Energy Conservation and Environmental Technology: European aviation emissions: trends and available reductions, Delft 1997

FIG. 3 FORECAST OF VEHICLE KM TRAVELLED BY CAR AND TRUCK 1995 – 2020

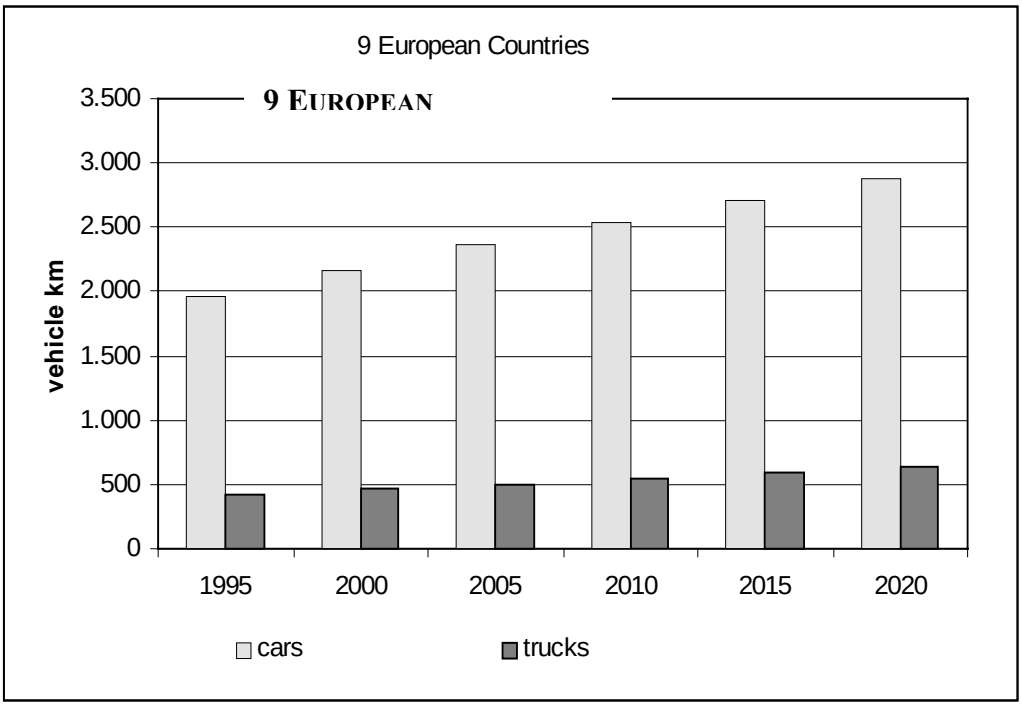
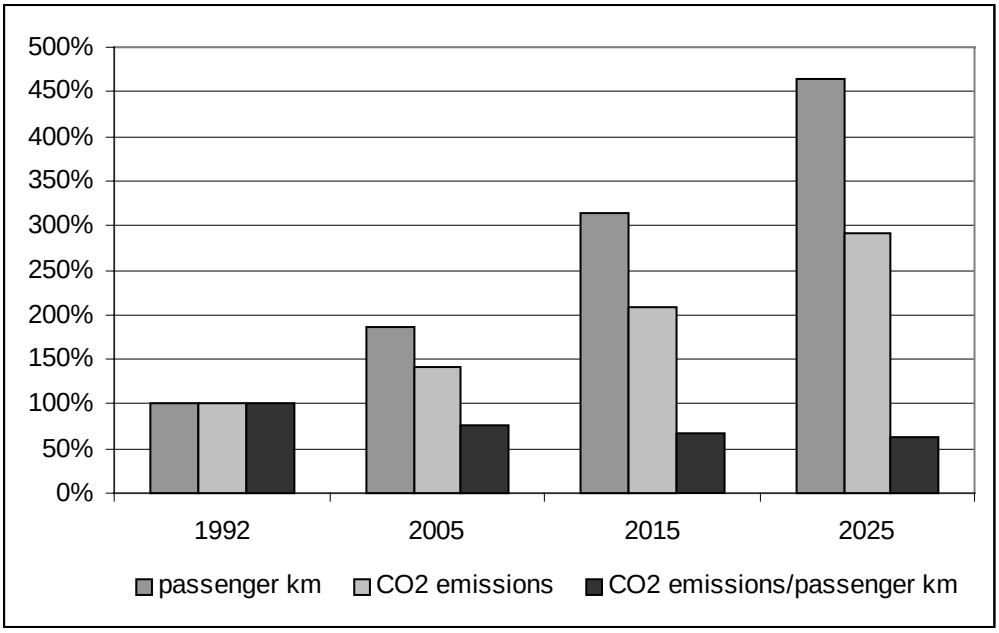


FIG. 4 AVIATION IN THE EU

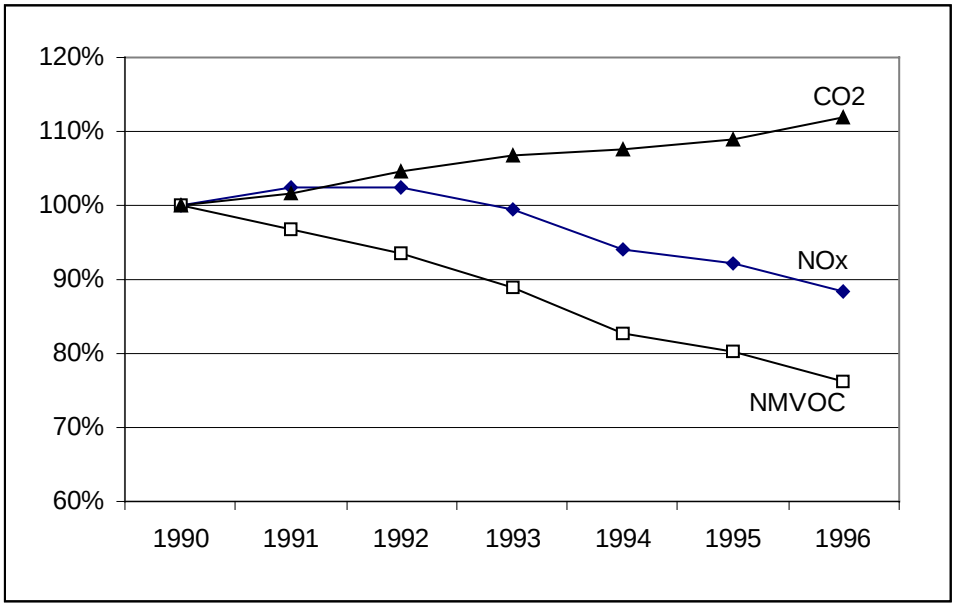


2. ENVIRONMENTAL IMPACTS

2.1. AIR EMISSIONS

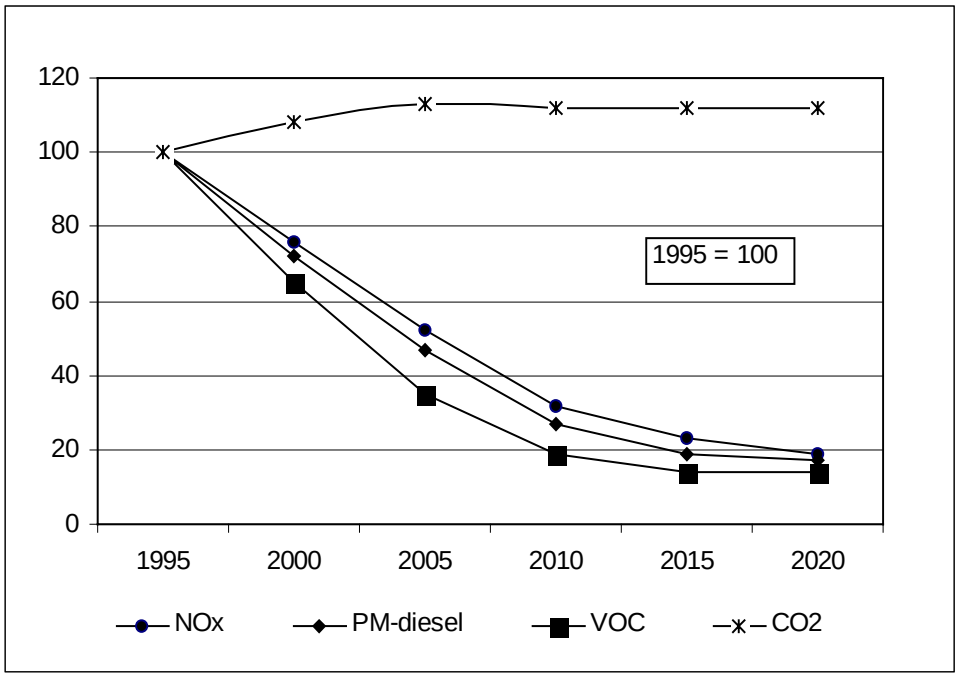
Regarding air pollution from transport there is a positive trend to be seen in the last years development. 1990 – 1996 NO_x emissions have decreased by 12 %, and NMVOC emissions by 24 %. This trend probably will continue. Until 2020 NO_x emissions from road transport are expected to diminish to 17 %, and NMVOC emissions to 11 % of 1990's figures. Thus NO_x and VOC emissions are corresponding with the targets set in the 5th Environmental Action Programme of the EU as well as the UN ECE Protocol to the Convention on long-range transboundary air pollution to abate acidification, eutrophication and ground-level ozone. Road transport emissions of PM10 follow a similar downward trend. Thus air pollution by NO_x and VOC emissions will no longer be much of a problem after 2020. As for PM10 emissions, the expected reduction rates are not sufficient to avoid carcinogenic effects.

FIG. 5 AIR EMISSIONS IN EU15: 1990 - 1996



The positive trend with air emissions does not hold for CO_2 however. CO_2 emissions in the European Union account for 14 % of worldwide CO_2 emissions, transport accounting for 26 % of EU's emissions. CO_2 emissions resulting form transport activities have been increasing considerably. In the last years transport's CO_2 emissions are showing the highest rates of increase (1885-1996: +40%), while CO_2 emissions from other activities (except energy branch) are decreasing or stagnating. CO_2 emissions from transport will continue to grow. Road transport CO_2 emissions will increase till 2005 at least, then remain on high level, despite the fact that emission factors for cars are supposed to decline from 197 g/km in 1990 to 134 g/km in 2020.

FIG. 6 AIR EMISSIONS IN EU15: 1995 - 2020



This upward trend of Co_2 emissions from transport strongly contradict the CO_2 reduction target of 8% until 2012 compared to 1090, the EU has accepted in Kyoto. In view of the CO2 reduction rate of 80% in 2050 considered necessary by IPCC for industrialised countries, the need of additional policy measures becomes apparent.

2.2 Noise

About 120 million people in the EU (32% of population) are exposed to road traffic noise levels above 55 L_{dn} dB. More than 50 million people are exposed to levels above 65 L_{dn} dB (13% of population).

10% of the EU population are exposed to rail traffic noise above 55 L_{dn} dB, and 1% are highly annoyed by rail traffic noise.

Some 10% of the total EU population may be highly annoyed by air transport noise[9]

2.3 Land Take

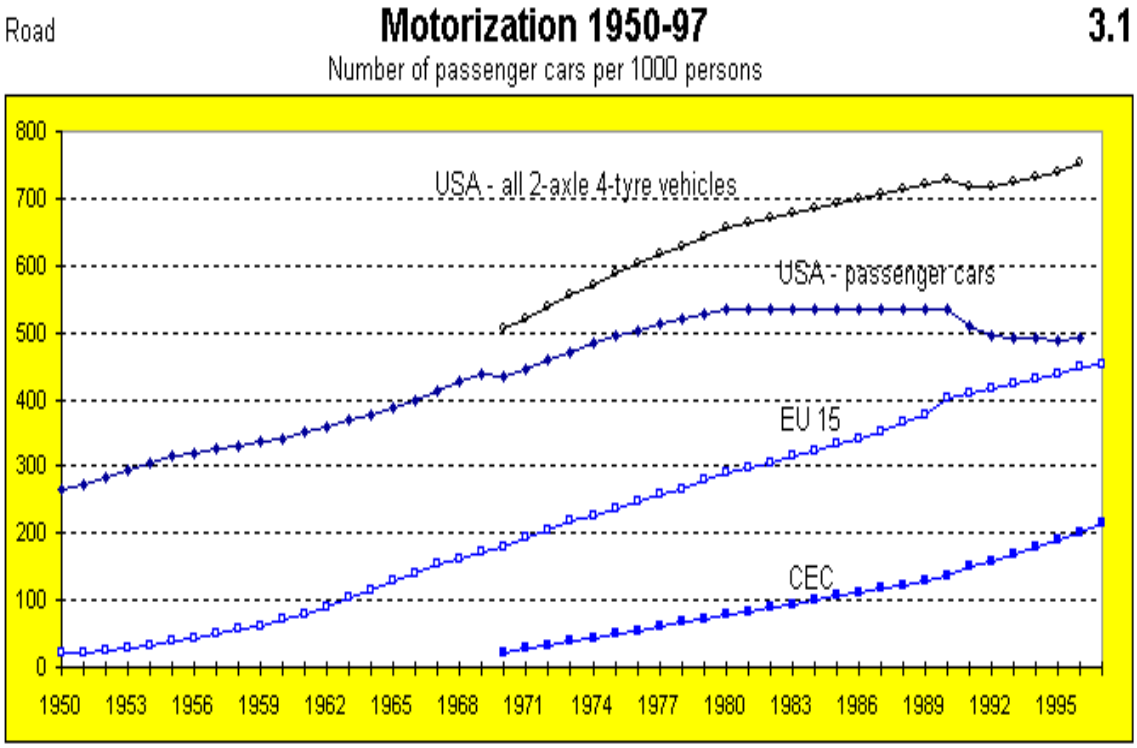
Transport infrastructure covers 1.2% of total available land area in the EU, ranging from about 0.5% to 4.5% in the single countries. During 1990-1996, 25000 ha, this is about 10 ha every day, were taken for motorway construction alone.

Most areas in the EU are highly fragmented by transport infrastructure. The average size of contiguous land units that are not cut through by major transport infrastructure is 130 km_2, ranging from 20 km_2 in Belgium to 600 km_2 in Finland, 7 EU countries lying far below the average.

[9] European Environment Agency (1999): Are we moving in the right direction? Indicators on transport environment integration in the EU.

Depending on the type of infrastructure the land affected by transport infrastructure may be up to three times the direct land take (see Tab. 1).
In many European areas land resources are relatively scarce. Land taken from transport is withdrawn from other uses. Land take in natural areas may led to a decrease of biodiversity, as may fragmentation by linear infrastructures. Negative visual impacts on landscape have to be taken in account.

Motorization 1950-97, EU 3.1
CO_2 Emissions (EU 15), EU 7.5

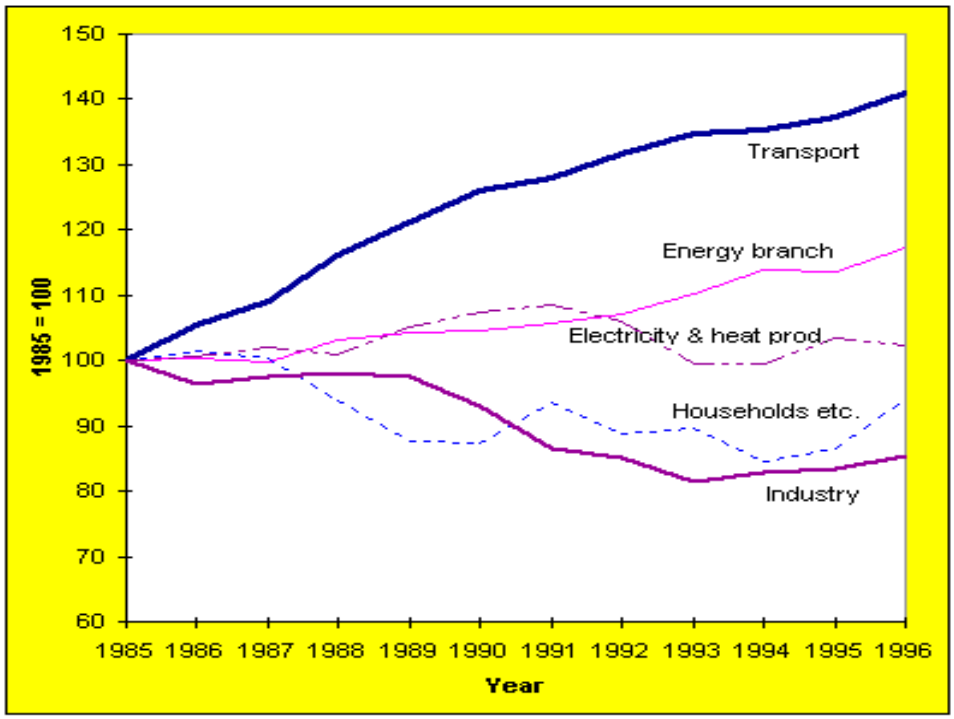


Note : USA : 2-axle 4-tyred vehicles include passenger cars, pick-ups, light vans and sports utility vehicles. Some of these vehicles are used for commercial purposes.

7.5

CO_2 Emissions (EU 15)

CO_2 Emissions from Fossil Fuels



Emissions From Fossil Fuels

Mio tonnes CO_2

	1985	90/85 % p.a.	1990	96/90 % p.a.	1996	% of EU
EU 15 (14% of world)	**2998.3**	+0.6	**3088.5**	+0.3	**3149.0**	100
Electricity and heat prod.	926.2	+1.4	994.2	-0.8	948.2	30
Energy branch	127.1	+0.9	132.9	+1.9	149.2	5
Industry	625.8	-1.4	581.8	-1.4	534.7	17
Households, commerce	733.9	-2.6	641.8	+1.3	691.5	22
Transport	585.3	+4.7	737.8	+1.9	825.4	26
of which :						
Railways (1)	11.7	-4.9	9.1	-1.3	8.4	0
Road transport	499.7	+4.6	626.1	+1.7	693.9	22
Air transport	61.5	+5.9	82.0	+3.7	101.7	3
Inland navigation (2)	12.4	+10.7	20.6	+0.4	21.1	1

Source : Eurostat

Notes : (1) : without fossil fuel for electricity production
(2) : including passenger transport and leisure boating