Assessing Scenarios on European Transport Policies

by means of Multicriteria Analysis[1]

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Abstract

In general terms, the general Common Transport Policy (CTP) objectives of the European Union may be formulated in efficiency, regional development and environmental categories. Setting objective targets in the environmental field based on scientific evidence is not yet possible, so that it is still necessary to resort to policy documents. The same holds largely for economic efficiency and regional development issues, so that also here a pragmatic approach is required. The first part of the paper analyses relevant scientific frameworks, in this context followed by a specification of the targets. In the second part, future developments and policy packages are assessed by applying a multicriteria evaluation method based on the so-called regime analysis to the scores on these targets in six CTP-policy scenarios. Two external social and institutional frameworks - Cooperation and Polarization - and three policy directions (optimizing efficiency, regional development and environmental objectives, respectively) are investigated. It is concluded that European and societal cooperation and policies aiming at increasing efficiency and environmental objectives (especially by means of price measures) will result in satisfactory achievement of European transport policy targets.

1 The Common Transport Policy of the European Union

The Maastricht Treaty states that the EU aims to 'promote a stable and non inflationary growth which respects the environment'. As part of the required action, it calls for the integration of the principles of sustainable development into all EU policies. This includes the regulations governing the Structural Funds programme, which supports a large number of transport projects. As an elaboration of these objectives to the transport sector, the Common Transport Policy (CTP) of the EU has the following objectives (CEC, 1992):

* free movement of goods and persons;
* development of a coherent, integrated transport system using the best available technology;
* reducing disparities between regions, e.g. by infrastructure construction;
* sustainable patterns of development by respecting the environment;
* actions to promote safety;
* encouraging social cohesion;
* developing appropriate relations with third countries

These objectives are however abstract in nature, while it is neither clear whether these objectives are complementary or conflicting. A scenario analysis is therefore extremely useful for analysing this problem. In order to focus the analysis and to find concrete targets for the CTP, the objectives concerned may be redefined in three issues (see also POSSUM, 1997): increasing the efficiency of transport systems, contributing to regional development and achieving environmental sustainability.

This paper will first set concrete targets for these three general objectives. Target setting cannot be a purely ivory tower task; it requires wide consensus. This paper tries to find a number of widely accepted statements and terms of reference, from both scientific and official policy documents which might offer a basis for target definition. Next, scenarios are constructed by maximizing these targets within the two external frameworks of Polarization and Cooperation. Then we will analyze the extent to which the targets identified are fulfilled in the distinct scenarios, by means of a multicriteria analysis based on regime analysis. Finally, some strategic policy conclusions for future EU policies are formulated.

2 Targets for the Environmental Dimension

Setting targets is a very difficult and politically sensitive task. A general problem of target setting is that very general targets (like economic growth) may be achieved by different, sometimes even contradictory means (see Tinbergen, 1956). Therefore, target setting must be an open process; an objective threshold does not exist, but has to be defined in a social context. Transport can predominantly be regarded as a means - so one can assume very different transport policy strategies and transport policy targets, being derived from more general targets. We will focus here on both scientific and political terms of reference for target setting, and will discuss target setting for environmental, regional development and efficiency issues, respectively.

For environmental targets, the idea of environmental sustainability needs to be transformed into operational targets. There is a crucial difference to be made between strong and weak sustainability which results from different viewpoints with regard to ecological, economic and social aspects. In addition, more pragmatic targets may be chosen based on official policy targets. These issues will successively be discussed in Subsections 2.1-2.3.

2.1 Strong sustainability

The term 'strong sustainability' refers to policy choices that give priority to ecological objectives. This priority expresses the fact that any human activity is more or less contingent on some natural resource; therefore, beyond certain limits there is no justification for economic trade-off analysis concerning the use of natural resources. These limits are to be scientifically determined and constitute a political constraint for economic activities.

Strong sustainability can be derived from the characteristics of economic and technological processes with regard to thermodynamics and ecology. These processes can be described as irreversible, entropy-increasing and non-substitutional (with regard to natural and manufactured capital). Additionally, risk aversion is the underlying strategy of strong sustainability to deal with uncertainty about future environmental conditions. Strong sustainability is the basis for so-called management rules, which are:

* use of renewables has to be in line with their ability to regenerate;
* use of non-renewables has to be in line with the increase in productivity of renewables;
* there has to be a balance between the natural assimilation capacity and anthropogenic emissions and waste;
* there has to be a balance between time-scale of human impacts and natural processes.

Several more practical applications of the concept strong sustainability are defined in the literature.

Critical Loads/Levels

Critical loads or levels can be defined as scientifically derived limits of environmental stress for receivers like ecosystems, parts of ecosystems, organisms and materials (SRU, 1994). This concept has also been adopted by The World Commission of the UN for Europe (UN-ECE) for different air pollution substances. The underlying assumption is, that there is no damage to be expected when the actual environmental stress levels are below Critical Levels or Loads.

Environmental Utilisation Space

Another approach to strong sustainability is the concept of Environmental Utilisation Space, which can be seen as an approximation of the ecosystems' capacities to buffer stresses by human impacts (Opschoor and Wetering, 1992). Another definition is '... the space of the natural environment which can be utilised by humanity without damaging crucial characteristics'. This concept depends on the different conditions of ecosystems, e.g. carrying capacity. Besides, it is possible to enlarge the Environmental Utilisation Space through human activities like reforestation. Like in the concept of Critical Loads/Levels, priority is given to ecological limits and not to economic processes. Moreover, this approach stresses social aspects, since the distribution of resources is included. Using the assumption of equal rights for any human being to environmental safety, equally individual access to resources is postulated.

Maximum Scale

The concept of Critical loads/Levels can be linked to Daly's (1992) concept of Maximum Scale. This approach does not consider a set of single environmental limits, but a physical measure for the size of the economic system in comparison with the natural system and its carrying capacity. The variables which determine this size (scale) are: population and standard of living (per capita consumption). Hardin (1992) describes the total human impact on the environment as population x per capita impact. The objective is to reduce the total human impact or the scale to a size compatible with the carrying capacity of nature.

Entropy

Kümmel (1980) defines an indicator for the pressure put on the natural system by human activities. This indicator consists of social welfare losses, based on the relative increase of entropy caused by production and consumption and the entropy-reduction due to nature.

Advantages of the concept of strong sustainability are that the settings of ecological objectives are limits which should not be exceeded, resulting in a long term protection of proper conditions for human living. The decision about the use of ecological resources beyond these limits is withdrawn from individual and economic trade-offs. Another advantage is the scientific determination of these limits, which is not dependent on psychological factors and therefore less prone to mistakes.

However, one has to bear in mind that human knowledge about the complex issue of ecosystem dependence is far from perfect; therefore, there is no guarantee that the limits are set right. Another criticism is that the impact on economic and social systems is not considered. The limitation of economic use of resources can result in massive regional or sectoral disturbances.

Moreover, the concept of Environmental Utilisation Space is seen as imposing severe political interventions in the market system and a mechanism to distribute resources without considering regional differences. So, some critics see the danger of eroding the market system, limiting individual freedom and changing personal preferences due to the absolute priority of nature. This priority given to nature is expressed particularly within Daly's concept of maximum scale.

It can be concluded that the concepts discussed above are up to now not capable of providing clear targets for sustainable transport policies. Next, we will investigate whether 'weak sustainability' concepts can provide clear targets.

2.2 Weak sustainability

In contrast to strong sustainability the concept of weak sustainability puts much more emphasis on the impacts of environmental aims on the economic system. The concept is based on the assumption that natural capital can be substituted by manufactured capital, so that environmental losses can be compensated for by e.g. infrastructural gains. Weak sustainability copes with uncertainty in a rather risk-loving way, trying to maximise economic benefits by taking environmental risks. In the literature several approaches can be found.

The Corridor concept

WBGU (1996) has developed a so-called Inverse-scenario for estimations of minimum global reduction efforts, using the example of the greenhouse effect. Starting from the effects of climate change on humans and nature, tolerable limits of future climate change are derived. With this information emission profiles can be calculated which ensure that the changes stay within the limits and that necessary reductions are easily identified. The starting point is the viewpoint of many economists that costs to adapt to climate change higher than 3-5% of global GNP lead to heavy disturbances of economic and social systems. Calculations of the tolerable climate change are based on this figure.

The advantage of this approach is that exogenous climate data can be integrated within economic models and therefore be transformed into endogenous variables. The maximum tolerated climate change can be reached in many different ways, and society can choose which way to go (e.g., starting drastically or transforming gradually).

On the other hand, there are some problems inherent in this approach. To determine the limits one has to conduct economic-ecologic impact assessments to analyze the economic impacts of environmental changes. The difficulties with these assessments are well known from the discussion about the monetarisation of damages to the environment. Especially with regard to the conventional method of discounting future values of goods, a wrong damage curve may be derived and used, resulting in the wrong tolerable climate change.

No Regrets Strategy

No Regrets Strategy means that only measures are taken which have a positive economic effect and additional environmental gains (Nijkamp et al., 1997). This strategy looks for reductions of environmental stress, which also induce cost savings which are as least as high as the costs of the measure (less water used, less energy consumed). The objective is to abolish all obstacles to the realisation of these measures and thereby to reduce the pressure on the environment without inducing costs for businesses or households. Therefore, political interventions should not impose new restrictions, but reduce transaction costs by abolishing lacks of information and capital. Some studies found a potential for reductions of CO_2 emissions of about 10-20% (Springman, 1991).

The advantage of this approach is the possible change of attitudes towards environmental protection, because it loses its character as a cost-driver. Furthermore, win-win solutions may be established, which leads to high acceptance. On the other hand, the realisation of this change is doubtful, because the individual maximisation of benefits is simply extended to environmental factors. Besides, thefact that the societal benefits from environmental improvements are ignored means that the social optimum is not reached.

The Solow Model

As a measure for the sustainable use of capital Solow (1986) proposes the maximum consumption per head which can be sustained indefinitely. This implies that not natural capital but total capital must remain constant, and that natural capital can be substituted by man-made capital. As a result, intergenerational equity is established; investing in non-renewables to increase the productivity of other input factors - like infrastructure, education, and modern machines - may compensate for the loss of natural resources. The advantage of this concept is the legimitation of the use of non-renewables, which is to date unavoidable, but the assumption of complete substitution is highly disputed.

Although the weak sustainability concepts are somewhat more concrete than the strong sustainability concepts, it is again not possible to define clear targets based on these concepts. Therefore, we will turn now to a more pragmatic way of defining targets; viz. analysing which targets are found in official documents.

2.3 Taking official policy targets

The reasoning behind official policy targets is often much more fragmented and ad hoc, than the above described top-down approaches. The logic is political rather than rational in a scientific sense. This may be illustrated by a few examples:

* the SO_2 reduction targets of the EU from 1988 have been calculated on the basis of the 'BATNEEC-Concept' (Best available technology not exceeding excessive costs) (Héritier et al., 1994). This concept implies, that only technologies are assumed, which have reached a sufficient degree of market diffusion and do not cause excessive - politically acceptable - costs;
* the EU CO_2 stabilization target from 1990 is based on the positive side-effects of industrial decline in Eastern Germany on the CO_2 balance of the EU. So most

countries could afford CO_2 emission increases and only a few already committed countries were to achieve a slight decrease of CO_2 emissions (Haigh, 1996);

* the proposed 25% reduction target of Germany is based on available evidence on climate change and on the technical potential to reduce CO_2 emissions (Beuermann and Jäger, 1996). The ambitious target was announced before elections to attract greening conservative voters.

The state of official environmental targets of the EU related to transport is presented in Table 1; for the sake of comparison, also German targets are included.

Table 1 Environmental targets of the European Union and Germany

Issue	EU reduction targets	German reduction targets
CO_2 emissions	Stabilization (1990-2000)	25% (1990-2005)
NO_x emissions	30% (1990-2005)	80% (1990-2005)
Dioxine	90% (1985-2005)	--
Heavy metals	70% (by 1995)	70% (by 1995)
Noise	threshold: 65db; no additional noise beyond 55db	threshold: 50db (by 2030)
Nature protection	'Natura 2000' network; habitat and birds directives	no additional net surface covered by roads
Benzol	--	90% (1988-2010)
VOC	30% (1990-1900)	80% (1987-2005)

Source: EU: CEC, 1993a; Germany: Gorissen, 1995.

Note: In March 1997 the EU ministers of environment agreed upon a 15% CO_2 reduction target for the year 2010 as an offer for the UN Earth Summit Conference.

One may argue that political goals, which have been formulated for 2005 or 2010 might become more widely accepted for the period until 2020, being the time frame for our scenarios. Targets may now be chosen based on indicators for environmental sustainability which are based on several criteria (POSSUM, 1997; Rienstra et al, 1997): first, the number of indicators should be as small as possible in order to keep the analysis manageable; second, the indicators should relate to all main environmental problems caused by transport. This analysis resulted in CO_2 and NO_x emissions as the most important indicators.

CO_2 emissions

When in addition to the above table also other sources are taken into consideration, it can be concluded that a 25-30% overall CO_2 emission reduction target for the year 2020 is in the lower range of what is required to avoid major environmental damage (see e.g., WBGU, 1996). If one assumes an overall 30% target and that different sectors have different cost-effective potentials, not every sector should have the same CO_2 reduction target. Stead (1997) suggests to take the predicted trends as a rough indicator for the cost-effective reduction potential. So it is assumed, that low growth sectors have a higher reduction potential than high growth sectors. According to the CEC (1996) overall CO_2 growth between 1992 and 2020 will be 15%, when current trends continue. Compared to the trend, a 30% target means a reduction of 39%. Overall mobility growth is estimated to be 22%. If one calculates the above reduction target for the year 2020, a 25% reduction from 1995 levels is required.

NO_x emissions

The same type of analysis may be applied to NO_x emissions, which is the second hardest objective to achieve and also an important indicator for several environmental impacts. When 1995 is taken as a reference year, up to 2020 a reduction of 80% is in line with the objectives stated in Table 2 and other sources.

It can be concluded that scientific concepts may provide insights into the necessary reductions of externalities, but that it is up to now too complex to set concrete targets based on these concepts. Therefore, targets are pragmatically chosen based on current policy documents. Next, we will turn to setting targets for the regional dimension.

3 Targets for the Regional Dimension

As mentioned in Section 1, social and economic cohesion is one of the fundamental objectives of the EU. However, a widely accepted and operational definition of cohesion does not exist. Cohesion is politically defined as the socially acceptable difference of economic and social welfare between regions or groups. The thresholds for acceptable differences differ from region to region and from context to context. This makes a target definition difficult to find.

Even the term 'convergence', which aims at the gradual reduction of differences in wealth, GDP or unemployment rates gives little help. Most regions would prefer high growth rates (even at the price of relative decline) to convergence at the price of low growth. The following goals for regional planning can be distinguished (Schleicher-Tappeser et al., 1996):

* *functionally balanced regions*; this derives from the idea to create equal living conditions in each region. Due to the diversity of European regions this model could not be implemented - despite considerable financial support;
* *spatial functional division of labour*; this approach refers to specialization and the reliance on comparative advantages, which culminated in concepts like 'tourist region', 'industrial region' or 'refuse disposal regions';
* *endogenous regional development*, stressing regional independence; endogenous development aims at allowing a region's inhabitants a 'satisfying' standard of living. Living conditions may vary according to specific natural and economic potentials, regional cultures and modes of institutional regulation.

Objective 1 regions - which receive more than 70% of the Structural EU Funds- are defined to have less than 75% of average per capita income of the EU (CEC, 1993b). On this basis a minimum target for regional development is a steady improvement of income and employment for these regions. Economic growth of objective1 regions should therefore be higher than the EU average.

Furthermore, an objective for the cohesion within peripheral regions should be defined. Unemployment seems to be a rough but easily available indicator. In this sense decreasing unemployment (say with an unemployment rate less than 5%) might be used as a target for the equity dimension within regions.

Regional development objectives and transport policies

What this means for transport policies depends on more specific goals of regional planning, the associated policy strategies and hence on the underlying theories of regional development and on the different economic structures. A uniform goal for a transport policy promoting regional development cannot be defined, since this depends on the specific situation and the choices within regions.

On this basis one can distinguish two different ideal type orientations: an export-led growth orientation requiring accessibility to the centres, and an inward-oriented orientation focusing on the quality of intraregional communication networks. Also analytically it is difficult to assess the regional development impact of new high-quality infrastructures to peripheral regions.

There is no linear correlation between regional development and the quality of transport links between the regions and other economic centres (Bruinsma et al., 1997; Vickerman, 1995). Due to different specific economic structures different regions have different transport needs. Some scientists even argue, that better transport links between strong and competitive centres and economically weak peripheries may increase polarization instead of cohesion (see the literature survey by Hey et al., 1996).

Furthermore, specific targets have to be related to indicators. But as Vickerman (1995) argues, traditional accessibility indicators focusing on time or distance between a peripheral region and a set of economic centres do not match the complexity of the issue. Accessibility indicators have to consider, that peripheral regions are dependent on the network quality within transit regions, discontinuities exist and interchanges become important. Furthermore, not only infrastructure, but also frequencies are relevant for measuring accessibility. Finally, different sectors have different needs with respect to connectivity, speed, price or modal choice (Vickerman, 1996).

Finally, good access for a regional centre may mean more peripherality for any other location along a corridor. On this basis Vickerman (1996) suggests a complex and eclectical mix of different accessibility indicators, taking into account frequency modal choices, economic structure, modal discontinuities etc. Although this would be an accurate choice, this is too complicated for assessing scenarios focusing on general trends. Therefore a simplified approach is required. We will apply two approaches, a traditional and an innovative one.

The traditional approach

This approach starts from the traditional idea of accessibility. A transport policy target is the improvement of 'access' to economic centres. This implies short travel times, user choices and low transport costs - normally between the regional centres and the most important international centres of economicactivity. CEC (1994) applies a BFLR-index, which measures the potential population which can be reached within a given travel time by using the best available modes. This index identifies 194 centres from regions at the NUTS III scale and measures the resident population which can be reached within 3 hours. Actually there is a difference between regions with the lowest and the highest accessibility by a factor 4. Due to geographical differences this difference never can be equalized but only improved. A general target may therefore be to improve the accessibility of peripheral centres by50-100% by the year 2020. A Gini-coefficient of accessibility based upon the BFLR-Index might be a tool to measure the dynamics of more equitable access of peripheral regions.

The innovative approach

This approach is more concerned with accessibility within regions. As several authors state (e.g., Vickerman, 1996) most traffic takes place within regions. Hence, the focus of this strategy is to improve accessibility within regions. On a European scale the objective of such a strategy is to give intraregional accessibility priority over interregional accessibility. This could be measured by a coefficient which compares intraregional (A_i) with interregional accessibility (A_e). A general target is to improve A_i/A_e by more than 25%. This measure would accept the given natural differences of accessibility between regions, but nevertheless would seek for a relative improvement. For A_e the BFLR -index can be used, for A_i an analogous indicator may be constructed identifying the centres within a NUTS III region.

4 Targets for the Efficiency Dimension

Reference points for efficiency targets may be found in general welfare economic theories, other theoretical reflections or policy documents of the EU. General welfare economics has identified two different criteria for efficiency improvements: the strict Pareto criterion and the wider Kaldor-Hicks criterion. The Pareto criterion is met, when a change induces an increase of welfare levels without reducing the welfare of any other individual. Generally it is assumed, that this can be best achieved under market conditions. The Kaldor-Hicks criterion is met when total welfare increases for one group due to the change are higher than the total losses of others.

So a starting point for both efficiency definitions is maximizing economic growth from a given set of resources. It is less evident what this may mean for the transport sector. In general, one could argue that transport policies should facilitate economic development. But this can be achieved by different sets of subtargets. Two approaches can now be identified for defining efficiency targets: defining transport as a resource or treating transport as a sector contributing to economic growth.

Transport as a source

A wide perspective treats transport itself as a resource and tries to maximize economic growth (Peake, 1994). So a transport efficient economy minimizes its transport needs to maintain a certain growth path. Dematerialization and the substitution of physical flows by non-physical flows (Pestel and Johnston, 1996) might be vital characteristics of a transport efficient economy. This certainly applies to freight transport. In the case of passenger transport however, mobility is not only a means (so as to find access to certain facilities), but also as final consumption (mainly leisure activities). This is a problem for the definition of transport as a resource for the economy.

Despite this reservation one may argue that, taking the link between energy use and economic development as a historical model (Peake, 1994), the decoupling of economic growth from mobility growth (both for passengers and freight) is a fundamental efficiency goal (for example, no mobility growth combined with 2.5% real BNP growth). Assuming that economic growth will be 100% over the next 20-30 years, decoupling would mean halving the transport intensity of the economy. As a target this would mean improving the transport efficiency of the economy by a factor 2.

Transport as contributor to economic growth

Yet, efficiency may also be characterized by the contribution of the transport sector to economic growth in a totally opposite sense. CEC (1993b) highlights the essential relationship between the functioning of the internal market, the competitiveness of the European economy and a fast, flexible and low cost transport system, which reduces natural spatial barriers as much as possible. The efficiency goal is not related to the overall economy, but rather to the transport sector itself, which is supposed to maximize its performance under a given set of public and private expenditures for transport services.

The traditional definition of efficiency relates to the transport sector itself (Van Gent and Nijkamp, 1991) and is essentially linked to the second definition. Transport is subordinated to the needs of the growing economy. Efficiency in this case means to provide a transport service at the lowest possible costs. The definition of efficiency in a free and competitive transport market is no problem: marginal costs (including external costs) have to be equal to the marginal willingness to pay for transport users. Transport necessarily implies some degree of government intervention, especially in the case of infrastructure policies, safety regulations and social minimum standards to avoid dumping practices by operators. For governments efficiency implies the optimal use of public finance in terms of investment profitability and minimization of public subsidies.

An efficiency goal for public investments into the transport sector might be, to realize at least the same rate of return for public investments, as for the average of the economy as a whole. A lower rate of return would indicate that more efficient uses of capital exist. A more ambitious efficiency target would be to set priorities for public investment priorities where the highest rates of return might be produced. Cost-Benefit Analysis offers a tool for the shadow-pricing of government investments (Hanley and Spash, 1993) - but this target is difficult to measure within general scenarios.

Another efficiency goal might be the minimization of direct and indirect subsidies of the government and the general public (e.g., health insurance system; especially to railways, private damage and repair costs etc.). In short: an efficient transport system must fully cover its costs in order to be viable.

A third efficiency goal might be the rule of 'optimal government intervention': trying to find the equilibrium, where marginal benefits are equal to marginal costs. In short: the point of reference for efficiency is the real or hypothetical market equilibrium.

In general however, the gradual abolishment of public subsidies to the transport sector by the strengthening of market mechanisms and shadow pricingseems to be the best measurable concrete target.

It can be concluded that it is not easy to formulate widely accepted and operational targets for the three normative frames. Scientific approaches are often too abstract to define specific operational targets and most political objectives do not reach to the year 2020. Hence a certain degree of voluntarism is unavoidable in setting targets. This may be justified by a reiterative and participatory approach.

Here, we choose a minimum threshold approach for each of the targets. On the basis of a review of different political and scientific reference points, several targets have been identified for the distinct policy dimensions. Now, we will give scores to these targets for six scenarios, which will be constructed first. Next, these scenarios will be assessed by means of multicriteria analysis.

5 Description of the Scenarios

The future of transport is largely influenced by institutional, economic and social-psychological developments (Nijkamp et al., 1997). Scenarios should therefore take into account these trends. On the other hand, treating all factors as internal ones may make the construction too complex and broad, so that lessons cannot be learned. Therefore, we will construct two - so-called external - frameworks 'Polarization' and 'Cooperation', which describe these trends in rather contrasting ways. In this way, we can test in this scenario analysis for the impacts of these external trends(see Table 2). The reference year in the analysis is 2020.

Table 2 Contents of the Polarization and Cooperation external frameworks

The Polarization Framework	**The Cooperation Framework**
Institutional/economic developments * EU integration is stopped (e.g., no new member stated, no EMU) * No European coordination of transport and environmental policies * Little cooperation in R & D * Low economic growth	*Institutional/economic developments* * EU integrates further (CEC-countries, EMU) * Strong coordination of transport and envi-ronmental policies * European coordination R & D * High economic growth
Social developments * Little support transport and environmental policy measures * Equity no important policy objective	*Social developments* * Much support for transport and environmental measures * Social cohesion/equity is an important issue

It should be acknowledged that these frameworks do not include any value statements, but are just a description of possible future developments. Another remark is that it may be possible that, for example, cooperation in one field (e.g., European integration) occurs, while in another field (e.g., immigration) another trend may be observed. The scenario analysis may also give clear indications of the impacts of such different developments.

Next, scenarios will be constructed within these frameworks for each of the three dimensions. These are constructed by maximizing efficiency, regional development and environmental issues, without taking the other issues into consideration. In addition, opinions of European experts on these issues have been investigated by means of a survey questionnaire. In this way it can be analysed to which extent the distinct scenarios and dimensions are complementary or conflicting in the achievement of the targets identified above. In Table 3 these scenarios are concisely presented for each of the three issue 'efficiency', 'regional development' and 'environment', within both frameworks. Because we focus in the present paper on scenario assessments instead of descriptions, we will not further elaborate on the contents of the scenarios. For an extensive description of the scenarios and the methodology we refer to POSSUM (1997) and Rienstra et al. (1997).

Table 3 Summary of the scenarios

Competitive nations Economic efficiency - Polarisation * Privatisation * Moderate pricing in all forms * Investments based on economic return * Growth mainly in European core zone * Public transport subsidy reduced * Public transport systems reduced * More energy efficient cars * Limited HST-network * Low mobility growth	*Competitive Europe* Economic efficiency - Cooperation * Large scale privatisation * Road and other pricing introduced very much * Investments based on maximum return * Stimulation for peripheral regions * Little new technologies * Some closure of public transport * Limited HST-development * Low mobility growth
Equitable Nations Regional development-Polarization * Some privatisation * No road pricing or fuel price increases * Little new transport infrastructure * Core zone declines, periphery high growth rates based on own strength * Public transport declines * Little technical development * Low mobility growth	*Equitable Europe* Regional development - Cooperation * No privatisation * No pricing measures * High growth in periphery initiated by European funds * Telecommunications important * HST and airport investments * Little new technologies * Reduced public transport use * High mobility growth
Environmental Nations Environment - Polarization * No privatisation * Limited road and other pricing * Core dominant and dense development * HST-network completed * Public transport expanded * Large scale investments in new fuels * Low mobility growth	*Environmental Europe* Environment - Cooperation * No privatisation * Much road and other pricing * Large scale investments in public transport * Car use restricted * Core zone dominant * Maglev and new fuels introduced * Public transport dominant * Very low mobility growth

Next it is interesting to which extent the targets which are identified in Sections 2-4 are achieved. This is presented in Table 4, which is based on the analysis of Drebog et al. (1997) and POSSUM (1997).

Table 4   Qualitative scores[1] for the targets in the distinct scenarios

	Comp. nations	**Eq. nations**	**Env. nations**	**Comp. Europe**	**Eq. Europe**	**Env. Europe**
Environmental						
25% reduction CO_2	3	2	5	5	1	5
80% reduction NO_x	4	2	5	4	1	5
Regional development						
incr. Gini-coefficient	1	4	1	2	5	1
unempl. obj. 1 reg.	2	4	1	2	5	3
Efficiency						
decoupling	3	2	2	4	1	3
full cost coverage	5	3	1	5	1	3

Note: 1) The scores indicate: 1 = situation worsens very much; 2 = situation worsens; 3 = no clear change; 4 = situation improves; 5 = target achieved

Now we will assess by means of regime analysis to which extent the scenarios achieve the distinct targets and which scenario is most attractive.

6 Assessing Scenarios by Applying Multicriteria Analysis

6.1 Introduction to multicriteria and regime analysis

The various future policy options developed and presented in Section 5 are mainly qualitative in nature. There is no way to order one. In addition, each of these options does not have a single performance measure, but a multiplicity of performance indicators or characteristics. This is a typical case of a multicriteria decision problem, where one preferred choice possibility out of a distinct number of options has to be selected. The typical information needed for a multicriteria analysis is the availability of an impact matrix (i.e., the scores of all relevant policy criteria for all alternatives to be considered) and a relative importance attached to each of the criteria (preferably in the focus of policy weights).

There is a wide variety of multicriteria decision methods, ranging from simple frequency countings to more complicated mathematical exercises. We refer to Nijkamp et al. (1991) for a comprehensive overview. In the past years, various multicriteria methods have become very popular in policy analysis, especially when the impacts to be assessed were qualitative in nature. In our case study, we will use the so-called regime method. This method has been based on various occasions and has proven its validity for many multicriteria choice problems. The method is essentially based on pairwise comparisons and aims to identify the maximum cardinal information possible from a set of qualitative data. It is also available as user-friendly software. The advantage of the regime method is twofold:

* it allows to deal with different categories of information precision, viz. ordinal

cardinal and mixed ordinal-cardinal information for both the impact scores and the weights;
* it allows to derive unambiguous statements on the relative dominance of each alternative considered by offering as a result an aggregate performance score which may be interpreted as the probability that a given alternative may be the most preferred one.

For details we refer to Nijkamp et al. (1991). We will now offer the outcomes of some of our multicriteria decision experiments.

6.2 Results of the scenario assessment

In order to analyse which of the scenarios presented in Section 5 are more or less preferable, we will apply the above mentioned regime analysis to the scores for the targets given in Table 4. We carried out two types of analysis; successively: first, all targets are treated equally (i.e., equal weights), while in the second experiment with our multicriteria analysis, priority is given to one of the three classes of targets. We used here the qualitative regime method, as described in Nijkamp et al. (1991).

Treating all targets equally

First, we applied a multicriteria analysis in which all targets 'unknown' and 'equal' priorities, respectively. There is clearly a difference between 'unknown' and 'equal weights'. 'Unknown' means that we have no information on any weight of any target, so that all qualitative rankings of weights are equally probable. 'Equal weights' means that we know that the value of all weights are identical; the results of these analyses are presented in Table 5.

The rank order of the scenarios in terms of their political importance appears to be equal in both analyses. 'Competitive Europe' appears to be the most preferable scenario in which the mix of targets is optimized; also 'Environmental Europe' is an attractive scenario according to these results. Apparently, the Cooperation framework combined with environmental or efficiency priorities results in the best possible achievement of the targets found earlier. This is probably the case, because both scenarios place an emphasis on pricing measures

Table 5 Results of the scenario assessments with unknown and equal priorities

Scenario	Priorities unknown	Priorities equal
Competitive Europe	0.919	1.000
Environmental Europe	0.772	0.800
Competitive Nations	0.530	0.600
Equitable Nations	0.420	0.400
Environmental Nations	0.244	0.200
Equitable Europe	0.115	0.000

(road pricing, fuel price increases), which have positive impacts on both environmental and efficiency objectives, while at the same time regional development issues are not neglected because of general cooperation trends (Rienstra et al., 1997).

Next, the Polarization framework appears to result in less attractive scenarios; generally, the scores found by applying the regime analysis are low. A final striking result is that both scenarios aiming at regional development appear to be less attractive when all targets are taken into account. Especially within the Cooperation framework this is the case; here the Polarization framework scores better than the Cooperation framework. This is likely the case, because regional development issues result in higher mobility levels and high investments in infrastructure, resulting in negative environmental impacts and an inefficient and unprofitable transport system.

Giving priority to one of the objectives

The scenarios are constructed by means of maximizing one of the three issues while suppressing the impacts on the other ones. Therefore, it is interesting to give different weights to the distinct targets in order to analyse to which extent the preference order of the scenarios differs. For example, in one analysis a high priority is given to both environmental targets, whereas the other targets receive a low priority; in this case one would expect higher scores for both environmental scenarios. The results of these analyses are presented in Table 6.

Table 6 Results of the scenario assessments with different priorities

Environment high/ Reg. development high	**Score**	**Efficiency high**	**Score**
Environmental Europe	0.901	Competitive Europe	1.000
Competitive Europe	0.899	Environmental Europe	0.800
Competitive Nations	0.499	Competitive Nations	0.600
Environmental Nations	0.400	Environmental Nations	0.301
Equitable Nations	0.301	Equitable Nations	0.299
Equitable Europe	0.000	Equitable Europe	0.000

Strikingly, the scores when environmental targets receive a high priority are equal to the results when regional development targets receive the highest priority. In both analyses Environmental and Competitive Europe receive about the same scores. Striking is also that the Environmental Nations scenario does not become much more attractive when environmental targets receive priority. Apparently, the Polarization framework is not very favourable for the achievement of other targets, so that the overall score of this scenario remains low. The
same holds for the regional development scenarios when these targets receive the highest priorities.

Finally, when efficiency targets get the highest priority, Competitive Europe scores again the highest, while Environmental Europe is still preferable to Competitive Nations, despite the fact that the latter is more focused on efficiency issues. Coordination seems to be preferable to Polarization for achieving these objectives.

Again both regional development scenarios appear to be least attractive, which can again be explained by the fact that regional development issues have no clear positive impact on the achievement of efficiency targets.

In conclusion, in all assessments the Cooperation framework is preferable to the Polarization framework for efficiency and environmental issues; for regional development issues this is less clear. Environmental and Competitive Europe are the most favourable scenarios, while regional development scenarios are much less preferable, even when regional development issues receive the highest priority.

7 Conclusions for European Transport Policies

The EU has not set concrete measurable targets for the Common Transport Policy (CTP) up to now. For analysing policy packages and researching their impacts it is however necessary to set concretely and objectively defined policy targets. In general terms, the general CTP objectives may be redefined in efficiency, regional development and environmental issues. Setting objective targets in the environmental field based on scientific frameworks is very difficult, because of the lack of knowledge about important issues like the greenhouse effect; also monetizing external costs still causes numerous problems. In addition, it is an extremely politically sensitive issue. Nevertheless, scientific frameworks provide interesting insights and inputs for target setting. For defining measurable targets however, it is still necessary to depend on policy documents in the environmental field. Reducing CO_2 and NO_x emissions appear to be the best targets, which are indicators for the most important externalities caused by transport.

The fields of economic efficiency and regional development provide better opportunities for defining targets, but also here no concrete measurable targets are found, so that again a more pragmatic approach is required. Improved accessibility of regions and unemployment rates in objective 1 regions are taken as regional development targets. For efficiency, decoupling mobility growth from economic growth and a full cost coverage of the transport system are defined as the main targets.

When targets are set, it becomes possible to assess future developments and policy packages, e.g. by regime analysis as applied in this paper to CTP policy scenarios for the year 2020. Six scenarios are assessed, through which two external social and institutional frameworks - Cooperation and Polarization - and three policy directions - optimizing efficiency, regional development and environmental objectives - are investigated.

From the assessment, it appears that cooperation in society and among European countries may be preferable for the achievement of efficiency and environmental targets. This may especially be explained by the fact that price measures may relatively easily be introduced in the Cooperation framework, so that these targets may be achieved to a large extent. Strikingly, a European focus on regional development will have very negative impacts on both efficiency and environmental targets, mainly due to large unprofitable investments and a large mobility growth.

Polarization in Europe and in society has more negative impacts, although general mobility levels may be lower in such an external framework. Policy measures can less easily be introduced because of societal resistance and free rider behaviour of individual countries, which may hamper the development of effective transport policies. These conclusions even hold when the regional development targets receive a high priority in the analysis compared to the other targets.

It can be concluded that European and societal cooperation and policies aiming at increasing efficiency and environmental objectives (especially by means of price measures) will result in an optimal achievement of transport policy targets.

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