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The Role of Indicators in Assessing Transport Policies; An Application to European Transport Scenarios[1]

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Abstract

Indicators play an important role in the strategic assessment of policy packages. In this paper the role of indicators in assessing transport policies is examined. As case study, the European Common Transport Policy (CTP) is used. Its three main objectives may be summarized as 'efficiency', 'environment' and 'regional development'. Based on empirical research from different sources and the general CTP objectives, the main indicators for assessing the CTP are identified and discussed. Next, concise scenarios are constructed for the above mentioned general objectives within two general external frameworks (cooperation and polarisation), after which qualitative scores for the distinct indicators are calculated and presented. It appears that environmental and efficiency objectives may go hand in hand to some extent, especially by introducing price measures; regional development may however be contradictory with the achievement of the other objectives. It is concluded that indicators are a useful tool for assessing policy packages, by making the impacts of measures clearer and easily accessible for policy makers.

1 Introduction

In shaping and assessing policies and policy packages, clearly defined indicators need to be identified. To base such indicators on objective scientific standards seems however not possible (Hey et al., 1998). It should for example be acknowledged, that indicators almost always include a certain political statement, while other issues may be neglected. Nevertheless, a selection of indicators have to be chosen, also because policy assessments cannot focus on too many issues.

As a result, there is an increasing level of interest and activity in the use of indicators for policy analysis and decision making purposes. Organisations such as the EU, the OECD, the UN Commission on Sustainable Development and the World Bank have been involved in the development of indicators for policy analysis and decision making purposes (e.g., CEC, 1996; OECD, 1994; World Bank, 1995a). There is already a body of literature on indicators for the transport sector (e.g., OECD, 1993; USEPA, 1996; World Bank, 1995b).

This paper focuses on identifying indicators for and assessing policy packages based on the European Common Transport Policy (CTP), which came into being under Article 74 of the Treaty of Rome. The CTP now covers several policy instruments and a range of strategic transport issues. Over recent years, expenditure under the CTP has increased, due to a number of factors (Hey, 1996). After liberalisation of transport markets, the Trans European Networks became a prerequisite for the proper functioning of the internal market (Nijkamp et al., 1994). The CTP is premised on seven objectives (CEC, 1992):

* the continued reinforcement and proper functioning of the internal market facilitating the free movement of goods and persons throughout the EU;
* the transition from the elimination of the artificial regulatory obstacles towards the adoption of the right balance of policies favouring the development of coherent, integrated transport systems for the Community as a whole using the best available technology;
* the strengthening of economic and social cohesion by the contribution which the development of transport infrastructure can make to reducing disparities between the regions and linking island, land-locked and peripheral regions with the central regions of the Community;
* measures to ensure that the development of transport systems contributes to a sustainable pattern of development by respecting the environment and, in particular, by contributing to the solution of major environmental problems such as the limitation of CO_2;
* actions to promote safety;
* measures in the social field;
* the development of appropriate relations with third countries, where necessary giving priority to those for which the transport of goods or persons is important for the Community as a whole.

It would be difficult to find disagreement with this set of objectives amongst most stakeholders. Agreement about the level of importance of each individual objective between stakeholders is, however, much more difficult.

This paper aims to asses the above mentioned objectives, via assessing scenarios and resulting scores on indicators and begins by a description of the indicator selection process. Next, each of the policy scenarios are described, and the main impacts of these scenarios are summarised by means of scores on the indicators; the time period 1997-2020 is used. The impact of each scenario on the indicators of economic efficiency, regional development and environmental protection are then presented, using the Spider model. Finally, conclusions are drawn.

2 The Selection of Indicators

Indicators may be used to assess policy impacts for a variety of reasons:
* to assess the performance of different policy packages;
* to synthesise, simplify and communicate complex information;
* to highlight key issues;
* to illustrate trends over time;
* to identify goals and targets.

The seven objectives of the CTP (see Section 1) can be divided into three distinct types: economic efficiency objectives, regional development objectives and environmental protection objectives (see POSSUM, 1997; Rienstra et al., 1997). It is these three types of objectives which are used in the paper to develop indicators and policy scenarios.

The process of selecting indicators is based on a synthesis of three approaches (Figure 1). The first approach involves the identification of existing targets from EU policy statements (e.g., CEC, 1992; CEC, 1993). The second approach involves the identification of all the key impacts of transport policy, by opinions of expert groups (see also Rienstra and Nijkamp, 1997). The third approach involves the review of existing indicators of transport policy from other relevant studies. These three approaches provide a basis for identifying, validating and checking the indicators. First, we will now discuss the opinions of experts.

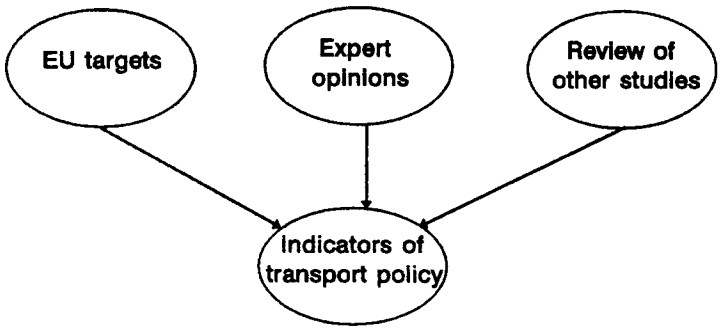


Figure 1 Three convergent approaches for developing indicators of transport policy

2.1 Investigating expert opinions

The main problems caused by transport may be of a direct nature (e.g., the impact on the environment) or of a indirect nature (e.g., impact on social weak groups) (Nijkamp et al., 1997). The main problems - which may give inputs for the choice of indicators - are identified by investigating the opinions of experts in various ways.

First, an **internal POSSUM workshop** was organised (12-13 September 1997) in which the main problems of transport were identified and discussed. Eleven experts participated in this workshop. Each participant was asked to identify five key issues which should be included in the scenario construction and analysis.

Second, a group of 15 **Dutch students** was set the same task in order to investigate the opinions of a younger generation. This group is an interesting one because they have some background to the issues but they are relatively new to the field and are not much influenced by opinions in the scientific world. In addition, this group may represent the views of future policy makers and researchers in the transport field.

Third, a questionnaire survey was distributed to the participants of the Euro-NECTAR conference (23-27 September 1996) and the COST 328 meeting (24 September 1996), both held in Mons, Belgium. This group represents **experts from all over Europe**, which may be expected to have insights in the problems and background factors. In total 33 responses were received.

Fourth, the questionnaire was sent to 96 **Polish experts**, of whom 13 completed and returned the questionnaire. This group may represent more specifically the CEC countries, which may have different views on the problems caused by transport because of the specific problems in these countries. In addition, also Polish students were interviewed. The problems identified may be grouped in three categories:

* **fragmentation, erosion and depletion**; this holds for social issues as well as of resources available to support society and economy. As a result, both societal issues and resources may be closely related;
* **human health and decline in well-being**; these issues relate to the individual perception of problems and relate both to environmental problems and more societal trends and issues;
* **bottlenecks for economic growth**; these problems are related to the bottlenecks for achieving a more efficient transport system and the impact of transport on economic growth.

In Figure 2 the results are presented of the spontaneous answers on the open questions of the above mentioned groups. When the results are analyzed, we find that the problems which are mentioned most are the depletion of non-renewable resources, local and global air pollution, safety and congestion; a very large share of the Dutch students also mentions the competitiveness of alternatives for conventional cars as a main problem. The other problems receive fewer responses. Some interesting differences can be found in the distinct groups of respondents. First, it appears that the students focus almost entirely on technical and physical issues like alternatives for cars, efficient use infrastructure, conges-

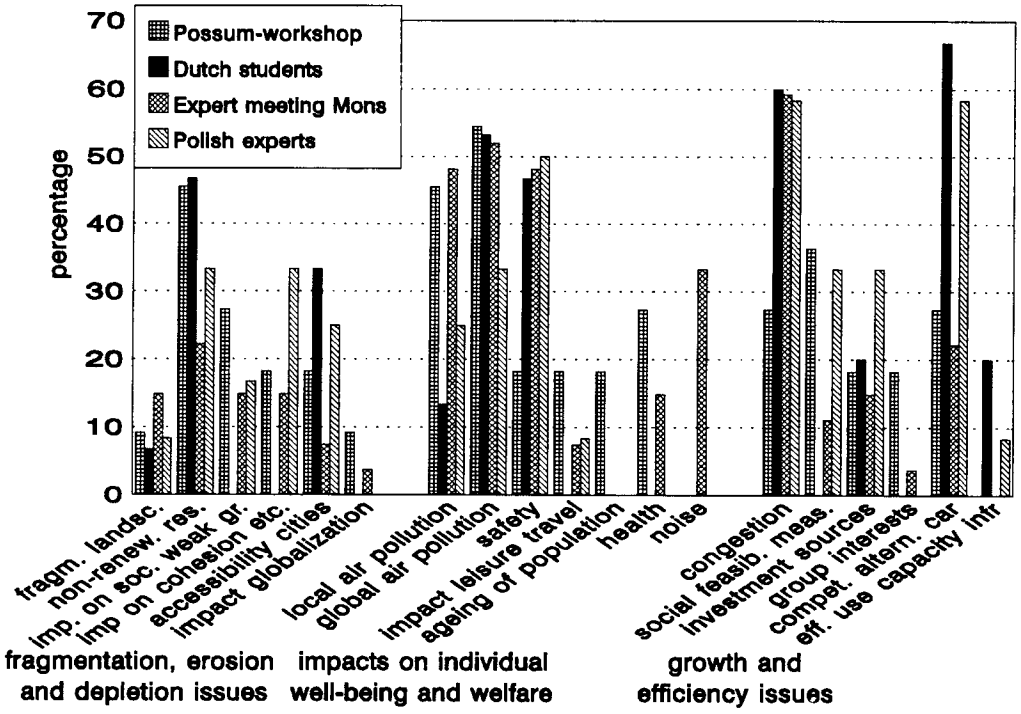


Figure 2 Perceived problems by the four focus groups

tion; while more 'social' or institutional issues are mentioned much less (e.g., impact on social weak groups, impact on the European cohesion, ageing etc.). Apparently, experts are more focused on such issues than the younger generation is. Interesting is also that the Polish experts show much concern with the competitiveness of the alternatives of the private car, which may be due to the fact that they are experiencing rapid deterioration of the public transport system.

Also some other striking results can be identified. Local air pollution is only a minor concern for the Dutch students and Polish experts, while congestion is mentioned the least in the POSSUM workshop and the depletion of non-renewable resources is mentioned the least by the Mons experts. Accessibility of cities on the other hand is often mentioned by the young generation, while noise annoyance only is mentioned by the experts in Mons. Furthermore, also global air pollution is mentioned the least by the Polish experts; in general it can be concluded that the Polish experts mention environmental issues less than the other focus groups do. On the other hand, this group is more concerned with investment sources, especially of the public sector, which may be due to the large budget cuts in Poland as a result of the economic transformation.

In the questionnaire to the Mons and Polish experts it was also asked to give scores to distinct problems as they occur now and the expectations on the importance in the year 2020; the results are presented in Figure 3.

It appears that in this way of questioning, the answers are much more equal than in the previous experiment. A second striking observation is that each

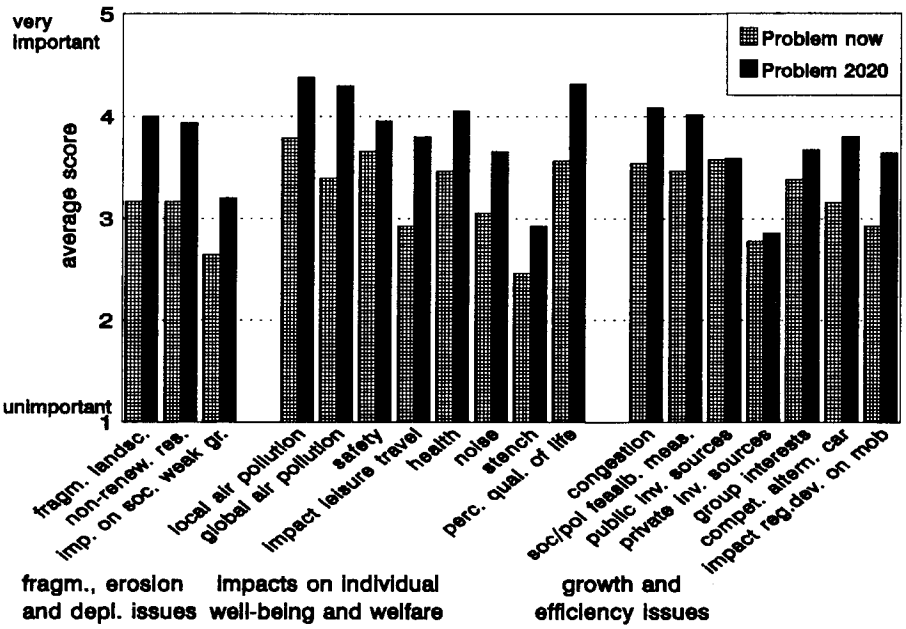


Figure 3 Average scores for problems caused by transport given by Mons experts

problem is likely to increase, so that policies and other measures are not expected to sufficiently reduce the problems caused by transport. Some of the most interesting results will be discussed next.

Fragmentation problems are mostly getting lower scores than other categories. Especially social fragmentation (represented by the impact on socially weak groups) is not considered to be an important problem. Interestingly, both fragmentation of landscapes and depletion of resources problems are likely to become much more important in the next 25 years.

Of the impacts on **individual well being** the highest scores are found for air pollution, safety, health and the perceived quality of life. Safety is however not expected to become a much more important problem; the other three issues receive a score of more than four. Striking is also the expectation that leisure travel will become much more important in the next 25 years, although nowadays this is not a main issue.

Finally, also **growth and efficiency** issues are quite important. Congestion is seen as the most important problem, followed by institutional problems like the social and political feasibility and the impact of group interests, while also the availability of public investment sources is considered much less problematic. In this respect it is interesting that the availability of private sources is not thought to become a main problem. The competitiveness of alternatives for the private car is not seen as an important problem, the same holds for the impact of regional development on mobility levels.

After the investigation of expert opinions, the second method was to review the literature; these results will concisely discussed now.

2.2 Indicators of economic efficiency

The economic efficiency indicators are derived mainly from general welfare economics theory and EU policy documents. General welfare economics identifies two different criteria for efficiency improvements: the strict Pareto criterion and the wider Kaldor-Hicks criterion (Baumol and Oates, 1988). 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 and compensation can take place (Baumol and Oates, 1988).

A starting point for both definitions is the maximisation of economic growth from a given set of resources. It is less evident what this may mean for the transport sector. When transport is regarded as a resource, economic efficiency can be defined as the minimisation of transport needs per unit of economic growth. Dematerialization and the substitution of physical flows by non-physical flows might be vital characteristics of a transport efficient economy (see for example Pestel and Johnston, 1996). When transport is regarded as a contributor to economic growth, economic growth takes on a different meaning. In EU policy documents, transport is seen as essential to the functioning of the internal market, where a low cost transport system reduces natural spatial barriers (e.g. CEC, 1993). In this context, economic efficiency is related to maximisation of transport performance per unit of (public and private) transport expenditure (see for example Van Gent and Nijkamp, 1991). Other economic efficiency indicators might include the minimization of direct, indirect private and public costs (e.g. costs of accidents, congestion, infrastructure construction, maintenance, etc.).

Since there are a number of perspectives on economic efficiency, it is not easy to formulate widely accepted and operational indicators for economic efficiency. Three indicators of economic efficiency are therefore chosen which accord fairly well with each of the different interpretations of economic efficiency and cover directly or indirectly the main efficiency issues mentioned by the experts:

* ratio of vehicle-km and 'green' GDP;
* ratio of total transport costs and 'green' GDP;
* total transport costs (public, private, direct and indirect).

'Green ' GDP accounts for some of the external costs not counted in the conventional measure of GDP (see for example Jackson and Marks, 1994). In order to move towards greater economic efficiency, each of the three indicators should decrease in magnitude. In an ideal situation, both total transport costs and vehicle-km decrease, whilst 'green' GDP increases. In other words, this represents a decoupling situation where economic growth is independent of transport growth (see Von Weiszäcker et al., 1997).

2.3 Indicators of regional development

The regional development indicators are derived mainly from literature concerning the effects of transport policy on regional development. Indicators from EU policy documents are also used. Generally speaking, regional development is interpreted by the EU as economic improvements in the poorest regions. The improvement in accessibility, through programmes such as the TENs is seen as a way of promoting regional development (CEC, 1992).

It is argued, however, that there is no clear link between regional development and the quality of transport links between the regions and other economic centres (Bruinsma et al., 1997; Vickerman, 1995). Different regions have different economic structures and different transport needs. It is argued that better transport links between strong competitive regions and economically weak peripheries may increase polarization instead of cohesion (see for example Hey et al., 1996). Vickerman (1995) argues that 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 the wider issues of quality, interchanges and discontinuities of the network. In order to account for these issues, Vickerman (1996) suggests a mix of different accessibility indicators, taking into account frequency, modal choices, economic structure, modal discontinuities, etc. This is a complicated approach for assessing the impacts of scenarios on regional development.

A traditional approach to accessibility may lead to the selection of an indicator such as the improvement of inter-regional access to economic centres. CEC (1994) applies a measure of average access time to major European economic centres using the best available modes. This index (called the BFLR-index) is a measure of average access times to 194 major economic centres from individual NUTS III regions. There is a difference between regions with the lowest and the highest accessibility by a factor of four. Due to geographical differences this difference never can be equalized, only improved.

A different approach to developing indicators of regional development concerns accessibility within regions. Since most traffic is regional, an alternative indicator of regional development might be intra-regional accessibility. This could be measured by a coefficient which compares intra-regional accessibility with inter-regional accessibility. The inter-regional accessibility could be measured using an analogous indicator to intra-regional accessibility, and could be constructed by identifying the main economic centres within each NUTS III region.

Like economic efficiency, there are a number of perspectives on regional development. It is not easy to formulate a small number of representative indicators of regional development. For the purposes of this paper, three indicators of regional development are chosen which accord fairly well with the different interpretations of regional development, while they also relate to the main issues identified above:

* ratio of BLFR-index for central regions and BLFR-index for peripheral regions;

* ratio of inter-regional accessibility (analogous to the BLFR-index) in central and inter-regional accessibility in peripheral regions;
* ratio of intra-regional and inter-regional accessibility.

It is assumed that regional development is associated with decreases in the magnitude of each indicator. In an ideal situation, both inter-regional accessibility and intra-regional accessibility increase at a faster rate in peripheral regions than in central regions. At the same time, inter-regional accessibility across Europe (all NUTS III regions) increases at a faster rate than intra-regional accessibility (BLFR-index).

2.4 Indicators of environmental protection

Indicators of environmental protection are arguably easier to identify. There is a more extensive body of literature on environmental indicators for transport (e.g., OECD, 1993), there are various EU environmental targets (CEC, 1996), and there are several other studies to have used environmental indicators to examine the impacts of transport policy on the environment (e.g., RCEP, 1994). One difficulty, however, is the selection of a small number of representative indicators from a large number of potentially useful environmental indicators.

Table 2 illustrates the range of available environmental indicators from a selection of literature sources. These indicators represent the spectrum of environmental impacts or transport, ranging from local to national through to global. There are also several EU environmental targets which can also be used to identify environmental indicators. Existing targets include CO_2 emissions, NO_x emissions, dioxins, volatile organic compounds (VOCs), noise and biodiversity (Table 3).

After reviewing expert opinions, the range of indicators from other studies and environmental targets adopted by the EU, the next indicators may be identified (for details, see Rienstra et al. 1997):

* carbon dioxide (CO_2) emissions from transport;
* nitrogen oxide (NO_x) emissions from transport;
* non-renewable energy consumed by transport.

The three environmental indicators reflect local, national and global impacts. CO_2 is the most significant greenhouse gas. Transport contributes more than 23% of total CO_2 emissions in Europe (CEC, 1992), which share is increasing year by year. More than half of all NO_x emissions in Europe are produced by transport (OECD/ECMT, 1995). Like CO_2, emissions of NO_x from transport have also increased over time, but emissions of NO_x can be reduced substantially through the use of technology. NO_x is an indicator of both local and national pollution. Nitrogen oxides, in combination with other pollutants, form secondary pollutants, such as nitrogen dioxide and ozone. These pollutants contribute to poor air quality and have been linked to various impacts on human health. NO_x emissions are also responsible for acidification (acid rain). The consumption of non-renewable energy by transport is an indicator of both resource consumption

Table 2 Examples of environmental indicators from a selection of literature sources

Type of indicator	Proposed by	Scale
RESOURCE CONSUMPTION:		
• proportion of energy consumed by transport	Department of the Environment (1996); Environment Canada (1995); OECD (1993)	global/national
• energy consumption by mode	Environment Canada (1995); OECD (1993); RSPB et al. (1995)	global/national
POLLUTION		
• proportion of global pollutants (CO_2, NO_x) from transport	Barton (1995); LGMB (1994); OECD(1993); Pearce (1993); RCEP (1994); RSPB et al. (1995); SERPLAN (1995)	global/national
• proportion of local pollutants (CO, VOCs, particulates) from transport	LGMB (1994); OECD (1993); Pearce (1993); RCEP (1994); RSPB et al. (1995)	global/national
• proportion of waste from transport sector	OECD (1993)	national
• proportion of population affected by transport noise	LGMB (1994); OECD (1993); RCEP (1994)	global/national/ regional/local
LAND:		
• land lost through infrastructure construction	Department of the Environment (1996): OECD (1993); RSPB et al. (1995); RCEP (1994)	global/national
MINERALS:		
• aggregates production for transport infrastructure	SERPLAN (1995); RCEP (1994)	national/regional
• oil production for transport	OECD (1993)	global
AIR:		
• levels of local pollutants in air	OECD (1993); LGMB (1994)	local
HEALTH:		
• incidence of asthma	LGMB (1994)	national /regional/local
• transport accidents	Barton (1995); OECD (1993); LGMB (1994); RSPB et al. (1995); Pearce (1993)	global/national /regional/local
• ambient noise levels from transport	OECD (1993)	national /regional/local

Table 3 EU environmental targets

Issue	EU environmental targets
CO_2 emissions	Stabilization (1990-2000)
NO_x emissions	30% reduction (1990-2005)
Dioxins	90% reduction (1985-2005)
Noise	threshold: 65db; no additional noise beyond 55db
Nature protection	'Natura 2000' network; habitat and birds directives
VOCs	30% reduction (1990-2000)

Source: Hey et al., 1998.

and pollution emissions. Generally speaking, the more of non-renewable energy is consumed by transport, the more pollution is produced. In addition to CO_2 and VO_x, energy consumption also indicates pollutants such as volatile organic compounds (VOCs), particulates and carbon monoxide (CO). Environmental protection is associated with decreases in the magnitude of each of the three indicators. In an ideal situation, all three indicators decrease simultaneously.

3 Policy Scenarios

Six scenarios are used to examine the impacts of transport policy on economic efficiency, regional development and environmental protection. The scenarios are constructed to reflect the three main policy objectives of the CTP (economic efficiency, regional development and environmental protection) and two alternative futures for Europe (external frameworks): 'polarisation' and 'cooperation'. The concern social and institutional issues, which may largely influence the future of transport, but - as found when discussing the expert opinions - are not considered to be the most important factors in our scenario analysis (see also Rienstra and Nijkamp, 1997). The characteristics of the two external frameworks are summarised in Table 4.

Table 4 Features of the polarisation and cooperation external frameworks

Polarisation	**Cooperation**
Institutional/economic * EU integration is halted: no new members, no EMU * Little European coordination of transport and environmental policies * Little cooperation in research and development * Low economic growth *Social* * Little support for transport and environmental policy measures * Equity is not an important policy objective	*Institutional/economic* * EU integrates further: more members, EMU * Strong coordination of European transport and environmental policies * European coordination of research and development * High economic growth *Social* * Wide support for transport and environmental measures * Social cohesion/equity is an important policy issue

The two alternative frameworks have been used in conjunction with the three broad objectives of the CTP (regional development, economic efficiency and environmental protection) to produce six scenarios (Table 5), each of which emphasises one of the three objectives within a polarisation or cooperation external framework.

Sets of policies in each scenario are constructed to be compatible with the policy objective and the external framework. Indicators of economic efficiency, regional development and environmental protection are then developed in order to assess the main impacts of each scenario. The results of the assessment are used to evaluate the complementarity of policy objectives, and the difference in outcomes according to alternative external frameworks. The two external frameworks allow comparison of the effects of different policy packages under two opposing and relatively extreme positions for the future of European policy-making and policy implementation. The detailed characteristics of each scenario are described elsewhere (POSSUM, 1997; Rienstra et al., 1997); a summary is presented in Table 6.

Table 6 Summary of the six 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	*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 * City development
Equitable Nations Regional development-Polarisation * Protectionism * Some privatisation * No road pricing or high fuel price increases * Little new transport infrastructure * Core zone declines, periphery high growth rates based on own strength * Public transport declines * Little technical development	*Equitable Europe* Regional development - Cooperation * No privatisation * No pricing measures * High growth in periphery initiated by European funds * Telecommunications important * Cities neglected * HST and airport investments * Little new technologies * Reduced public transport use * High mobility growth
Environmental Nations Environment - Polarisation * No privatisation * Limited road and other pricing * Core dominant and dense development * HST network completed * Public transport expanded * Large scale investments in new fuels	*Environmental Europe* Environment - Cooperation * No privatisation * Much road and other pricing * Large scale investments in public transport * Car use restricted * Core zone dominant * New fuels introduced * Public transport dominant

The indicators of economic efficiency, regional development and environmental protection are used to analyse the impacts of the scenarios on the three main policy objectives, and examine the extent to which these objectives are achieved for each scenario

4 Indicator Scores for Each Scenario

Next, the distinct scenarios can be analysed by giving scores on the indicators identified above. Based on expert opinions each scenario was given a score ranging from 1 to 5, in which a score of '1' means that the indicator develops

very negatively, while a score of '5' means a very positive development, in which the policy objective with respect to that indicator is achieved. The scores on the various indicators are presented in an adapted version of the Spider model, as developed in Nijkamp et al. (1997).

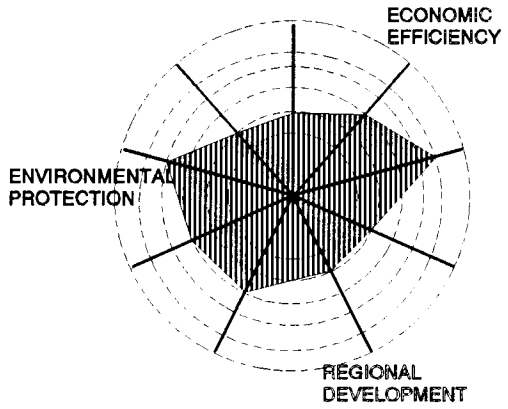
The Spider model is divided in three dimensions each presenting one of the three objectives of efficiency, regional development and environmental protection. Next, these dimensions are subdivided in three axes, each presenting one of the indicators. The order of the indicators - starting with the vertical axis - is: (i) vehicle km./'green' GDP, (ii) transport costs/'green' GDP, (iii) all transport costs, (iv) intra-regional accessibility, (v) inter-regional accessibility, (vi) ratio intra-/inter regional accessibility, (vii) CO_2 emissions, (viii) NO_x emissions, (ix) non-renewable energy use (see also Stead and Banister, 1997). The inner circle of the Spider model presents the score '1', the outer circle the score '5'. (see Figure 4). It should be acknowledged when analysing the distinct figures, that the marked space is no measure for the attractiveness of the scenario, because this depends on the order of the distinct axes. The next conclusions can be drawn regarding the distinct scenarios.

In the *Competitive nations* scenario, reduced mobility growth and more energy efficient vehicles will have a positive effect on reducing CO_2 and NO_x emissions. Government expenditure on transport will fall. Transport subsidies will be lower because of the emphasis on privatisation and liberalisation. The same holds for investments in infrastructure. Regional disparities will increase. Total vehicle kilometres will be reduced to some extent, because of road pricing measures combined with low economic growth (assumed for all scenarios in the polarisation framework). These factors will help reduce congestion.

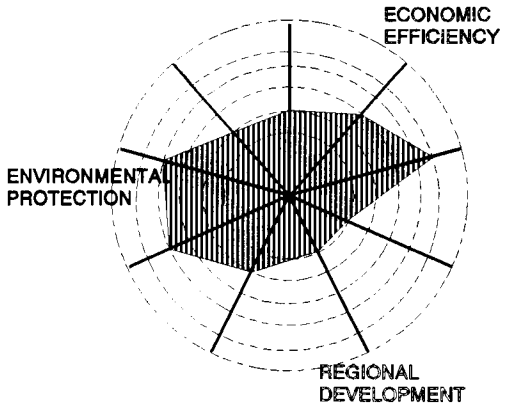
The *Equitable nations* scenario will have no great impact on emissions. Mobility growth will remain unchanged. Modal shift and new technologies are unlikely. Government expenditure on transport subsidies and infrastructure will decrease and will be directed at particular locations or population groups. Total vehicle kilometres will not change significantly because of higher growth in peripheral regions, counteracting any reductions in the core-zone. Regional development objectives will be achieved.

The *Environmental nations* scenario will result in the introduction of alternative fuels and, consequently, significant reductions in CO_2 and NO_x emissions. This will require large government subsidies. Investment in public transport infrastructure will be high if a significant modal shift is to be achieved. The scenario will not have very positive or negative effects on other indicators. Mobility levels will remain relatively unchanged if emission reductions can be achieved through technological developments.

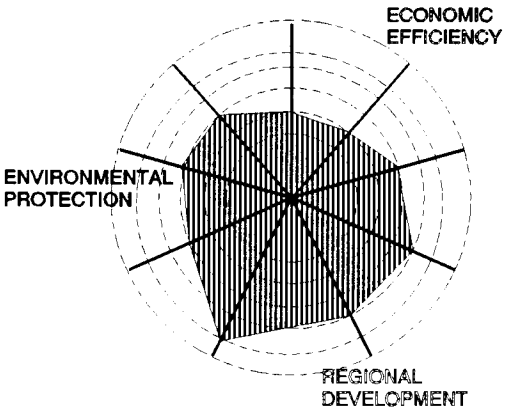
In the *Competitive Europe* scenario, emissions of CO_2 and NO_x are likely to fall as a result of road pricing measures. Because of the privatisation of transport operations and the introduction of road pricing, government expenditure on transport subsidies will be reduced. Similar reductions will take place for expenditure on transport infrastructure, although some investments in infrastructure in peripheral regions will still be approved. Regional development objectives are not achieved in this scenario. Transport demand will be reduced because of



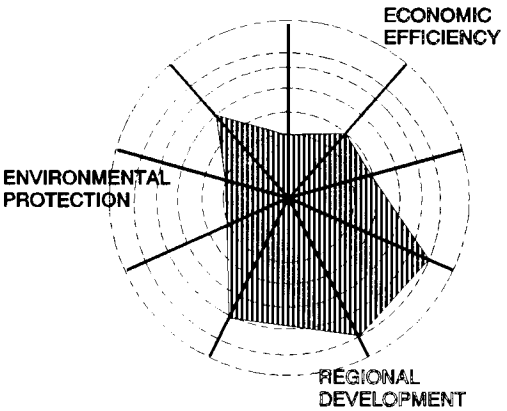
1. SPIDER MODEL FOR COMPETITIVE NATIONS



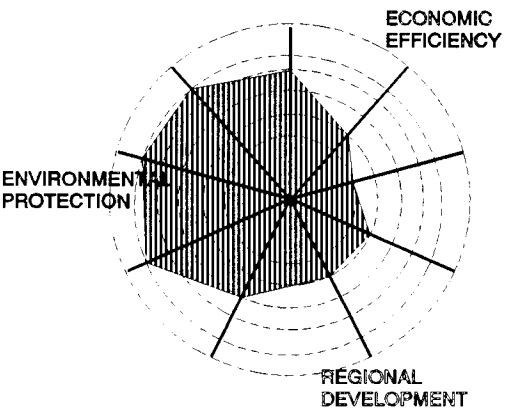
4. SPIDER MODEL FOR COMPETITIVE EUROPE



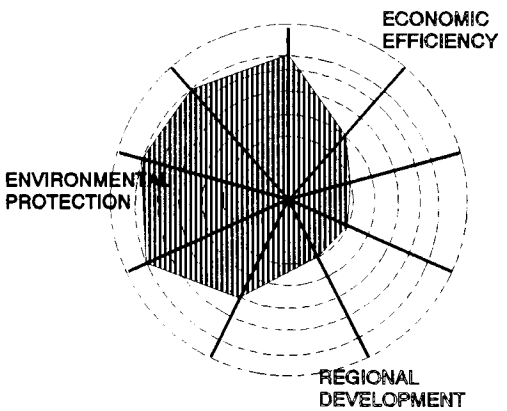
2. SPIDER MODEL FOR EQUITABLE EUROPE



5. SPIDER MODEL FOR EQUITABLE EUROPE



3. SPIDER MODEL FOR ENVIRONMENTAL NATIONS



6. SPIDER MODEL FOR ENVIRONMENTAL EUROPE

Figure 4 Scores of distinct scenarios presented in the Spider model

the pricing mechanisms used and the spatial concentration which has taken place. As a result of these measures, congestion will also be reduced.

In the *Equitable Europe* scenario, travel distance will increase, mainly due to higher long distance travel. This growth will be fuelled by the construction of Trans-European transport infrastructure. This will result in economic growth in peripheral regions. Environmental and economic objectives will not be achieved. Emissions of CO_2 and NO_x will grow, and congestion in most areas will increase.

In the *Environmental Europe* scenario, the modal shift achieved by policy will have some positive impacts on reducing CO_2 and NO_x emissions, but require large government expenditure for subsidies and infrastructure. These will be partly paid by road pricing revenues, so that overall government expenditure for transport provision does not increase. Total transport demand will decrease to some extent due to reduced car use, and this in turn will have positive benefits on congestion levels. Negative impacts on the regional development of peripheral regions will occur as a consequence of measures to reduce car use and promote more extensive provision of public transport in the core-zone.

There is no win-win-win strategy within either external framework. Lower scores on some indicators (movement towards the objective) are matched by higher scores on other indicators (movement away from the objective).

5 Conclusions

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

This paper has discussed a variety of international, national and regional/local indicators of sustainable development which have been developed for transport and other sectors. Relevant indicators from other sources have been used to compile a set of potential indicators and inputs from experts have been used to identify the main issues. The process of indicator design, generation and selection begins with a scoping exercise, in which principles of sustainable development are identified and the concept of sustainable mobility is discussed.

Literature on environmental indicators is fairly extensive and comprehensive. A range of indicators for this objective are in use. Literature on indicators of regional development, on the other hand, are much less extensive or comprehensive. Only a small number of indicators are suitable for use, due to the absence of appropriate measures and data. Examples of indicators of economic efficiency are not as extensive as environmental indicators, but more extensive than regional development indicators. A reasonable number of indicators are suitable for use.

A total of 9 indicators have been chosen, each representing one or more key impacts of transport on issues of regional development, economy and/or environment. These indicators are used to assess scenarios with respect to the Common Transport Policy of the EU within two external frameworks (polarisation and cooperation). Interestingly, the polarisation framework gives a better starting point for the achievement of efficiency and environmental objectives, due to the lower mobility levels. This advantage is however compensated by the more efficient policy making in the cooperation framework, so that in the end the outcomes within the two frameworks are about similar. For regional development this may not hold, because of the higher regional development funds in the cooperation framework; regional development within the polarisation framework should be achieved on own strength, therefore.

It seems that there may be some complementarity between economic efficiency and environmental protection objectives in most scenarios. There is little complementarity, however, between regional development and environmental or efficiency objectives. It is unlikely that all three main objectives can be achieved simultaneously (Figure 5).

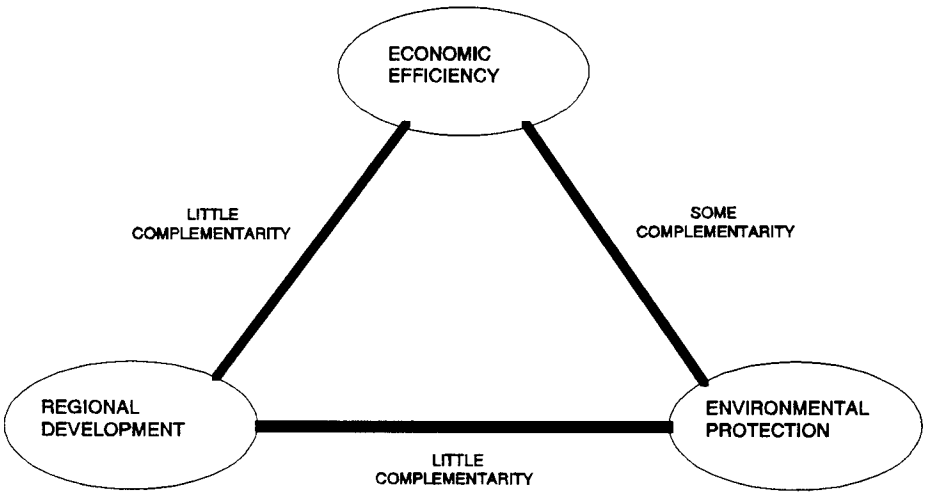


Figure 5 The complementarity of economic efficiency, regional development and environmental protection policy objectives

It can be concluded, that indicators are a useful tool for assessing policy packages, by making the impacts of measures clearer and easily accessible for policy makers.

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