Desirability and Feasibility of Sustainable Urban Transport Systems
Nijkamp, P.; Ouwersloot, H.; Rienstra, S.

published in
Urban Studies
1997

document version
Publisher's PDF, also known as Version of record

Link to publication in VU Research Portal

citation for published version (APA)

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

• Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
• You may not further distribute the material or use it for any profit-making activity or commercial gain
• You may freely distribute the URL identifying the publication in the public portal

Take down policy
If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

E-mail address:
vuresearchportal.ub@vu.nl
Sustainable Urban Transport Systems: An Expert-based Strategic Scenario Approach

Peter Nijkamp, Hans Ouwersloot and Sytze A. Rienstra

Summary. Current trends in transport indicate that the system is moving away from sustainability and that major changes are necessary to make the transport system more compatible with environmental sustainability. Main problems may occur in urban transport, where not many promising solutions are expected, while the problems are severe. In view of the great number of uncertainties, we will in our paper resort to the use of scenarios. We will address in particular expert scenarios, concerned with a sustainable transport system, by applying the recently developed spider model. Based on a set of distinct characteristics, represented in eight axes in the spatial, institutional, economic and social-psychological field, an evaluation framework is constructed which visualises the driving forces that largely influence the future of the urban transport system. Next, expected and desired scenarios are constructed on the basis of information obtained from a survey among Dutch transport experts (both average scenarios and scenarios reflecting segments of respondents). The expected scenarios show that many current trends will continue, while the transport system is largely the same as the current one. The desired scenarios on the other hand, suggest the emergence and the need for a more collective system, in which also many new modes are operating. In the paper the resulting urban transport systems are also discussed. By calculating the CO$_2$ emissions in the average expected and desired scenario, we can test the fulfilment of environmental quality norms. It appears that the expected scenario does not lead to a significant reduction of those emissions; the desired scenario however, may lead to a large scale reduction of the emissions. The conclusion is that the differences in expert opinion are small and that a sustainable (urban) transport system is still far away in the future, although the compact city concept may perhaps offer a promising perspective.

1. Introduction

The industrialised part of our world appears to have the highest transport mobility rates. In particular, the economic heartlands of the developed world have to digest unprecedented volumes of traffic, and hence traffic in urban areas is a major problem causing high social costs. Clearly, transport is a necessary part of economic development, but causes at the same time a wide range of negative (i.e. unpaid) externalities in the form of congestion, traffic insecurity, environmental pollution, landscape destruction and solid waste. According to recent estimates, already nowadays the social costs of transport amount to some 3 per cent of GDP (Verhoeef, 1996) and this figure is gradually rising in all countries. In the light of recent policy targets to reduce not only the growth

Peter Nijkamp, Hans Ouwersloot and Sytze A. Rienstra are in the Department of Spatial Economics, Free University Amsterdam, De Boelelaan 1105, 1081 HV Amsterdam, The Netherlands. Fax: x-31-20 4446004. E-mail: rienenstra@econ.vu.nl; pnikamp@econ.vu.nl; houwersloot@econ.vu.nl.
of pollution emissions, but also their absolute levels, it is clear that transport activities do create an unsustainable development, especially in urbanised areas (OECD/ECMT, 1995).

A wide range of policy measures has recently been proposed to cope with the high social costs of geographical mobility—for example, information campaigns, user charges, emission standards, constraints on mobility, new forms of land use and physical planning, and new transport technologies. A main objective in most urban areas is also to stimulate public transport and to reduce car use (Pharoah and Apel, 1996). Experiences from different countries and cities, however, have shown that there is no single unambiguous and effective remedy.

Many problems are nowadays found in the field of urban transport (Hart, 1994). Metropolitan areas continue to be more productive and innovative growth poles than rural regions, and consequently the spatial area covered by large metropolises has largely increased. At the same time, a trend of suburbanisation took place, while car ownership and use rose dramatically (Nijkamp, 1994). The awareness has grown that the future of cities is largely dependent on transport accessibility, while at the same time transport externalities may erode the quality of life in cities. And thus the question is: what will be the viability of urban transport in light of the great many externalities? Therefore, it is interesting to analyse how transport experts judge the future of—especially urban—transport and whether there will be scope for sustainable urban transport. Clearly, this question is fraught with many difficulties. In the context of the present paper, we will conceive of a sustainable transport system as a system which generates—now and in the foreseeable future—a level of mobility which does not exceed pre-specified levels of negative externalities (pollution emission, noise annoyance, etc.).

In this paper we will discuss the future of (urban) transport by designing several scenarios, based on an extensive survey questionnaire among a large sample of Dutch transport experts. First, we will elaborate on the factors influencing urban transport. Next, the general expert-based scenarios—an expected and a desired one—are discussed with particular reference to urban transport. Then we will turn to a more detailed scenario analysis of so-called proactive and conservative strategies. In the final section, some conclusions are drawn.

2. Factors Influencing Urban Transport

Although the intricate relationship between transport and spatial organisation is widely recognised, other driving factors may also be distinguished that are critical for the future of the urban transport system. In this section, we will concisely discuss spatial, institutional, economic and socio-psychological factors. The focus in this analysis will be put on possibilities to reduce car use and stimulate public transport use.

Urban Transport and Spatial Organisation

A general phenomenon experienced by almost all cities in the world is the suburbanisation of residents (OECD/ECMT, 1995). Although the first waves of this suburbanisation occurred many decades ago (partly based on public transport), the extent to which it has developed since the early 1960s has been unprecedented. Particularly the private car has brought low-density living within reach of large groups of upper and lower middle-class families. In fact, suburbanisation of living was a consequence of various broad changes in society, such as income increase, smaller households, more leisure time and changing housing preferences. Suburbanisation is usually also associated with negative socio-economic and environmental impacts, such as longer working and shopping trips, more energy consumption, pollution, accidents and problems of public transport provision in low-density areas (Masser et al., 1992).

The suburbanisation of living was followed by a second wave of suburbanisation
of employment in the 1970s and 1980s. Thus, dwellings as well as jobs tended to disperse further from urban centres into a broader metropolitan area, a process which may be called extended suburbanisation or counter-suburbanisation (Breheny, 1996). Such decentralised cities are usually negatively valued, because they contribute to an increase in the length of work trips and prohibit public transport solutions for commuting.

At the same time, there are some signs which suggest that suburbanisation of living may have passed its peak and that a phase of re-urbanisation may start. In this view, there is a strong revitalisation trend in inner-city areas, accompanied by the attraction of affluent residents who can afford to pay the increased rents in city centres (gentrification).

In the light of the above trends and views on suburbanisation and urban sprawl, one particular extreme type of future city can be identified, namely the diffuse (decentralised) city. Large cities such as London and Paris, and smaller ones such as Milan and Brussels, seem to conform to this development pattern. In regard to spatial planning however, a contrasting concept has recently gained much popularity: the ‘compact’ city, where housing is provided at a relatively high density and jobs are concentrated in the central city and in a limited number of sub-centres. The compact city has become a leading principle in Dutch physical planning in recent years, and is currently adopted in Europe as a guideline for urban planning (Breheny, 1996).

Such compact urban spatial organisation may have a drastic impact on the future of transport (mobility level, modal split) (Nijkamp and Rienstra, 1996). In general, compact (high-density) cities are associated with a high use of public transport and a low gasoline consumption (Newman and Kenworthy, 1989). At the same time, however, it should be noticed that the compact city concept also has some intrinsic limitations in terms of quality of life, land use and prices, and congestion, while many other success factors (level of well-being, telecommunications) also have a huge impact on the future of transport and the introduction of new technologies. Finally, it should be recognised that spatial organisation is not the only factor influencing urban transport, as will be discussed next.

**Institutional and Economic Factors**

In recent years, a marked shift in emphasis on economic principles for a combined transport, environment and spatial policy can be observed. In spatial planning a trend towards abolishment of rigid planning systems is found, because government intervention is less accepted in society and is perceived to be less effective (Fokkema and Nijkamp, 1994). In transport policy, various user-charge principles are increasingly being discussed and implemented, such as road pricing, toll principles, parking fees and perhaps in the long run even tradable permits. These measures mainly affect car transport and may stimulate the use of public transport.

However, there is also the trend to abolish unjustified and unnecessary protectionist or privileged regulations in order to increase the efficiency of transport operations. In this respect, increased attention is being paid to the efficiency and the profitability of, for example, public urban transit companies. For example, in many cities of the UK, public bus companies have largely been privatised, which has had an enormous impact on the way the bus network is being operated. Important factors in this respect are the minimum volume of passengers between given points that are necessary for a collective transport mode to be in operation and to make it feasible from an economic perspective. In this respect, barriers to adoption arise when (critical) spatial threshold levels of demand for collective modes are not reached—for example, due to a low population density (Rienstra et al., 1996).

Another aspect in which collective systems may be distinguished from individual ones concerns the dependence on supplemen-
tary transport systems. Travelling by collective modes is intermodal by nature, while individual modes offer door-to-door transport. This makes the functioning of collective modes dependent on connectivity with other transport systems (including walking and cycling) that offer transport to and from the nodes. Co-ordination problems between different modes may be an important failure factor in this case. However, socio-psychological factors may also play an important role, as will be indicated hereafter.

**Socio-psychological Factors**

The private car appears to have a strong psychological appeal, because factors like pleasure, privacy, personal control and representativeness largely contribute to the preference for the private car (Vlek and Michon, 1992). The same may hold for the diffuse life-pattern of individuals, since living conditions in compact urban areas may be considered worse than those in more diffuse cities.

Another problem for collectivisation of transport is that the behaviour of individuals is hard to change, because the perceived advantages of other transport options appear to be low, while the acceptance of the construction of large-scale infrastructure in cities with little space may cause resistance in society. Subterranean construction is an (expensive) solution in this case. The same may hold when large-scale measures are taken to reduce car traffic in cities.

In this respect, it should be added that in democratic countries governments do not favour measures which largely run counter to public opinion (Rietveld, 1996). Therefore, a change in public attitude would first have to occur before the above discussed policies could be introduced successfully.

It may be concluded that there are many factors influencing the urban transport system, while the future outcomes of these factors are uncertain. Therefore, it is interesting to analyse how transport experts view the future. This will be investigated by means of scenario experiments in the next sections.

3. **Methodology of Scenario Construction**

To investigate the future in such a complex and multi-faceted environment, scenarios are a promising and interesting tool. Therefore, we will in this paper design several scenarios—focusing on urban transport—based on expert opinions. First, however, we will briefly discuss the methodology of scenario construction in general and the methodology used in this paper.

**General Introduction**

Scenarios for new transport systems can be designed on the basis of different principles. At least three different approaches to transport scenario design can be distinguished:

1. *A single technological paradigm* (e.g. magnetic levitation); this is a straightforward engineering approach, in which a new technology is assumed as the core of a transport system, while next the consequences can be traced by a qualitative impact assessment (see Gröbler and Nakicenovic, 1991).

2. *A compound transport–land-use package approach* (e.g. a transport system for zero-emission cities); in this case, a comprehensive set of relevant features of the transport system is combined with contextual factors (such as land use, commuting behaviour, residential policy) in order to create a multi-faceted image of a comprehensive nature (see Masser et al., 1992).

3. *A compound behavioural framing approach* in which the background conditions of transport behaviour (spatial, institutional, economic, socio-psychological) are mapped out (e.g. a deregulated urban transport system); in this approach, the framing conditions are used to identify which transport technologies are in agreement with behavioural preferences and expectations, based, for example, on expert opinion (see Nijkamp et al., 1997). The latter approach has been adopted in this paper.
There are several ways of constructing scenarios: they may be intuitive, a literary product (mostly historical), idealistic, based on qualitative expert assessment, or an instrument for quantitative forecasts (Svidén, 1989). The main distinctions between scenarios are the following (Nijkamp and Blaas, 1994):

—A scenario may be either descriptive or normative. Descriptive scenarios scan the future and map out a range of possibilities. Normative scenarios include issues about, for example, the desirability of a development or future choice. Normative scenarios may be constructed by means of majority responses, but also by using small minority opinions.

—A scenario may be projective (based on forecasting, in which the future picture is based upon the present situation and future paths leading to it) or it may be prospective (based on backcasting in which first the future image is given, while next the paths leading to it are described).

—Future images may be trend or extreme (reference) scenarios; the former are based on extrapolations of current trends, while the latter suppose a shock or structural change, which leads to an entirely different future of the transport system.

In this paper, we will construct both descriptive (expected) and normative (desired) scenarios, which are prospective and both trend-oriented and extreme in nature. First, the methodology used in this paper will be elaborated.

Methodology Used for Sustainable Transport Scenarios: The Spider Model

Many driving factors are important for the future of transport systems. For our analysis, we have classified them into four groups—spatial, institutional, economic and social/psychological aspects (see Section 2). In the scenarios designed here, the future transport system is supposed to be the result of forces and developments in these four fields. The most important future developments may be studied by using a qualitative multi-criteria analysis, which is visualised here by means of the so-called spider model (see Figure 1).

For each of the four above-mentioned fields, two characteristic features are distinguished. These features can be qualitatively depicted by means of axes drawn in spider space, which represent the most important factors influencing the future of transport and the transport technologies used. They will now concisely be described.

The first quadrant contains the spatial aspects influencing transport systems. On the first axis, possible developments in future spatial organisation are mapped out. At the one extreme (interior) side of this axis we find the so-called chains and zones model in contrast to the specialisation and concentration model depicted at the exterior side. The chains and zones model refers to uncontrolled land use and many criss-cross mobility patterns, whereas the specialisation and concentration model represents mainly large-scale concentration (RPD, 1991). The second axis concerning the spatial aspects depicts a range of urban patterns; it describes two opposed patterns—the diffuse and the compact city (as a result of explicit urban policy efforts).

In the institutional domain (axes 3 and 4), we investigate the control and managerial systems for sustainable mobility. On the third axis, the degree of government intervention is depicted; the opposing extreme modes here are regulation versus market-based measures. The management of transport modes and infrastructure are found on the next axis, where the two extreme ways in which this can be organised—public versus private—are presented. In this context, public transport means that the ownership and the operation of the transport companies are the sole responsibility of the government (or governmental agencies).

Another important driving force stems from the economic field in terms of efficiency and financing. The fifth axis concerns the feasibility of transport, as the required profitability of the system is an important factor for the future of transport.
The main question in this case is whether the government wants to subsidise transport or whether transport modes should be operated on a commercial basis; in this context, the private financing of infrastructure may also be attractive. The next axis describes the involvement of the government with the economy. The extremes are the overall introduction of market principles in the economy versus co-ordination by the government (which may be achieved by some form of centralised government). This consideration is important for future economic growth, regional development, the construction of infrastructure towards peripheral regions, etc.

Finally, socio-psychological factors are considered. On the seventh axis, equity is confronted with inequity. Non-intervention may favour inequity in society (for example, an uneven income distribution, or uneven chances for individuals, in terms of travelling and education), while on the other hand much public governance may emphasise equity measures (social security, discounts on travelling costs, etc.). The eighth and final axis reflects individualisation versus social cohesion, including related social behavioural developments (for example, demographic, educational), which may have again consequences for transport.

Spiders can now be constructed by combining the eight points on the successive axes. The final step is to compose a comprehensive future scenario that neatly fits to all the scores as they appear in the spider. This highly interpretative task is accomplished by systematic consideration of the scores with the help of additional data and feed-back from experts. Some additional remarks are in order here regarding the interpretation of these axes.

The order of items on each of the eight axes is such that the interior points may be associated with non-intervention strategies, or laissez-faire policy (market forces; conservative attitudes, etc.), which may lead to a transport system which is dominated by individual modes (for example, powered by...
alternative fuels; a market-based scenario). The exterior points reflect the result of policy interventions (land-use planning, control strategies, regulatory measures, etc.), in which the transport system is dominated by collective modes (a regulatory scenario). Both may serve as reference scenarios for the expert-based design approaches. (For a more detailed description, see Nijkamp et al., 1997.)

Next, it should be clear that the position on the axis is purely qualitative: no cardinal scale of any type is implicitly involved in the Spider model; by construction only an ordinal scale is implied. Hence, neither the difference nor the ratio of the points on the axes has any meaning. Similarly, the size of the resulting interior area has no real meaning. Admittedly, a small area suggests some political conservatism (in the popular meaning of the word) as opposed to the association of a progressive attitude with a large surface. Finally, we notice that in this spider model, technology is seen as the result of the various force fields in the model. That means in particular that it is assumed that the technology develops as a response to the backgrounds which have been used to design the scenarios. A principal (and also somewhat extreme) consequence of this approach is that it is assumed that in each generated scenario, the technology is an endogenous factor which takes care of the resulting state of the world being sustainable.

The Spider Model Applied to Dutch Experts

Our analysis is mainly focused on the long-range sustainability possibilities of (urban) transport systems. In this paper, we are primarily concerned with the construction of two types of scenario—desired and expected ones—in order to depict many social and institutional uncertainties in the design and planning of future transport systems. The scenarios described hereafter are based on an extensive survey questionnaire which has been sent to about 750 Dutch transport experts and researchers. The survey contained a wide array of questions about the various key fields covering the constituents of scenarios, as well as about the viability and desirability of several new transport modes which are at present under development. In order to focus on a concrete reality, a sustainable transport system in the Dutch Randstad—the major conurbation in the western part of the Netherlands—in the year 2030 is taken as a frame of reference. For a detailed description and account of the questionnaire used, we refer to Nijkamp et al. (1997); here we only note that the response rate was 36 per cent (n = 271), and that the response gave a representative picture of the sample.

The questions underlying the various spider items were consistently sub-divided into ‘expected’ and ‘desired’ answers, in order to distinguish between a factual ‘objective’ thought and a normative ‘subjective’ wish or need felt. Rather than describing the statistical results of this scenario experiment, we will depict here the resulting spatial, societal and transport patterns in the future by way of an interpretative analysis.

The transport experts were asked to give their views—by means of scores or rank orders—on expected and desired trends. Their aggregate views—based on the maximum frequency of any one item (mostly on a qualitative rank-order scale ranging from 1 to 5)—were then depicted in the spider model. By using these opinions, it is possible to construct an ‘expected’ and a ‘desired’ scenario. Clearly, not all aspects of future developments could be investigated in full depth, in order to keep the questionnaire within reasonable limits. This means that in designing the various scenarios some consistent interpretative reasoning had to be followed, amongst others with the help of participants of various international workshops devoted to the topic of this study. In other words, the scenarios are elaborated opinions and interpreted views of the respondents, supplemented with opinions of participants in various international workshops.
For most items of the scenarios the majority answers—or the average scores—were taken as the starting-point for the analysis, while in relevant cases the answers of significant minorities were taken into account too. The items used for the scores on the axes are presented in Figure 2.

It may be clear that the distinct axes are not entirely independent from one another, a situation which is impossible to achieve. The definition of the items on the axes has been made as independent as possible, however. Clearly, it is difficult to trace the distribution of opinions over the axes presented, so that tests of significance are hard to obtain.

In a next stage, an additional validation round has been carried out, by circulating a second (short) survey with tentative results among the respondents. The results indicated clearly that the scenarios were largely supported by the Dutch transport experts; the large majority appeared to confirm that the scenarios were a rather good representation of the expectations and wishes revealed by them. In this way, the translation of questions into scores on the distinct axes has been agreed upon by the experts (Nijkamp et al., 1997). Now, in Sections 4 and 5 we will discuss scenarios of the whole sample, while in Section 6 scenarios of sub-groups of respondents will be constructed.

4. Expected and Desired Expert-based Scenarios of the Whole Sample

As mentioned above, the scenarios designed in our study were based on views expressed by transport experts. On the basis of the answers given by these experts it is now possible to design both an expected and a desired average scenario. The scenarios underlying these scenarios are depicted in Figure 3. After a general description of the scenarios, we will especially pay attention to urban aspects. For a more detailed description, we refer to Nijkamp et al. (1997).

The Expected Scenario

The spider results. The most striking feature of the expected spider, as depicted in Figure 3, is that it is so intermediate. In particular it appears to be mainly a continuation of current trends, with its hesitant emphasis on the market, combined with the wish to keep a significant degree of control over the
transport sector. Hence we see in the institutional and economic fields that scores in the direction of market-based intervention and market principles go hand-in-hand with an indeterminateness concerning public/private management and profitable/subsidised transport. The experts also expect a continuation of the trend towards individualisation. The expectation of a moderately increasing inequity is in line with this, this inequity being more acceptable in an individualising society. In the spatial field, however, the expectations are more in the ‘authority-induced’ sphere, witnessed by scores in the direction of both the compact city concept, and a trend towards specialisation and concentration.

The scenario. Three major trends drive the expected scenario. First, there is the continued trend of individualisation, although this trend is not carried to its extreme. Secondly, the public authorities continue to withdraw on their core business, which—in the case of economic policy—is the correction of market failures, for which task preferably market-like instruments are chosen. The third trend concerns the return of power to the nation states. The political power of the national governments of the member-states of the EU is enlarged at the expense of the power of central EU agencies. Only when EU regulation would result in a win-win situation, do the national governments refrain from their national primacy. Due to the tendency for free-rider behaviour (a form of individualisation and weakening social cohesion at the state level) and the great divergence between the states’ interests, the number of cases for EU regulation is not so great, however. Situations where all member states hold a winning position will be rare.

Some profound consequences of these trends appear. In the political domain, the unification of EU member-states comes to a halt, although the interior market will be established. Consequently, European
regional development policy, one of the spearheads of current EU policy, is abolished. Environmental policies on the other hand, are increasingly being designed at the European level, since the trans-border character of many environmental problems indeed gives rise to win-win situations in the case of co-operation.

Socially, individualisation means in the first place more and smaller households, and also a much greater variety in living forms. Further, the government’s withdrawal on core business, taken together with the weakening of social cohesion, means that the social security system is largely abolished. The simultaneous occurrence of these events implies a dramatic change in the government’s involvement with the social population structure. For one thing, inequity rises quite dramatically, which is however acceptable to the strongly individualised population.

All these developments have their impacts on the spatial structure of the country. It is important to observe, however, that the government considers spatial planning as a key instrument for dealing with its core business. Hence, authorities opt for the development of specialisation and concentration of activities in compact cities. Yet other developments intervene with this policy, so it becomes reasonably, but not completely successful.

The first and foremost reason for this disruption is the reliance on market-based principles for intervention. Principally, this leaves free choice to the people, and therefore almost no obligatory policy can be implemented. In addition to this, European funds for rural and peripheral development have dried up because there is little support for funding outside the economic core zone. Combined with a competitive climate within the EU, this means an important incentive for people to move into the core zone, implicitly overaccentuating the importance of big cities therein.

The cities themselves are faced with great problems. The decrease in average household size requires more—and other types of—dwellings than are available. The existing pool of houses is not adequate to meet this demand, since these houses were built for traditional families in the first place. Consequently, a pressure on urban development exists to build new houses at its borders, countervailing the compact city policy. Further, social housing programmes are not part of policy, and hence people are free to choose where they live. Combined with greater income inequality and deteriorating social cohesion, this results in severe segregation. When revitalised, downtown is populated by the highest income classes; otherwise the lowest income classes will occupy the old and depreciated dwellings in the centre and the old living quarters. Middle-class people live near the centre, and also in sub-centres and suburbs. The rest of the highest income classes, however, can afford to live outside the city, in the greenfields, just within reach of the city by their private cars.

(Urban) transport in the expected scenario. Mobility is largely determined by the spatial division of production, consumption and labour, and income (growth). The modal split is the result of relative price differentials combined with the qualitative characteristics of each mode.

The only-partial success of the adopted spatial policy of compact cities and specialisation and concentration, consequently has a limited impact on the reduction of mobility growth. In particular the increasing inequality of the income distribution, enabling the better-off to live at comfortable distances from the lowest income classes in the city, leads to a significant rise in mobility. Another factor is the openness of the European market, which clearly is unfavourable for the mobility levels.

Also within the city, mobility reduction is a hard task since the goal of the compact city is only partially reached. Finally, the continuing individualisation—resulting in smaller households and preferences for individual transport modes—stimulates mobility growth and reduces possibilities for spatial concentration.

Concerning the modal split, a similarly
unfavourable picture emerges. The limited success of spatial policies results in overall less voluminous transport flows. In practice, only a few of those linkages exist, mainly between (sub-)centres of cities. So this spatial structure is not particularly favourable for public transport modes. This is reinforced by other trends. The reluctance of governments to intervene in the market process seriously diminishes the prospects of making private car use unattractive. Concurrently, no substantial efforts will be put into trying to keep public transport viable. After all, a public transport system will remain that is stripped to its thickest bones, where trains will serve on medium- to long-range links between main cities—capitals and other important cities in Europe—and metro and light rail are likely to play a role in intra-city transport, especially on main lines connecting (sub-)centres.

The remainder is served by car, or by any other futuristic transport that can be fancied, as long as it is personal and individual. It may be expected that a significant share of these cars will be powered by electricity. Recall that the bulk of the people live in the city where transport needs are short-distanced—that means well within reach of the limited range of electric cars. At the same time, due to increased income inequality, a significant number of the lower income classes cannot afford a car. For them a low-profile bus and tram system will remain. Although this sub-system surely is not profitable, the abolition of this minimal system would exceed the limits of acceptable inequity.

The Desired Scenario

The spider results. The scores of the desired spider are generally closer to the exterior than to the interior. This reveals a tendency to have more reliability on government action in a non-market-based way—particularly in the institutional field. In the economic field, a high score for coordination/centralisation is combined with a desire for profitable transport. A similarly surprising combination is found in the spatial field, where the experts have an outspoken desire for the development of compact cities in a spatial structure that has the characteristics of a chains and zones model. In the social/psychological field finally, the experts desire a return to the path of increasing social cohesion, in line with a much greater emphasis on equity issues.

The scenario. Four more or less coherent trends can be identified as determining most aspects of the desired scenario. First, there is the growing tendency to regard equity issues as an important aspect of welfare, hence something that has to be striven for. Concurrently, it is desired that governments take the lead in this programme for equity and other developments. In short, public authorities regain their predominant role in society. Thirdly, and in addition to this, the trend of increasing reliance on market-based intervention by the government comes to a halt. Other types of regulation and control are acceptable. Concurrently, it is observed that within the EU the subsidiarity principle is implemented. Achieving sustainable transport is a policy goal in itself; indeed, it is one of the most important objectives. Therefore, spatial policy, for example, is to a large extent determined by the objectives of transport policy.

An obvious implication of these trends is the negative impact on economic growth. The choice for more government intervention, which is less exclusively market-oriented, limits to a significant extent the dynamic possibilities of a more laissez-faire-oriented economy. Therefore economic growth is reduced for the gains of more equity—the abolition of the social security system is stopped—more social cohesion, better possibilities of fighting environmental problems and other negative externalities.

Notice that this return to strong governments is made possible by the reversal of the individualisation trend which gives the authorities an electoral basis to show concern
for societal problems. This political justification is further enhanced by the increased importance of the subsidiarity principle, which brings politics closer to the people and therefore increases the engagement and consequently the acceptability of government intervention.

Important and distinctive consequences of these developments are found in the spatial field. The equity issue, in combination with the subsidiarity principle, gives a great incentive to regional development policy. Hence rural and peripheral regions are firmly supported—which leads to their development. People respond to this by moving out of the traditional economic core zone in significant numbers. The cities in the regions thus flourish and the resulting city network is considered to be of a non-hierarchical type. In practice, it will remain largely hierarchical, due to differences in population and the economic law that more activities are possible with larger markets, but the emphasis on equity prohibits recognising this. This point is serious, since it has important consequences for the transport sector, as will be discussed below.

So, a network of cities comes into existence, which themselves are compact as a result of local, but also national, policies. The emphasis on achieving a sustainable transport system means that people are seduced into living in the neighbourhood of major public transport nodes in the cities—where high-speed trains, conventional trains, metro and light-rail systems meet—and also that these cities are compact to reduce the demand for transport within them. The trend of less individualisation also helps to make this type of city life possible since it implies that the existing stock of dwellings is quite well suited to meet future demand. This same objective makes cities to a large extent self-supporting—the opposite of specialised cities. In brief, in the desired scenario we encounter a sketch of the development of a chains and zones model of spatial development existing for compact cities that have low degrees of specialisation.

Since the cities are of primary concern to policy, much attention is paid to the socio-demographic structure. Nevertheless, since the experts do not desire a totalitarian regime, people have freedom of choice, and the rich still prefer to live outside. They will not choose to live downtown, since policy is directed to equity and hence downtown will be revitalised to a level which is attractive to the middle class, but has not enough exposure to attract part of the highest income class. Thus the highest income classes will move to green suburbs. At the same time, the absolute number of those who can afford to live outside is less, since more equity implies fewer rich people.

(Urban) transport in the desired scenario. The combination of transport as a spearhead of policy and the extending influence of governments means that public transport is heavily stimulated. Moreover, the growing willingness of the people to change behaviour and the larger set of policy instruments the government has available (not being dependent on market-oriented measures only) makes the policy successful. In practice, this means both that car use is discouraged and that efforts are pursued to stimulate public transport modes.

At the inter-city level, EU policy is connecting the main economic centres by high-quality public transport—in particular, the upgraded and modernised train. The spatial structure discussed above is very well suited to this policy: the concentration of population around cities leads to voluminous links between these nodes of the transport network, which are very well served by train. The European authorities grasp these opportunities by large investments in infrastructure for collective modes.

Within the compact cities, the most favourable transport mode is the bicycle, or else the car which is fuelled by electricity since distances are relatively short. As far as centre and sub-centres are concerned, this structure is well served by metro and light rail, fed by car and bicycle. The old living quarters, where the poor live, are served by
trams and buses. Only the rich, living outside the cities, are largely dependent on their conventionally fuelled cars, but they have to pay a high price: the price of petrol is artificially increased (by taxes), road pricing is introduced and perhaps parking policies further reduce the attractiveness of the car. On the other hand, good park-and-ride facilities complete this set of policy measures, also offering the rich good, but public, transport for a reasonable price. Another alternative is the introduction of new fuels for cars. Such alternatives are strongly encouraged and supported by the European authorities that have taken the lead in environmental policy. Notice also that the reversal of the individualisation trend and the limited economic growth contribute to the reduction of mobility growth.

It is no wonder that in this scenario public transport becomes profitable without direct subsidies, because of the large shift in modal split in favour of public transport. However, the fact that no clear hierarchical pattern of cities occurs, means that trains have to be subsidised to some extent, because there are many not voluminous transport relations. The withdrawal of the government from management is however the final step in realising this almost-profitable public transport sector. Governments remain the owners of public transport, but its operational tasks are delegated to managers who work on the basis of market principles. All in all, this guarantees a public transport sector of very high quality, which nevertheless takes up its social responsibility of operating a significant number of unprofitable lines for equity’s sake.

So it may be concluded that both scenarios lead to significantly different transport (systems), in particular with respect to dominant modes for short-distance transport, mobility growth and modal split. In the next section we will discuss the scenarios in sustainability terms with respect to one of the leading indicators of sustainability—CO$_2$ emissions caused by the transport system. This gives us an opportunity to test the feasibility of such future scenarios.

5. CO$_2$ Emissions in the Expected and Desired Scenarios

International policy documents indicate that a reduction of 80 per cent of the CO$_2$ emissions should be the objective for the year 2025 in Western countries (Rienstra et al., 1996). Many countries are already agreed upon this objective; so this may be an indication of the changes needed in the transport sector, which is an important source of CO$_2$ emissions.

For the calculation of the CO$_2$ emissions in the distinct scenarios, several assumptions have to be made, for example, on the future energy efficiency of transport modes, the mobility level in both urban areas and long-distance transport, the modal split, and—especially for emissions of collective modes and electric cars—the way electricity is produced. It is clear that these assumptions largely influence the resulting CO$_2$ emissions. In Rienstra et al. (1995) such calculations have been made for the expected and desired scenarios; the main results are presented in Table 1.

Despite efficiency improvements in transport technologies, the final energy demand in the expected scenario is comparable to that of 1989. Although much less than in 1989, the transport system is still dominated by individual transport by means of passenger cars (about 50 per cent of total mobility). For the largest part, these are still powered by fossil motor fuels, but there is also some introduction of biofuels and electricity. Collective local transport relies mainly on buses, which to a large extent are diesel-powered, although metro and light-rail systems will also be expanded. Fossil energy consumption and CO$_2$ emissions in the expected scenario are therefore only slightly lower than in 1989. Primary energy consumption however, is higher than in 1989 (see Table 1). Thus, the expected scenario will not result in a large-scale reduction of CO$_2$ emissions.

The desired scenario is characterised by a significant shift from individual to collective transport modes. This scenario results in a significant decrease in final and primary energy consumption, compared to 1989. The
fossil energy consumption and CO₂ emissions are 80 per cent lower than in 1989, which corresponds to the above-mentioned target in the policies of many countries.

The conclusion from this analysis is clear. The desired scenario results in the target levels of CO₂ emissions for the year 2030, whereas the expected scenario does not.

6. Scenarios for Categories of Respondents

The above analysis is based on the typical average Dutch expert. The construction of the scenarios and all that follows starts from the majority of answers that are given to the respective questions. Interesting as it is, this approach can disguise important and meaningful differences between various categories of respondents. In this section we look for such differences, in particular between respondents that may be regarded as proactive versus those who are predominantly conservative. We first give an account of why and how we arrived at these particular groups, and then study differences between them.

The analysis of various categories of respondent is of interest for two reasons. First, if we fail to find a significant heterogeneity among the groups, this would be evidence of great consensus among the experts. Consequently, this would increase the reliability of the constructed scenarios: when all experts agree, who would dare to disagree? Secondly, if we do find differences, this could at least facilitate a further discussion on which scenarios would be the more likely or more interesting to explore. Such an analysis might also provide insight into the way different stakeholders in the decision-making process view the future of transport. This will help us in interpreting plans, suggestions and other types of proposal. Also, more creative scenarios may be distinguished in this way.

We experimented with various ways to define categories of respondent—for example, by profession, age, education, etc. In most cases, the differences we found were very marginal—for instance, on only one axis there was a difference, which means that for the defined categories the constructed scenarios were more or less identical to the general ones. This is quite remarkable given the significant variation in the variables defining the categories. An interesting inference from this observation is that, concerning the development of plans in the near future, conflict between different groups and players is not to be expected, which again may be very helpful in the timely implementation of policy. (See Nijkamp et al. (1997) for further discussion of the consensus issue.) On the other hand, we did find one categorisation for which clearly different scenarios were constructed, a categorisation which was based on the perception of the possibilities of (induced) change.

People can be different in their perception of the extent to which the future course of events is open for change. Some people may think that with appropriate instruments the policy-maker can achieve any goal he or she likes; others may think that the future of the world is predetermined and that no policy-maker can achieve any goal, whatever instrument is used. For obvious reasons, we refer to these categories of people as proactive or

<table>
<thead>
<tr>
<th></th>
<th>Final energy consumption</th>
<th>Primary energy consumption</th>
<th>Use fossil energy</th>
<th>CO₂ emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected scenario</td>
<td>100</td>
<td>123</td>
<td>87</td>
<td>90</td>
</tr>
<tr>
<td>Desired scenario</td>
<td>55</td>
<td>70</td>
<td>18</td>
<td>19</td>
</tr>
</tbody>
</table>

Note: 1989 = 100.
Source: Rienstra et al. (1995).
conservative, respectively. Clearly, a great number of people will not fall in either category, forming a third group we label as modal, since this group is typically the largest of the three. For the purpose of this paper, we are especially interested in the differences between the proactive and conservative groups, which appeared to be the most significant.

To classify the respondents into the three categories we analysed five questions in our survey (see Table 2). Each of these questions can be characterised as capturing an element of potential change in the state of events, in particular in response to some input. Hence, the answers represent the extent to which respondents foresee that action is possible or likely. Notice that these questions typically do not make a distinction between desired and expected response, as is the case for the questions underlying the construction of the axes. Also, the questions used to construct the classification are mutually distinct from the questions used for the scenario construction. For each of these questions, we could identify a large group of about 55–70 per cent of the respondents with an intermediate perception of reactivity. Some 10–20 per cent perceive more action, while about 15–30 per cent foresee less action in response to the inputs. For each of the respondents, we subsequently count the number of times they give an active, or inactive perception. We then find that 21.4 per cent of the respondents more often give active than inactive answers; these are the ones we classify as proactive. On the other hand, 25.1 per cent of the respondents give at least twice as many inactive as active answers. These respondents are called conservative. The remaining 53.5 per cent form the mode. Classifying respondents this way is reasonably consistent. Only 2 out of 68 conservative respondents, gave an active answer to some of the questions. On the other hand, 23 out of 58 proactive respondents (40 per cent) occasionally answered in an inactive sense. This suggests that it is in practice more difficult to be consistently proactive than being consistently conservative.

The scenarios (both expected and desired) of the modal group are identical to those of the whole sample. This is no real surprise, given the general consensus in the data, combined with the modal character of this group. Also, the desired scenario for the proactive respondents is almost identical to the corresponding scenario for the entire sample. The remaining scenarios, however, show more or less remarkable discrepancies.

**Conservative Scenarios**

First, we will now discuss the scenarios of the conservatives; whose spiders are presented in Figure 4. The conservatives’ desired scenario is characterised by less regulation in the institutional field, and less co-ordination/centralisation in the economic sphere. Note that both observations are consistent with the general perception about what conservative people desire. In scenario terms, this means that conservatives put less emphasis on a well-functioning public transport system, and consequently accept that transport will mainly be carried out by car. Also, wherever public intervention is required this should take place at the appropriate level (the subsidiarity principle)—i.e. local authorities for local problems, etc. Since fewer measures co-ordinating car use are not accompanied by more subsidies to

<table>
<thead>
<tr>
<th>Table 2. Items underlying categorisation proactives, modal and conservatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the relationship between economic growth and the mobility level?</td>
</tr>
<tr>
<td>What impact does the current individualisation trend have on mobility growth?</td>
</tr>
<tr>
<td>To what extent may individuals sacrifice in order to achieve sustainability?</td>
</tr>
<tr>
<td>To what extent will a very strong fuel price increase reduce car use?</td>
</tr>
<tr>
<td>To what extent will this same price lead to more use of collective modes?</td>
</tr>
</tbody>
</table>
public transport, the latter’s profitability will deteriorate significantly. Given the emphasis on the chains and zones model of spatial development—which clearly is unfriendly for short-distance public transport—mainly long-distance railway transport will survive economically.

The differences in the conservatives’ expected scenario are exclusively found in the spatial field. On both axes of this field, the conservatives’ expectation is located more inward, meaning that they expect a spatial structure more characterised as chains and zones, and a city concept that has more features of the diffuse city. The main consequences of these deviations—as far as transport is concerned—are to be found in the reduced potential of public transport. Both observations lead to less concentrated traffic on the links of the transport network, which is unfavourable for public transport modes of all kinds. Combined with the overall bad circumstances for public transport, it is to be expected that it will have a hard time to survive. A counter-effect, however, results from the lower spatial specialisation and concentration, which may be explained by a continued emphasis on market forces. This means that economic activities will be more evenly spread over locations. This will lead to an increase in mobility, which is predominantly of a criss-cross character and hence may help to fight congestion in general.

It is interesting to observe that conservatives generally predict severe problems for public transport modes. However, they desire this to come from a purposive greater reliance on market principles (or survival of the fittest transport mode), but rather expect it to come from a more spread-out location pattern. Apparently, conservatives do not think that the desired policy change of introducing more market principles is within reach, but expect that forces less under government control will finally result in the dominance of private transport. Notice that
this is perfectly in line with our characterisation of conservatives in this paper: people who have less confidence in the effectiveness of government policy.

Further, recall that the sustainability of the transport system was explicitly stated as a constraint for the developed scenarios. With increased mobility and less public transport, the conservatives have to find other ways to meet this constraint. Two options are open for this—namely, the rapid development of new transport modes, or reliance on technological innovations for existing modes. Since the conservatives do not show great enthusiasm for new modes, the only conclusion can be that they have huge expectations of technologies improving the environmental friendliness of the car.

In conclusion, the conservatives have less trust in the effectiveness of government policies, but have more confidence in market forces both in spatial development and for making current transport modes environmentally benign.

### Proactive Scenarios

We now turn to the proactive group. Discrepancies from the overall scenarios are found for the expected case, but not for the desired case. This is noteworthy since, *a priori*, it would be expected that more differences should appear in the desired scenario, as this scenario is less bound by notions of credibility or inertia in society. It is generally easier to give your preferences than your expectations, and consequently desired scenarios are more likely to be extreme—and hence deviating from mainstream—than expected scenarios. Still, for the proactive group, the opposite seems to be the case. The differences that are found in the expected scenario are quite large, and appear in the spatial, economic and institutional fields (see Figure 5).

In the spatial field, the proactives share the expectations of the conservatives that location patterns will be more of a chains and zones type with accordingly less

---

**Figure 5.** The expected scenario of proactives.
concentration, and also that urban development goes more in the direction of a diffuse city. Although it is remarkable that apparently opposite groups share the same expectations, in this field it is not embarrassing. In fact, it is most likely that both outcomes are the result of entirely different processes. On the one hand—in the conservatives’ scenario—the diffuse city is the result of giving a free hand to market powers. This would in particular mean that the rich can afford to live in suburbs that will thus experience a modest growth, consequently resulting in a chains and zones development of diffuse cities. On the other hand—the proactive’s view—the authorities may give special attention to less developed regions, stimulating their development with the result, again, of a chains and zones spatial structure with predominantly diffuse cities.

In the economic and institutional fields, the proactives expect more influence by regulatory bodies, and less market orientation. Clearly, proactives foresee a continuing important role for governments to regulate markets in general, and the transport market in particular. Still, proactives expect the transport sector to be almost profitable, in contrast to the other groups. It is difficult to combine the notions of more regulation and less subsidy in the transport sector, but apparently the proactives simply believe in public transport having the potential to be profitable (also notice that proactives have the same location on the axis concerning the profitability of the transport sector in their desired scenario). In this sense, it is remarkable that the proactives do not differ from other groups in their expectations in the social/psychological field, since it might be expected that this group should put—at least in the desired scenario—more emphasis on equity and a reversal of the individualisation trend.

In terms of scenarios, the combined expectations of more regulation, more spatial diffusion and profitable transport can only be achieved by strong government intervention, supported by significant technological developments in the sphere of public transport and new modes. The most important intervening action is taxation of car use, to such an extent that this use is indeed dramatically reduced. To reach this, a climate of acceptance of intervention has to be created, and also strong reactions of people have to occur. Notice that both these elements are typical of how the proactive group is defined, and in this sense the scenario is consistent. Moreover, technological progress is required to support this scenario. Indeed, the proactives have great expectations of new transport modes like people-movers and electric cars.

What we have demonstrated in this section is that there are differences between various categories of respondent, which in addition lead to different scenarios with respect to (urban) transport. An interesting aspect of this exercise is that comparable expectations in deviance of the mainstream (in the spatial field) can be combined with opposing expectations in the economic and the institutional fields. This shows the flexibility of the spider model, which is again caused by the role of technological development. In the spider model, technology is assumed to balance other developments, in the sense also that the goal of a sustainable transport system is more or less reached.

7. Conclusions

Official policies in European countries clearly focus on achieving a sustainable urban transport system; to a large extent, this should be achieved by stimulating a modal shift towards collective modes. At the same time, we see in reality that this policy aim is often not achieved and that the external costs of transport are still increasing. From the scenario analysis in this paper, it becomes clear that Dutch experts expect these trends to be continued. Governments are not expected to provide a clear policy direction, while also citizens are not prepared to change their current behaviour to a large extent. Only spatial policies (concentration of population and activities) may be introduced in a rather successful way. It is clear that in this expected situation policy objectives—for
example, a large-scale reduction of CO₂ emissions—will not be achieved.

The desired scenario of the same Dutch experts reflects the official policy of achieving a modal shift. In this respect, the role of governments should largely be increased. The subsidiarity principle results in a large local responsibility for the urban transport system; while policies at the European and national levels support the wish to reduce car use and reincrease the role of public transport; also, new transport modes (such as the electric car) will replace conventional cars. At the same time, society is prepared to accept these changes and to adapt its behaviour. In this way, the above-mentioned policy objectives may be achieved.

Another interesting result is that the compact city concept is largely included in both the expected and desired scenarios of the experts. In this way, one of the main conditions for the success of collective modes is fulfilled, but it also becomes clear that this alone is not sufficient for the success of collective modes.

The tension between wish and thought becomes clear: the experts desire some major changes and a reversal of current trends (individualisation, government intervention, equity), but expect an enormous inertia in society, prohibiting these changes. Hence, the experts doubt that the market will solve the sustainable transport issue, as witnessed by the CO₂ exercises, but do not believe that people can be induced to change their behaviour. A classical dilemma between individual and society’s utility maximisation is implicitly sketched.

In general, it appears that little difference is found in sub-groups according to age, education type, employer, gender, etc. The consensus among experts appears to be large, which is in itself an interesting finding since this makes the scenarios more reliable, while this may also reduce institutional barriers for imposing policy packages. Only when the general attitudes towards several societal and behavioural issues are investigated, rather meaningfully different alternative scenarios are identified. The main conclusion is that ‘conservatives’ have more confidence in market forces and technological innovations, while the role of public transport is relatively less than in the scenarios of the whole sample. ‘Proactive’ respondents on the other hand expect more emphasis on public transport and on changes in societal trends; at the same time, they have less confidence in the achievement of the compact city. Quite striking is that the desires of this group do not differ largely from the general desired scenario.

From the analysis in this paper it becomes clear that when the official policy objective of achieving a modal shift is achieved, large changes in government policy as well as in society as a whole will be necessary. When this occurs, an environmentally friendly transport system which is oriented at public transport is certainly feasible.

Note
1. This means that most questions were framed like: ‘What developments do you expect/desire, conditional on the fact that the Dutch transport system is sustainable in the year 2030’.

References


RPD (NATIONAL PHYSICAL PLANNING AGENCY) (1991) *Perspectives in Europe; Exploring Options for a European Spatial Policy for North Western-Europe*, Department of Housing, Physical Planning and Environment (VROM), The Hague.

