 culteit der Economische Wetenschappen en Econometrie

Serie Research Memoranda

Roads Towards Environmentally Sustainable Transport

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Research Memorandum 1993-69

December 1993

vrije Universiteit *amsterdam*

ROADS TOWARDS ENVIRONMENTALLY SUSTAINABLE TRANSPORT

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PN/452/jk/roads

Abstract

This paper explores roads towards environmentally sustainable transport, with particular emphasis on the bottlenecks preventing the achievement of policy objectives of reconciling the economic interests of the transport sector with environmental constraints. Several arguments substantiated by empirical evidence from various countries are put forward to demonstrate that current megatrends in transport are at odds with a sustainable development and lead to high social costs. A variety of policy strategies is discussed to improve the current threatening situation.

1. Transport: A Matter of Sustainability

Recently, transport questions have increasingly been put in the context of sustainable development (Banister and Button 1993, Button 1993, Himanen et al. 1992, 1993, Nijkamp and Priemus 1992, Short 1992). The concept of sustainable development is often narrowed down to environmental concern, but is has to be recognized that a broader interpretation in terms of a balanced (co-evolutionary) industrial, social, ecological and economic development is more adequate.

The current literature shows an abundance of possible definitions of sustainable development (see e.g. Barbier 1989, Pearce et al. 1990 and Pezzy 1989). In general, sustainability refers to long-term availability of proper means that are necessary for a long-term achievement of prespecified goals. It is a dynamic concept that takes into consideration the expanding needs of a growing world population, including all its social, economic, ecological, geographical and cultural dimensions. A prerequisite for sustainable development is the availability of environmental goods and services, such as material and energy inputs, assimilation of waste products, and a stream of natural services that are essential for supporting economic production and human welfare.

According to Van Pelt et al. (1990) the environment is not a burden, but forms a potential means of welfare improvement. Welfare benefits may emerge from the environment directly (through environmental amenities) and indirectly (through the production of goods and services). The production of goods and services uses renewable and non-renewable natural resources, uses the environment as waste assimilator, and benefits from general environmental services. At the same time, the environment also puts constraints on quantitative ant qualitative dimensions of consumption and production processes. Too much pressure on the environment may negatively affect long-run social welfare both through lower-quality environmental amenities and decreased environmental productivity. Barbier (1989) distinguishes between absolute natural resource scarcity, when resources have ceased to exist, and relative natural resource scarcity, when the quality of natural resources is decreasing and hence its productivity. A concern for sustainability requires that much insight is gained in critical threshold levels for absolute and relative environmental scarcity.

Development is - ecologically - sustainable when long run (per capita) social welfare improvement is not impeded by environmental deterioration, either through environmental amenities or through environmental productivity, or through a combination of the two. The condition for sustainable development is that production and consumption patterns do not cause such environmental degradation, i.e. remain within boundaries set by the environment. These boundaries are expressed in terms of critical levels, quality standards, maximum sustainable yield or carrying capacity, resilience, vulnerability, fragility, etc. (Munn 1989).

The previous observations apply also to transportation issues. Transport can be positioned at the cross-roads of economic and environmental interests. On the one hand, transport is a necessary activity in an economy characterized by product and labour specialisation: it leads to a significant rise in productivity of the total capital base of an economy, while at the same time it increases our welfare perception (the 'locomotive' society). On the other hand, transport erodes the stock of natural assets of our world (both stocks of energy and raw materials and the environment at large).Consequently, mobility of persons and commodities plays a conflicting role in the development of any economy.

The intricate link between mobility patterns and economic growth can be illustrated by means of Table 1 derived from Short (1992). The author also esti-

Year	Passenger Traffic (pass-kms)	Annual Change (%)	Freight (tkms)	Annual Change (%)	GDP (1)	Annual Change (%)
1970	100		100		100	
1971	106.6	6.6	101.0	1.0	103.2	3.2
1972	112.1	5.1	105.4	4.4	107.7	4.3
1973	118.3	5.5	113.2	7.4	113.8	5.7
1974	117.0	-1.1	116.6	3.0	116.2	2.1
1975	121.7	4.0	108.9	-6.6	115.2	-0.8
1976	125.9	3.5	115.0	5.6	120.3	4.4
1977	130.5	3.7	118.4	3.0	123.6	2.7
1978	136.7	4.8	123.9	4.6	127.2	3.0
1979	138.4	1.2	133.2	7.6	131.8	3.6
1980	141.6	2.3	131.6	-1.3	133.8	1.6
1981	142.3	0.5	130.6	-0.7	134.2	0.3
1982	145.9	2.6	129.5	-0.9	135.5	0.9
1983	146.4	0.3	131.4	1.5	137.7	1.7
1984	150.3	2.7	134.8	2.6	141.2	2.5
1985	152.6	1.5	137.0	1.6	144.9	2.6
1986	159.2	4.3	141.4	3.2	148.8	2.7
1987	166.5	4.6	146.5	3.6	153.2	3.0
1988	174.5	4.8	157.2	7.3	159.0	3.8
1989	180.4	3.4	163.2	3.8	164.1	3.2
1990	185.2	2.7	163.6	0.3	168.6	2.8

Table 1. Relationship between transport growth and economic growth in OECD Europe. 1970-1990 (1970=100)

mated the elasticity figures for mobility: in OECD Europe each one per cent increase in GDP has been accompanied by an increase of 1.74 per cent in road freight transport and 1.40 per cent n private car traffic, the wealthier countries having the highest mobility increases.

It goes without saying that the environmental consequences of this fast rise in transport are rather dramatic, even though precise information is not (yet) available. Table 2 (again taken from Short 1992) illustrates the point that - in contrast to a relatively more favourable trend in industry - the transport sector has become a heavier polluter of the environment in the past two decades. This means that the growth in the transport sector is increasingly at odds with sustainable development, not only in terms of air pollution (e.g., CO, CO_2, CFC, NO_x or VOC), but also in terms of persistent micropollutants, noise disturbance, landscape deterioration, climate effects, fatalities and congestion. This conflicting issue will be further discussed in the next section.

Sector	1973	1978	1983	1988
Transport	596	688	665	773
Industry	1 037	994	857	923
Other	973	1 034	973	1 046
Total	2 606	2 715	2 495	2 742

Source: International Energy Agency, OECD.

Table 2. CO_2 emissions in OECD countries 1973-1988 (millions of tonnes)

2. Transport and Sustainable Development: Are the Tides Changing?

The awareness of the dramatic consequences of a further rise in transport for the environment has not only been a matter of concern for scientific researchers, but also for planners and policy-makers. In various countries (e.g., Canada, Denmark, Japan, the Netherlands, Sweden) fairly drastic measures have been proposed by governments to curb the ever increasing trend of transport, e.g. by economic incentives, technological incentives, regulations and prohibitions, or physical planning measures (see INRO-TNO 1992). A notable example is the so-called Green Paper (1992), prepared by the EC commissioner for transport, which aims to create a framework for a common strategy of sustainable mobility that should contain the impact of transport on the environment, while allowing transport to continue to fulfil its economic and social functions and thus to ensure the long term development of transport in the community. The basic message of the green paper was next intergrated in a policy strategy for common transport in the EC (see Commission of European Communities 1992).

It is evident that such a sustainable development would require a coordination (or at least harmonisation) of the multitude of transport policies in different member states, which used to be a responsibility of national or regional governments. However, a common sustainable EC transport policy will need a time span of many years, leaving many possibilities for flexible initiatives at a decentralized level. In this context, it is interesting to observe that the environment does not only pose an impediment to further growth, but may also offer new opportunities for local development. A healthy living and working environment in a city where unsafety, air and noise pollution and congestion caused by cars are cut back, may increase the economic, social and cultural attractiveness of a city (see also Nijkamp and Perrels 1993).

It should be recognized however, that there are many structural phenomena which cause the role of transport to rise rather than to decline. Examples of such strategic causes are: increased female labour force participation leading to more trips, increase in leisure time and income generating more mobility, segmentation of society and individualisation of households causing a general rise in mobility, the completion of the European market leading to more cross-border person and commodity transport etc. Unless such changes in structural backgrounds are modified, transport will continue to be a threat for a sound sustainable development Clearly, there may be countervailing powers, such as new logistic concepts (e.g., product channel management, ISDN, EDI) increasing the efficiency of transport, multimodal transport systems aiming at optimizing the performance of the transport system as a whole, telematics aiming at optimizing drivers' behaviour through the provision of real time information, fleet control serving to reduce transport costs, or institutional measures (e.g., cabotage) aiming at an improvement of competitiveness in the transport sector. Although such counteracting developments are undoubtedly of some interest, it has to be admitted that new trends such as dematerialisation, JIT delivery systems, the rise of buyers markets and internationalisation trends may reduce the actual effectiveness of the above countervailing phenomena for environmental sustainability.

The above observations on mobility patterns at both the demand and supply side, underlying trends and steering mechanisms can - from the viewpoint of sustainable development - be represented as follows (see Figure 1).

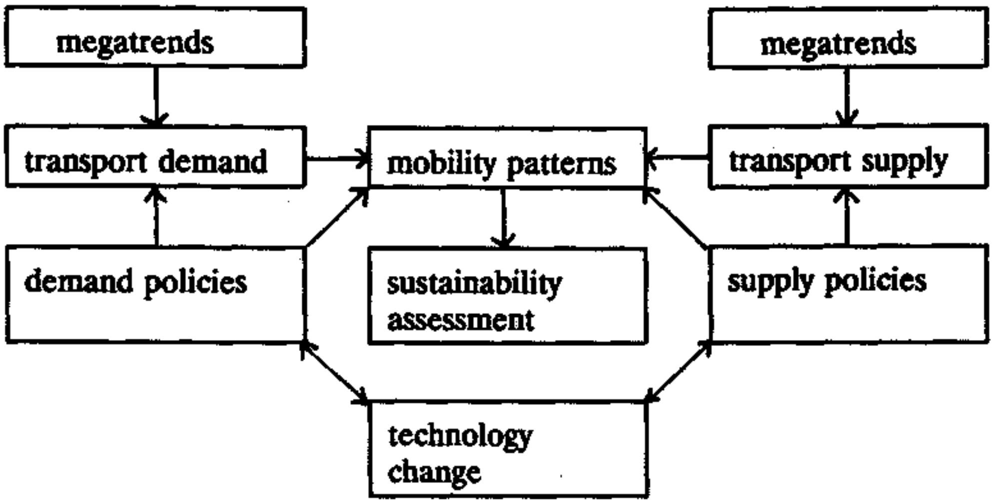

Figure 1. Force field for sustainable transport development

In light of the force field sketched in Figure 1 various interesting research questions emerge:

- what is the information on facts influencing mobility patterns
- what is the state of art in assessing sustainable transport development
- which are the possibilities of steering mechanisms to influence mobility patterns?

These question will be dealt with in subsequent sections.

3. Roads to a Mobile Society

Despite the general concern about the environmental implications of surface transport (in particular, road transport) and despite many attempts at curbing the world-wide trend towards more spatial mobility, the actual practice is disappointing. Even though many countries have adopted a minimum policy requirements strategy that transport needs should be satisfied with the least possible environmental decay, we observe in almost all countries a structural rise in spatial mobility which exceeds even the speed of implementation of environmentally friendly car technology. In various countries road traffic has more than doubled in the past two decades. Figures 2 and 3 taken from Kürer (1992) illustrate the above points and show that private cars and trucks have become

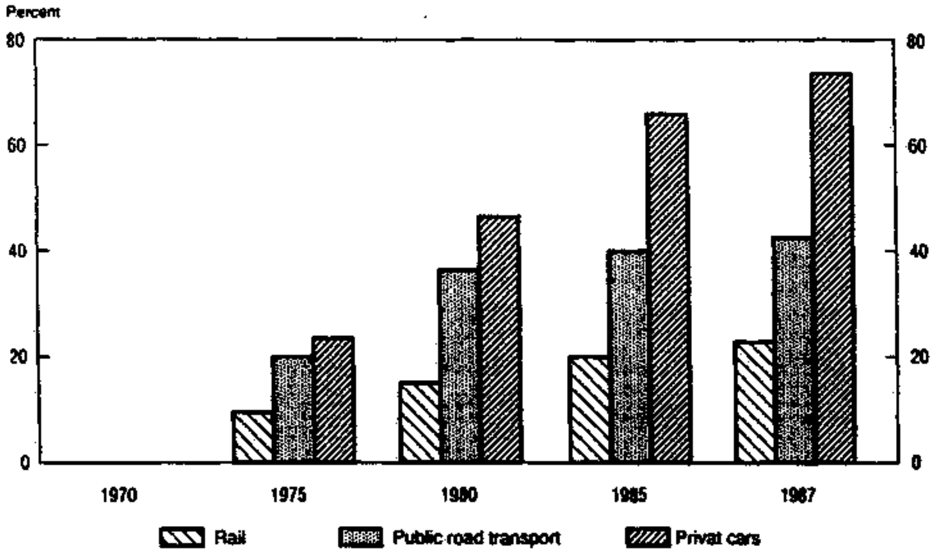

Figure 2. Relative change of passenger-kilometers in comparison to transport in OECD Europe (1970)

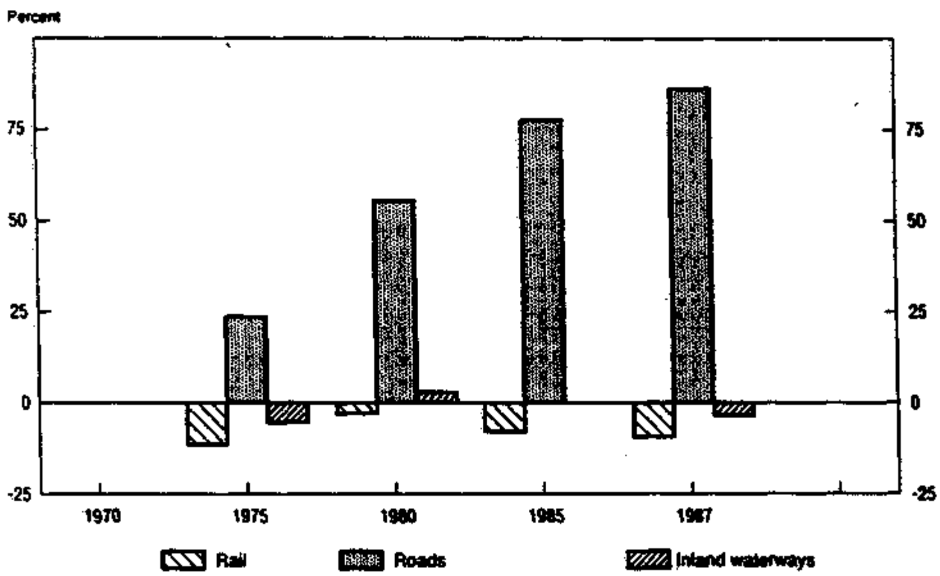

Figure 3. Relative change of tonne-kilometers in comparison to transport in OECD Europe (1970)

It is evident that the growth rates of transport may differ significantly among various countries, depending on the general level of welfare, spatial dispersion of population and size of the country. Clearly, much information is needed to produce reliable traffic forecasts and mobility pattern estimates. Some interesting information can be found in recent study on mobility trends in various EC countries by Van Maarseveen and Kraan (1991). Some general data on population density, car density and infrastructure (viz. motorway and rail) density can be found in Table 3. Especially the difference in car density in various countries (with a maximum for Germany and a minimum for Ireland) is noteworthy.

Country	Population density inh./km^2	Cars per 1000 inhabitants	Motorway density m. per km^2	Rail density m. per km^2
France	101.6	402.7	10.9	63
Italy	190.8	434.7	19.9	54
Fed.Rep. Germany	248.1	472.2	33.8	110
United Kingdom	233.1	348.7	12.7	74
Denmark	118.3	321.6	13.9	58
Netherlands	155.8	355.7	50.5	68
Belgium	324.6	363.9	48.7	120
Luxembourg	153.6	454.1	38.5	100
Ireland	49.4	211.6	-	27

Table 3. General density data on 9 EC countries
Source: Van Maarseveen and Kraan (1991)

The same authors have also collected data on annual mobility rates for car and train (1971-1986) for these EC countries (see Tables 4 and 5).

country	Passenger kms(*10^9) 1971	Passenger kms(*10^9) 1986	Annual growth rate (% per year)
France	285.0	517.0	4.1
Italy	271.9	394.4	2.5
Fed.Rep.Germany	371.8	510.3	2.1
United Kingdom	330.0	428.0	1.7
Denmark	35.0	43.9	1.5
Netherlands	88.9	124.3	2.3
Belgium	36.8	56.4	4.4
Luxembourg	--	--	--
Ireland	--	--	--

Table 4. Annual mobility rates by car (1971-1986) in 9 EC countries
Source: Van Maarseveen and Kraan (1991)

country	Passenger kms($*10^9$) 1970	Passenger kms($*10^9$) 1985	Annual growth rate (% per year)
France	40.98	61.89	2.8
Italy	32.46	37.40	0.9
Fed.Rep.Germany	37.46	42.71	0.9
United Kingdom	30.41	29.70	-0.2
Denmark	3.35	4.51	2.0
Netherlands	8.01	9.01	0.8
Belgium	7.57	6.57	-0.8
Luxembourg	0.21	0.23	0.7
Ireland	0.58	1.02	3.8

Table 5. Annual mobility rates by train (1971-1986) in 9 EC countries
Source: Van Maarseveen and Kraan (1991)

The information from Table 4 shows a uniform rapid rise in car mobility (with a maximum for Ireland, France and a minimum for Denmark and the United Kingdom). Table 5 indicates significant variation in train mobility (with a maximum for Ireland, France and Denmark, and a negative growth rate for Belgium and the United Kingdom). Clearly, car mobility rates are much higher than train mobility rates.

The authors have also analyzed the impact of car ownership on mobility, both by car and train, using a specific transportation model called the Mobility Scanner (see Table 6).

country	% growth car population 1970-1985	impact on passenger kms by car (%)	impact on passenger kms by train (%)
France	3.6	0.6	-0.3
Italy	5.4	1.2	-0.5
Fed.Rep.Germany	4.2	0.9	-0.5
United Kingdom	2.8	0.5	-0.3
Denmark	2.2	0.3	-0.1
Netherlands	4.4	0.7	-0.4
Belgium	3.3	0.6	-0.3
Luxembourg	3.4	0.8	-0.4
Ireland	4.0	0.4	-0.1

Table 6. The impact of car ownership on mobility in 1985 (base year 1970) in annual rates for 9 EC countries
Source: Van Maarseveen and Kraan (1991)

From the above information it is clear that car mobility has risen drastically in most countries. Thus the overall conclusion is clear: there is an evident situation in Europe of a strong rise in car ownership and car use, and a modest rise in train use.

Furthermore, there is a close connection between numbers of cars, average annual car kilometers and total car kilometers, as is illustrated by some Dutch figures taken from Blaas et al. (1992). These figures show the steady rise in all these variables.

Table 7. Number of cars, average annual car kilometers and total car kilometers in the Netherlands, 1970-1989.

	number of cars	average annual car kilometers	total car kilometers
1970	2.405	14.890	35.810
1971	2.637	14.980	39.510
1972	2.833	14.390	40.760
1973	3.005	14.300	42.960
1974	3.134	13.850	43.400
1975	3.289	14.430	47.450
1976	3.444	14.530	50.050
1977	3.636	14.380	52.290
1978	3.811	15.010	57.190
1979	4.052	14.360	58.190
1980	4.240	13.880	58.850
1981	4.314	13.570	58.520
1982	4.350	13.860	60.260
1983	4.438	14.220	63.110
1984	4.519	14.460	65.340
1985	4.600	14.120	64.950
1986	4.462	14.680	68.140
1987	4.755	14.980	71.230
1988	4.921	15.350	75.530
1989	5.086	15.190	77.260

The increased mobility of persons by private car can be explained from several background factors, such as demographic developments, technological progress, physical planning rise in car ownership and driver's license ownership, general rise in income, rise in leisure time and the relatively low costs of car driving.

The increase in freight transport depends on different factors, such as rise in flexibility in delivery, trend toward high value-low volume goods, need for JIT transport, containerisation, suburbanisation and spatial decentralisation, and government policy.

Despite all plans to reduce car traffic, road transport has apparently been a fast grower in the past decades. The environmental impacts of road transport are unfortunately also most unfavourable. This can be illustrated by a reference to Table 8 taken from Gwilliam and Geerlings (1992).

TABLE 8 Hierarchy of the impacts on the environment by modes of transport				
	Air pollution	Water pollution	Soil pollution	Health and safety
Road	***	*	***	***
Rail	*		**	*
Inland waterways		**	*	
Sea	*	**	*	
Air	*		*	*

* small impact , ** significant impact, *** great impact

Table 8. Classification of impacts on the environment by modes of transport

The conclusion to be drawn at this stage is that the ways of living, working and recreating in our modern society - to a large extent based on private car use - threatens the environment to an unprecedented degree and is thus at odds with environmental sustainability. The negative consequences of this mobility drift will be further discussed in the next section.

4. Sustainable Transport Development: Fictions and Frictions

As mentioned above, transport in our modern society has a wide variety of negative environmental consequences: noise, particulates, vibration, risk, accidents, fuel emissions, depletion of natural resources, urban sprawl, damage to built environment, community severance, congestion, visual intrusion, aesthetics etc. Most of these environmental effects are unpriced in nature: there is no clear market system which provides sufficient signals to redress environmentally damaging behaviour, in the sense of charging the related social costs to the cause of the damage (the 'polluter pays' principle). Such signal failures lead of course to an overexploitation of unpriced (or underpriced) goods thereby reinforcing environmental decay. Conventional economic wisdom teaches us that such negative externalities can be coped with by means of appropriate taxes (the Pigouvian solution) or otherwise by means of prohibitions or standards. This requires that governments act as representatives of environmental interest. It is wellknown however that such policies require full insight into behavioral reactions of all actors, and unfortunately in many cases the government response is not always leading to the desired results. This response failure is even reinforced by the fact that governments are also an interest party in a broader political and economic game (for instance, taxes on fuel are necessary to avoid budget deficits and hence it is in the interest of governments to have at least a minimum level of fuel consumption by private cars). For further details on this issue we refer to Barde and Button (1990) and Barde (1993).

In recent years, much attention has been given to policy strategies for charging all costs (including social costs) of transport to road users. This is also witnessed in the current popularity of road pricing schemes. Nevertheless, the success of such schemes is sometimes doubtful, as such measures are often used on the basis of conflicting objectives (see also Himanen et al. 1993). A main problem inherent in such road pricing schemes is the fact that the financial revenue accruing to the government tries to cover a set of mutually conflicting options:

- road pricing can be used - in the form of tolls, e.g. - to finance new expansion of road infrastructure;

- user charges can be collected from can drivers in order to cover expenses (or deficits) in new public transport;

- road pricing can be used as an economic instrument in order to reduce congestion and to ensure that traffic will remain within acceptable capacity limits;

- user charges can be levied in order to compensate for external costs (environmental decay, lack of safety etc.), as a result of both signal and response failures.

Another problem is that external costs are extremely difficult to measure. Such external costs comprise inter alia congestion costs, environmental pollution and decay, and fatalities.

Traffic congestion is a clear example of an external cost to the individual road user, but of an internal cost to the transport system as a whole. The congestion costs are not spread uniformly over society: they differ per time of day and per region. In a densely populated country like the Netherlands the estimated average congestion costs (per inhabitant) amount to approximately 30 ECU per annum (see Nijkamp and Oosterman 1992).

Environmental pollution and decay includes inter alia air pollution and noise annoyance. The assessment of such impacts is difficult to measure due to their high variability and uncertainty. The environmental costs related to road transport vary also across different countries (see Himanen et al. 1993). Some indicative estimates for the Netherlands point at an amount of approximately 20 ECU per inhabitant annually.

Finally, the costs of road accidents deserve thorough attention (see Dugonjic et al. 1993). About 50,000 people are killed every year on European roads, and some further 1,500,000 are injured (Group 2000, 1990). According to Masser et al. (1992), in the former Federal Republic of Germany (FRG) more than half a million people have died in road accidents since 1950. The same authors allege that through safer cars and better roads traffic deaths per 100,000 population have more than halved between 1970 and 1985, from 32,0 to 13,1, but this means still 8.000 fatal accidents per year.

It is noteworthy that significant differences exist between European countries: from 22 people killed in traffic per 100,000 population per year in Portugal to 10 people in the Netherlands (see Table 9).

Country	Number of persons killed	Killed/100.000 inhab.
Austria	1,402	18.4
Belgium	1,993	20.1
Denmark	670	13.1
Finland	734	14.8
France	10,528	18.7
Germany, Fed.Rep	7,995	12.9
Greece	1,699	17.0
Ireland	460	13.1
Italy	6,410	11.2
Luxembourg	67	16.8
Netherlands	1,456	9.8
Norway	381	9.0
Portugal	2,375	22.7
Spain	7,188	18.5
Sweden	904	10.6
Switzerland	925	13.9
United Kingdom	5,554	9.7
EC + Efta	50,741	14.8

Table 9. Road transport fatalities per year and per one hundred thousand inhabitants (1989)

Source: ECE, Statistics of Road Traffic Accidents in Europe, 1991

The social costs inherent in road fatalities comprise material damage, productivity and productin loss, medical costs, prevention costs, preventon costs and public services expenditures. For the Netherlands some tentative estimates of all such costs point at an amount of approximately 200 ECU per inhabitant per year.

These tentative results show that safety costs in road transport are to be regarded as the highest social costs.

The above rough figures indicate that more thorough research is needed on the assessment of social costs of transport, eventhough physical environmental empact assessment of the transport sector has significantly improved in the past years (see for a good example, Statistics Finland 1992). Despite a broad range of uncertainty in assessing social costs of mobility, there is an increasing awareness that effecive strategies and necessary to cope with the negative externalities of transport and to ensure environmentally sustainable transport. This issue will be discussed in the next section.

5. Policy Strategies on Transport and Environment

Policy strategies aiming at a sustainable development of transport systems may be diverse in nature and in time span. (cf. Button and Gillingwater 1986). for instance, fuel taxes may have a short run effect, whereas new patterns of living and working will have a long range effect on the environmental implications of transport.

In the present section we will make a distinction into four types of policy strategies: demand oriented polices, supply oriented policies, technology policies and physical planning. Each of these will successively be discussed.

5.1 Demand oriented policies

Demand oriented policies cnstitute a broad set of stimuli serving to change transport behaviour. Examples are:

- variabilisation of transport costs (e.g., via fuel tax, road pricing, user charges, peak load charges).

- selective use of different transport modes (e.g., car or van pooling, special lanes on motorways for carpoolers, park and ride systems etc.).

- regulatory or prohibitive measures (e.g., parking restraints, emission and noise standardsfor cars, mandatory vehicle inspections, speed limits, higher taxes for bigger cars, improvement of transport network flows via coordinated traffic lights etc.).

- information and communication campaigns (e.g., on unleaded petrol).

5.2 Supply oriented policies

Supply oriented transport policy solution comprise a broad set of measures serving to improve the quantity or quality of capacity of transport systems. Examples are:

- conventional expansion of physical infrastructure so as to increase capacity (e.g., expansion of terminals at airports, doubling lanes on motorways etc.)

- improvement of public transport (e.g., increase of frequency and punctually separate bus lanes, deregulation of public transport, competitive fare policy integration of public transport systems, etc.)

- traffic calming measures (e.g., restricted entry to urban centres, priority for pedestrians etc.)

- discouragement of car ownership (e.g., parking licenses, obstacles to easily obtaining driver's licenses etc.)

- development of new sophisticated infrastructure solutions (e.g., light rail, subterranean solution)

- better management and use of existing transport modes (e.g., flexible working hours, inter-operability etc.).

5.3 Technology policies

New technological advances in vehicle technology and infrastructure design may redress a considerable part of the negative externalities of transport. Examples are:

- sophisticated car technology (e.g., engine and vehicle design, zero emission cars, catalytic converters, electric cars, in vehicle route guidance systems, computerized efficient fuel and emission control via electronic sensors etc.)

- telematics solutions (e.g., automatic debiting, automatic speed control, real time information on road situations, traffic and fleet management, modal transfer information, teleworking/teleshopping etc.)

- new logistic systems (e.g., design of new logistic platforms, logistic service centres, tracking and tracing systems, use of ISDN and EDI etc.).

5.4 Physical planning measures

Physical planning concerns the spatial location and redistribution of human activities and thus has a structural impact on mobility patterns in a society. Examples of measures favouring ecologically sustainable transport developments are:

- land use regulations (e.g., building permits for offices nearby terminals of public transport, discouragement of suburban shopping malls)

- urban policy (e.g., compact city design, suburban concentration policy

It seems plausible to assume that only a balanced package of the above mentioned four strategic options will be able to pave the road towards environmentally sustainable transport. In recent years various future scenarios have been developed and discussed with a view on conditions for influencing spatial behaviour of various actors (see e.g., Eriksson and Leinmark 1992, and Masser et al. 1992). Although there seems to be a preference for more environmentally friendly ways of living, working and travelling, actual practice shows that there are many resistances and bottlenecks.

In a recent study by Blaas et al. (1992) the background factors for such behavioural inertia have been investigated more systematically. There appears to be an intricate intertwining of car ownership, car use and driving style in relation socio-economic and demographic characteristics of households. A separate intervention based on one of such attributes will likely not lead to a successful outcome. Thus transport-environment policy has to be built up more in terms of cohesive policy packages.

6. Concluding Remarks

In recent policy documents (e.g., Group Transport 2000 Plus 1990, Minister of Supply and Services 1992) it has been advocated that transport policy should simultaneously be guided by various considerations such as efficiency, fairness, safety and environmental protection. All costs related to transport (including external costs) would have to be charged to the transport system user in order to avoid biased (i.e., relatively too high) travel choices. This would imply that in general the market system would have to play a more important role in the provision and use of transport services. If travellers would pay for what they use and cause, a more rational policy on the provision and financing of new infrastructures can be built. This holds of course for all transport modes without offering any priority to any node in advance. Only in this way are governments and infrastructure owners accountable for their decisions.

A fundamental solution for paving the road towards an ecologically sustainable transport solution is not easily in reach, as the transport sector is a glaring example of conventional government intervention. A phase of deregulation followed by one of environmentally sustainable regulation seems to be the only way to ensure a balanced position of modern transport systems.

Needless to say that a transport policy focused on sustainable transport has to meet a great variety of challenges: financing new infrastructures, international harmonisation, assessment and changing of all costs to various user categories and transport modes, development of market principles for infrastructure owner/managers, conflict resolution between efficiency and accessibility (or spatial equity), separation of property rights from operation/management of transport networks, and so forth. In this context, more attention would be required for improvement of information provision and for enhancing the acceptability of new transport policy measures and instruments oriented towards environmentally sustainable transport systems in the future.

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