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COMMUNICATION FROM THE COMMISSION

TO THE COUNCIL, THE EUROPEAN PARLIAMENT,
THE ECONOMIC AND SOCIAL COMMITTEE
AND THE COMMITTEE OF THE REGIONS

ON TRANSPORT AND CO_2

- Developing a Community Approach -

EXECUTIVE SUMMARY

The Greenhouse Gas (GHG) emission reduction targets agreed at Kyoto mark an important milestone in curbing man-made climate change. But they represent a first step only in view of the need to dramatically reduce emissions in the long term in order to stabilise the Earth's climate. The European Union has made an important contribution to the Kyoto agreement and the Commission is convinced that it should continue to play a leadership role. The first priority must, therefore, be to develop a robust, credible and cost-effective implementation strategy to reach the Union's Kyoto target.

This will require action in all sectors of the economy, right across the Union. Particular attention will have to be given to transport CO_2 emissions, which, on unchanged trends, will increase further in the order of 40% by 2010 (compared to 1990 levels).

This Communication contains elements for curbing CO_2 emission growth in transport building especially on the Common Transport Policy. The Communication takes stock of existing Community policy approaches which are expected to contribute to curbing the growth in CO_2 emissions from transport and which in the Commission's view must underpin the Community's effort to ensure an adequate and cost-effective contribution from this sector to the attainment of the EU's commitments made in Kyoto. In addition, the emission reduction potential of a certain number of other promising policies which could be taken at Community, Member State and local level is assessed. The Communication constitutes a first response to the challenge posed by the agreed climate change objectives to transport policy and will have to be developed into a comprehensive strategy in the light of the elaboration of the Community's post Kyoto strategy, on which the Commission intends publishing a text before the Summer. This strategy will also have to deal with the question of the sectoral repartition of the Kyoto target, an issue that is not addressed in this Communication.

In the short to medium term, it is proposed as a starting point that the available "no-regrets" potential is fully exploited by acting on policy approaches which have already been developed. These measures are expected to lead to significant economic and transport benefits, in addition to which there are also likely to be other environmental benefits (notably reductions in "conventional" emissions such as NO_x and CO).

This Communication indicates that up to 2010 growth in CO_2 emissions could be halved by implementing a number of cost-effective policy approaches already outlined by the Commission or currently under preparation. However, it should be noted that significant policy efforts will have to be made to achieve results in terms of CO_2 emissions by 2010. The Commission is of the opinion that rapid progress on these measures is desirable since, otherwise - in view of the significant contribution which transport must make to the attainment of the Kyoto target - more costly policies will have to be developed.

Promising policy approaches include :

- Improved logistics

- Strategy to reduce CO_2 emissions from passenger cars

- Revitalisation of railways

- Promotion of public transport

- Promotion of short-sea shipping

- Promotion of intermodal transport

- Measures to enhance ATM in air transport

- Fiscal measures in aviation (kerosene taxation, VAT)

- Stepwise introduction of fair and efficient pricing in all modes of transport

- Strategic Environmental Analysis of TEN-T transport infrastructure investments

- Promotion of a series of complementary measures to be taken by national, regional and local authorities, including land-use planning.

In the long term (post 2010), the large scale introduction of new technologies such as fuel cells and alternative fuels could more than halve current transport emission levels. Although some of these options could reach significant market penetration rates over the next decade, it is unlikely that alternative fuels and propulsion technologies on the whole can make a significant contribution before 2010 since they are not sufficiently cost-competitive. However, the preparatory work must begin now. In view of the significant long term potential of alternative propulsion technologies, the Commission intends to favour important investments in Research and Development as well as Demonstration. The Commission considers that its proposal for the Community's Fifth Framework Programme for Research and Development constitutes an important opportunity for unlocking this technological potential by making these technologies more economically viable.

Clearly, most of the required measures will need to be implemented by Member States and local authorities and will therefore require efforts at all policy levels. To provide more transparency and a good co-ordination, objective monitoring mechanisms will, have to be created with the support of the European Environmental Agency. This allows action plans to be developed and facilitates an evaluation of the effectiveness of policy actions.

In many cases the proposed measures imply that traditional practices and patterns of mobility will have to be reviewed. Whilst this approach is expected to lead to significant overall benefits, it is clear that vested interests and rigidities will have to be overcome to realise the potential. The Commission, therefore, calls on the Council and the European Parliament as well as transport operators, users and workers to take their responsibility and act on these proposals at the appropriate level. Change will not be easy. But the alternatives to the measures discussed in this Communication would entail significantly higher costs without resulting in the transport and economic benefits the proposed approach could generate.

1. INTRODUCTION

In 1995, CO_2 emissions from transport represented 26% of total EU CO_2 emissions. On unchanged trends, a significant further increase in the order of 40% is expected by 2010, outstripping growth in all other sectors. It is clear that, if left unchecked, growth in transport CO_2 emissions would make it extremely difficult to achieve the CO_2 emission reduction target agreed at Kyoto (an economy-wide reduction of 8% from 1990 levels by 2008-2012). As part of the Community's post-Kyoto strategy, appropriate action on transport CO_2 emissions will therefore have to be taken.

This Communication provides a first assessment of the effectiveness in limiting CO_2 emissions from transport of a range of policies at Community, Member State and local levels. These policies have either already been proposed by the Commission or are being implemented, or have been shown to have significant CO_2 benefits in research or in individual projects. Of course, this approach will have to be refined as the Community develops its overall strategy with a view to the 1998 Buenos-Aires Conference, and the Commission is preparing before the summer a common and co-ordinated policy approach to achieve this. This Communication, therefore, limits itself to identifying a package of measures which will contribute to the reduction of transport CO_2 emissions and to proposing a process under which actions can be developed on different levels. The Commission underlines that further initiatives may be needed in the light of the development of the overall strategy to follow up on the Community's Kyoto commitments.

Clearly, all possibilities for implementing no-regrets measures, which lead to benefits other than reductions in CO_2 emissions, should be taken up in all sectors. As far as more expensive measures are concerned, an economically efficient approach will have to be developed that reduces emissions most where it costs least. This means that, in order to minimise the total burden for the economy as a whole, emission reductions will have to take place in such a way that the marginal costs involved are equal across sectors and gases. The Commission believes that there exists a significant potential for limiting transport CO_2 emissions.

This approach should take all six gases covered by the Kyoto protocol into account. Obviously CO_2 is the most important gas as it accounts for about 80% of the total global warming potential of all six greenhouse gases. But looking at CO_2 emissions alone would overestimate the apparent share of the transport sector in total greenhouse gas emissions; although there are emissions of greenhouse gases other than CO_2 from transport (e.g. caused by air-conditioning systems in cars), compared to CO_2 their importance is relatively small.

The high growth rate in transport emissions is due to three factors. First, transport is a derived demand. Growth in production and consumption , as well as structural changes (in land-use, lifestyle, etc.) have led to a more than proportional increase in the demand for transport services. Second, due to a progressive shift towards road transport the growth in energy demand has been even stronger. Thirdly, transport energy demand is currently supplied almost entirely from fossil fuels, mainly oil.

In the long term, technological progress on alternative propulsion systems and fuels is expected to allow significant reductions in emissions at low cost to society as a whole. In the meantime priority should be given to the swift implementation of Common Transport Policy

measures which have been proposed or even already adopted, complemented by additional measures at different policy levels. A strategy based on packages of measures at different policy levels is the most efficient way to achieve a reduction in CO_2 emissions.

The most important measures are discussed in the following chapters. Where possible, an attempt to quantify or qualify the potential reduction in growth has been made in a box at the end of the section describing the measure. For a number of measures, no estimates are presented; either because data was not available or because these measures only have a small impact on the reduction in the growth of CO_2. Unless stated otherwise, the percentage reductions in CO_2 emissions indicate by how much CO_2 emissions can be reduced by 2010 compared to the baseline (i.e. no additional policy action) forecast for the same year.

Many of the proposed medium term actions would also help to reduce other problems associated with transport, such as congestion, poor air quality and health risks, and would, therefore, generate multiple benefits. These other benefits are likely to be more readily understood and more visible, and would therefore help to ensure rapid adoption and implementation of the proposed strategy.

1.1 Current situation, trends and analysis

In the European Union, the share of transport CO_2 emissions in total increased from 19% in 1985 to 26% in 1995. EU transport CO_2 emissions currently account for about 3.5% of global CO_2 emissions.

Whilst in the period 1985 to 1995 economic growth in the EU-15 led to an increase in Gross Domestic Product of 26%, CO_2 emissions from transport grew by 37%. One fifth (about 7%) of the CO_2 growth from transport was due to a modal shift to less energy efficient modes of transport, and four-fifth (about 30%) to transport growth in general. Total emissions from all other sources declined by 5% (see also Annex 1). CO_2 emissions from non-transport sectors appear to have been decoupled from economic growth, through fuel switching (in electricity generation), structural change (industry) and improved energy efficiency (the domestic sector).

In transport, emission growth outstripped economic growth. In order to better understand this development, it is useful to break CO_2 transport emission growth down into its constituent components. In a schematic form these may be presented as:

- Economic growth
- Real transport costs, the spatial organisation of economic and social life and the role of logistics in the production process.
- The repartition of transport demand over the different modes (influenced by relative prices, quality etc.).
- The relation between mileage and transport services (influenced by loading ratios, empty running, vehicle sizes etc.) in different modes.
- Fuel economy (unit of fuel use per unit of transport).
- Carbon intensity of different fuels.

The significant growth in transport CO_2 emissions can be explained by the following factors: First, demand for transport services outpaced economic growth, especially in freight. Forces driving this process include changes in the spatial organisation of economic activities (e.g. the completion of the Internal Market), a reduction in real transport prices and changes in logistics systems which have generally lead to a substitution of inventories, by just in time transport. Secondly, there has been a marked shift away from modes of transport that are relatively energy efficient towards road transport. An important underlying cause of this modal shift is customer dissatisfaction with prices, quality and flexibility of these modes. Since road transport is relatively energy intensive, this process has increased energy use per ton of freight shipped and passenger kilometre performed. Thirdly, there is evidence that the average fuel efficiency of road transport decreased in this period due to a shift towards heavier cars, for example as a result of improved safety requirements. The relation between tonkilometres and mileage in road freight does not seem to have changed much (with about 30% of the trucks running empty and a loading ratio of approx. 50%).

Transport is a derived demand: in addition to action in transport, measures to address transport CO_2 emissions will, therefore, also have to cover areas outside the transport sector (e.g. land use planning).

Bluntly imposed reductions in transport would cause significant economic costs in view of the derived nature of transport. The longer-term objective should be to arrive at a less transport-intensive path of economic development primarily through the full internalisation of the external costs of transport which is likely to induce significant improvements in the efficiency of transport operations. Furthermore, a stronger consideration of traffic generation effects in spatial planning and the assessment of the transport effects of other sectors and sectoral policies should be pursued. In addition, the focus should be primarily on areas – such as urban areas or major transport corridors or nodes – where traffic growth already gives rise to an unsustainable situation in terms, for example, or pervasive congestion, air pollution or noise. These external costs provide an additional justification for measures to be taken and will increase their political acceptability.

While this Communication focuses on their potential to curb CO_2 emissions, the transport policy measures discussed were primarily aimed at improving the efficiency of the transport sector itself and, thereby, on the competitiveness of the economy as a whole. In order to render the strategy as cost- effective as possible, strong emphasis will have to be put on these measures.

An example of such synergies are policies to address congestion, which undermines the efficiency of the transport system and decreases fuel efficiency. Addressing traffic growth in such situations (e.g. congested city centres) would lead to improvements in travel speeds, reduced pollution and significant cuts in CO_2 emissions provided measures are taken to avoid that the newly freed capacity attracts additional traffic.

In order to properly focus policy efforts it is helpful to differentiate between different modes, both in terms of their importance as a source of CO_2 and in terms of growth trends.

Road is the most important source which largely determines the trend in the transport sector: passenger cars account for about 50% of transport CO_2, and road freight for about 35%. Road transport CO_2 has increased by nearly 36% from 1985 to 1995. Urban traffic is responsible for about half of the road transport figure. Air traffic generates only 12% of transport CO_2, but recorded a significant increase (57%) over the period 1985 to 1995 and is forecast to grow at 6% per annum. There are of course also the rail, inland waterway and maritime transport sectors. These modes are usually less energy-intensive (see annex 2).

Road and air transport are therefore the two main focuses for reducing CO_2, because of their share in emissions and/or because of their growth trends. For inland transport especially, a strategy for reducing CO_2 emissions can build on Community policies already in place and proposed to improve the efficiency of the individual modes and to promote a shift towards more energy-efficient modes (which will also contribute towards other environmental objectives).

However a cost-effective strategy might also require emission reduction efforts for the other modes, especially when these efforts could come as no-regret options.

2. THE COMMUNITY POLICY: AIMING AT SUSTAINABLE TRANSPORT

Improving the efficiency of all modes of transport

2.1 Road Freight

The potential for better and more efficient logistics is substantial, both in terms of the location of production and logistics facilities and could generate an improvement in transport operations. Road hauliers can increase the utilisation of vehicles and reduce empty running[1]. A pro-active approach could be based on information programmes, promotion of voluntary actions and better management practices[2]. To improve the implementation of measures that reduce empty running, transport audits could be incorporated within already existing quality certification systems, which might encompass

[1] Estimates for the UK freight sector indicate that only around 62 % of the available capacity is used. Adding empty running this proportion falls to 44 %.

[2] See Action Programme "Freight Intermodality" in the Communication from the Commission. Intermodality and Intermodal Freight Transport in the European Union – A system Approach to freight transport. Strategies and action to enhance efficiency, services and sustainability. COM(97) 243 final of 29.5.1997

reviews and audits of driver behaviour, routing, scheduling operations, etc. The Commission will study the feasibility of better incorporating transport considerations into the EMAS and will continue to promote and disseminate best practice within the road freight transport sector.

Improved logistics and more efficient freight operations could achieve a reduction in truck operations and vehicle.km in the order of 10-40 %, with an equivalent decrease in CO_2 emissions.

This is an example where efficiency improvements in the transport sector itself go hand in hand with a reduction in traffic and the associated CO_2 emissions: innovative approaches for providing the same transport services with less vehicle kilometres. In 1997 Mr Kinnock asked a small advisory group to consider the encouragement of the use of Best Practice to reduce the impact of freight transport. The report of the advisory group [1] has highlighted the potential of measures that could generate significant "no regrets" savings in transport movements and fuel consumption in addition to very large cost savings to enterprises and shippers. For example, driver training can reduce fuel consumption up to 20%, improved lorry aerodynamics could lead to fuel savings on trunk routes of up to 19% and use of computer routing software can reduce vehicle movements by up to 20%. The further development of City Logistics can also make a significant contribution. Measures to reap this potential should be further developed and disseminated. The Commission is currently considering the appropriate follow-up to be given to the Advisory Group's report.

2.2 Passenger cars

Passenger cars account for about half of transport-related CO_2 emissions in the EU. Passenger car CO_2 emissions have exhibited a strong growth trend in the past and are expected to grow significantly in the future. The average fuel economy of passenger cars improved until the late 1980s under the influence of increased fuel prices following the oil crises. However, over the last few years, an increase in average fuel consumption has occurred mainly due to a trend towards heavier and more powerful cars, for example as a result of improved safety requirements. For viable development in the future fuel-efficient cars will be needed, which are at the same time safe, reliable, environmentally friendly, and which meet consumer requirements in terms of transportation needs and affordable prices. A reduction in the average fuel consumption of new vehicles can be arrived at in two ways: via technical improvements in new models, and by consumers choosing lower consumption vehicles ('down-sizing').

Against this background, the EU has adopted a strategy to reduce CO_2 emissions from passenger cars by improving the fuel economy[2] with the

[1] Report of the Advisory Group on Best Practice and Charges in Freight Transport to Neil Kinnock, European Commissioner for Transport, March 1998.

[2] COM (95) 689 final 20.12.95, Council conclusion of 25.06.96

objective to achieve an average CO_2 emission value of 120g/km by 2005 (or 2010 at the latest) for all new cars.

The objective is to be achieved by a package of complementary measures : (1) an environmental agreement with the automotive industry under which the industry would commit itself to reducing the average CO_2 emissions of new cars sold; (2) fiscal measures in the context of vehicle taxation; and (3) a consumer information scheme to influence the market. The Commission intends to soon put forward legislative proposals for a monitoring system on the average CO_2 emissions from cars and for a consumer information scheme.

The Commission is discussing the possibility of an environmental agreement as part of the strategy with the *European Automobile Manufacturers Association* (ACEA). ACEA has recently presented a proposal for an agreement which includes a CO2 objective of 140g/km for 2008. The provision of fuels of a sufficient quality to enable the application of the technologies needed for the industry to achieve its CO2 commitments under an agreement, is being examined as well as the effect of the strategy on NOx and particulate emissions.

The objective of the EU strategy to reduce CO_2 emissions from passenger cars corresponds to an improvement in the average fuel economy of new cars in the market in the order of 30%. Further analysis undertaken by the Commission Services suggests that a promising package complementing an environmental agreement with the automotive industry and a consumer information scheme is an increase in fuel taxation implemented in combination with a vehicle tax related incentive.

It is expected that, during the period 2000-2010, new technological developments are gradually incorporated into new car models based on the internal combustion system. While alternative propulsion and alternative fuel based vehicles are likely to become increasingly available, the scale of their introduction in the market is likely to be limited, unless strong government action is introduced.

2.3 Rail Freight

Unlocking the potential of railways to carry a larger part of freight transport is a crucial dimension of the Common Transport Policy. The 1996 White Paper on the Revitalisation of the Community's Railways[1] set out the need for the railways to respond better to customers' needs and to improve their performance.

The intensification of this policy approach in rail transport represents a significant potential for cutting CO_2 emissions. To be successful railways will have to be made more responsive to customer needs which will require

[1] White Paper "A strategy for Revitalising the Community Railways (COM (96) 421 final)

the introduction of market forces. This should bring about more efficient use of existing railway infrastructure as well as a simplification of operational procedures.

The 1997 Communication on Trans-European Rail Freeways[1] is pushing forward the development of rail freight services ahead of further liberalisation: the first freeways are already operational and several others are under development. Under this scheme some Member States and infrastructure managers' open access to rail networks on a voluntary basis, without waiting for changes in Community legislation.

In order to ensure that the framework conditions for an efficient internal rail market are in place, the Commission will come forward with three policy packages in the course of 1998. The first will contain guidelines for the use, management and pricing of rail infrastructure; the second will comprise rules on the financial relationship between the State and the railways, whilst the third will set out an approach to further technical harmonisation and interoperability in conventional rail.

Assuming a cross-price elasticity of 0.5 between rail freight and road freight, a decrease of 25% in railway freight tariffs (reflecting a corresponding increase in efficiency due to improved performance) would allow a reduction of CO_2 emissions from road transport of about 4.5%. In terms of CO_2 emissions from the transport sector as a whole, the reduction would amount to 3%. This assumes that all new railway activities would come from a modal shift from road.[2]

2.4 Public Passenger Transport

On passenger traffic, the 1996 Green Paper "The Citizens' Network"[3] examined the potential of public passenger transport as a means of reducing congestion, especially in urban areas. Identifying innovative and imaginative schemes already in existence, the document pointed the way forward for urban transport in different circumstances.

The forthcoming Communication on Developing the Citizens' Network will take these arguments a step further by indicating how a modernised regulatory framework can be created at Community level and which actions should be developed at local level. An important area is the case of regional trains and buses, where both possibilities and needs for a better balancing of supply and demand often exist. There are examples where the energy consumption and thus CO_2 emissions per passenger kilometre are very high at weekends as well as for early and late departures.

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[1] Communication from the Commission. Trans-European Freight Freeways. COM/97/ 242 Final of 29.5.1997

[2] Own calculations of the Services of the Commission.

[3] The Citizens' Network fulfilling the potential of public passenger transport in Europe. European Commission Green Paper. 1996

Table 3 in Annex 4 shows that the occupancy rates of vehicles have a very strong impact on the energy intensity of passenger transport. When full, a small car can even be less energy intensive than a double-decker bus, if the bus is only one-quarter full. The inherent environmental superiority of public transport depends, to a considerable extent, on the way in which it is organised. The Commission-financed ISOTOPE research study showed that cost reductions of up to 15% may be feasible from increased operational efficiency in urban public transport[1]. As these cost reductions reflect mainly efficiency improvements, they probably also reduce CO_2 emissions. Therefore, the Commission will further investigate how the functioning of market forces in public transport can be improved.

In the framework of mobility management and mobility behaviour in general, the Commission urges business undertakings to look responsibly at measures to reduce car use, as well as to encourage alternatives such as paid season tickets for public transport for their staff.

National, regional and local authorities, in co-operation with the business community itself, have an important role to play in reviewing the effect of subsidies and other financial and fiscal advantages. Company cars, allowances for commuting and free parking all encourage rather than discourage private car usage.

To facilitate a changeover from private cars to other types of transport, public transport systems need to be improved[2]. This will provide an incentive to relinquish cars and to opt for collective forms of transport which have a much lower energy intensity. High quality public transport may also help to attract and retain opportunities for job creation in urban centres. Efficiency improvements to public transport systems represent an important potential for limiting CO_2 from transport. For a public transport system to become competitive it needs to meet passenger needs together with recovering costs and overall efficiency. Changes in behaviour can be further promoted by effective information campaigns to encourage drivers to opt for public transport.

2.5 Shipping

Seaborne transport has a much higher energy-efficiency than other modes of transport like air and road.

The promotion of maritime transport - short sea shipping within the EU - represents another potential for modal shift in the EU, including in its peripheral Member States[3]. A Communication on short-sea shipping[1]

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[1] ISOTOPE : Improved Structure and Organisation of Urban Transport Operations of Passengers in Europe.

[2] A 5% shift of passenger car transport to public transport by bus and rail would reduce CO_2 emissions by 2 % (own calculations of the Services of the Commission)

[3] A 1 % modal shift from road freight transport to shipping would allow a reduction of CO_2 emissions from transport by 0.2 % (own calculations of the Services of the Commission)

outlined the potential of this environmentally friendly mode, and identified the gaps which need to be closed in order to make maritime transport a more attractive solution.

The Kyoto Protocol recognises the world-wide character of shipping and gives the International Maritime Organisation the task of pursuing a limitation or reduction of emissions of greenhouse gases[2]. The Commission fully supports all efforts to be undertaken within the IMO and is of the opinion that measures decided in that organisation should not be restricted to the shipping industry of industrialised countries (Annex I Countries to the Kyoto Protocol).

In the light of the deadlines in the Kyoto Protocol, an appropriate framework should be realised outside the recently finalised Annex V VI of Marpol 73/78[3]

2.6 Air Transport

Air transport has the highest CO_2 emissions per passenger kilometre and per ton of freight shipped. Moreover, growth in aviation is two to three times higher than average growth in transport.

Although the share in transport emissions is still relatively small (12%), this clearly implies that action in aviation is required. The Commission will, therefore, in 1998 present a Communication on air transport and the environment. This Communication will analyse policy options and present recommendations and, where appropriate, proposals for significant improvements of the environmental performance of air transport, including CO_2 emissions. Options that will be analysed include stricter international emission standards, measures aimed at promoting the efficiency of the air transport system, including taxation and charging, and the policies to develop alternatives to aviation, where appropriate.

The present effort to integrate the Air Traffic Management System at a European level can also make an important contribution.

Ideally, the length of a flight should be minimised in terms of time and distance. Various constraints, such as route design, national borders, military operations, layout of navigational aids as well as weather and other environmental restrictions result in increases of flight distances of about 10%. Significant improvement in CO_2 emissions from aviation may be obtained by improving ATM efficiency. The enhancement of the

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[1] The Development of Short-Sea Shipping in Europe: Prospects and Challenges. COM/95317 final of 5 July 1995

[2] Article 2.2 and 3.2 of Kyoto Protocol

[3] In September 1997 a Conference of the contracting parties to the MARPOL 73/78 Convention adopted a Protocol adding a new Annex VI "Regulations for the prevention of air pollution from ships" to the MARPOL Convention dealing with the prevention of air pollution from ships. Greenhouse gases are not incorporated in this Annex. An ad-hoc resolution invited the IMO to consider CO_2 emissions.

performance of ATM systems already mentioned would contribute to reducing CO_2 emissions in the short term.

Studies commissioned by EUROCONTROL suggest that such optimisation could contribute to energy consumption savings of about 7%, thus reducing CO_2 emissions at an equivalent rate.

In addition to the fiscal treatment of kerosene used as aviation fuel, the fact that VAT is not applied to intra-EU air fares may have artificially increased demand for air transport. The Commission is examining the VAT regime in relation to passenger transport and will present, during 1998, a consultation paper on this subject. The Commission is currently also studying the issue of kerosene taxation.

Creating an integrated EU Transportation System

2.7 Intermodality, combined transport and logistics

Putting forward a new systems approach, the 1997 Communication on Intermodality and Intermodal Freight Transport in the European Union[1] promotes intermodality as a tool whereby transport services are offered as mode-independent door-to-door connections, based on a variety of modal transport alternatives. The objective is to develop a framework for optimal integration of all modes to enable efficient and cost-effective use of the whole transport system through seamless, customer-oriented door-to-door services, whilst at the same time favouring competition between operators.

To a large extent, this can be realised by making more effective use of existing capacities throughout the transport system. An Action Programme was developed by the Commission, setting out the necessary measures for the creation of an integrated intermodal transport system[2].

Moreover, the EU has invested considerable resources into research and development of information systems for road transport. The progressive implementation of these systems in the coming years will allow a significant improvement in the information flow to car users, allowing them to avoid congested areas and thereby increase fuel economy. To limit new induced car traffic demand, other complementary measures may be needed (e.g. road-pricing).

Traffic management measures improving the flow of vehicles in urban areas can reduce CO_2 emissions by 5% to 15%, depending on the local situation.

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[1] Communication from the Commission. Intermodality and Intermodal Freight Transport in the European Union - A system approach to freight transport. Strategies and actions to enhance efficiency, services and sustainability. COM(97) 243 final of 29.5.1997

[2] idem

As urban traffic represents about 30% of all vehicle traffic, this could produce an overall CO_2 reduction from transport of 3%.[1]

Combined transport can make an important contribution to decreasing the growth in road transport movements in a cost-effective manner. For long haul routes, railways, maritime transport and inland waterway modes have consistently better CO_2 performance than road transport. They should be encouraged to take over long haul movements that currently go by road. The aim of the Community's PACT programme is to grant financial assistance for innovative actions that promote combined transport. Further to the Action Programme in the Communication on Short-Sea Shipping, progress in developing combined transport will be made through the development of European Rail Freight Freeways and by the implementation of an Action Programme to improve intermodality. The availability of a network of terminals to tranship goods from road to rail and inland waterways is obviously of significant importance. Effective realisation of all planned EU-terminals would allow a significant growth in Combined Transport, which would reduce CO_2 emissions by about 2 - 3%.[2]

Efficiency gains that could be realised in an intermodal transport system would reduce CO_2 emissions, e.g. the creation of an integrated logistics management system which makes full use of telematics would allow a CO_2 reduction of about 4%.[3]

2.8 Fuel Taxation

Community Directives on the excise duty of mineral oils lay down minimum rates of duty which must be respected by the Member States. The Commission has made a proposal for a Council Directive to restructure the Community framework for the taxation of energy products[4]. The adoption of the proposal would increase the minimum rate on gasoline by 45% and on diesel by 27% by 1998 and by 74% and 62% in 2002. The increase by 2002 is only indicative and would require a future confirmation by the Council. But as most Member States apply tax rates above the EU minimum, the direct impact of the proposed Directive on national tax rates would be limited. Even though fuel taxation has increased during the last decade, the total fuel prices to the consumer have decreased in relation to per capita income. Differential treatment favouring public transport over private motor vehicles could also be established by refunding part of the fuel duties paid by

[1] Volkswirtschaftliche Kosten - Wirksamkeitsanalyse von Massnahmen zur Reduktion der CO_2 Emissionen des Verkehrs in Osterreich.

[2] Volkswirtschaftliche Kosten-Wirksamkeitsanalyse von Massnahmen zur Reduktion der CO2-Emissionen des Verkehrs in Osterreich.

[3] Volkswirtschaftliche Kosten - Wirksamkeitsanalyse von Massnahmen zur Reduktion der CO_2 - Emissionen des Verkehrs in Osterreich

[4] Proposal for setting up a Community Framework for the taxation of energy products (COM (97) 30 final)

operators of public service vehicles. Alternative fuels with lower global warming impact could also be encouraged by reduced rates of fuel duty[1].

The current directives on excise duty on mineral oils lay down minimum rates of excise duty, which must be respected by Member States. They are free to apply rates above these minima. However, there is provision under article 8 (4) of Directive 92/81/EEC whereby Member States can seek the approval of the Commission and the Council to depart from the general rules in certain circumstances. Most Member States have under this provision been authorised to apply rates below the minima on motor fuels used for public transport.

The new proposal has incorporated this provision and provides Member States with a number of options enabling them to pursue more ambitious environmental policies, without prior Council authorisation. Passenger transport or public captive fleets using natural gas and LPG, rail transport and navigation on inland waterways may benefit from reduced excise duty on motor fuels to encourage their development. There is a similar provision for reductions for products from renewable sources with lower global warning impact (e.g. road fuel gases and biofuels). Finally, the Proposal also provides for the possibility for Member States to reduce their level of fuel taxation below the minimum rates to facilitate the introduction of transport pricing instruments such as road pricing which can address specific transport problems more precisely.

CO_2 emissions from aviation must also be addressed. The Commission has suggested that the introduction of a tax on kerosene should be considered in the relevant international fora. The effects of such an introduction - at international, EU, and national level - is currently being studied by independent experts. The Commission has proposed that the Community should introduce such taxation within the framework of an ICAO initiative.

The Commission believes that increases in the Community's minimum fuel taxes constitute an important element in a strategy for reducing CO_2 emissions from transport. However, where more cost-effective other economic and/or fiscal instruments can be introduced, these should be implemented where appropriate In those cases the Commission has already proposed that Member States should have the possibility to reduce the level of fuel taxation below the minimum.

2.9 Fair and Efficient Pricing

The Union's objective of ensuring sustainable transport requires that prices reflect underlying costs to society which would otherwise not be taken into account by transport users. These costs include the damage caused to transport infrastructure, air and water pollution from transport, CO_2

[1] Article 8(4) of Directive 92/81/EEC provides that Member States can obtain the approval of the Commission and the Council exemptions from the general rules under certain circumstances. Most Member States have been allowed to apply rates below the minima on motor fuels used for public transport

emissions, the costs of time delays caused by congestion, transport related accident costs (beyond insurance premiums), and the noise "pollution" from transport. The 1995 Green Paper on Fair and Efficient Pricing[1] showed not only that taxes and charges are currently not only set in very different ways across modes of transport, but also that they do not fully reflect external costs in general.

The varying degrees to which the social costs of different transport modes are taken into account lead inevitably to inefficiencies both in the use and the provision of transport infrastructure and services. Due to prices that do not reflect the underlying social costs, transport demand is too high for some modes or for certain times of day. At the same time, public transport services or other forms of collective transport may be under-utilised. Competition between modes is distorted, and artificial obstacles to the development of intermodal transport are created. "Distortions" in demand will almost automatically lead to inefficient provision of transport infrastructure and services leading to higher overall costs to the society. All these inefficiencies impede CO_2 reduction in transport.

If designed to reflect the level of costs imposed on the society, differentiated charges would be the highest in congested periods and densely populated periods and regions (i.e. regions with a high level of CO_2 emissions), while transport in peripheral regions would carry lower charges.

Road pricing, involving a system whereby the number of kilometres driven on different roads is recorded, with tariffs per kilometre set on road type, vehicle type and degree of congestion, can be an attractive policy tool for curbing congestion and CO_2 emissions. Advanced technology is now becoming available which may make it possible to implement those systems on a wide-scale basis with a substantial decrease in the related technical costs, making it an economically efficient instrument.

At the Community level, the policy of internalising all external costs of transport would reduce CO_2 emissions on average by 11.5%. In addition to CO_2 reductions, the net benefit to European citizens from reduced time spent suffering congestion, and from decreased accidents, noise and other emissions would range between 28-78 billion ECU per year.[2]

2.10 Efficient Infrastructure

Transport problems have often been associated with insufficient infrastructure capacity. Whilst building transport infrastructure is a priority with Trans-European connections in economically less developed areas, for large parts of the EU expanding infrastructure seems nearly impossible due

[1] Towards Fair and Efficient Pricing in Transport. Green Paper. COM (95) 691 final

[2] Source: TRENEN II - Models for transport environment and energy, working paper, 1998, EUNET - Socio-economic and spatial impacts of transport, working paper 1998.

to physical, social or environmental reasons. In such cases transport infrastructure policy must aim to manage transport demand better.

With the entry into force of the Maastricht Treaty, additional emphasis is put on the development of a Trans-European Transport Network (TEN-T), contributing to the overall sustainability of transport systems. By using part of the TEN-T budget for projects which permit a modal shift from road to other means of transport, a more sustainable transport chain can be promoted. In the same way TEN-T implementation in the different Member States will give priority to the development and establishment of interoperability between national networks, transfer points, nodes and terminals as well as to the use of intelligent traffic management systems to optimise the use of infrastructure.

The services of the Commission are developing a methodology for the Strategic Environmental Assessment (SEA) of the TEN-T. Systematic implementation of this new policy tool would improve the sustainability of transport systems, i.a. in terms of CO_2 emissions, by augmenting the importance of environmental sustainability considerations in the selection of projects.

Furthermore, the development of GNSS (Global Navigation Satellite Systems), in particular as part of the TEN-T can improve transport efficiency for all modes, through more reliable, efficient and highly accurate navigation and positioning-fixing services for European and other users.

The improved transport efficiency and reliability of transport resulting from carefully selected investments in transport infrastructure and telematics will have a beneficial impact on CO_2 emissions as demonstsrated in several THERMIE projects, provided they don't generate additional transport demand.

3. COMPLEMENTARY MEASURES FOR REDUCING CO_2 FROM TRANSPORT

In the preceding chapters the emphasis was mainly put on a series of instruments for combating CO_2 emissions which have been developed under the Common Transport Policy since the publication of the 1992 White Paper[1].

But in addition to CTP-driven regulatory and economic/fiscal measures, a CO_2 abatement policy could also benefit from initiatives taken by national or local authorities. The need for and the strength of such additional measures is likely to be different between Member States according to their specific local situation.

[1] White Paper on the Future Development of Transport Policy COM (92) 494

3.1 Measures by national, regional and local authorities

Within the framework of a better traffic management - often in relation to air quality management - national and local authorities can play an important role by contributing to the development of traffic plans. They are ideally placed to deploy measures to discourage the use of the private car and to encourage the use of public transport and alternative forms of transport including, in some areas, cycling and walking.

Measures to control the availability of parking in congested areas can best be implemented by local authorities. Higher parking charges may be more effective in reducing short range trips into a city centre rather than long distance journeys.

Authorities can restrict certain lanes to high occupancy vehicles in order to encourage car-sharing especially during rush hours. Low vehicle occupancy means more vehicles on the road, more congestion, higher energy consumption and more CO_2 emissions. However, as is also the case with a number of other traffic management schemes, the effect of car-sharing on CO_2 emissions can be diminished by a latent surge in demand provoked by increased free capacity. Other measures which could be envisaged by local authorities include "Park and Ride Facilities" to encourage people to leave their cars on the outskirts of cities and to use public transport to complete their journeys, thereby reducing congestion and CO_2 emissions.

Various traffic calming measures can also have benefits in terms of CO_2 reduction. The systematic introduction of such measures, combined with restrictions for cars and lorries (especially in urban areas) may in the longer term affect the propensity to travel. By reducing the average speed of traffic behavioural changes may be provoked (e.g. a wider use of cycling and walking).

The circulation of lorries in cities creates a specific problem. In some cases, City Logistics Systems have been able to reduce the mileage driven within city centres by some 60%, as demonstrated by THERMIE programme. Under such a system an independent city logistics company collects freight from the forwarders' terminals according to a fixed timetable. After sorting, the goods are transported to the destinations along optimised routes. The system not only reduces CO_2 emissions from transport, it also reduces uneconomical fleet use.

Technological and organisational measures in transport need to be supported and/or balanced by appropriate fiscal/economic instruments. Only a combination of measures can produce a substantial reduction of CO_2 emissions in cities while also meeting other environmental goals together with the need for fair access for all.

Possible impact of various local measures[1] on total CO_2 emissions from transport (% reductions):

- promotion of cycling: 4%
- speed limits and better speed control: 5%
- information campaigns: 3%
- higher urban parking charges: 1%
- restrictions for cars and lorries in cities: 1%.

3.2 Land-use planning and transport

Good collaboration between those who are responsible for traffic management and land-use planners is important for the long-term efficiency of transport systems. Land-use plans should be carefully designed in the context of long-term mobility plans.

By considering where people live and where their professional activities take place, land-use planners can make a useful contribution to more efficient mobility in terms of trips made, distance travelled and the type of transport mode used. As land-use policies have a direct effect on CO_2 emissions, effective long-term land-use planning can influence CO_2 emissions from transport by minimising the need to travel.

The need to travel can be minimised in several ways: by reducing the distance between places of residence, employment and commercial or other activities. Urban sprawl has given rise to longer average travel distances per trip per person per day. It is clear that land-use planning can also enhance the functioning of public transport, by ensuring that trip-generating activities are concentrated in locations that are easily accessible by public transport. The combination of better traffic management, improved public transport and integrated land-use can have an important leverage effect on the efficiency of the transportation system and on the demand for mobility.

Land-use policies are not efficient in reducing CO_2 unless they are complemented by a package of transport policy measures. Emissions per capita per day can be reduced to about one third by 2010 using the following bundle of measures[2]

- increased prices for car use and financial incentives to use more efficient cars
- increased inner-city parking charges
- faster public transport (25%) and reducing car speeds by 40%
- land-use management in the periphery in order to reverse the trend of urban sprawl.

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[1] Volkswirtschaftliche Kosten-Wirksamkeitsanalyse von Massnahmen zur Reduktion der CO_2-Emissionen des Verkehrs in Osterreich.

[2] IRPUD (1998): Sustainable urban spatial structures. Do we need to rebuild our cities? http://irpud.raumplanung.unidortmund.de/irpud/pro/co2/co2-e.htm.

4. EFFECTS AND COSTS: AN ASSESSMENT

Developing a cost-effective approach for transport CO_2 reduction means arriving at a least-cost package of compatible measures which realises a given objective for CO_2 reduction. A given objective for CO_2 reduction can be achieved by different combinations of levels of mobility, carrier energy efficiency and fuel mix. It is also possible that changes in one of those three factors will not take place independently, but will have feedback effects on the other two factors. These feedback effects may be positive but also negative.

For those reasons any quantitative evaluation of the effectiveness of policy measures intended to reduce congestion, energy-consumption and related CO_2 emissions will inevitably be surrounded by relatively large margins of uncertainty. However, by bringing together available results from research in this area, it is possible to indicate orders of magnitude of expected effects from various policy instruments and combinations of them.

Fully implementing the package of transport policy measures outlined in this Communication could reduce CO_2 emissions from transport by a maximum of 20-35% in comparison to the baseline. The most important reductions, of up to 7-16%, would come from the internalisation of external costs of transport by means of efficient pricing (see Annex V). Fully implementing the passenger car fuel economy strategy could reduce CO_2 by 3 to 9% in 2010. Obviously, more important reductions in CO_2 emissions will occur after 2010 with the progressive renewal of the car fleet. Revitalisation of railways, the introduction of a modernised regulatory framework for public transport and developing intermodality and logistics could decrease CO_2 by up to almost 10%. Because of interaction effects between the different measures, the total reduction potential is not equal to a simple addition of the effects of the individual measures. Moreover, since the implementation of some of these measures will require careful preparation and a phasing in, the realistically achievable reduction is likely to be of the order of 20-25 %.

In many cases, these policy measures would also lead to economic advantages for society, rather than implying an overall cost. For example, internalisation of external costs at Community level would bring about benefits ranging between 28-78 billion ECU due to less time spent in congestion, decreases in accidents, noise and other emissions and better land-use planning.

5. LONG TERM SOLUTIONS

5.1 Further potential for reduction of CO_2 from transport

There are obviously limits to the fuel efficiency improvements that can be gained by further improving the internal combustion engine. For the future, the technical answer to the problem of CO_2 emissions lies in the development of alternative propulsion technologies, notably hybrid car technology and fuel cells.

5.2 Hybrid Cars

In the medium-term, CO_2 reductions can be obtained by the introduction of hybrid cars powered by a combination of a battery and a conventional engine. Hybrid technology could provide 20-50% fuel savings in urban driving conditions compared to existing vehicles.

5.3 Fuel Cells

Fuel cell technology is a longer-term solution, although several automobile constructors are already announcing the commercialisation of such vehicles - probably on a limited scale - by 2004. Fuel cell vehicles produce electricity for an electric motor directly from a chemical reaction. Due to their high energy efficiency fuel cells have a high CO_2 emission reduction potential.

The main barrier to the deployment of fuel cells is cost. The main research targets within the next five to ten years will be cost reduction, system simplification and improved lifetime and reliability. Some of the necessary cost reduction is expected to come as a result of volume manufacturing. There exists also a need for cheaper materials and low-cost component designs.

5.4 New fuels

The potential of new fuels, including biofuels[1], to reduce CO_2 emissions depends on a number of elements, in particular their production costs, their production capacity and the availability of adequate distribution infrastructures which should therefore be developed where appropriate.

In the longer term, technological constraints preventing alternative vehicles from competing with conventional diesel and gasoline vehicles will be reduced.

5.5 The Role of transport related R &D

A transport research and development strategy should aim to further develop the long-term strategies for sustainable transport. These strategies should also address promising solutions that are yet too expensive to be implemented in the short term.

Transport related research in the 4th Framework programme for research, development and demonstration has focused mainly on experimentation with alternative transport policies, and the development of more energy-efficient road vehicles and aircraft. The further development of technologies will allow a swift modal shift to rail or shipping.

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[1] In the White Paper on Renewable Energy Sources (COM/97/599 final) the Commission puts forward an action plan to promote the use of renewable energy.

Research into technologies which will allow improved batteries, fuel cells, transmission and control systems for hybrid vehicles, more energy efficient aircraft, etc. is already under way and should shorten the path towards a cost-efficient implementation of these techniques. Appropriate tools for supporting the monitoring of carbon dioxide emissions from transport are being developed. It is the intention to continue this process under the Fifth Framework Programme for Research and Demonstration (1998 - 2002) addressing all elements for establishing a long-term balance between the growing demand for mobility and the various environmental, social and economic constraints.

Research into the relationship between transport and the production-consumption process is expected to provide ideas on how to decouple the link between economic growth and traffic volumes.

To enhance the efficiency of transport special attention will also be given to the operational, regulatory and administrative aspects.

6. ACTION PLANS AND MONITORING

As the implementation of an efficient CO_2 policy in the transport sector has to be based on a package of complementary measures and concerns many decision-making levels and actors, a good co-ordination is a pre-requisite for its success. It is best supported by action plans at different levels – Community, Member States, local government – involving the different stakeholders (e.g. the general public, business community). These actions plans should also take into account benefits in terms of other transport and environmental objectives which will enhance their overall attractiveness. Action plans and their implementation should be supported by monitoring mechanisms on the development in transport CO_2 emissions which should also include policy monitoring.

Action plans at the most appropriate levels should be oriented towards achieving the full potential of the package of measures outlined in this Communication. They should be based on the identification of measures to be taken and of the responsible actors and on an analysis of the effectiveness of the measures. They should lead to a consensus between the relevant actors about the sharing-out of responsibilities. The implementation of the action plan should be monitored by the responsible authorities in co-operation with the other actors involved and reviewed if its effectiveness should prove insufficient.

A more precise definition of these action plans and their contents, including the question of possible sectoral targets, can only take place when the overall post Kyoto strategy is developed in more detail.

The Commission – in co-operation with the European Environment Agency – is currently working on the development of a broader monitoring system on transport and environment which will include CO_2.

7. CONCLUSIONS

On unchanged trends and policies, CO_2 emissions from transport - road and air transport in particular - will continue to rise strongly. If left unchecked, this strong

growth would pose significant problems for achieving the emission reduction objective agreed in Kyoto. Policy action in transport is therefore required.

The analysis presented in this Communication allows two main conclusions to be drawn about how this can be achieved:

- In the medium term (up until 2010) growth in CO_2 emissions from transport can be roughly halved by fully and rapidly implementing a number of policy approaches that the Commission has put forward. Four broad categories of measures are crucial in this respect:

  - Action on passenger car fuel economy

  - Progress with fair and efficient pricing in transport

  - The completion of the internal market in rail transport

  - Measures to better integrate the various modes of transport, both in freight and in passenger transport into intermodal transport systems.

The estimates presented in this paper indicate that, if implemented as part of a coherent policy strategy, these measures have the potential to reduce growth in emissions by 20-25% below the baseline over the next 15 years, marking a radical break in current trends.

They also have two key characteristics in common: Firstly, they are likely to result in significant economic, environmental and transport benefits, because they enhance transport efficiency and sustainability. Secondly, they require major changes in existing policy frameworks and sometimes difficult adjustments in operating practices. Together they represent a challenging agenda that clearly cannot be achieved overnight. However, the importance of reaching the Kyoto target reinforces the need to make more urgent progress on these policies.

- In the longer term (post 2010) alternative propulsion systems and fuels hold out the potential for radical reductions in transport CO_2 emissions. Most of these options, however, are still too costly and have operating drawbacks. It is therefore unlikely that they will be able to make a major contribution to cutting emissions from transport before 2010.

  A bold Research and Development programme is needed to resolve these problems. That is why the Commission in its proposal for the Fifth Framework Programme for Research and Development (FPV) put significant emphasis on key actions that will help to address transport policy challenges.. In addition, demonstration and experimentation are essential and the Commission is assisting Member States and local and regional authorities in this process through the ALTENER and THERMIE programmes.

Three additional considerations regarding the approach should be borne in mind:

First, many of the required measures need to be implemented by Member States and local authorities. The approach can, therefore, only be successful if supported at all policy levels. This will also require that responsibilities for implementation are clearly assigned.

Secondly, although the measures outlined in this Communication are expected to lead to significant economic and environmental gains, its implementation will require major efforts at all policy levels and will affect both transport workers and users significantly. It will only succeed if it is given the necessary attention and emphasis. Therefore, the Commission believes that action plans for CO_2 reduction are needed at different levels, involving all the stakeholders. Alternative approaches that do not fit into this framework could also undermine its implementation and risk carrying a significant cost.

Thirdly, monitoring the effects of these policies on CO_2 emissions from transport is essential to evaluate their (cost-)effectiveness and to provide more transparency in policy development. Moreover, through the exchange of best practice which this process engenders, monitoring and dissemination of results is expected to contribute to a more effective policy development throughout the Community. The Commission will invite the European Environment Agency to carry out this task and report on a regular basis.

Annex 1

Table 1

EU 15

Mio tonnes CO_2

	1985	Growth 90/85 % p.a.	1990	Growth 95/90 % p.a.	1995	Growth 1995/1985 % p.a.	%/period
Total	**2 997.3**	0.6	**3 087.7**	-0.3	**3 047.6**	0.2	1.7
Electricity and heat	926.2	1.4	994.1	-1.0	946.4	0.2	2.2
Energy Branch	126.1	0.9	132.0	1.7	143.4	1.3	13.7
Industry	625.8	-1.4	581.8	-2.1	523.4	-1.8	-16.4
Household	733.9	-2.6	642.0	-0.3	630.9	-1.5	-14.0
Transport	585.3	4.7	737.8	1.7	803.5	3.2	37.3
Railways[1]	11.7	-4.9	9.1	-1.4	8.5	-3.1	-27.4
Road transport	499.7	4.6	626.1	1.6	677.9	3.1	35.7
Air transport	61.5	5.9	82.0	3.3	96.5	4.6	56.9
Inland navigation	12.4	10.7	20.6	0.0	20.6	5.2	66.1

Source: EUROSTAT

[1] Not including emissions due to electricity generation

Annex 2

Table 2 (a)

Estimated specific emissions of CO_2

	Estimate for EU 15
Passenger traffic	**CO2-emissions in gram/passenger.km**
Road Car	125
Road Bus	45
Railway	65
Air	200
Freight traffic	**CO2-emissions in gram/ton.km**
Road	190
Rail	30
Inland Navigation	30
Maritime Transport	2

Annex 3

Estimated Average life -cycle CO_2 emissions in g/km (1)

Fuel	Total
Gasoline	222-282
Reformulated Gasoline	222-283
Diesel	173-266
Liquefied Petroleum Gases (LPG)	180-203
Compressed Natural Gas (CNG)	164-253
Methanol from Coal	424-426
Methanol from NG	250-252
Methanol from Wood	65-81
Ethanol from Sugar Cane	70-123
Ethanol from Corn	90-263
Ethanol from Wood	65-81
Liquid Hydrogen ICEV	29-88
Liquid Hydrogen FCEV	48-77
EV -using electricity generated from:	
Coal	224-423
Oil	214-403
Gas (CCGT)	134-182
Nuclear	59-63
Hydro renewables	44-48

(1) Source: Policies Measures for Common Section, Working Paper 13 L. Michaelis, OECD (Annex I Expert Group on the UNFCC)

Annex 4

Table 3 - Primary energy use of different modes of transportation at different occupancies, in megajoules per passenger kilometre.

	Occupancy	
	25%	100%
Automobile:		
Diesel under 1.4 litres	2.26	057
Gasoline over 2.0 litres	4.65	1.16
Railway:		
German Inter-city	1.14	0.29
Brussels-Paris TGV	2.86	0.72
Bus:		
Double-decker	0.70	0.17
Minibus	1.42	0.35
Aircraft:		
Boeing 727	5.78	1.45
Airbus A320	4.02	1.15

Source: OECD Proceedings. Towards Sustainable Transportation. The Vancouver Conference.

Annex 5

Cost-efficiency analysis of CO_2 reduction policy measures

In the passenger car sector CO_2 policy measures may be taken at low cost because car owners do not fully take into account future fuel costs when buying a car. This is less likely to occur in the freight sector. Calculations with the EUCARS-model indicate that fine-tuned combinations of instruments offer the best chances for realising more ambitious targets at lower costs. A combination of fiscal instruments, i.e. tax incentives and fuel taxation, has been identified as being very efficient. Appropriate forms of purchase incentivesstrengthen the effect of the fuel tax. The main conclusion to be drawn from these simulation results is that some combination of the two different forms of fiscal instruments would be less costly than either alone.

Simulations of the effect of a decrease in real prices of public transport indicate that its efficiency is low. This can be attributed to essentially two elements. Firstly, evidence shows that the quality and availability of public transport is more important than its price. Secondly, the existing low market share of public transport limits the relative importance of any measure in this area, especially in the short-and-medium-term.

Using the transport model TRENEN[1] for Brussels and the transport-land use model Meplan[2] for London and south east England, for the Helsinki region, the Basque country and Naples region, the cost effectiveness of some pricing measures has been analysed.

The results of the model runs indicate that the most cost efficient measure in each case is the policy of *internalising external costs*. CO_2 emission reductions range from 7% (Basque region) to 16% (Naples region) with benefits ranging between 130-300 MECU per year. The benefits consist of decreases in congestion, accidents and other externalities and in the Meplan model also of more optimal locational choices.

The results for Brussels show that the internalising of external effects could be approximated by a simple *cordon toll* and abolishing unpaid *parking*. This measure would reduce CO_2 by 11%

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[1] TRENEN II.- Models for Transport, Environment and Energy, (Working Paper, 1998).

[2] EUNET - Socio-economic and Spatial Impacts of Transport (Working Paper, 1998).

and would benefit the society about 90 MECU per year. A cordon toll with the current parking subsidies would reduce CO_2 by 7% and benefit the society by 70 MECU.

A decrease in *public transport fares* by 25% due to increases in efficiency following deregulation would bring about only modest decreases in CO_2, *viz.* 2-6.4%. This is due to the fact that the new passengers come mainly from the slower modes, i.e. cycling and walking, and not from car users. The impact on the overall welfare of the society is in some cases positive (net benefit of 22 MECU for Brussels) and in other negative (net cost of 3 MECU for Helsinki region) depending on the initial level of public transport utilisation and subsidisation.

Increases in *fuel taxes* from reducing the existing fixed vehicle taxes in a fiscally neutral way would reduce CO_2 emissions between 0-4.8%.

Speed decreases on motorways by 20 km/h would only have a limited impact on CO_2 emissions - reductions would range between 0.0-3%. The measure would, however, have a small positive net impact on the welfare of the society.

Annex 6

Table 4: relative capital costs of alternative vehicle technologies

Transport technology	1990	1995	2010
gasoline car	100	100	100
diesel car	114	114	114
LPG car	105	105	105
methanol car	104	104	104
ethanol car	104	104	104
CNG car	113	113	113
electric battery module car	-	-	181
electric city car	-	195	117
hydrogen combustion car	-	-	128
fuel cell hydrogen	-	748	254[1]

Source: Potential from changes in Fuel and New Vehicle Technologies for Cars (C.E.S. - K.U. Leuven, IFP, NTUA)

[1] Important reductions expected by 2030

Annex 7

Table 5: Operational and maintenance costs (estimates)

Transport technology	1995 (ECU 90/y)	2010 (ECU 90/y)
gasoline car	456	456
diesel car	470	470
LPG car	481	481
methanol car	473	473
ethanol car	473	473
CNG car	676	676
electric car	700	420
fuel cell hydrogen car	980	420[1]
hydrogen combustion car	676	676

Source: Potential from Changes in Fuel and New Vehicle Technologies for Cars (C.E.S. - K.U. Leuven, IFP, NTUA)

[1] Significant decrease expected by 2030

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