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SUSTAINABLE TRANSPORT: CHALLENGES AND OPPORTUNITIES[1]

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This paper explores sustainable transport within the European Union (EU), arguing that a strong sustainable transport definition needs to be used if targets set at Kyoto are to be achieved. The EU strategy is now (2006) based on modal shift, decoupling and technological innovation, weakening the more radical strategy set up in 2001. It seems that expansion of the EU, lower levels of growth, and the possibilities of continuing high costs of oil have resulted in changing priorities, but above all travel demand has continued to grow. The Kyoto targets are becoming much harder to reach. The paper then outlines the three groups of measures that have been promoted, looking at (1) technology and pricing, (2) regulation, taxation and congestion charging, and (3) land use, development and planning, arguing that strong action is required on all three sets of options. Even then, there is an additional requirement, namely the need to gain public acceptability through information, marketing and engagement so that positive outcomes can be matched up with policy intentions. Real progress towards reducing carbon emissions is possible provided that mutually supporting measures are taken, with political commitment to real change and public support for that change.

KEYWORDS: Technology, pricing, regulation, sustainable development, acceptability

1. INTRODUCTION

In recent years most literature has supported the need to achieve greater sustainability in the transport system. Even though there still remains some uncertainty about the effectiveness of alternative policies, many promising measures have been implemented in an increasing number of cities and countries throughout the world. The next steps must be to encourage a more widespread adoption of best practice in the implementation of sustainable transport policies. Thus, the most pressing problem is how to make sustainable transport policies more acceptable, both among the general public and their elected politicians.

The broad aim of a sustainable transport strategy in mobility terms should be to allow the output from transport to be maintained or increased, but at the same time to reduce the energy inputs, particularly in terms of the use of non-renewable resources. This would mean a reduction in emissions (including CO_2), improvements in air quality, and the use of alternative fuels. A stronger sustainable transport argument would require both transport output and energy input to diminish over time, through a combination of policy measures and technological innovation (Banister et al., 2000). Moreover, it is important to evaluate the consistency of sustainable transport strategies with policies that address other dimensions of sustainable development, including sustainable economic growth, social, distributional and equity issues, and intergenerational concerns.

In 2001, transport accounted for 32.2% of all energy use in the EU, 28.7% in Canada and 26.8% in the USA (Eurostat, 2004; Natural Resources Canada, 2004). Within the EU, oil makes up 46% of all final energy consumption, and transport accounts for 70% of all oil consumption. Fuel prices are also very different in the EU as compared with the USA and Canada – the equivalent prices ($ PPP per US gallon – 3.8 litres) for 2004 are UK $6.41, Germany $5.44, US $2.16 and Canada $2.39. But it should be noted that the

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importance of oil is receding in terms of the dependency of economies on it for energy in all sectors except transport, which is still almost totally dependent on oil.

This paper takes an EU and UK perspective and argues that challenging targets for carbon reductions in transport must be set, combining policy measures into groups of mutually supporting packages to cover the economic, the technological, and the planning and development opportunities, but at the same time maintaining and increasing stakeholder support for behavioural change. It is only through the combined effects of all possible policy measures that any real progress towards sustainable transport can be achieved.

2. POLITICAL IMPERATIVE

Within the EU, there is a strong imperative to take action to achieve the 8% GHG reduction targets set by the Kyoto Protocol. Since April 2004, the Protocol has been legally binding on EU Member States. In fact, there is a desire to exceed those levels in some countries (e.g. UK, Denmark, Germany and Austria). Transport is embedded within the demands of enlargement[3] and sustainable development, and it is argued that "a modern transport system must be sustainable from an economic and social, as well as an environmental viewpoint" (EC, 2001, pp. 10). This statement has resulted from the Cardiff Council (June 1998), when the EU Transport Council was requested to establish the means by which transport can be integrated within sustainable development. A joint expert group was set up to report on the means to define an environmentally sustainable transport system, together with the appropriate measures and likely impacts on transport demand and behavioural change. This review was undertaken in 2000, and it resulted in further work to set up environmental targets for transport policy, a legal framework for the Transport Environment Reporting Mechanism (TERM), and the impact of e-commerce on transport (2001). The joint expert group has looked at sustainability impact assessment methodologies for transport, strategic environmental assessment and the trans European transport networks, enlargement and transport, and transport and health. The process involves extensive review of the main problems to be resolved and the necessary actions to achieve targets.

The White Paper (EC, 2001) recognises that transport energy consumption is increasing and that 28% of CO_2 emissions are now transport related (pp. 10). In 1990, 739m tonnes of CO_2 were released from the transport sector, rising to 900m tonnes in 2000. Further substantial increases are forecast for 2010 when 1113m tonnes will be produced. Road transport accounts for 84% of the 2000 figure, and the total will increase substantially with the enlargement of the EU, even though the level of motorisation in the accession countries is lower.

The EU target (by 2012) is to achieve an average CO_2 emissions figure of 120 g/km for all new cars, but there is considerable opposition from the car manufacturers to this figure. It seems that even the intermediate target of 140g/km will be not achieved by 2008 for all new cars. The means to reach this target are: (a) Voluntary agreements with the car manufacturers to improve vehicle technology; (b) Fiscal means to ensure a move towards more fuel efficient cars; (c) Improved information on fuel economy of cars.

[3] In May 2004, the EU expanded from 15 European nations to 25 nations and on 1st January 2007, two further countries joined. Most of the data and actions referred to in this paper relates to the EU15 rather than the enlarged EU25 or EU27.

The transport sector is heavily dependent on technological improvements to reduce energy consumption and CO_2 emissions, but this must be set against the forecast growth in demand. There is no question that governments are prepared to enter into voluntary agreements with industry to deliver "cleaner" vehicles, but the real issue here is whether there is sufficient resolve to go further than this to use pricing mechanisms to reduce air travel and car use, and to encourage a substantial switch to public transport.

The EU in their transport policy statement (EC, 2001) forecast a growth of 24% in passenger km (1998-2010), but only a growth of 10% in vehicle km with their Option C[4]. This would lead to an increase of only 1% in CO_2 emissions. With respect to car and air travel, there are a series of proposals from the EU: (a) Controlling the growth in air transport: Strong regulation, more efficient use of air space, consultation on social issues relating to air traffic control, closer cooperation, and enforcement; Rethinking air transport taxation and the introduction of a kerosene tax and differential en route air navigation charges. The latest thinking here is that nothing will be done before 2008; Discuss the future of airports to make best use of existing capacity, review airport charging systems, integrate air transport with other modes and determine what new airport infrastructure is required; Present a new slot allocation system to improve access, whilst taking account of the need to reduce environmental impacts of airports; Negotiate with the US a joint transatlantic aviation agreement. (b) Car travel: Halving the number of people killed annually on EU roads by 2010 (to 20,000); Framework directive for the infrastructure charging system offset by the removal of existing taxes allowing cross financing; Alternative fuels to make up 20% of total consumption by 2020, and that hydrogen and biofuels should be tax exempt; Harmonisation of taxation for commercial (not passenger) road transport fuel.

The potential problem presented by the growth in air travel (about 5% per annum) threatens to overwhelm the progress being made in moving toward sustainable transport in cities. This paper concentrates on the issues related to sustainable transport in cities and regions rather than the more difficult challenges presented by air travel (Cairns et al., 2006).

The EU seems gradually to be moving towards sustainable transport in terms of its policy objectives, even though the environmental imperative has been demoted, as economic and social issues have again become more important, as can been seen in the recent EU midterm review of transport policy (CEC, 2006). Since then, five main external issues have arisen that have resulted in a fundamental reassessment of the EU transport policy objectives. First, the enlargement of the EU from the EU15 to the EU25 (and the EU27 from 2007) has meant that the priority of congestion and pollution in the EU15 have to be balanced by the priority for improved accessibility in the new EU10 (or EU12). Secondly, economic growth in the EU has been lower than expected and there is a concern that EU competitiveness in the global market has been reduced. Thirdly, oil prices have doubled and seem likely to remain high, at least for the next 4-5 years. Fourthly, the Kyoto Protocol has become a reality and the EU is strongly committed to taking the lead role in ensuring that the emissions reduction commitments of its member states are achieved. Finally, there is an increased risk of disruption caused by terrorist attacks and transport networks are the prime target.

[4] Option C is the strongest of three options for achieving sustainable transport, and it consists of pricing (Option A), promotion of alternative modes and targeted investment in the Trans European transport network. It assumes that there will be substantially higher vehicle occupancy levels in cars, airplanes, buses and railways.

There seems to be a much greater level of uncertainty within the EU, and the ambitious aims of the 2001 White Paper have been reviewed (CEC, 2006). A series of significant changes in direction have been made and these are highlighted under three headings:

1. *Modal Shift* – The use of the pricing mechanism and investment in the more efficient modes of transport has been modified with the concept of "co-modality". This is the optimised use of all modes of transport and reflects the need to identify complete journeys and the linkages between the trip stages. Such thinking has been central to the freight sector in terms of logistics chains, but less prominent in the passenger sector.
2. *Decoupling* – The strong commitment in 2001 to decoupling transport growth from economic growth has been weakened as the concern is now over the negative effects of transport. No reference is made in the mid term review to transport demand, only to using a range of policy measures to reduce its environmental impact. The economic arguments concerning competitiveness have reemerged as dominant over the issues of resource use in transport and its impact on the environment. Reduction strategies have been replaced by mitigation of the effects and adaptation through technological advances.
3. *Technological Innovation* – Much greater emphasis has been placed on the role of technology in the mid term review, as a means to improve environmental quality and to make best use of the existing infrastructure. Measures include: Reductions in the dependency of transport on oil through a programme of "green" powered vehicles (2009) and a strategy for energy use in transport (2007); Intelligent transport systems will be used to cut costs and provide better information, to improve efficiency through real time management systems, and to provide tracking facilities for road pricing; Smart charging will be initiated through the development of a model to assess the external costs of all forms of transport (2008).

As can be seen from this summary of the mid term review, very little is said on sustainable urban development and transport except to note that some of the priorities will impact on the urban environment, but a Green (Discussion) Paper on Urban Transport is promised for 2007.

Two unresolved issues need to be highlighted. It seems to be extraordinarily difficult to get agreement, even within the EU, on the actions that should be taken at the highest political level. The importance of appropriate pricing policies in aviation and the reluctance to impose common pricing strategies or mandatory targets on industry reflects on the weakness of the politicians and the power of the various interest parties. Secondly, the EU has never been easy in its role as compared with those of the national and local governments (the subsidiarity principle). On the one hand, it wants to be seen to coordinate and lead action at the European level, but on the other it does not want to antagonise the different national priorities. This is a key policy dilemma for sustainable transport. Strong leadership is required for effective action at the EU level, but there is a concern about how much responsibility should be given to the European Parliament and to the Commission.

At the political level, there is also the problem of the necessity to implement innovative policies, some of which require primary legislation within national governments to enact EU Directives. With a political cycle of four or five years, this means that innovative policies on sustainable transport need to be introduced soon after the politicians are returned to power, and it is often the case that transport does not feature high enough on the political agenda to command immediate action. Hence, little

happens until later in the political cycle, which in turn means that good intentions may not be translated into policy action until after the next set of elections.

Within democracies, this may present insuperable problems for the implementation of innovative policies, with the net result that policy is always incremental. To circumvent such barriers requires support for innovation from all parties and continuity in government. Such a situation may be more likely at the EU level where there is considerable cross party support for sustainable transport in the European Parliament and perhaps greater continuity in policy than is apparent at the national level. Whatever the political difficulties, it is also suggesting that there needs to be a consistency in direction with respect to policies on sustainable transport if progress is to be made towards the targets set for 2010 in the White Paper (EC, 2001).

There is an uneasy relationship between the EU and national governments in terms of responsibilities, initiatives and resourcing of actions for sustainable transport. In part this is reflected in the EU notion of subsidiarity, which is trying to devolve the responsibility for action to the lowest appropriate level. But there do seem to be certain actions that require legislation (e.g. regulations and standards) that have to be taken at the EU level, and many actions on environmental issues come within that remit (e.g. taxation on fuel and emissions standards). The links with industry (including both the vehicle manufacturers and the oil companies) are required at both the EU and local levels. The second observation is that environmental concerns are not new, as there is at least thirty years experience in using add-on technologies, and regulations on emissions have been introduced through local initiatives, particularly in the USA and Canada. The EU has been catching up here, but it has taken the lead in addressing the need to reduce GHG emissions and the use of carbon based fuels in transport, partly through technology and regulation, but principally through pricing.

3. OPTIONS AVAILABLE

Sustainable transport can only be achieved with a strong combination of four separate sets of policy measures: (a) Technology and pricing, including investment in technology in transport modes, in information systems and in the transport system itself; (b) Regulation, including driver and vehicle licensing, taxation and pricing, standards and traffic regulations; (c) Land use development, including planning and regulations; (d) Information, including social pressure, awareness raising, demonstration, persuasion, and individual marketing.

Technology and Pricing - It is important to use the best available technology, and there is little controversy here as clear signals can be given to industry to produce more efficient vehicles, making the best use of renewal energy sources and hybrid engines. For the general public, these options are again non controversial as it enables them to carry out their activities with minimal change. It also seems to be accepted in the EU that the external costs of transport should be reflected in the actual costs of travel through higher fuel prices or through some form of road user charging. Demand management both reduces congestion and improves environmental quality, but it does require public support to work effectively. Similarly, physical restraint measures and development patterns that support shorter travel distances are seen as desirable in terms of improving levels of accessibility.

There is a lively debate in the UK on the need to address the challenges of climate change, and of the role that transport should play, as it now (2005) accounts for 27% of greenhouse gases (and 29% of CO_2 emissions – Defra (2006a, pp. 61). The UK

government has been very positive about being able to meet its share of the EU Kyoto Protocol set targets for CO_2 reductions (12.5%), and it has gone further to commit itself to a self imposed 20% target reduction (1990-2010). There are no explicit targets for the transport sector, but it is expected to make a major contribution to the national reduction targets.

Initially, action within the UK has revolved around raising the price of fuel through the fuel duty escalator. This was introduced in 1993 as the main policy lever to be used to achieve the Kyoto targets in the transport sector. The escalator was an annual increase in fuel duty above the rate of inflation, initially set at 3% and raised to 5% (later in 1993) and to 6% (July, 1997). The price of a litre of fuel increased from 56 pence to 85 pence (1994-2000), of which about 64 pence is tax and duty. Without the fuel price escalator, the pump price would be about 75 pence, not the 90 pence current pump price (2006). The escalator was removed in 2000, after pressure from industry and other interests, particularly those in rural areas.

Since then, there have been several documents produced by government and think tanks about the necessity for a national system for road pricing in the UK (DfT, 2004, 2006), but the only schemes that have been implemented have been in London and Durham. Even here, the motivation has not been to reduce CO_2 emissions, but to reduce traffic congestion. There has however been a substantial improvement in local air quality in central London resulting from the congestion charge, and CO_2 emissions levels are down by 19%, mainly due to fewer cars, higher speeds and less stop-start driving (Banister, 2007a).

Voluntary agreements with the car manufacturers have been established, and a target agreed that by 2008 all new vehicles in the EU would average 140 g/km of CO_2[5]. In the UK, the current level for new cars is 169 g/km of CO_2 (2005) with only 18% reaching the 140 g/km target. Industry is now complaining that the targets are too difficult and the only real change has been a switch to diesel, with diesel now accounting for over a third of the new car market (SMMT, 2006). But the scale of the challenge is illustrated by the fact that for every ultra clean Prius sold in the UK (3500 in 2005), there were 50 4×4 SUVs sold (179,000 in 2005). The real problems have been that there are only a few vehicles that are available with the low emissions profile, and consumer purchasing patterns still favour the larger cars. Recent changes in the taxation system for company cars and the Vehicle Excise Duty (VED) mean that there are some incentives to use low emission vehicles, but these changes are seen as being fairly marginal when set against the higher purchase costs of hybrid vehicles (Table 1).

TABLE 1: Annual charges for vehicle taxation in 2006 (£)

Band	CO_2 emissions (g/km)	Diesel car	Petrol car	Alternative fuel car
A	Under 100	0	0	0
B	101 –120	50	40	30
C	121-150	110	100	90
D	151-165	135	125	115
E	166-185	160	150	140
F	186-225	195	190	180
G	Over 225	210	210	200

Source: Driver and Vehicle Licensing Agency (2006)
(http://www.direct.gov.uk/Motoring/OwningAVehicle/HowToTaxYourVehicle/HowToTaxYourVehicleArticles/)

[5] g/km of CO_2 is the average figure allocated to all new cars in the UK since 1997, and it relates to a series of independent tests carried out on vehicles over a set of standard test routes to assess fuel consumption and emissions profiles.

Biofuels[6] are making a limited impact with some diesel fuel now having 5% biodiesel added to it, and there is a new requirement that 5% of all fuel sold in the UK will have to come from renewables by 2010/11, to meet the EU Biofuels Directive target. In the UK this has taken the form of a Renewable Transport Fuel Obligation (RTFO) and it will become operational in 2008. It is now the main mechanism to achieve carbon reductions in the transport sector (1.7 MtC by 2010 – Table 2).

TABLE 2: Summary of CO_2 reduction measures being taken in the UK transport sector

2000 Climate Change Programme	Total savings = 5.0MtC
(a) Voluntary agreements with industry (including reform of company car taxation and graduated VED)	2.3MtC
(b) Wider transport policies (Transport 2010)	0.8MtC
(c) Fuel duty escalator (ended 2000, but still in estimates)	1.9MtC
2006 Climate Change Programme – additional measures	New savings = 1.8MtC
(a) Renewable transport fuel obligation (RTFO)	1.7MtC
(b) Further improvements in vehicle fuel efficiency after 2008	0.1MtC

Source: Based on Defra (2006a, pp. 61-67)

The most recent UK Climate Change Programme (Defra, 2006a) has maintained a high level of optimism about the overall UK targets being achieved:

> "the package of existing and new policy measures in the Programme are projected to reduce carbon dioxide emissions to 15-18% levels – the new measures saving 12 million tonnes of carbon by 2010. This is very good progress. Our overall emissions of greenhouse gases are now projected to be 23-25% below 1990 levels in 2010 – around double our Kyoto target" (Defra, 2006a, Executive Summary).

Internationally, the UK has been very active in trying to build consensus and move forwards from the current Kyoto Protocol as seen in the G8 Summit at Gleneagles (July, 2005) and the Montreal Climate Change Conference (December, 2005). This involves the extension of the EU Emissions Trading Scheme (ETS) to include aviation and land transport (from 2008 or more likely 2010), the Clean Development Mechanism (including carbon offsets), the clean energy investment framework, and the application of the best available technologies. Domestically, there are a range of policies, but transport remains the only sector where increases are still expected.

Yet very little seems to be actually happening, even if the headline figures in Table 2 suggest that transport is making a contribution. The 2000 UK Climate Change Programme targeted a 5MtC saving from transport (-12.8% as compared with 1990 levels), and additional savings of 1.8MtC were identified in the 2006 Review (-17.4% in total – Defra, 2006a). The voluntary agreement with the motor industry will not be reached in 2008, and the more likely figure is 160 g/km of CO_2 (EFT&E, 2005), so the figure in Table 2 should be halved. At the current rate of progress, the 140 g/km CO_2 emission target will only be reached in 2022 (Environmental Audit Committee, 2006, para. 22).

The wider transport policies outline in the Transport 2010 document said very little about carbon reduction (6 mentions in the whole document, DfT, 2000), but two arguments were introduced. One suggested that reductions in congestion from the

[6] Biofuels are assumed to be carbon neutral as they "fix" carbon in their growth stage and "release" the stored carbon when they are used as fuel. However, there are transport costs associated with production, processing and distribution.

proposed investment programme would lead to more efficient use of fuel, and the other was the proposition that a national system of road pricing could be introduced. But even this possibility was only mentioned once in the document at the end in the future directions section. The fuel duty escalator was the main pricing measure introduced (1993-2000), but it is still included in the calculations when it is no longer in operation. The justification is that "carbon savings have been estimated by comparing the level of emissions with the fuel duty escalator in place with what would have happened had the fuel duty been increased annually in line with inflation" (Defra, 2006b, para. 1.198, pp. 69). This was a one off saving and its impact has been eroded since as fuel duties have only been raised twice (2000 and 2003), and then only in line with inflation (Environmental Audit Committee, 2006, para. 69). The savings given in Table 2 are the maximum figures, and the more likely contribution is 61% of this maximum (Banister, 2007b).

The additional measures (Table 2) look to further improvements in vehicle fuel efficiency and the use of renewable fuels. Bioethanol and biodiesel have substantial potential (Banister and Hickman, 2006), but even here there are questions over whether these fuels will be sourced from the UK or overseas. At present, it seems that about 1MtC will be UK based and the rest will be sourced from overseas (Defra, 2006a, para. 17, pp. 64). There is nothing in the latest review on the use of lower speed limits or the land use and planning system to reduce trip lengths in helping achieve the Kyoto targets.

The optimistic view is to accept the figures in Table 2 and expect a 6.8MtC contribution from the transport sector by 2010, which would mean that there will be a 3% reduction in the transport related carbon emissions over the Kyoto Protocol period. The realistic view is that the voluntary agreement may achieve half its target and that if the fuel prices increase with the global price of oil, then there would be a net saving of 2.3MtC from the existing measures. With contributions from the RTFO, this figure may increase to 4MtC, but this means a 4% increase in carbon emissions from transport. Technology and pricing in combination will not succeed in getting anywhere near the targets set for Kyoto or the higher levels proposed by the UK government.

The role of transport is an uneasy one in terms of whether it should take its "fair" share or any share of the reduction. The initiatives taken in the transport sector have depended on the fuel duty escalator (abolished in 2000), voluntary schemes (ineffective), and the outcomes of policy interventions (unspecified). The only effective measure may be the RTFO, and even here there may be problems in achieving the production levels required. Much of the biofuels will have to be imported and should not be counted in the UK's renewables balance sheet. The net effect is that transport's emissions will continue to increase and that the most accurate estimate would be an increase of 14.3% (1990-2010). This is substantially less than the expected growth in traffic (over 20%), and it will reflect the switch to diesel and the RTFO. But even these positive moves may be reduced by the growth of larger vehicles in the stock.

Regulation, taxation and pricing - For many people, environmentally sustainable transport requires a radical change in the way in which travel decisions are made. Naturally, people feel nervous about this possibility, and they are reluctant to alter their behaviour. The implementation of radical policy alternatives may have substantial positive demonstration effects provided that it is well tested so that negative outcomes for even a small numbers of participants can be avoided. In the EU, there is an acceptance that transport users ought to pay their full external costs, and several pricing initiatives have been introduced under the umbrella of fair and efficient pricing (CEC, 1995). Some countries in the EU now relate the annual taxation for vehicles to their

pollution profile. Germany has established different classes of cars for annual taxes levied on owners of cars. Electric cars are completely tax-free for the first five years. There are dramatically reduced tax rates for the more energy-efficient and least polluting cars, and much higher rates for large cars that are energy inefficient and more polluting. Cars meeting Euro IV standards are considered especially sustainable and benefit from large tax reduction (German Federal Ministry for Finance, 2003). In the UK, Annual vehicle taxation is related to the CO_2 emissions figures, with seven bands (Table 1).

Probably the best example is the experience from congestion charging in Central London. This is the most radical transport policy that has been introduced in the UK in the last 20 years. It represents a watershed in policy action. The idea had been around for many years, but no politician had the conviction of actually taking it forwards. Even with a new Mayor hugely committed to congestion charging, it was a struggle to get it through the legal, planning and political processes within a 30 month period (1st July 2000 to 17th February 2003). This relates strongly to the issue of the conflicts between long and short-term strategies (Banister, 2003). The long term view is that congestion charging is an essential element of a sustainable transport strategy, whilst the short-term view is that it is almost impossible to introduce in a four-year electoral cycle (as exists in the UK).

To achieve acceptability, there has been extensive consultation with all parties, resulting in much compromise. For example, under half (45%) of vehicles actually pay the full charge (£5, raised to £8 in July 2005), while a further 29% have discounts of varying kinds, and the remaining 26% of vehicles are exempt. The large number of discounts and exemptions has reduced the effectiveness of the policy, and problems may be created later if these exemptions are to be reassessed. There was also a reduction in the proposed charge of £15 for lorries to £5, minor boundary changes, and a slight shortening of the charging period (0700-1830 on weekdays). Much analysis and monitoring is being carried out to determine both the transport and the non-transport impacts of congestion charging, both within the cordon area and in the London conurbation as a whole (www.open.gov.uk/glondon/transport/rocol.htm and www.cclondon.com).

Such an example raises important policy dilemmas. The potential demonstration effects of the congestion charging scheme are substantial, as many other cities may learn from London and introduce their own schemes. But in order to achieve implementation, many concessions have been made, and these may in turn reduce the effectiveness of congestion charging. A balance must be struck between the desired scheme and an acceptable scheme. The potential risk is substantial, but such choices have to be made if radical environmentally sustainable transport polices are to be introduced at all. Conversely, implementation of a scheme could be seen as the first step in a process where incremental changes are then added to the basic scheme until the final goal of a full electronic road pricing scheme in London is achieved. In the first two years (February 2003 to 2005), the scheme and the technology have worked well and gained widespread acceptance, with measurable reductions in both traffic levels and congestion in Central London and around the congestion charging area. In this case, both the social norms and perceptions of its effectiveness were sufficiently high for implementation, and the outcome has exceeded expectations (Table 3).

TABLE 3: Impacts of congestion charging in Central London

1. Traffic down 20% entering the Congestion Charging Zone and some 16% within the Zone – congestion reduced by 26%
2. Speeds increased 10-15% within the Zone.
3. Increase of 5% in traffic on Inner Ring Road around the Zone, but little change in traffic speeds.
4. About 100,000 motorists pay each day.
5. Most travellers have switched to buses, which run more freely and frequencies have been increased. Bus patronage has increased by 16%, reliability has improved (30% reduction in wait time), and speeds have increased by over 15% in the Central Area.
6. Net revenue in 2005/06 was £122 million.
7. Public acceptance is now 55% for the Scheme and 30% against it, when before implementation the figures were 40% for and 40% against.

Source: TfL (2006)

Land Use, Development and Planning - In general terms, transport has clear impacts on land use and urban form, which affects trip lengths, speeds and mode choice, whilst there is less impact on the frequency of travel. Conversely, development patterns and urban form may influence travel behaviour. Higher density development is more likely to be clustered around a public transport network, whilst highway networks enable commercial strip 'edge city' development and low density, urban sprawl. More specifically, the empirical evidence leads to the following conclusions on sustainable urban development and transport (Banister, 2005).

1. The location of new development, particularly housing, should be of a substantial size and located near to or within existing settlements so that the total population is at least 25,000 and probably nearer to 50,000, with medium densities (over 40 persons per hectare). The provision of local facilities and services should be phased so as to encourage the development of local travel patterns.
2. As settlement size increases, the trips become shorter and the proportion of trips by public transport increases. Diseconomies of size appear for the largest conurbations as trip lengths increase to accommodate the complex structures of these cities.
3. Average journey lengths by car are relatively constant (around 12km) at densities over 15 persons per hectare, but at lower densities car journey lengths increase by up to 35%. Similarly, as density increases, the number of trips by car decreases from 72% of all journeys to 51%. Car use in the high density locations is half that in the lowest density locations.
4. Mixed use developments should reduce trip lengths and car dependence. Although research here is limited and concentrates on the work journey, there is considerable potential for enhancing the proximity of housing to all types of facilities and services.
5. Development should be located near to public transport interchanges and corridors so that high levels of accessibility for all can be provided. But this may also encourage long distance public transport commuting. Free flowing strategic highway networks are likely to encourage the dispersal and sprawl of development and stretch commuting.
6. The availability of parking is a key determinant of whether a car is used or not and further research is required to determine appropriate standards linked to accessibility levels.

Such developments conform to the requirements of service and information based economies. Settlements of this scale would also be linked together to form agglomerations of polycentric cities, with clear hierarchies that would allow a close proximity of everyday facilities and accessibility to higher order activities (Hall and Pain, 2006; Banister, 2007b).

An important issue for the design of the sustainable city is an understanding of the impact of transport measures on the broader economy, city competitiveness and quality of life indicators. At the moment, under investment in the transport sector, particularly for public transport, walking and cycling, is constraining the level - and, critically, the quality - of development. It is sometimes suggested that restrictions (e.g. parking or pricing regimes) may disadvantage traders within the city and result in falling turnover, rental levels and lead to city centre decline. The logic of this argument is clear, but little is known about the short or longer-term impacts of transport measures on city vitality and viability. Counter arguments about increases in quality and turnover can also be made.

The role integrated urban and transport planning can help in avoiding the need to travel and in achieving the sustainable city has been underestimated. To reduce levels of car dependence and trip lengths, planning decisions must have an instrumental role through establishing and implementing clear development principles based on sustainability. Although urban planning and transport are only two of the major elements in sustainability, urban planners can take positive action in both fields. But this may result in transport capacity being freed up and latent demand may take up the new space. Some mechanism(s) of providing a 'lock in' of benefits is required, including measures such as the reallocation of road space (Williams, 2005).

A prime challenge for future urban planning and transport policy is to give active mobility much more emphasis. This requires a real shift in attitude, with strategies focused on active mobility systems and networks, and walking and cycling as prime means of travel, with high quality integration with other modes.

Finally, there are a series of more strategic issues that must be addressed if sustainable land use and transport is to be achieved nationally and regionally. Cities are changing from centres of work to centres that have a much wider role, including functions of leisure, education, government and retirement. Patterns of dispersal and decentralisation are important, as are the possibilities for recentralisation, with densification and new forms of urban living. It is here that issues relating to urban design, in terms of innovation and quality need to be considered as part of the sustainable and inclusive city. Cities are no longer just the centres of wealth creation, but they need to address concerns over the quality of the environment, including equity issues, access to open space, low crime rates, safe and secure living, clean air, affordable housing and access to services and facilities. All these topics should be the focus of a renewed interest in the development of the sustainable and fair city.

Information, Acceptability and Marketing - The messages are clear. There is strong support for enlarging the scope of public discourse and empowering all the key stakeholders through an interactive and participatory process. The open and active involvement of all parties would be far more effective than the conventional passive means of persuasion. Thus, broad coalitions should be formed to include specialists, researchers, academics, practitioners, policy makers and activists in the related areas of transport, land use, urban affairs, environment, public health, ecology, engineering, green modes and public transport. It is only when such coalitions form that a real debate about sustainable transport can take place. There must be a willingness to change and an acceptance of collective responsibility. To achieve environmentally sustainable transport, the arguments must be sufficiently powerful to overcome the dependence on the car and the fact that the costs of delay and congestion have already been internalised by drivers.

Sustainable transport needs to be seen by the public as being of a sufficient importance, and the proposed policy package must be seen to actually deliver the desired outcomes

(effectiveness). For example, congestion is now accepted as a major constraint on individuals' quality of life and the efficiency of business. Increasingly, surveys of public opinions in the EU are indicating that change is essential and that action is expected. Both the general public and business support priority being given to environmentally friendly modes, and even decision makers agree (usual levels of support are about 80%). Yet the same people are less positive in their views of the support of others (e.g. the public's perceptions of the politicians' views) for the same policies (typically around 40%). This suggests that there is a greater than expected willingness to experiment to reduce trip lengths, to combine trips, to switch modes, or to cancel trips altogether and reduce the need to use the car. This is not an anti-car argument, as any such proposal is doomed to failure, but it is an argument about individuals and firms reducing vehicle kilometres travelled, particularly where there is only one person in the vehicle (or empty return trips for freight vehicles).

In addition, it seems necessary to understand the implications and expectations of the individual. There are two key elements to the personal (rather than the social) dimension. The first is that there is an acceptance that the policy package being proposed will work (the effectiveness test), and that it is efficient. The second is that it is fair, both to the individual travellers, and more generally to society as a whole.

A small initial change, if sufficiently well supported and publicised (like a Car Free Day or European Mobility Week – 16-22nd September 2006), can lead to new attitudes to the car. It is through the active involvement of users of transport in a partnership that change can be realised. There are many such events happening in cities through direct action (Reclaim the Streets), through the reallocation of spaces and streets to people (the World Squares initiative, pedestrianisation, street closures), through lowering speed limits (Home Zones), through travel plans, and through cycle networks and exclusive bus networks. It must be seen as an active process that is participatory and inclusive.

One soft means by which such a change can be facilitated is to demonstrate that sustainable transport improves public health (individually and collectively). Increasing evidence is linking transport-induced emissions with declining health, and there is now overwhelming evidence of strong links between exercise (or lack of it) and obesity. Walking, cycling and public transport are all more healthy than using the car. Physical activity "almost halves the risk of cardiovascular disease and also reduces the risk of diabetes, osteoporosis and colon cancer as well as relieving anxiety and depression" (www.warren.usyd.edu.au/transport). Active transport is good for you, but there are still the indirect effects emanating from pollution, which damages health and causes problems related to asthma, bronchitis, leukaemia, and lung disease. There are also the wider effects of increases in CO_2, ozone depletion, acid rain and smog. Environmentally sustainable transport offers improvements in individual health as well as a cleaner and healthier environment (Pucher and Dijkstra, 2003).

Healthy transport means strong action on separating people from traffic and having exclusive routes for people and cyclists. It also means the promotion of travel plans for all businesses and activities that are major generators of traffic. For example, every school in the UK will have their own School Travel Plan by 2010. It is often thought that such policies are politically unpopular, but there now seems to be strong support for action and many decision makers have underestimated the strength of feeling for change.

While the effects on public acceptance of sustainable transport policies are not well understood, there has been substantial public participation in these and similar programmes, which even if temporary builds public knowledge and experience (good or bad), and can eventually lead to attitudinal and behaviour change.

Much of conventional choice theory assumes that each individual has complete knowledge of the alternatives and can make a rational choice – this is the basis of consumer choice modelling. More recent empirical research (e.g. Brög et al., 2004) suggests that a much more proactive approach is required that not only informs individuals about the alternatives that are available, but also helps them decide which is most suitable for them. Information has to be taken to the customer, rather than assuming that they will find it themselves. Individualised marketing is the best example of this dialogue-based technique for promoting the use of public transport, cycling and walking as alternatives to the car. It has been developed and applied in many European and Australian cities with positive outcomes (reductions in car use of around 10 %), and more importantly, it seems that changes in travel behaviour are maintained over time.

Public acceptability seems to be high provided that social norms can be changed and the policy measures are presented as a package that can effectively be implemented. The process needs to build up trust and respect between the different actors over time, so communication and active involvement is essential. It also seems that legitimacy must be based on a participatory and inclusive approach that involves "selling" the message of sustainable transport to individuals, groups and localities through explaining the need for changes in behaviour and convincing them of the importance of their contribution. This responds to the Schade and Schlag (2003) goals of importance and fairness in urban transport pricing strategies, and the need to both guide and force change (Vlek, 2000). In many situations, there are strong positive measures (reducing global warming and healthy transport) that can be promoted, but underlying success is the need for a high level commitment to sustainable transport and strong leadership.

4. CONCLUSIONS

Behaviour changes continuously in response to policy measures, but also to changing personal circumstances (e.g. the acquisition of a car), location and life cycle changes. Analysis needs to explore change, as both the net effects (average) and the individual effects (variance) are important to understanding overall behavioural change. The economic rationality arguments seem to be weak with respect to this volatility in individual behaviour. There is a need to engage with people through debate and discussion, so that they can be convinced about the legitimacy and fairness of the need for behavioural change. This means a gradual change through the reassessment of whether particular activities are essential, and whether they can be undertaken with others, or more locally, or by public transport, or with no travel at all through the use of telecommunications. Over the longer term, there are other decisions that have an important impact on sustainable transport, such as moving home, changing job, or new family commitment, as well as car acquisition questions. It is here that economic rationality has a more important role to play, but sustainability should be pushed higher up the agenda. Political leadership has a key role here in establishing broader social and distributional objectives, and a clearer perspective on how sustainable transport and improvements in the quality of life can be achieved.

Even though there is an acceptance that transport is contributing increasingly to global warming and the lowering of environmental quality in cities (and elsewhere), that is not sufficient to encourage effective action. Nor has the recent linking of transport emissions to a range of health impacts together with the concern over obesity provided a sufficient impetus to change. The scientific evidence of the links and a potential causality between transport and public health is now emerging (Transportation Research Board, 2002), in

particular as it relates to accident associated trauma, the effects of air pollutants on respiratory health (in particular particulates from diesel), increasing levels of driver stress, and the community costs of noise. But the links between health, global warming and transport are not entirely clear, and even if specific causal links could be established, the question remains whether it would be sufficient to permit dramatic changes in public policies and travel behaviour. Perhaps there is a case here for a high level education programme that explains and widely publicises the links between transport, the environment and health, and the necessity to adopt healthier lifestyles, including more walking and cycling for daily travel.

There is also a concern over the loss of competitiveness in the economy resulting from increased regulation and control (CEC, 2006). In the EU the possibilities for sustainable transport are seen as more of an opportunity to open new markets for products and environmentally based policies in transport. This uncertainty is reinforced by the essentially short-term view of all politicians (to the next election), and this is where the longer-term perspective of the EU provides some optimism that there will be commitment and continuity of change over time.

A clear conclusion is reached, namely that transport can have and must have an instrumental role in achieving sustainable development (Banister, 2005, 2007a), and that to achieve such a change probably requires a paradigm shift. The city is the most sustainable urban form and most (70-80%) of the world's population will live there. The logic of this argument is clear, namely that the car's role in the city of 2030 is limited. The service and knowledge based society with high values placed on leisure activities can be achieved through sustainable urban living in clean cities. However, the problem is not in the vision, but in the means to achieve it. There are two basic options. First, the value system of individuals and firms need to change so that the car is not seen as the current dream that is promoted in the adverts. The collective benefits of clean cities must be given a higher priority than the individual mobility provided by the car. The cultural link between cars and freedom has to be tackled – this is behavioural change through choice. Second, an ecological disaster would occur that is directly related to the problem of the car. This might be the result of some kind of climate change induced disaster or health epidemic that is of a sufficient scale to change values and priorities – this is behavioural change through necessity.

Realistically, it is hard to conceptualise such a change in advance of disaster actually occurring, particularly as current lifestyles are so transport dependent. There is enormous capital tied up in cities, in local and national economies, in the motor industry and in private cars. One of the unresolved questions is the impact that a non-car based urban future would have on the city economy and the property market. One view would be that as movement around the city would be easier and cleaner, particularly on public transport, and this would lead to the revitalisation of the city centre and strong pressures for further centralisation. The contrary view is that development pressures would move towards the peripheral sites, the edge cities and greenfield locations which would still be accessible by "clean" cars. Further decentralisation would take place, with the city centres becoming less attractive. At present, the evidence is mixed with many key locations within cities still demanding high rents and property prices, but elsewhere it is the peripheral locations that are becoming the new growth centres.

In this paper it has been argued that paradigm shift towards sustainable transport is necessary and not difficult to achieve at least in cities provided that there is both strong political and public support. The proposal is not a new radical shift in thinking, but a rebalancing of priorities away from an overriding concern with economic growth

towards one that gives much greater prominence to social and environmental priorities. The climate change imperative provides the necessary impetus for change, yet this paper has shown that at present the political commitment is not sufficiently strong, even in the EU and the UK which have both led the debate for strong action to reduce the impacts of climate change. It has also shown that the necessary policy measures are available, provided that they are implemented as a set of mutually supporting packages. If strong implementation takes place, then transport can make a substantial contribution to reducing carbon emissions.

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