

# Unsustainable Transport

City transport in the new century

David Banister

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## Unsustainable Transport

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# **Unsustainable Transport**

## **City transport in the new century**

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We have not inherited the Earth from our ancestors, but we are borrowing it for our children. (Old Indian Saying)

One of the major problems facing authors when writing books is to think of a suitable title that both reflects the content of the book and will catch the eye of the potential reader. Further, all good book titles comprise no more than three words. For me, this makes inspiration difficult, as I have already used up all possible combinations of the relevant three words, hence this book has a more cryptic title that should be followed by its real content, sustainable urban development and transport.

‘Unsustainable transport’ is meant to suggest that we have a series of choices to make with respect to transport and sustainable development. Even making no choice needs to be placed within the same context, as that would have important implications for cities and regions. The book presents a global and local perspective on the nature of sustainable development, and the crucial role that transport has in making or breaking cities. It also presents the range of options available, together with a commentary on the barriers to implementation and explanations of why outcomes often do not match up to expectations. There is an investigation of cities in developing countries, which are growing at a phenomenal rate and where many of the same problems are now manifesting themselves. But so is a different set of innovative solutions. Visions of the sustainable city are presented, together with a summary of the packages of policy measures in transport and other sectors that could be used to move in a more ‘sustainable’ direction.

Throughout the book, I have taken a positive line in the argument, stating that sustainable urban development is a feasible and necessary policy objective, and that transport has a major role to play in its achievement. Even though many of the trends are in the wrong direction (unsustainable) and there are many barriers to effective implementation, this does not mean that all hope is lost. The book reflects the opportunities for a fundamental shift in thinking about the future of transport policy. Realization of that aim can be achieved if transport is placed at the centre of sustainable urban development.

Ten years ago, the influential Royal Commission on Environmental Pollution stated that the key to a sustainable transport policy is coordinated



action by government and industry on several fronts. Economic growth cannot continue in a sustainable way unless transport and land use planning are integrated. Technology must be improved to cut fuel consumption and make vehicles less polluting. New residential, commercial and leisure developments should be sensibly located, so that people do not have to travel long distances, and are not forced to use cars for their journeys. The cost of private transport will have to rise because at the moment it does not reflect damage done to health and the environment. Resources should be switched from road-building to improving public transport.

Part of the thinking behind this book is to reflect on what has been achieved over this 10-year period, to see where we have gone wrong and where progress has been made. As T.S. Eliot is reported to have said ‘and the end of all our exploring will be to arrive where we started and know the place for the first time’. We have now reached that point, and it is time to decide whether there is now a sufficient momentum to move towards sustainable transport.

*David Banister*  
*March 2005*

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Dominic Stead also made a major contribution to Chapter 3 on transport intensity and Chapter 5 on the key relationships between transport and urban form. Chapter 3 is in part based on a paper written with Dominic Stead and presented at a STELLA Conference in Helsinki (2002) and subsequently published in the *European Journal of Transport Infrastructure Research*, 2(2/3), pp. 161–178.

Chapter 4 on Public Policy is based on a contribution to the Encyclopedia of Life Support Systems (EOLSS), which in turn used material from the EU DANTE Consortium research. This project was concerned with the barriers to implementation, and subsequent research covered the issues of public acceptability of sustainable transport futures. I would like to thank the following contributors to the DANTE project: Stephen Marshall, Daniel Mittler, Alan McLellan (again) and Nick Green of the Bartlett School of Planning, University College London, and our partners in the DANTE team – Kees Maat, Erik Louw and Hugo Priemus of Delft University; Sandra Mathers and Laurie Pickup of Transport and Travel Research Ltd.; Jens Peder Kristensen of PLS Consult A/S, Aarhus; Massimo Marciani of FIT Consulting,

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This book is central to the Spon series on transport and sustainable development as it integrates all three elements. It has arisen out of a Masters course Specialism that I run at the Bartlett School of Planning in University College London, and the book has been read and commented on by the students taking the Specialism. My thanks to them all for their input, mainly complementary, but always incisive and in some cases inspirational. Thanks also to Lloyd Wright for reading the complete draft of the book and taking the trouble to engage in serious debate about the issues that it raises. Lizzie also volunteered to read the final draft – this is beyond the call of duty.

## Abbreviations

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BRT	Bus Rapid Transit
CAFE	Corporate Average Fuel Efficiency
CO	Carbon Monoxide
CO <sub>2</sub>	Carbon Dioxide
ECMT	European Conference of Ministers of Transport
EDI	Electronic Data Interchange
EJ	Exa Joules
EU (EU15)	European Union (the 15 members of the EU to 1st May 2004)
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GIS	Geographical Information System
HGV	Heavy Goods Vehicles – over 3.5 tonnes gross unladen weight
ICT	Information and Communications Technologies
IPCC	Intergovernmental Panel on Climate Change
ITS	Intelligent Transport Systems
LA21	Local Agenda 21
LGV	Light Goods Vehicles – under 3.5 tonnes gross unladen weight
LPG	Liquid Petroleum Gas
LRT	Light Rail Transit
MRT	Mass Rapid Transit
NECAR	New Electric Car – made by Mercedes
NGO	Non Governmental Organization
NO <sub>x</sub>	Nitrogen Oxides
OECD	Organisation for Economic Cooperation and Development
PM <sub>10</sub>	Particulate Matter under 10 microns in diameter
RCEP	Royal Commission on Environmental Pollution
SACTRA	Standing Advisory Committee on Trunk Road Appraisal
SUV	Sports Utility Vehicle
TGV	Train à Grand Vitesse
UK	United Kingdom
UNDP	United Nations Development Programme
US (USA)	United States (of America)
VAT	Value Added Tax
VED	Vehicle Excise Duty
VOC	Volatile Organic Compounds
WHO	World Health Organisation

I would like to dedicate this book to my parents, Michael and Rachel, who have just celebrated their 60th (diamond) wedding anniversary. They are two of the most environmentally sustainable people that I know, even when it comes to transport. They may have little to learn from this book, but others I hope will have much to learn from it.

## Introduction

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### 1.1 Introduction

At the beginning of the twenty-first century, there are many new challenges facing the world, but the one that has captured the headlines has been the growing instability of many natural phenomena, whether it is volcanic activity, flooding, drought, fire, and hurricanes. The climate is changing and the evidence is clear that global warming is taking place with the small but consistent increases in temperatures across the globe. Much of the world's population is located in areas that are susceptible to flooding and 20 of the 30 megacities (population of over 10 million in 2015) are located near to sea level or in river flood plains. Rising sea level and the propensity for flooding may affect all of these locations where some 500 million people will live. Such a statement may appear alarmist, but it does give an indication of the scale of change taking place. Not all parts of the cities are at sea level, but enormous investment is needed to safeguard the population. In addition to the problems of sea level rises, there seem to be increasing occurrences of other disasters, such as crop failures, new diseases, fires and storms, and threats to biodiversity. Some of these are directly caused by human activity, but in other cases their causes are not so obvious.

It is clear that this process of global warming needs to be moderated and if possible stabilized. This means that there should be a substantial reduction in all forms of carbon consumption, as it is the use of these resources that is the principal cause of global warming. The total global emissions of CO<sub>2</sub> (the main global warming gas) have increased by about 60 per cent (1971–2001) to nearly 24 billion tonnes (IEA, 2000 and 2001).

Transport's share of this total has increased from 19.3 per cent (1971) to 28.9 per cent (2001), so both the absolute and relative share attributable to transport consumption is increasing (EC, 2003). In addition, transport is almost totally dependent on oil for energy and there seems to be little prospect for a major change even if prices were to rise substantially (see Chapters 7 and 8). Attempts to introduce alternative fuel vehicles have so far been unsuccessful and the capital investment in petrol and diesel-engined vehicles is vast. Change has to come gradually, and clear direction is also required for emerging new transport markets, such as air travel and the growth in car ownership in

developing countries. Optimistically, one might be suggesting that a 20-year time horizon is needed before a significant (over 20 per cent) proportion of the vehicle fleet is run on non-carbon-based fuels (e.g. fuel cells or electricity generated from renewable sources such as wind and water power).

Apart from the search for alternative fuels and the expectation that technology will provide some of the answers (see Chapter 8), there are other actions that can be taken now. One set of actions relates to clear economic signals being given to all consumers of carbon-based energy that demand must decrease through more efficient use of that energy in transport. These actions should be complemented by high-level decisions on using the full range of economic measures to encourage efficient use of alternative fuels, to invest in the best available technology, and to reduce substantially the use of carbon-based fuels (see Chapter 7). The second set of actions relates to the cities in which the majority of the world's population will live. This is where the concept of sustainable urban development becomes important, as cities are seen as being the source of economic wealth and prosperity, and the centres of sustainable development. It is only in cities that many of the activities essential to the creation of wealth and well-being can take place.

The prime objective of sustainable urban development should be to facilitate that development whilst at the same time ensuring that the use of carbon resources are within the limits of sustainability, and that all individuals have access to that development in terms of their welfare and well-being. Within the context of cities, transport has a key role in ensuring the efficient operation of the wealth-creating activities, as well as contributing towards social well-being and providing access to those activities. But transport, as a major and increasing consumer of energy, should also contribute substantially to the environmental objective of reducing its use of these carbon-based energy sources. Achieving all three objectives may be an impossible task. The purpose of this book is to assess the options available and come to some conclusions on the most appropriate role for transport in contributing fully to sustainable urban development.

## **1.2 Sustainable development**

Sustainable development has become part of the common language. Since the classic Brundtland report stated that 'a sustainable condition for this planet is one in which there is a stability for both social and physical systems, achieved through meeting the needs of the present without compromising the ability of future generations to meet their own needs' (WCED, 1987, p. 43), it has been used by most researchers and decision-makers interested in the environment, and like many of the terms that are used and supported, it is difficult to define precisely. Underlying the concept of sustainable development is the need to

redress the balance between economic, social and environmental priorities. In the past, it was argued that economic growth was paramount and that this would take priority over all other concerns. As incomes and wealth rise, there would be trickle-down effects to help those that could not participate in the new prosperity, and that there would also be resources available to clean up the environment. In practice though, this 'natural allegiance' between the three dimensions of sustainable development was not occurring. It was realized about this time (1987) that a more positive approach was needed that redressed the balance between the overriding economic imperative and the other two components of development. The trigger for this fundamental change in priorities has been the concern over the global environment (primarily global warming), but also the other transboundary issues such as acid rain.

Much effort has been directed at trying to define sustainable development. In this book our focus is on the three basic elements already alluded to here. Economic development relates to the growth in the economy over time and how this is reflected in the wealth of individual countries. Social development addresses the question of the distribution of that wealth between individuals (social equity) and over space (spatial equity). Environment development is the protection of the environment, both in terms of maintaining the current stock of environmental resources (intragenerational) and in terms of bequeathing to subsequent generations a stock that has not been substantially depleted (intergenerational). The definition of the environment includes the global and local environment in terms of the use of resources and the generation of pollution. It also covers issues relating to biodiversity, water quality, sanitation and waste-management.

In addition to these three basic elements, there are two other important factors. Increasingly it is accepted that effective implementation of sustainable development requires all actors to be involved in that process. It must be seen as being participatory so that private individuals, companies, industries and governments all 'buy in' to the proposals being considered. Exclusion from the process means that it is much harder to develop strategies for change. Explanation, understanding and engagement are all essential elements of successful implementation, particularly with respect to sustainable development, as this requires the full co-operation of all parties.

The second factor is the role of governance in achieving sustainable development. Much of the decision-making process is carried out at all levels of government within a sectoral framework. Sustainable development is all embracing and requires new thinking so that cross-sectoral decisions can be made. This in turn means that both the responsibilities and resources should be reallocated between departments to facilitate action. There may need to be changes in the organizational structures of government so that this can take



place, with the establishment of new institutional structures to implement sustainable development. It seems that stable government with appropriate structures is essential and there needs to be consistency in objectives over time. Further, it is often difficult to introduce major changes within the life span of one government, so continuity is essential. It is here that clear leadership and direction is required at all levels of government if real changes are to take place. All five aspects of sustainable development will be used in this book.

### 1.3 The debate

As with many new initiatives, there is substantial debate over the meaning of sustainable development and the usefulness of the concept. For example, the World Economic Forum (Esty, 2002) suggests that the Brundtland definition of sustainable development is a 'buzz word largely devoid of meaning' and that there needs to be a clearer trade-off between the environment and development. The question is raised about whether there can ever be win-win situations as someone always loses when policy choices are made. But, as stated above, sustainable development does help focus the attention of decision-makers at all levels on a wider range of indicators of well-being and it forces more integrated policy-making. More holistic forms of decision-making must be encouraged.

The experience since Brundtland has also taught us a series of other lessons that need to be addressed if the path of sustainable urban development is to be followed:

- 1 Reductions have to start modestly as the capital stock involved in the global energy system is vast and long-lived. It would be costly to replace that investment, but the switch to low-carbon technologies must occur when replacement takes place.
- 2 Clear fiscal incentives should be given to all users of carbon-based energy sources so that prices will rise (i.e. carbon taxes) and restrictions will be imposed on emissions. Industry, business and domestic users need to be given guidance and a clear framework within which to make decisions.
- 3 Strong action is required on research and development in the science and technology of climate change and in promoting its implications. This also includes action on clean energy research and the best means by which research can be quickly translated into practice in all parts of the world.
- 4 The lead for change to a low-carbon economy must come from the rich countries, but all countries must play a role. Industry is the key player in supporting research and development, and must be at the forefront of best practice.

- 5 Action is required now and uncertainty is not a reason for inaction or weak action. Politicians in key nations need to take on the roles of champions and demonstrate leadership.

Once such a framework has been set in place, then it becomes easier to see how urban development and transport fits into this wider picture. The imperative to reduce all forms of carbon consumption must be reflected across all sectors. It provides the context within which other key issues can be placed. The most important of these is that of 'fair shares in environmental space', where it is argued that each country should have the opportunity to consume the same amount of resources relative to its population ([www.mbnet.mb.ca/linkages/consume](http://www.mbnet.mb.ca/linkages/consume)). The estimates for a global population of 6 billion are for 2.0 tonnes of CO<sub>2</sub> per person to stabilize emission levels, but average levels globally are 3.9 tonnes per person and, as we shall see (Chapter 2, Table 2.3), the figures for many rich countries are much higher than this in the transport sector alone. It reflects the global distribution of income, where the top 15 per cent of population has 80 per cent of the world's income, the next 25 per cent has a further 15 per cent, and the remaining 60 per cent have only 5 per cent of the world's income (World Bank, 1998).

#### 1.4 The car as an icon

If there is one object that has become an icon of the twentieth century, it is the car and it is difficult to see how that will change. It can be seen as a 'security' in that it is always available and never too far away. If it is parked at a distance, then people become nervous, and even if they are in the country, many do not venture too far away from that security. This is because of the desire to be 'in the car and motoring', so that one can feel safe and isolated from the dangers outside, and enjoying the luxury that it provides. As Urry (2001) argues, the car has a special combination of factors that seem to give it a dominant role as a global icon:

- 1 It is a *manufactured object* produced by the iconic firms that symbolize capitalism and industry from which both Fordism and post Fordism have emerged.
- 2 It is the main item of *individual consumption* after housing, which provides it and the user with status. But it is also represented as a family member with a name, rebellious features, and an age.
- 3 It has a powerful *machinic complex* through its technical and social linkages with a wide range of supply industries, including parts and accessories, petrol stations, road construction and maintenance, service areas, repair garages and car parks.

- 4 It provides *individual mobility* that subordinates other forms of mobility (public transport, cycle and walk) as it reorganizes the way in which people participate in work, family life, leisure and social activities.
- 5 It is the dominant *culture* that maintains major discourses on the quality of life from its use in films, on the news, and at the centre of much advertising.
- 6 It is one of the most important *users of resources* resulting from the range and scale of materials consumed, the space requirements and the power used in the manufacture of cars and roads, and in responding to the material, air quality, accidents, visual, noise and other costs of car-based travel.

Most of these attributes are well known (Whitelegg, 1997), but the power of and the addiction to the car has often been underestimated. The car offers individuals the means to 'escape' from the real environment by allowing them to have their own flexibility and freedom. The advertisements are very successful in selling that dream of individuality and convenience, and the ability to do what you want (within reason). But that same car is both socially and spatially divisive as it allows cities to spread with the consequences that all people have to travel much longer distances than before, with space becoming something that you want to pass through rather than to stop in (Urry, 2001). For those without a car, the fragmented city becomes more hostile and it can force even reluctant users into their cars, thus exacerbating the problem even further. The car is the one item of consumption that seems to give the user huge (perceived) benefits, but at the same time imposes costs on many others both directly (e.g. through pollution effects) and indirectly (e.g. through congestion and poorer access to facilities).

Perhaps the car is embedded so much within our society, that it is impossible to make any real change to that situation. If the 'car as icon' view spreads to countries where current levels of motorization are low, then what future is there for the city, the environment and for those without a car? The car may however become a victim of its own success as the means to accommodate it will never expand as fast as ownership levels, so it will become less attractive to use it as congestion increases. Urry (2001) proposes three stages where transitions have taken place in attitudes to the car. In the early days, car drivers inhabited the roads with the pioneering spirit of freedom and the image of the open road. As car ownership became more universal, this changed to inhabiting the car, where the car drivers were 'safe' in the metal boxes with complete privacy and the ability to listen to radio, cassette, or CD, as if they were in their own homes. The car was really seen as an extension of the home, as a detachable room that could be taken to different places. The third stage is inhabiting the intelligent car, where some of the routine tasks are

allocated to the vehicle rather than the driver. Included here are traffic control functions, route guidance and information systems. In addition, technology has been used to 'reform' the car and make it more sustainable, through the use of materials that can be recycled, new materials, alternative propulsion systems, and the development of the 'smart car'. The car has become a more sophisticated office with mobile systems for telephones, e-mail and Internet access, so the driver can make the best use of time with even more flexibility.

The icon still remains, but it has adapted itself to the differing requirements of the congested road environment and the driver. Manufacturers and advertisers have been successful in responding to changes so that the car still remains attractive. The public transport system has struggled to compete with the car at every stage. The implications of this car culture must not be underestimated, as it helps to explain why rational behaviour in the economic sense does not prevail. Even though pricing measures are important, behavioural change requires strong complementary actions to be taken across the board if real change is to take place. Single policy measures are limited in their scope, and successful implementation requires creative packages of complementary measures (see Chapter 11) to be introduced consistently over a period of time. A crucial element of the package must be effective engagement with car drivers so that they understand why particular measures are important to the achievement of sustainable urban development, and that they are prepared to respond positively to those measures. If there is little or no support for the measures, then there is little chance of success even if they are implemented successfully. People (and particularly car drivers) are extremely resourceful in finding ways to avoid doing something that they do not support. It is small wonder that so many measures introduced with good intention have not worked as expected, as the target group (often car drivers) have found ways to get round them.

## **1.5 Car ownership and car use**

There is a clear link between car ownership and car use, and any coherent strategy to reduce car use is doomed to failure as it is not really addressing the cause of unsustainable mobility, namely the car (Gilbert, 2000). Any increase in car ownership is likely to result in more urban sprawl, greater consumption of land for transport, and more material consumption overall. Even if technology permits the development of the Eco-car,<sup>1</sup> this does not constitute a solution to the problem, as there is still considerable energy tied up with its production over the life of the vehicle. The only solution to sustainable transport in cities is to push hard on a low technology alternative that has a reduction of car ownership at its centre, so that individuals voluntarily give it up.

A powerful argument for this approach is presented by Gilbert (2000),

but the mechanisms by which such a change can take place are difficult to envisage in any democratic society. Singapore has come closest to it through rationing the availability of new cars by auctioning the right to own them. The annual auction of the ownership permits only applies to new cars and has the effect of substantially raising the costs of ownership and making it even more exclusive. But even here, the numbers of cars are still increasing, although that increase is at a much lower rate than would be the case under normal market conditions. The alternative might be a more voluntary approach where individuals choose to live in car free locations within cities. Public transport in cities should be of a sufficiently high standard to make car ownership unattractive, particularly if the costs of ownership are high because of the city insurance premiums. Car free developments can mean that no parking space is allocated to the dwelling, or that cars are not permitted on the site at all. The space that would have been allocated to the car can be used for increasing the amount of open space, or to get higher densities on the site. There is a necessary trade-off here between the need to balance open space and homes. Such new thinking makes a clear case for car ownership to be 'voluntarily reduced'.

Car free housing can lead to wider areas of the city being designated as clear zones or areas where only non-polluting forms of transport would be allowed. Electric vehicles would be used within the area, preferably powered from renewable energy sources. All forms of polluting transport would be parked outside the area. Most travel inside would be by walk and bicycle, electric bus and tram, with electric vehicles being used for deliveries and to transport those with some mobility limitation. These areas should provide clear demonstration of the benefits of zero levels of transport pollution, and the quality aspects of city living would be considerably enhanced, as these areas would be both clean and quiet.

It is often argued that mobility should be encouraged and not discouraged, and that there is nothing unsustainable about the growth in long distance travel and the use of resources. In this book we do not take the opposite view, but argue that mobility is essential to current lifestyles and the patterns of production and consumption. It is really a matter of degree and this is why sustainable transport requires action to reduce the need to travel in cities (through development and land-use policies), to make people fully aware of the costs of travel (through fiscal and regulatory policies), and to make full use of the technological options available (through a switch to non-carbon sources of fuel). Sustainable urban development can only be achieved through less travel and better travel, and all three core strategies need to be applied effectively as a package of measures individually designed for each city. So it is not saying that mobility is bad, but that people and firms should be given the opportunity to travel less rather than being 'forced' to travel further.

## 1.6 The structure of the book

The focus of this book is narrower than these more ambitious objectives. It will concentrate on the links between sustainable urban development and transport. It is not a polemical piece against car ownership and use of the car in the city, as many cities have structured themselves around the use of the car. It is acknowledged that the car has a powerful iconic role in all societies and that we have learned to live with the car. But we also have to live in cities and these urban areas should be accessible and attractive to all residents. This means that we should be designing cities for people, businesses, prosperity and security as well as a high quality environment. Transport plays an essential role in creating the sustainable city, but it should not be the main agent in its destruction. So the question is ‘What can transport in all its forms contribute to the sustainable city?’.

The three parts of the book address these issues. The first part places the debate within the global context, highlighting important trends and the background to the importance of sustainable urban development. There is a chapter on the links between sustainability and transport intensity that argues for the decoupling of economic growth from transport growth. The public policy context, in terms of institutional and organizational issues, is complemented by a discussion of the main barriers to implementation. This first part demonstrates the nature and scale of the problems to be addressed, together with some of the difficulties in their resolution. At this point, some might agree that it is too difficult to proceed further and accept that transport in cities can never be made more sustainable.

For the more adventurous, the second part provides the heart of the book, as it presents the three main elements of a transport strategy as it relates to sustainable urban development. There are chapters on urban form and its impacts on travel patterns and on the regulatory and fiscal options available to internalize some of the external costs of transport. It is here that creative combinations of policies can create urban areas that are highly attractive places to live, with spaces that are conducive to walking and cycling. It is also the scale at which innovative forms of public transport can offer a high quality alternative to the car. The important role that technology will play in reducing the dependence of all modes of transport on carbon-based fuels is also covered, as is the potential contribution of information and communications technologies (ICTs) to changing activity patterns and business practices.

There are three main themes in the last part of the book, which is more synthetic. The first provides a clear contrast with the main focus on cities in developed countries, as it covers thinking within cities in developing countries that are now experiencing rapid growth both in population and levels of mobility. Although some signs suggest that they are following the same paths

towards motorization, there is also evidence of innovation and the possibility that they might retain a high level of commitment to public transport and providing cities for people. In the second, visioning about the future of the sustainable city provides a longer term perspective, through the application of a backcasting scenario building process. This starts from the premise that the desirable city of the future forms the vision, and transport in its weak and strong sustainability form is then fitted into that vision. The intention here is to show that futures need not be based only on trends, but that they can also be more radical and attractive in their thinking. Finally, an extended conclusion brings all the previous discussion back together, highlighting some of the main challenges presented in this book.

To put this in a slightly different way, the focus on the urban situation is natural as over half the population of the world lives in urban areas (over 25,000 population), and this number is likely to increase to 70 per cent by 2020. Already in the developed countries the levels are above 70 per cent. The argument underlying the book is that the city is central to sustainable development. As the population increases and land becomes scarcer, the most 'efficient' and 'sustainable' development type must be where economies of scale and scope exist through closer proximity, higher densities, and a full range of services, facilities and jobs. Underlying this argument is the important supporting role that transport plays in providing the links between people, firms, services, facilities and jobs. The primary aim is to maintain high levels of accessibility with trip lengths being as short as possible. In this sense sustainable development is not a goal, but a change in direction.

## Note

- 1 The term eco-car is used in this book to describe a small passenger vehicle that is highly efficient and uses alternative fuel sources such as hydrogen and electricity generated from renewable sources. The nearest production vehicle is the hybrid vehicle that combines low energy conventional power with electric power obtained from a dynamo and regenerative energy (from the breaks) – the Toyota Prius. It is similar to what Amory Lovins ([www.hypercar.com](http://www.hypercar.com)) and others have called the hyper-car.

## The global picture

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### 2.1 Introduction

Transport is vital to national and international economies and it provides substantial benefits to individuals and businesses, such as its impacts on employment, prices and economic growth at all levels (ECMT, 2000). However, there is also well documented evidence that transport creates substantial externalities through congestion, urban pollution, greenhouse gas emissions, noise, accidents and a multitude of other factors (Banister, 2002a; Maddison *et al.*, 1996, and Table 2.1). In addition to the external costs, there are important social and distributional consequences as not everyone has or will ever have equal access to motorized transport. Such a universal requirement is unrealistic, but there are many situations where participation cannot take place because there are no adequate transport services. Subsidies to the individual or the service can be provided, but this may not help the objective of sustainability (Button and Rietveld, 2002). More recently, there has been an increasing concern over the health effects of transport-induced pollution, particularly in urban areas, and it is argued that these negative effects particularly impact on the low-income population as they suffer greater exposure to these effects (Social Exclusion Unit, 2002). Within the framework of sustainable development, it is important to balance the positive role of transport in contributing to the economic (and leisure) prosperity with these negative factors relating to the environmental, social and health implications. There are no simple solutions to these conflicting factors, but it is necessary to establish the basic parameters of the debate. To help in giving a flavour of the main aspects, two propositions will be discussed in this chapter.

### 2.2 Proposition 1 – Transport is unsustainable

Travel patterns in most developed countries are increasingly dependent on the car. Levels of mobility and car ownership have risen substantially over the recent past and that increase seems likely to continue to rise. In the EU15 there was an increase of over 31 per cent in the numbers of vehicles owned (1984–1994), and it is likely that in the next 25 years (to 2020) that number will increase by a further 50 per cent (OECD, 1995).<sup>1</sup> By 2001, the level of vehicle



**Table 2.1 Environmental impacts of transport in the United Kingdom**

Environmental media	Environmental impacts	Transport's contribution (1995 unless otherwise stated)
Energy and mineral resources	<ul style="list-style-type: none"><li>➤ Energy resources used for transport (mainly oil-based)</li><li>➤ Extraction of infrastructure construction materials</li></ul>	<ul style="list-style-type: none"><li>➤ 44.8 million tonnes of petroleum consumed by transport.</li><li>➤ transport accounts for approximately one-third of the UK's total energy consumption</li><li>➤ approximately 120,000 tonnes of aggregates per kilometre of 3-lane motorway</li><li>➤ 78 million tonnes of roadstone extracted</li></ul>
Land resources	<ul style="list-style-type: none"><li>➤ Land used for infrastructure</li></ul>	<ul style="list-style-type: none"><li>➤ approximately 4.2 hectares of land per kilometre of 3-lane motorway</li><li>➤ 1,725 hectares of rural land developed for transport and utilities per annum (1992)</li></ul>
Water resources	<ul style="list-style-type: none"><li>➤ Surface and groundwater pollution by surface run-off</li><li>➤ Changes to water systems by infrastructure construction</li><li>➤ Pollution from oil spillage</li></ul>	<ul style="list-style-type: none"><li>➤ 25 per cent of water pollution incidents in England and Wales caused by oil</li><li>➤ 585 oil spills reported in the UK</li><li>➤ 142 oil spills requiring clean up in the UK</li></ul>
Air quality	<ul style="list-style-type: none"><li>➤ Global pollutants (such as carbon dioxide)</li><li>➤ Local pollutants (such as carbon monoxide, nitrogen oxides, particulate matter, volatile organic compounds)</li></ul>	<ul style="list-style-type: none"><li>➤ 25 per cent of the UK's carbon dioxide emissions (CO<sub>2</sub>)</li><li>➤ 76 per cent of the UK's emissions of carbon monoxide (CO)</li><li>➤ 56 per cent of the UK's emissions of nitrogen oxides (NO<sub>x</sub>)</li><li>➤ 51 per cent of the UK's emissions of black smoke (particulates)</li><li>➤ 40 per cent of UK emissions of volatile organic compounds (VOCs)</li></ul>
Solid waste	<ul style="list-style-type: none"><li>➤ Scrapped vehicles</li><li>➤ Waste oil and tyres</li></ul>	<ul style="list-style-type: none"><li>➤ approximately 1.5 million vehicles scrapped</li><li>➤ more than 40 million scrapped tyres</li></ul>
Biodiversity	<ul style="list-style-type: none"><li>➤ Partition or destruction of wildlife habitats from infrastructure construction</li></ul>	
Noise and vibration	<ul style="list-style-type: none"><li>➤ Noise and vibration near main roads, railway lines and airports</li></ul>	<ul style="list-style-type: none"><li>➤ approximately 3,500 complaints about noise from road traffic</li><li>➤ approximately 6,500 complaints about noise from air traffic</li></ul>
Built environment	<ul style="list-style-type: none"><li>➤ Structural damage to infrastructure (e.g. road surfaces, bridges)</li><li>➤ Property damage from accidents</li><li>➤ Building corrosion from local pollutants</li></ul>	<ul style="list-style-type: none"><li>➤ more than £15 million annual road damage costs</li></ul>
Health	<ul style="list-style-type: none"><li>➤ Deaths and injuries from road accidents</li><li>➤ Noise disturbance</li><li>➤ Illness and premature death from local pollutants</li></ul>	<ul style="list-style-type: none"><li>➤ 3,500 deaths (2001)</li><li>➤ 44,000 serious injuries (2001)</li><li>➤ 49 per cent of people who can hear noise from aircraft or trains consider it a nuisance (1991)</li><li>➤ 63 per cent of people who can hear noise from road traffic consider it a nuisance (1991)</li><li>➤ between 12,000 and 24,000 premature deaths due to air pollution (2001)</li><li>➤ between 14,000 and 24,000 hospital admissions and re-admissions may be associated with air pollution (2001)</li></ul>

Sources: Banister (1998a); Central Statistical Office (1997); Committee on the Medical Effects of Air Pollutants (1998); Department of the Environment, Transport and the Regions (1997*d, e, f* and *g*); Department of Trade and Industry (1997); Maddison *et al.* (1996); OECD (1988) and Royal Commission on Environmental Pollution (1994).

ownership in the EU15 had reached 629 vehicles per 1000 population (238 million vehicles for 378 million population), similar to the mid 1980s levels in the United States. Road capacity will not increase by the same amount, so congestion will grow, particularly in the cities. The car brings many benefits to the individual user, but its wider social costs present a fundamental challenge to sustainable urban development.

At present, about 70 per cent of all vehicles are in OECD countries, with the remaining 30 per cent being in the emerging and developing countries. However, over the next 25 years, the distribution will change as the number of vehicles increases by a further 75 per cent (to 2020), and as 43 per cent of vehicles will now be in the emerging and developing countries (Table 2.2).

Several important points relate to this table. Cars account for about 60 per cent of all vehicles in both 1995 and 2020, but they are more important in the OECD countries. In the emerging and developing countries light trucks (15 per cent) and motorcycles (32 per cent) form important elements in the vehicle fleet. In the year 2005, the global numbers of vehicles will exceed 1000 million for the first time, and before 2030 the number of vehicles in non-OECD countries will exceed that of the OECD countries. The scale of the problem is vast and increasing.

There are key differences in the problem of transport in the OECD and the non-OECD countries. In developing economies, cities are coping with rapid motorization (10–15 per cent per annum) and an urban population that is growing by 6 per cent per annum (World Bank, 1996). At comparable levels of income, industrial countries have few cars, but in developing countries car

**Table 2.2 Expected growth in worldwide vehicle ownership and traffic**

Thousands	1995		2020	
	Cars	Vehicles	Cars	Vehicles
OECD North America	170,460	231,557	247,328	335,056
Europe	160,215	203,429	244,720	300,054
Pacific	52,654	101,188	82,193	147,251
Total OECD	383,329	536,174	574,241	782,361
Rest of world	111,255	240,357	283,349	580,288
Global totals	494,584	776,531	857,590	1,362,649
Vehicle-kilometres – billions	7,792	12,341	13,569	21,953

*Notes:* All vehicles include cars, light trucks, motorcycles and heavy trucks.

OECD North America – US, Canada;

OECD Europe – Austria, Belgium, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, UK, Finland;

OECD Pacific – Japan, Australia, New Zealand.

Mexico is a member of OECD (since 1994) but is excluded from these OECD figures

*Source:* OECD (1995).

ownership rates are much higher. There is also less road space available. For example, in Bangkok and Calcutta 7–11 per cent of urban space is devoted to transport activities, but the corresponding figures in European cities are 20–25 per cent and over 30 per cent in Manhattan (World Bank, 1996).

This means that city roads in developing countries are more congested at lower levels of car ownership. Slow moving traffic and ill maintained vehicles cause greater levels of pollution than that experienced from more efficient modern vehicles operating in less congested conditions. High land and housing costs in central areas contribute to sprawling, land-consuming cities with long and slow journeys to and from work, often taking over five hours a day. This is the classic ‘Bangkok Effect’ where congestion and pollution are so bad that vehicles are ‘abandoned’ on roads as it is quicker to walk (Table 2.2).

### **2.3 Proposition 2 – Sustainable urban development is dependent upon the city being the centre of vitality, opportunity and wealth, and that transport has a major role to play**

Society is becoming more urbanized and we have now reached the point where over half the world’s population of 6 billion people live in cities (2000, EC, 2003). The number of people living in cities is growing at a rate of 60 million a year, and the level of urbanization will continue to increase, as the urban population will rise to over 61 per cent in 2025 (UNCHS, 1996). This growth is distributed unevenly over the world, and it is in the cities of the developing world that urbanization is taking place at the most rapid rate. In the northern cities, this transformation has already been seen as some 80 per cent of the population is living in cities, with the tendency now to move out from the larger urban areas to smaller places. Much of the current thinking is looking at the means by which population can be attracted back into the cities.

The scale of the changes taking place is only now being fully appreciated. Although the growth rates of urban population are declining from 3.8 per cent (1980–1985) to 2.9 per cent (2000–2005), this still means a doubling of city population every 25 years. In 1995, there were some six cities with populations over 15 million, led by Tokyo with its massive 27 million population, and a further nine cities with populations over 10 million. By 2015, it is expected that there will be 27 cities with populations over 10 million, seven of which will have reached 20 million (UNCHS, 1996). Eighteen of these cities will be in Asia, five in South America, two in North America and two in Africa. There will be none in Europe.

In addition to these individual cities, many will effectively join to form new agglomeration cities, which although having their own identity will be networked giving total populations of over 30 million. This does not mean that the built up area is continuous, as the distances between them are still

substantial, but that they are becoming hugely attractive growth centres for investment and migration. The Pearl River Delta linking Hong Kong with Guangzhou is the best known example (Hall and Pfeiffer, 2000), but others include the Jakarta to Surabaya corridor in Indonesia, the east coast of Japan from Tokyo through Nagoya to Osaka, and the axis between Sao Paulo and Rio de Janeiro in Brazil. It is not just in the megacities that the growth in urban population is taking place, but across cities of all sizes. It is in the cities that jobs are located and where investment is taking place. But it does seem that the largest cities may grow at the expense of the smaller ones, at least in terms of human capital, as the best educated tend to migrate to the largest centres.

Cities have witnessed the four great transformations that have swept society over the last two hundred years, with the industrial revolution, followed by transport and telecommunications innovations, the switch to democracy, and the most recent development of the network society, with most jobs and wealth being created in the service and information sectors. It is not surprising that most of these developments have been concentrated in the cities, which themselves have become the key nodes in the global systems that are both interactive and interdependent. Although economies are now global, and the levels of communication and interaction required to service them have grown exponentially, there still seem to be strong arguments for agglomeration economies, as businesses are dependent on each other. There is still a requirement for face-to-face contact, and travel is easier over shorter rather than longer distances.

These trends provide an important framework within which to place the second proposition. The global trend towards urbanization and economic factors promoting agglomeration should support sustainable urban development. In addition to the city being the centre of vitality, opportunity and wealth, it is the necessary supporting infrastructure (water, waste, electricity, communications, and transport) that also needs to be provided so that the city can 'work'. The underlying argument here is that it is only in the city that these high levels of accessibility and proximity can be maintained, at a reasonable cost.

## **2.4 The ten principles of sustainable development and transport**

Current trends in transport and the growing dependence on the car (and air travel) constitute one of the main challenges to sustainable development. Conventionally, there are seven key issues that need to be addressed if transport is to conform to the principles of sustainable development (EFTE, 1994; Banister, 1997a).

- 1 Growing congestion in many urban areas has been increasing in its

- duration and intensity. On average, speeds in cities have been declining by about 5 per cent per decade (EFTE, 1994), and the severity of congestion increases with city size (Dasgupta, 1993).
- 2 Increasing air pollution has resulted in national air quality standards and those recommended by the World Health Organization being exceeded in many cities. Air pollution affects health, impairs visibility, and damages buildings and local ecology – it reduces the quality of urban life.
  - 3 Traffic noise affects all city life and it is estimated by the OECD/ECMT (1995) that about 15 per cent of the population in developed countries is exposed to high levels of noise, mainly generated by traffic. Disturbance is also caused by vibration, particularly from heavy lorries, and night time deliveries.
  - 4 Road safety is a major concern in cities and elsewhere. Worldwide, traffic accidents result in 250,000 deaths and about 10 million injuries each year (Downey, 1995). The accident rates are now declining in some countries (with high levels of motorization), but increasing in others (with low levels of motorization). This is a very high cost ‘accepted’ by society.
  - 5 Degradation of urban landscapes results from the construction of new roads and transport facilities, the demolition of historic buildings, and reductions in open space. Transport contributes to the decaying urban fabric and neglect of central city areas, as well as urban sprawl (Ewing, 1997).
  - 6 Use of space by traffic facilitates the movement of the motorist, but reduces the accessibility of others as transport routes become barriers, as parked vehicles form obstacles for pedestrians, cyclists and those with disabilities. Car dependency results in traffic domination in urban areas, sometimes splitting communities.
  - 7 Global warming results from the use of fossil fuels. Transport (2001) accounts for 28.9 per cent of CO<sub>2</sub> emissions and this level is rising in relative terms as well as in absolute quantities. Transport is almost wholly dependent on oil, and this is a non-renewable energy source.

In addition, transport has also facilitated changes in the city, and three land-use and development factors need to be added to the list above.

- 8 Decentralization of cities has been facilitated by the car, in combination with efficient public transport. This has resulted in a substantial growth in trip lengths and patterns that are dispersed rather than concentrated on the city centre. This in turn increases car dependence and reduces the possibilities of promoting efficient public transport.
- 9 Development pressures have taken place around car accessible

locations which are not accessible to all people (including the edge city developments). The spatial segregation of activities in urban areas again increases trip lengths and has strong distributional consequences. High land and property prices are symbolic of a buoyant economy, but they are also socially exclusive, particularly in terms of access to low-cost city centre housing.

- 10 Globalization and the relocation of industry (including the information economy) have resulted in new patterns of distribution and the transport intensity of freight has increased globally, regionally and locally.

Policy options on transport in most OECD countries have changed substantially over the last 20 years with the realization that the road building option is no longer the solution to congestion, and even if it were the environmental and social costs are too high. In advanced economies with extensive road networks, additional links have only a marginal effect on accessibility (Banister and Berechman, 2000). Demand management, combined with strong policies to promote public transport and the concentration of development will both reduce congestion and have environmental and social benefits. This is the key to sustainable development.

In the non-OECD countries the situation is different as the high quality basic infrastructure is not yet available, so any new investment in roads may have a major impact on accessibility, with markets being flooded by non-local products. The case for new road construction is stronger in these countries and cities, but again it must be placed within the context of a policy towards sustainable development that also builds upon the city as the key element. It is not possible or desirable in the non-OECD countries to accommodate the expected growth in demand for car travel. Even if it were possible, it would necessitate massive reconstruction of existing cities, as road space would need to be expanded.

To establish a policy that addresses the ten principles of sustainable development listed above, there are seven basic objectives to be met:

- 1 reduce the need to travel;
- 2 reduce the absolute levels of car use and road freight in urban areas;
- 3 promote more energy efficient modes of travel for both passenger and freight;
- 4 reduce noise and vehicle emissions at source;
- 5 encourage a more efficient and environmentally sensitive use of the vehicle stock;
- 6 improve safety of pedestrians and all road users;
- 7 improve the attractiveness of cities for residents, workers, shoppers and visitors.

This list (based on OECD/ECMT, 1995, pp. 133–134) would tackle the problems of congestion, air pollution, noise, safety, degradation of urban landscapes, the use of space, and global warming. In addition, objective 1 would help reduce city decentralization, whilst objective 7 would in part address the question of development pressures. The more general economic context of globalization is really external to the objectives set here. The land-use and planning strategies have a clear potential to reduce the need to travel, and both transport and land-use policies will help reduce the absolute levels of car use and promote the use of more environmentally friendly transport. Targets and standards are important tools to tackle noise and emissions at source. Road safety and the attractiveness of cities can again be addressed by transport and land-use policies, as well as by the application of targets and standards (OECD/ECMT, 1995).

The potential for change is clearly there, at least in theory. But any review of the trends and actions would suggest that in practice the achievement of sustainable development objectives listed above has been very limited. The need to travel has not been reduced, nor has there been any evidence of reductions in the use of cars and lorries. Promotion of public transport has taken place in many cities with high quality services being provided and patronage levels have increased. But, even here, the costs have been high as subsidy levels have risen and as the new patronage has come from cycling and walking. Noise levels have remained unchanged as reductions at source have been balanced by increases in traffic. Emissions levels have been substantially reduced through the use of catalytic converters, but CO<sub>2</sub> levels have increased as this is related directly to the carbon content of the fuel. There are only limited examples of forms of road pricing to reduce the use of the car.<sup>2</sup> Many countries have high levels of fuel taxation, typically set at 75–85 per cent of the pump prices. Although this level of pricing reduces consumption, it is primarily a means to raise revenues for the national Treasuries. Load factors in cars and lorries have declined, whilst high occupancy vehicle lanes have proved only a limited success. Road safety is one area of success, but even here it is limited to certain countries, often with high levels of motorization. The number of pedestrian casualties related to other accidents involving road users has also been increasing. Policies to promote city centres are taking place to produce multi-centre structures within a metropolitan region, and this may be reducing levels of out-migration, as regeneration and new development takes place.

This brief (and general) assessment makes disappointing reading but, with the exception of a limited number of cities, little progress has been made towards sustainable development and transport. Any improvement has been more than outweighed by the underlying growth in car-based mobility. There is a series of constraints that need to be addressed if a clear strategy on transport and sustainable development is to be established.