

Urban Transport and the Environment

An International Perspective

Urban Transport and the Environment **An International Perspective**

World Conference on Transport Research Society
And
Institute for Transport Policy Studies



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INVESTOR IN PEOPLE

FOREWORD

At the present time, emissions of greenhouse gases from transport are continuing to rise in almost all countries, at a rate much higher than those from industrial or domestic use. If this trend continues, transport will certainly be the largest sector influencing the global atmospheric environment in the 21st century.

Even now in many of the developed countries, car ownership and use are continuing to rise. On the other hand, although engine technology has recently been much improved, the usage level of low emission cars is still much lower than that needed to clear up environmental problems. For this reason, the reduction of local atmospheric pollution caused by transport in urban areas has also not been as successful as it should have been.

In developing countries, along with the increase in income, there is a rapid shift from walking and cycling to motorised transport. Since many of the motorized vehicles are aged or poorly maintained, deterioration of the environment especially in urban areas has been getting worse. Especially in rapidly growing countries, where motorisation is occurring at a very swift pace while the automobile maintenance system is not developing at the corresponding rate, local environmental pollution is very serious. Moreover, the potential impact of this local traffic on the global environment as a whole is becoming critical.

Although various countermeasures have been taken both in developed and developing countries, their effects have tended to be limited because of lack of systematic implementation. It is also a sad fact that the valuable experiences of one country are not sufficiently reflected in the policy measures taken by other countries. In order to adequately address the environmental problems arising from transport, it is imperative to gather the policy experiences from each country into a knowledge-base which can be shared by all.

This book focuses particularly on urban transport, since this is a serious local issue with a significant influence on the global environment. It attempts firstly to understand the current conditions of urban transport and the environment. Then it tries to give a picture of what sort of measures can be taken to improve the situation and what their effects on the environment would be. For this purpose, the relationships of the various objectives, measures and effects are first presented systematically. Since these objectives, measures and effects may differ from country to country and from city to city, experiences in different cities in the world, collected through international cooperative research, are presented. By compiling them into a future perspective for transport and the environment, the book aims to identify future issues and suggest policy directions to contribute to more integrated measures for cities around the world in order to improve the local and global environment.

For understanding the environmental problems of urban transport and finding suitable countermeasures, it is important to have adequate knowledge not only of transport planning and engineering but also of the mechanisms of environmental impacts and of the effectiveness of measures. This book is designed for researchers, practitioners and students who work in either the transport or the environment field and are interested in an integrated understanding

of both. In addition, we hope that for those attempting to take a cross-speciality approach to the development of policy measures, it will serve as a reference to promote further international collaborative research and cooperative work.

A Special Interest Group on Transport and the Environment was established at the 9th Seoul Conference of the World Conference on Transport Research Society (WCTRS) held in July 2001, together with another related Special Interest Group on Transport Policy Instruments. A major trigger for this initiative was the growing seriousness of the urban transport impact on the environment and an awareness of the importance of international collaboration for dealing with it.

The WCTRS is an international forum bringing together researchers and practitioners in transport, which has extended beyond established disciplines such as engineering and economics, and modes of transport like railways, roads, shipping and aviation, to include experts in a variety of fields including logistics, land use, and financing. Concerning the problems of transport and the environment in cities, it was considered essential to carry out research by bringing together experts from representative cities around the world. It was decided that researchers with a deep interest in the environment would be selected from among the members of WCTRS, and an international research programme under the title of “Comparative Study on Urban Transport and the Environment (CUTE)” would be undertaken. It was only the wealth of human resources within the WCTRS, and the long-standing relations of trust among individual members, that made it possible for the authors to realise this challenging systematic work “Urban Transport and the Environment”.

The research was started on the initiative of Hideo Nakamura of the ITPS (Institute for Transport Policy Studies, Tokyo) as a joint research project with the WCTRS. The overall progress of the research and the details of its structure were ensured by Hideo Nakamura, Yoshitsugu Hayashi, Anthony D. May and Kazuaki Miyamoto, and the research was conducted through the cooperation of Werner Rothengatter, Genevieve Giuliano, Daniel Sperling, Alain Bonnafous, Dominique Mignot and Wolfgang Schade, requiring six major meetings and innumerable e-mail communications. Some of these members also served as lead authors for individual chapters.

In addition to the lead authors, chapter sections were contributed by the researchers listed below. As it was our purpose not only to understand the general mechanisms of the transport environment problems but also to share experiences of various practices that have been adopted in different cities of the world, we requested other researchers who had expert knowledge of practice in these cities to join our project as writers.

The secretariat for this research, provided by the ITPS, bore the responsible for maintaining steady progress in the research and writing. We gratefully acknowledge the support of the Japanese Ministry of Land, Infrastructure and Transport and of the Nippon Foundation. In addition, we especially thank former Vice Minister Jiro Hanyu in person, for his invaluable advice from the first proposal of the CUTE project up to final publication.

March 2004

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URBAN TRANSPORT AND THE ENVIRONMENT
(CUTE)**

2001-2004

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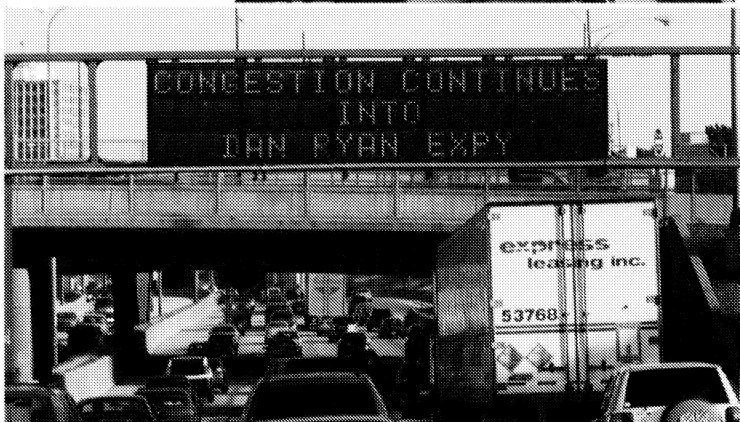
- Intro* Traffic congestion in Bangkok by Shinya Hanaoka.
- Intro* Traffic congestion in Chicago by Express Highway Research Foundation of Japan.
- Chap1* Congested highway in Tokyo by Metropolitan expressway public corporation.
- Chap1* Buses at Portland by Yuichiro Kaneko.
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INTRODUCTION

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INTRODUCTION

I.1 The Present State of Transport-related Environmental Problems

In developed countries, there are notable examples of countermeasures to lighten the burden that traffic imposes on the environment. In Freiburg, Germany, a rail link allows direct access from the city centre tram mall to the residential suburbs on the one hand and the main line rail station on the other, which has led to a significant shift to public transport. In Japan the “green” car tax system has encouraged purchase of vehicles with low rates of emission and fuel consumption. In the UK, the concept of Integrated Transport has established itself as a mainstay of transport policy. In the Netherlands, too, the national transport policy is remarkable in that it is concerned with location regulations which take into consideration the available transport systems in the area and actually seeks for slower transport modes in towns.

In developing and newly industrialised countries, also, there are numerous creditable examples to be found. For example, the raising of the taxation rate on leaded petrol in Thailand led successfully in just a few years to a national changeover to unleaded fuel. Or there is the case of Cairo, in Egypt, where the attractive, recently introduced underground system, together with the well utilised traditional suburban tramways, has allowed rail to maintain a 20% share of public transport for the past twenty years, a figure that would be notably high in a developed country, let alone a developing one.

However, it can hardly be said that good practices like these are being readily transferred from one country to another. There may well be these individual success stories, both in the developed and developing worlds, yet in the end there is no denying the overall picture which is that attempts to use transfer of policies as a means for dealing with transport-related environmental problems are generally feeble, and individual policy initiatives are not systematically organised.

One of the barriers is that the relationships between transport and the environment are extremely complicated. To give one example, the advances in engine technology development achieved by automobile manufacturers in developed countries since the latter half of the 1990s have been truly remarkable from an environmental point of view. In Japan, as a result of the introduction of a “green” car tax preference, there has been a very rapid shift among consumers to cars with lower fuel consumption, and this in turn spurs competition in technology development among the manufacturers, leading to a positive chain reaction. This example shows how it is possible to control the load imposed on the environment by traffic once the mechanisms linking the multiple parties have been properly grasped and effective policies have been discerned. However, in developing countries, there is a widespread demand among consumers for poor quality second-hand cars and engines at extremely low prices. It is extremely difficult to control this unless there are policy measures that encompass the complex mechanisms operating between demand and supply. Unless the chain mechanisms linking the

multiple parties can be grasped in this way, and effective policies discerned, it will be extremely difficult to control the load imposed by traffic on the environment.

Research to date, however, has concentrated on advances in discrete areas of analysis such as car ownership, travel behaviour models, traffic management, energy consumption, life cycle assessment, pollution diffusion, environment tax schemes, urban planning regulation and the like. Comprehensive analyses of environmental influences taking transport as their focus have rarely been attempted. Moreover, transport-related environmental problems clearly differ regionally between Europe, America, Japan, the newly industrialised and the developing nations, in terms of problems, public awareness and the assignment of priorities. Analyses and surveys being conducted are almost invariably concerned with particular regions or countries, and are therefore of little help for a wider understanding of transport environment issues or for projects of international collaboration. One of the important recent exceptions has been the EST (Environmentally Sustainable Transport) project proposed by the OECD to bring to light examples of "best practice" in the area of sustainable transport systems. Now we are at the stage of being able to prepare concrete methods to transfer these models of success to other countries and cities.

The deterioration in the global environment has led to the creation of an international framework of measures, including the establishment of Global Environmental Facilities (GEF) by the World Bank, the proposal and approval of the Kyoto Protocol, and concrete plans for implementing the Kyoto mechanisms in such applications as Clean Development Mechanisms (CDMs). Various projects, including for example afforestation and the re-equipment of electricity generating facilities, have been suggested, and concrete means of implementation are under consideration. But in the transport sector, the sad reality is that virtually no ideas have been put forward.

I.2 The Approaches Required and the Contents of this Book

As will already be apparent from the above remarks, solutions to traffic-related environmental problems depend on the following requirements:

- a) understanding these problems within a more comprehensive and general framework
- b) the establishment and provision of policy instruments and of a knowledge-base regarding their effects
- c) support for policy choices aimed at the improvement of local environments
- d) actual case studies of policy applications in representative cities together with "pathology histories" illustrating negative effects
- e) institutions and policies that facilitate international collaboration for environmental improvements on a world scale.

Local environmental problems and the effects of the remedial measures exhibit peculiarities specific to the country and region affected as well as to the time of occurrence. It is therefore valuable to know the experiences of other cities and to understand the underpinning explanatory mechanisms. At the same time, in solving environmental problems on the world scale, it is imperative to be able to devise and enact countermeasures jointly, on the basis of a shared international understanding.

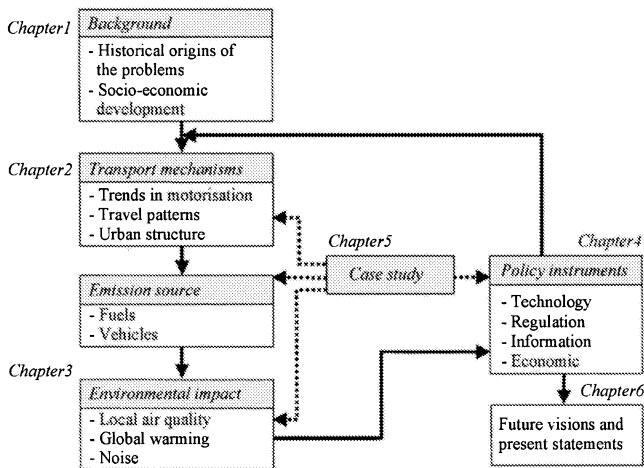


Figure I.1 Chapter structure of this book

For these reasons, this book will not confine itself to the introduction of individual policy examples. Rather, it will follow the structure set out in Figure I.1 below. First, chapter 1, dealing with the environmental problems stemming from urban transport, will trace the path of development that has led from the earliest powered transport to the present day, providing an overall outline of the subject, working from the developed to the developing countries, and from local pollution occurrences to global environmental issues. Following on from this, in chapter 2, we shall be analysing the means and mechanisms by which transport comes to act upon its environment, in particular from the point of view of the various factors that have an effect on transport demand and traffic flow. Chapter 3 then addresses the mechanisms that lead to the generation of exhaust gas emissions, a root cause of traffic pollution, and assesses the impact which they have on the local and global environments. A classification of policy approaches is next undertaken in chapter 4, from the various angles of technology, regulation, information and awareness, and economic measures, applied to such strategy areas as transport demand, traffic flow and sources of emissions. There is also some discussion in this chapter of knowledge bases from which appropriate instruments can be selected. Actual examples of these policies being put into practice and of the benefits accruing from them are presented in chapter 5, for cities such as Nagoya, Los Angeles and Berlin in the developed countries, and

Bangkok, Cairo and Santiago in the developing ones. Finally, chapter 6 offers some future visions and present position statements concerning the prospects for sustainable urban transport.

I.3 The Treatment of “Urban Transport and the Environment” in this Book

As the terms “urban transport” and “environment” are both open to an extremely wide interpretation, it is impossible for this book to describe all of the problems involved in these two areas. For example, air and sea transport also result in toxic gas emissions into the atmosphere, while in certain areas the vibrations caused by rail traffic are a serious environmental hazard. Another concern is that while global environment problems may have grave future effects for the population of the whole planet, actual interest in such matters is very scant in developing countries. However, we as authors neither have the expertise to deal with the entire range of these problems, nor the necessary page space at our disposal were we tempted to try.

We therefore propose to restrict the coverage of this book to the following matters.

Means of transport

The subject treated will be the transport of passengers and goods in cities. The private modes studied will include walking, cycling and individually owned automobiles; the public modes will take in all kinds of motorised transport from railways and trams through automated guideway transit and buses to paratransit. (Figure I.2).

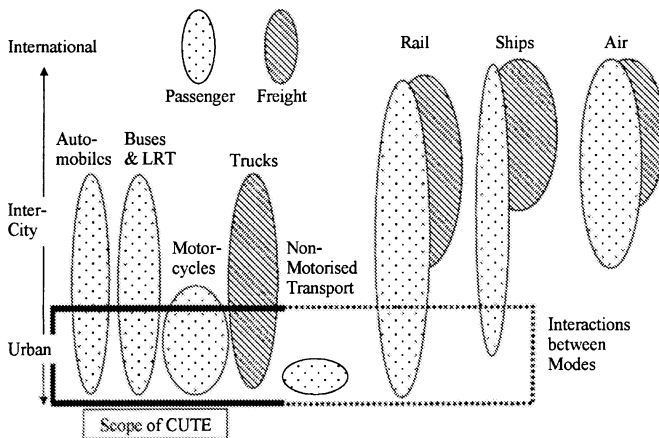


Figure I.2 *Means of transport covered in the Comparative study on Urban Transport and the Environment (CUTE)*

Environmental problems

Here we shall deal with problems of atmospheric pollution from urban road traffic attributable to causes such as emissions of carbon monoxide (CO), nitrogen oxides (NO_x) and particulate matter (PM), and noise pollution due to both rail and road transport, and also with wider-scale local environmental problems such as acid rain, due mainly to exhaust gas emissions from road traffic, and finally the global environment problem arising from the so-called “greenhouse gases” (Figure I.3).

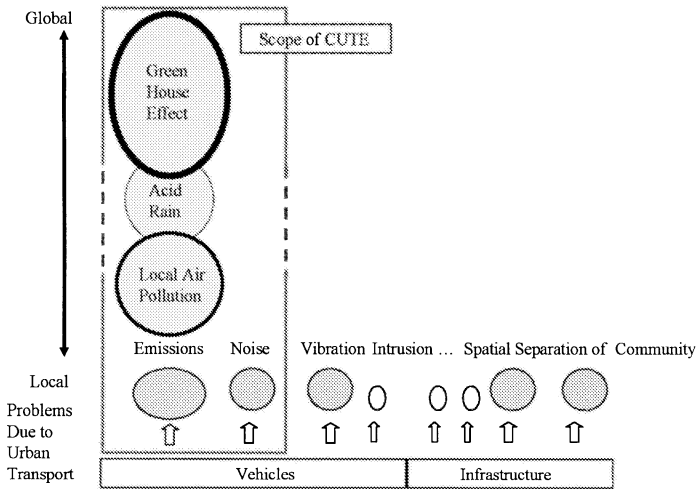


Figure I.3 *Environmental problems covered in CUTE*

Time span

The time span covered extends from the present to the relatively near future (about 15 or 20 years ahead). Regarding both transport and environmental problems, it is often the case that things that previously went wrong in the developed countries are now occurring again in the developing ones. In some cases it is the results of what happened earlier in the developed world that have led to the present serious situations in the developing world; situations which in turn are now set to aggravate future problems in the same areas. For example, it is not uncommon to find the environmentally harmful automobiles once driven in the developed countries being put to a second use in the developing ones now. Accordingly, our account will have to pay attention to these regional lags in the stages of development, and to the differences in the environmental problems found from one region to another.

Policy objectives

The primary policy objectives as far as this book is concerned are the amelioration of local atmospheric and noise pollution, and the prevention of global warming. At the same time,

however, we need to appreciate the fact that transport exists, and is used, in order to serve other objectives. These objectives may vary somewhat depending on the country or city in question, but most typically they are efficiency, fairness, liveability, equity, safety and economic growth, all of which are valued not only for the present generation but also for future ones. In certain cases, purposes like these may conflict with the kind of environmental improvement objectives we are concerned with in this book, or may be an obstacle to the implementation of an effective environmental strategy. To take one example, a restriction in the use of cars, while desirable from the environmental point of view, might bring an inconvenience in day-to-day living and a loss in production efficiency from the point of view of the people whose mobility is hampered by it. It could also possibly have a detrimental effect on the whole urban economy. On the other hand, it is also possible that the pursuit of these objectives might serve as a reinforcing motive for the policies we are envisaging. For example, effective pricing for the use of a road can result in a double benefits of improved efficiency, convenience and safety on the one hand and environmental improvement on the other. Similarly, an improvement in fuel efficiency leads to a more effective use of resources.

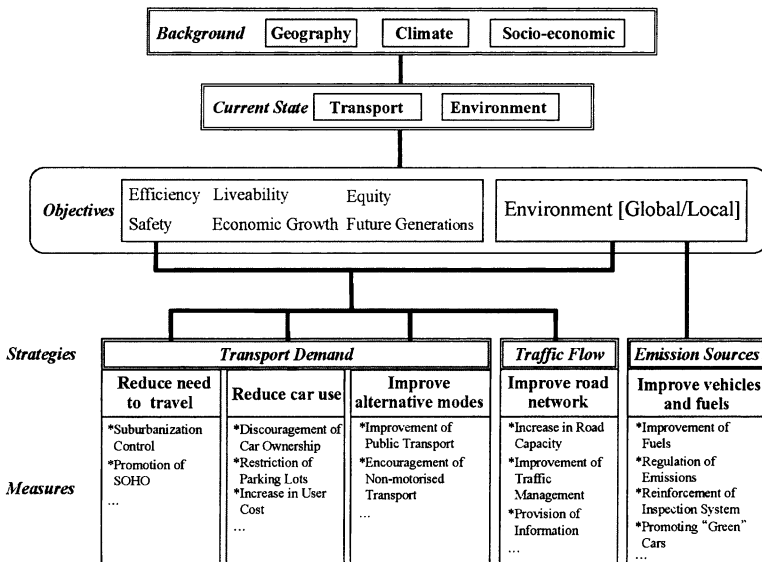


Figure I.4 Objectives and alternative strategies for transport and land use policy

Strategies for the attainment of policy objectives

To meet these objectives, a strategy is needed for the choice of an appropriate direction in policy, taking into consideration geographical features, climate and the socio-economic conditions of the region, as shown in Figure I.4. The principal strategies are likely to be reducing the needs to travel; reducing car use; providing improved alternative to the car,

improving the operation of the road network; and improving vehicles and fuels. The promotion of these alternative strategies requires individual measures of the kinds exemplified in the figure.

Policy instruments

The measures for promoting the above mentioned strategies depend for their implementation on a range of technology, regulation, information and public awareness, and economic instruments. In this book, accordingly, the various policy measures will be classified on the two axes of “strategy,” indicating the direction of the intended effect, and “type of instrument.” It is on the matrix thus generated that all the individual policies will be categorised. By way of example, Table 4.3.1 in chapter 4 presents a diverse selection of policy examples fitted in place on this matrix.

CHAPTER 1

OVERVIEW OF URBAN TRANSPORT AND THE ENVIRONMENT

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 Yoshikuni Kobayashi
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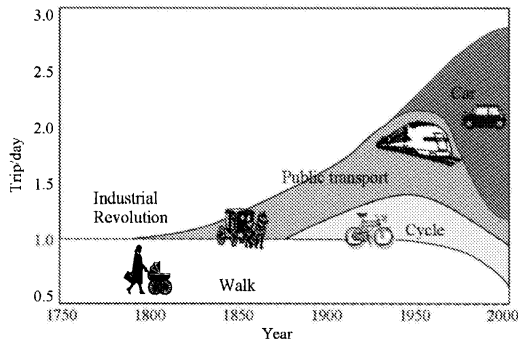
KEY MESSAGES

- *Following the Industrial Revolution, motorised transport emerged and expanded the mobility of people and goods. The trends towards increased motorisation, originating in America in the beginning of 20th century, has brought about a revolutionary change in people's lifestyles.*
- *In the last half of 20th century, motorisation has spread in one after another region over the world and has dramatically improved people's mobility. It has brought convenience and prosperity and encouraged urbanisation, but it also has brought negative effects such as air pollution, and noise.*
- *The exponential growth of car ownership and usage accelerates oil consumptions. Consequently it generates substantial amounts of greenhouse gas emissions, and will cause significant impact on the global environment.*
- *Motorisation in developing countries is progressing much faster than that experienced in developed countries. This situation raises greater concern about the future global environment.*
- *In order to sustain mobility while, at the same time, minimising its negative effects on the environment, it is necessary to make major improvements in the transport sector, and especially in urban transport, which accounts for a large share of the problems.*

1.1 DEVELOPMENT OF MOTORISED SOCIETY

1.1.1 Transport and Industrial Revolution

Human mobility was extremely limited up until the Industrial Revolution. On the level of everyday activity, mobility consisted of going to the fields to work and carrying the crops to the market. Trips were limited in terms of both frequency and distance. The power for land transportation came exclusively from human legs and from horses, while water transportation depended on wind power for sailing or muscle power for rowing. Saitz (1979) estimates that human mobility in terms of the number of trips was around 1.1 per day (Figure 1.1.1). The daily distance covered in such ways could not far exceed 10 kilometres. Considering in addition that total world population in the 1500s was roughly 500million (UN, 1999), equivalent to one twelfth of the total today (UN, 1998), the overall volume of transport was very small, and had only a minimal impact on the environment.



Source: Saitz (1979).

Figure 1.1.1 *Change in number of trips and shares by different transport modes*

With the start of the Industrial Revolution in the latter half of the 18th century and its subsequent acceleration following the invention of Watt's steam engine, natural power sources such as water, wind and the effort of humans and draught animals came to be replaced by sources such as steam that utilised thermal power. Steam engines first led to greater efficiency in the spinning, textile and mining industries, and were then introduced to other industrial sectors, resulting in a great expansion of factory production.

As large-scale manufacturing industries developed, further improvements were made in transport to allow large quantities of raw materials, fuel and manufactured products to be moved as rapidly as possible. A canal network had been constructed in Great Britain by the end of the 18th century, and in the half-century following canals began to be superseded in their