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TRANSPORT DILEMMAS IN DENSE URBAN AREAS: EXAMPLES FROM EASTERN ASIA

by
Paul A. BARTER

Institute for Sustainability and Technology Policy (ISTP)
Murdoch University, Western Australia.

Introduction

The spatial implications of urban transport patterns have long been an important theme in the planning and transport literature (Hansen, 1959; Mumford, 1961; Thomson, 1977). However, most debate over the connections between transport and the concept of the "Compact City" has focused on cities with relatively low densities. This chapter highlights results from a study of transport patterns in nine large urban areas of eastern Asia, most of which have high urban densities, and with income levels ranging from lower-middle income to high income.

It is widely accepted that low urban densities tend to go together with a high level of reliance on private cars and with low roles for public transport, walking and cycling (Newman and Kenworthy, 1996). In the context of low-density urban areas, arguments have raged over the transport-related pros and cons of encouraging more compact urban development (Bernick and Cervero, 1997). However, at the other end of the urban density spectrum many aspects of the debate are quite different. High urban densities exist in most large cities in the South and have profound implications for transport policy in these cities. Scholars and planners who may be attuned to the debates in low-density cities must not overlook these implications, which include both challenges and opportunities.

This paper examines these issues with reference to a comparative data set on nine major Asian cities of various income levels. The cities are Surabaya, Jakarta and Manila, which in 1990 were lower-middle-income cities, Bangkok, Kuala Lumpur and Seoul, which were upper-middle-income cities, and Singapore, Hong Kong and Tokyo, which are high-income cities. A comparative perspective relative to certain other regions is also provided (using eleven high-income cities in Europe, six in Australia, seven in Canada and thirteen in the United States[1]). Most data presented here are from the 1990 update and extension (Kenworthy and Laube et al., 1999) of earlier work by Newman and Kenworthy (1989). Data were collected by a team (which included the author) at the Institute for Sustainability and Technology Policy, Murdoch University, and were primarily from official source documents such as transportation studies, vehicle registration data, etc. Great care has been taken to ensure reliability and comparability of the data, especially in cities with less developed data keeping capacity. The definitions used for the urban areas in this study are the full functional urban areas, wherever possible.

The first section of this chapter outlines a small number of key urban and transport characteristics of the Asian cities in the sample and places them into an international context. This sets the scene for discussions of

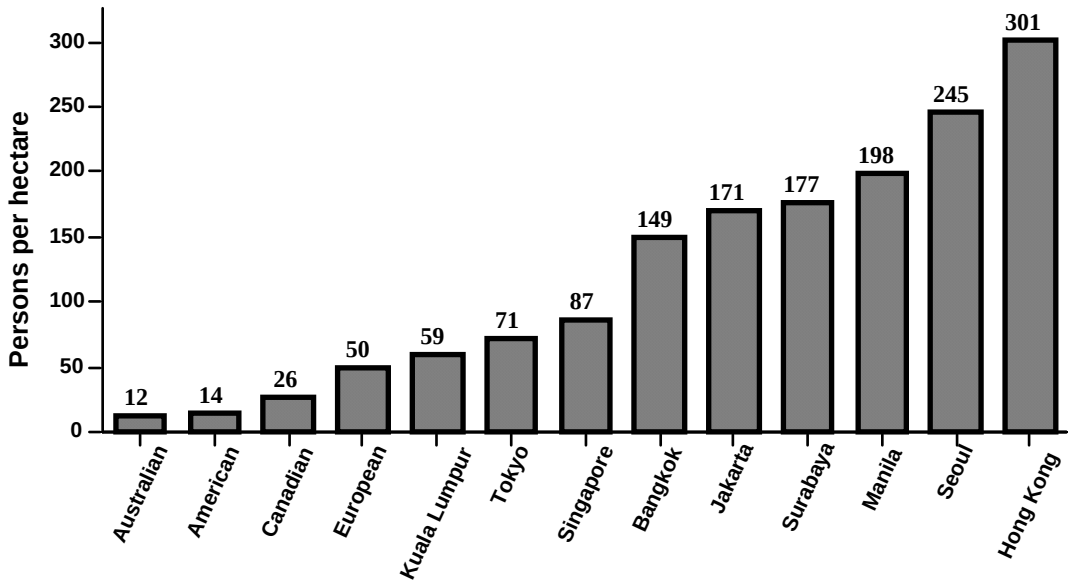
the transport opportunities and challenges that result from high densities. Finally, implications of high urban densities for transport policies are discussed.

Background: Characteristics of the Asian Cities in International Perspective

The indicators shown here all reveal a similar regional pattern, with the cities of the United States having on average the lowest urban densities, the highest usage of private motor vehicles and the lowest use of public transport. The Asian cities are, on average, at the opposite extreme with high densities, low vehicle use and high public transport use. The European, Canadian and Australian cities fall between these extremes.

Asian cities, including most of those in this sample, are typically very densely settled (Fig. 1). Only Kuala Lumpur has a middle density similar to typical western European levels. Six of the Asian cities have high urban densities – above 100 persons per hectare (pph). It should be noted that the population densities quoted here are urban densities, calculated using the urbanised area only (including roads, residential, commercial, industrial and other urban land uses but excluding water bodies, large parks, agriculture and other non-urban land-uses). Although some of these Asian densities may appear highly unusual when compared with Western cities, high urban densities are in fact common worldwide. Densities above 100 persons per hectare (pph) seem to be typical of large cities in developing countries, especially in Asia. For example, Bombay, Bangalore, Madras, Cairo, Dhaka, Shanghai, Hanoi, and Pusan all have well over 200 persons per hectare (Barter, 1999). Historically, high urban densities also existed last century in the West but now persist only in the inner areas of the largest cities such as Paris or New York (Newman and Hogan, 1987).

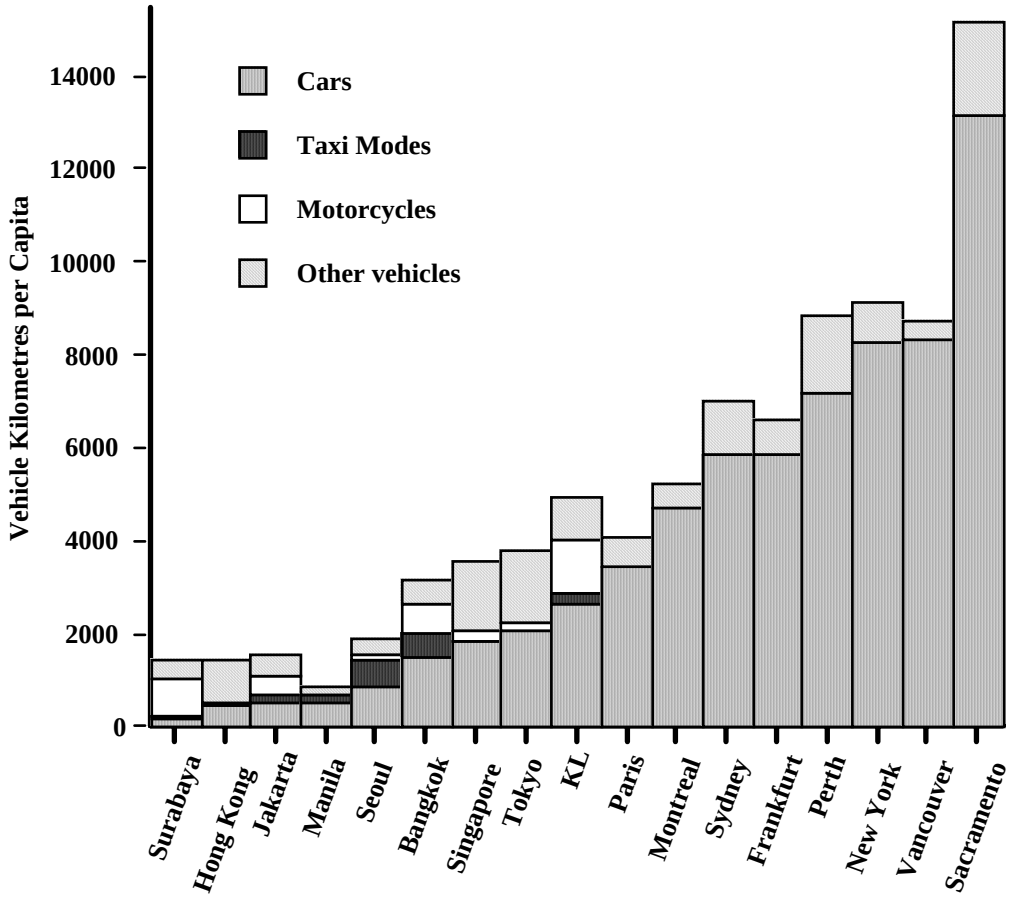
Fig. 1 Urban densities in Asian cities and for other regional groupings of cities from an international sample of cities, 1990.



Turning now to transport indicators, we find that most of the Asian cities have rather low levels of vehicle use per capita. There is a very wide range in the levels of private motor vehicle use (vehicle kilometres of travel - VKT) per capita among the cities in this international sample and even within the Asian group of

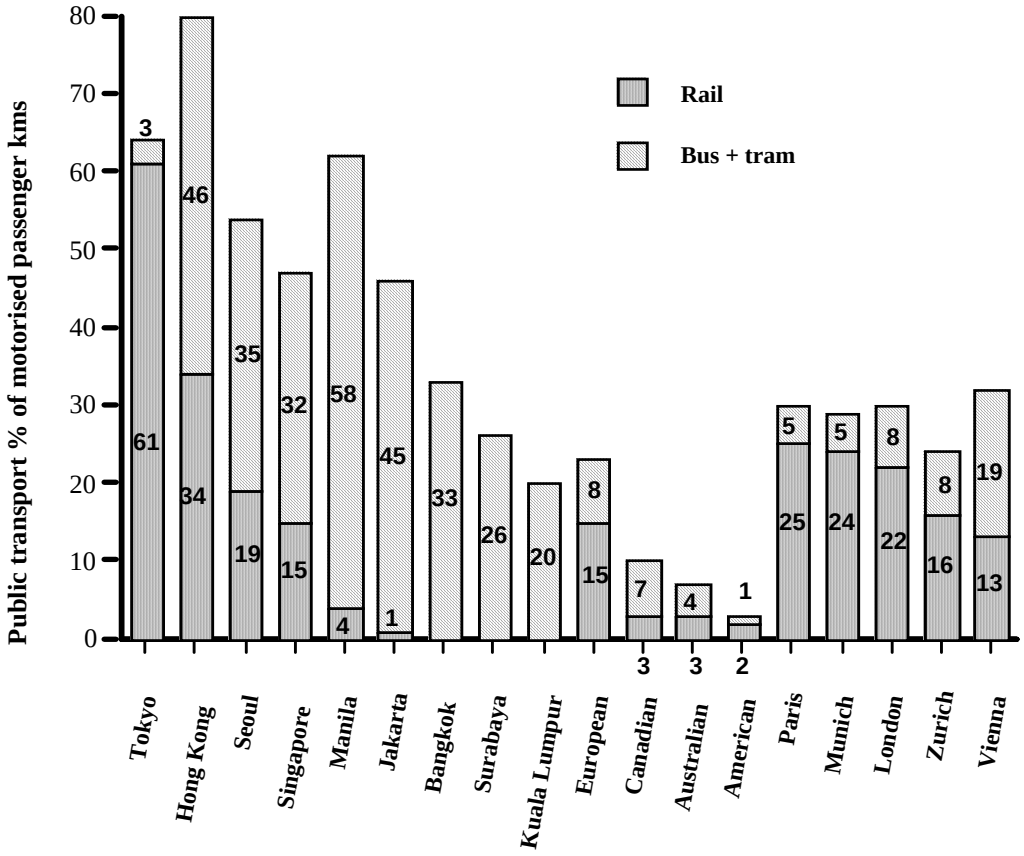
cities (Fig. 2). Variations in the level of public transport use are just as pronounced (Fig. 3). To a considerable extent, these variations reflect income levels, although at the urban level (as opposed to national data) the connection between income and transport patterns is by no means as direct and simple as is widely believed (Kenworthy, et al., 1997). For example, within this sample of nine Asian cities there is no clear-cut relationship between income and car ownership nor is there one between income and public transport usage. The least-squares linear regression for car ownership versus GRP per capita within the Asian sample (r^2=0.2767) is not significant at the 95% confidence level. Rising income is an enabling factor that can unleash the potential for rapidly rising use of private vehicles but it is not necessarily the primary determining factor (Barter, 1999; Kenworthy and Laube et al., 1999).

Fig. 2 Private vehicle use per capita for Asian cities and the extreme cases from each other region in an international sample of cities, 1990.



Note:
The “other” vehicles are primarily goods vehicles. However, in cases where motorcycle VKT figures are not specified separately, then these are included in the "other vehicles" VKT figure. In cases where taxi VKT are not specified separately they are generally included under car VKT.

Fig. 3 Role of public transport modes as a percentage of total motorised travel in Asian and selected European cities in an international sample of cities, 1990.

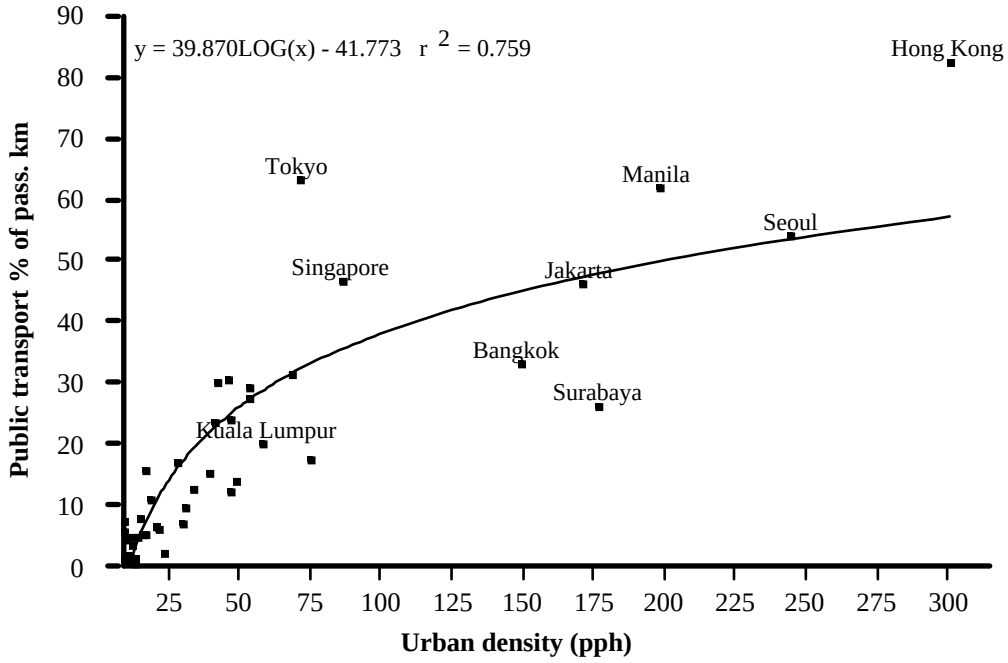


Transport Opportunities of High Urban Densities

High density presents both opportunities and challenges in the transport arena. It is opportunities that have often been emphasised in the compact city literature. For example, high density offers the opportunity for average trip lengths to be short and to foster successful, economically viable public transport (Pushkarev and Zupan, 1977). Such high densities also promote a high level of accessibility for non-motorised modes of transport and enable cities to have low levels of energy use per person in transport (Newman and Kenworthy, 1989).

The opportunity that high urban density presents to public transport is exemplified by the case of Hong Kong, where in 1990 public transport carried 82 percent of all motorised passenger kilometres. A number of mechanisms explain the potential for high levels of public transport in dense cities but there is not space to go into them here. Figure 4 makes clear that a very high role for public transport is possible in high density cities, even in those with high incomes. However, the examples of Bangkok and Surabaya suggest that high density does not necessarily guarantee the success of public transport.

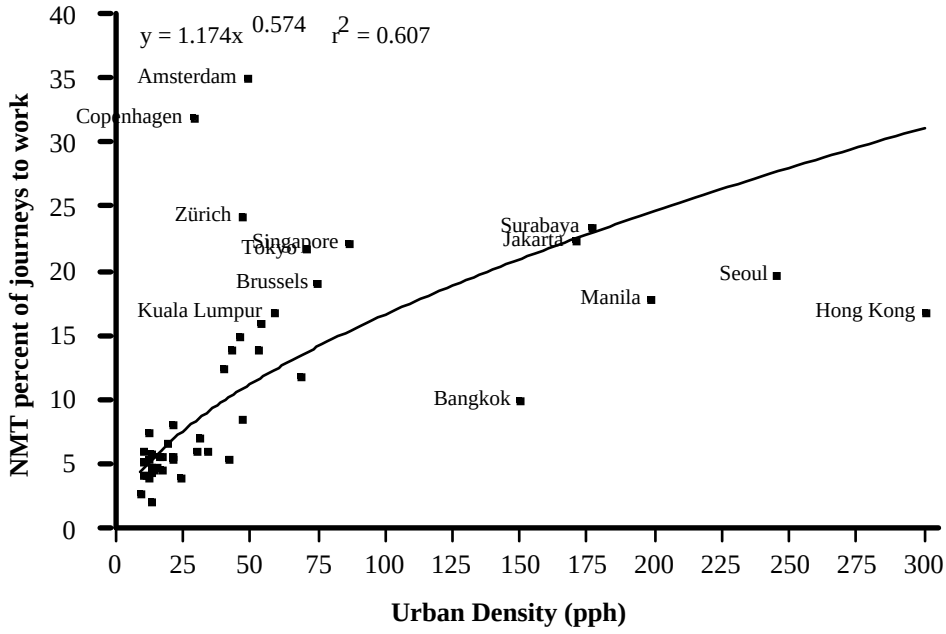
Fig. 4 Public transport percent of total motorised passenger kilometres versus urban density in an international sample of cities, 1990



Another opportunity of high densities is the possibility that many trips can be short and therefore easily made on foot or by non-motorised vehicles. Figure 5 demonstrates that a high role for non-motorised transport is possible even in middle density cities. The potential should be high, in theory, for non-motorised transport to play a very large role in dense Asian cities.

However, Fig. 5 also shows that although high density provides an opportunity for non-motorised transport to play an important role, it does not guarantee it. For example, Bangkok seems to have remarkably little walking or cycling to work despite its relatively high density. In fact, the graph shows that the levels of non-motorised transport for work trips in the high and very high-density Asian cities in this sample are no higher than levels found in most middle-density cities. This probably reflects the hostility of the street environments for people on foot or on bicycles in most of these cities.

Fig. 5 Non-motorised transport (NMT) work-trip mode share versus urban density in an international sample of cities, 1990



Thus, some of the Asian cities in this sample are apparently not fully exploiting the potential that their high urban densities offer to encourage flourishing public transport and non-motorised transport. Policy settings that work with this potential are likely to reap significant rewards for dense cities.

Transport Challenges of High Urban Densities

High urban densities also present formidable transport-related challenges, especially for cities where rising incomes have begun to unleash the potential for higher private vehicle ownership and usage. For example, traffic congestion tends to emerge rapidly as dense cities motorise, even if vehicle use per capita remains relatively low. This is not simply a result of poorly developed road systems, since in dense cities' road capacities per capita are inherently and inevitably low. It is physically impossible for dense cities to match the road provision levels of low-density cities. Furthermore, air pollution and other local impacts of traffic can become severe problems for dense cities even at low levels of motorisation. The most successful transport policies in dense cities are those that are compatible with the spatial realities of such urban areas.

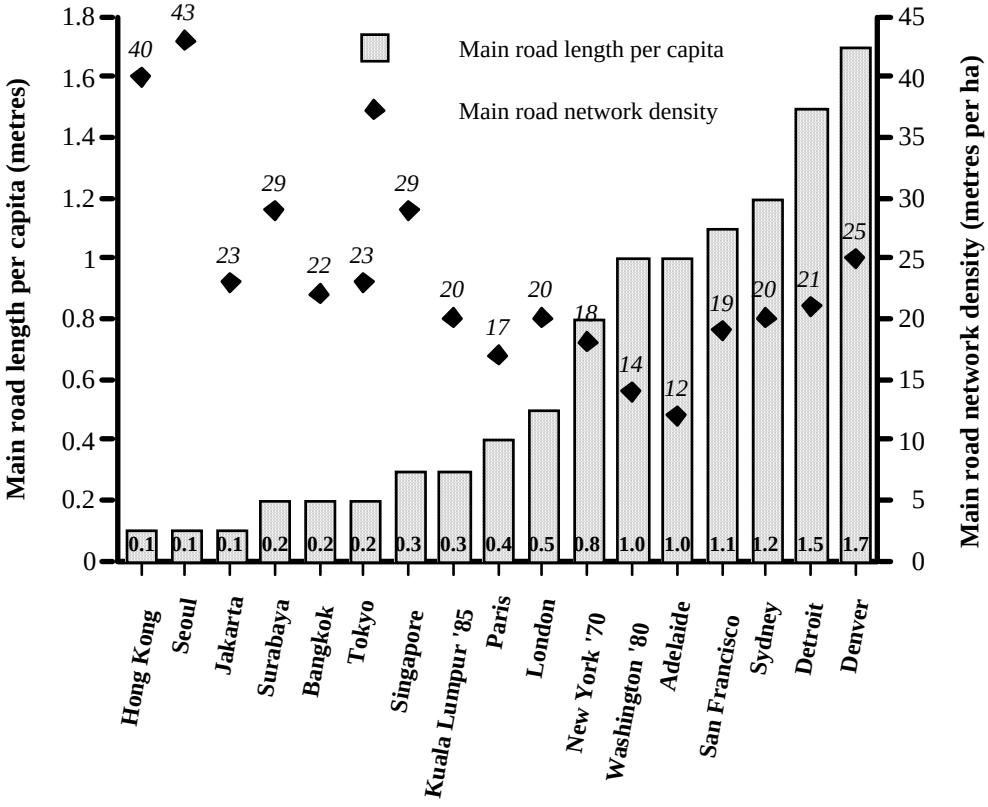
The voracious demand for space by cars has been understood for many years (Mumford, 1961). An influx of cars therefore creates great difficulties for established dense urban areas and generates substantial pressure for activities to spread out to make way for access by cars. Research on transport space consumption using the product of the space occupied by the *time* that it is occupied, shows enormous differences (up to 90 times) in space consumption between cars and public transport for a trip to work in a central business district (Bruun and Schiller, 1995). This approach emphasises the importance of the space consumed for car parking, especially that which is occupied for the entire day in expensive central areas. Unfortunately, the recognition of the inefficiencies of private transport from a spatial perspective has often not penetrated to a policy level.

Congestion and Road provision

Severe traffic congestion has emerged quickly in a number of dense Asian cities, including Bangkok, Manila, Seoul and Jakarta, despite relatively low levels of vehicle ownership and use. The traffic problems of many Asian cities are often perceived in terms of a lack of road capacity (Bodell, 1995; Midgley, 1994; Tanaboriboon, 1993; World Bank, 1996). It is true that Asian cities generally have low levels of road length per person relative to cities in the other regions in the international sample. However, it is too simplistic to blame traffic problems on a lack of road space. The issue is in fact more fundamentally a spatial one, related to the high densities of development of most of the Asian cities. In fact, high-density urban form is the central underlying reason for the low road provision per person of the dense Asian cities. Road space is inherently a scarce commodity in dense cities and, logically, any measure of road capacity *per person* will necessarily be low in dense cities unless road capacity *per hectare* can be made unusually high.

Figure 6 illustrates these points using data on main roads lengths from the international sample. Main road density varies little across most cities in the sample. In fact, the higher density Asian cities actually tended to have slightly higher arterial road densities than others. Yet, the Asian cities, especially the highest density ones, had very low main road length per person.

Fig. 6 Main roads network density compared to main road length per person in Asian cities and a number of other cities in an international sample, ca. 1990



Note:
Tokyo's arterial road data are for Tokyo-to, not the larger Tokyo Metropolitan Transportation Area (TMTA).

Could arterial road density be raised to high enough levels in dense cities to bring their arterial road lengths per person up to levels comparable with European or even American cities and hence allow vehicle use per person also to rise to similar levels? The answer must almost certainly be no, unless urban densities decrease tremendously. It would be difficult to increase arterial road network density in any city beyond a certain point (Zahavi, 1976).

Expressways provide one way to increase the network density and capacity. However, spatial and financial constraints must inevitably limit this network density as well. In any case, some Asian cities in this sample already have quite dense expressway networks even by international standards. Data from Barter (1999) shows that in 1990 Hong Kong had 4.4 metres of expressway per hectare of urbanised land. Kuala Lumpur had an expressway density of 3.6 metres per hectare (m/ha) in 1985 and by 1997 it had approximately 4.1 m/ha. Seoul's 1995 figure was about 3.1 m/ha and Singapore's 1990 figure was 3.3 m/ha. These figures can be compared with Los Angeles (County) with 3.9 metres of expressway per urban hectare in 1990, Paris with 2.8 m/ha in 1990, and New York (Tri-State Region) with 2.7 m/ha in 1980.

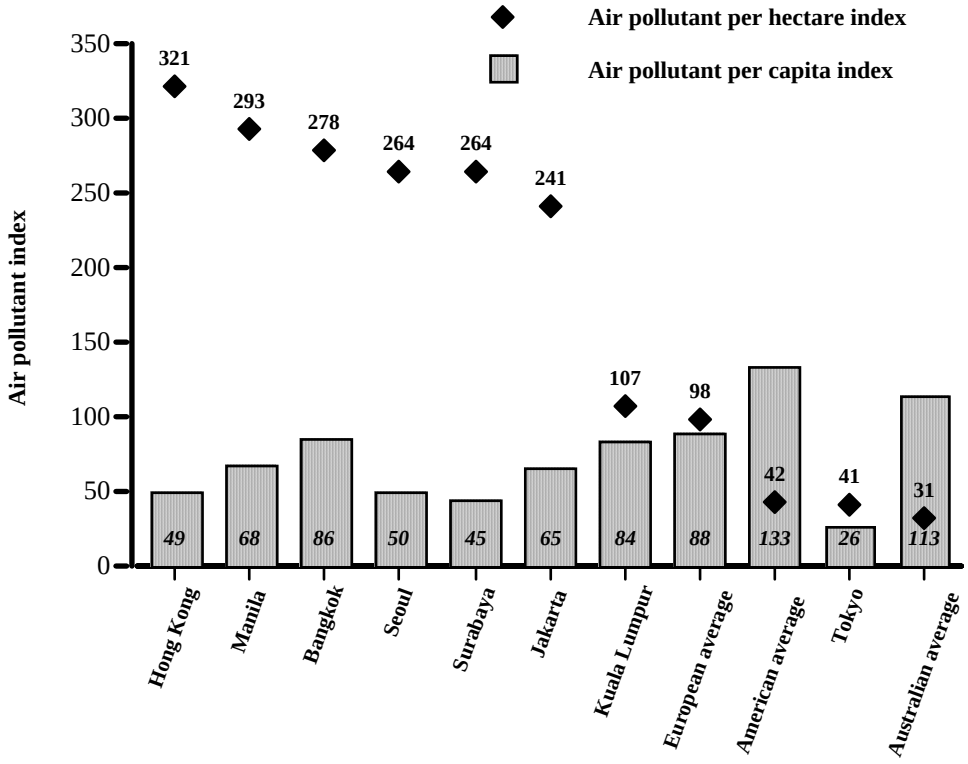
It will be very difficult indeed, if not impossible, for dense cities to remain dense **and** to significantly increase their road provision per capita, except perhaps by using extraordinary means such as extremely high-capacity, perhaps multi-decked or underground roads, all of which are extremely expensive. These comments may seem obvious at this point, but they have not previously been emphasised in the literature on urban transport, and indeed the opposite view has frequently been put that substantially increasing road supply in Asian cities is a viable and desirable policy direction.

Air pollution

Dense cities also tend to be especially prone to suffering from acute air pollution from traffic. This is illustrated in Fig. 7. Indices of local pollutant emissions per capita and of emissions per hectare for each city were calculated using data on transport emissions of four pollutants of local concern, namely nitrogen oxides (NO_x), carbon monoxide (CO), sulfur dioxide (SO_2) and volatile hydrocarbons (VHC). The emissions-per-person index was derived from the emissions-per-capita figures by multiplying by a coefficient such that for each of the four pollutants the overall average became 25; then these four figures were added to produce the overall index. Thus, if a city had average emissions per capita (within this sample) for each of the four pollutants then it would have an index value of 100. The emissions-per-hectare index was then simply the per-capita index multiplied by the urban density of the city and again normalised so that the average city would again have a value of 100.

Although the Asian cities had below average pollutant emissions per capita, most of them had much higher than average emissions per urban hectare. This matches the many reports of severe air pollution in several of the Asian cities studied here, especially Bangkok, Manila and recently also Hong Kong.

Fig. 7 Indices of transport air pollution emissions per capita and per hectare in Asian cities and other regional averages in an international sample of cities, 1990



Notes:
a. The American, Australian and European averages here cover slightly smaller samples of cities for which the emissions data were available.
b. For both of the indices, the overall average over all cities in the international sample is 100.
c. The pollutants covered are CO, SO_2, NO_x, and VHC.

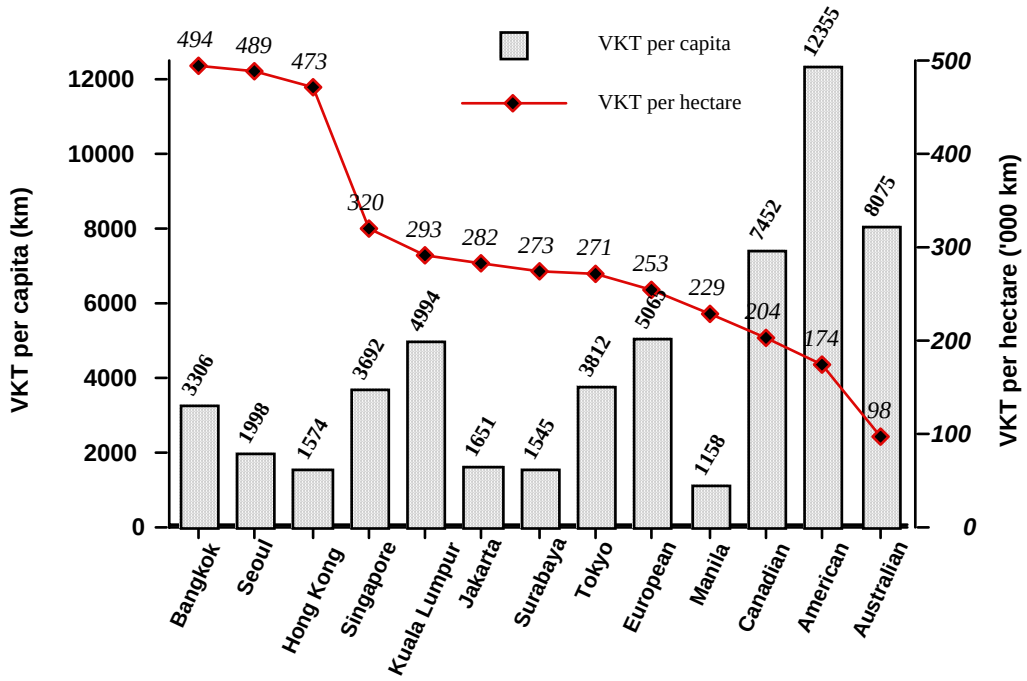
American and Australian cities may be "villains" when it comes to their high levels of CO_2 emissions per person from transport and they also have the highest emissions per capita of local pollutants, but they nevertheless have rather low emissions of local pollutants per hectare. At the opposite extreme, transport in Hong Kong, Seoul, Jakarta, Surabaya and Manila contributes low CO_2 emissions per capita and low local air pollutant emissions per capita, but each of these cities face the challenge of high levels of traffic pollutants per hectare. These cities' high densities are "unforgiving" in this respect.

Traffic intensity

The parameter called "traffic intensity" (or vehicle kilometres per year per hectare) helps us to understand the air pollution conclusions above. In principle, traffic intensity figures should provide an indicator of the level of "impact" of traffic (all else being equal). It can be expected that cities with high traffic intensity will be those that are likely to have the most severe local air pollution, noise and general traffic nuisance problems (notwithstanding variations from city to city in vehicle fleets, vehicle emissions rates, detailed traffic patterns, city shape and meteorological patterns).

By 1990, most of the Asian cities already had higher vehicle use per hectare than cities in any of the other regions (Fig. 8). This is a striking result, given the low vehicle use per person in most Asian cities.

Fig. 8 Traffic per hectare compared with traffic per person in an international sample of cities, 1990



Note:
These data on vehicle kilometres of travel (VKT) data include vehicle kilometres of on-road public transport.

It is noteworthy that the two highest density cities in the international sample, Hong Kong and Seoul, had very high traffic intensities, despite their low levels of vehicle use per capita. This underlines the strong spatial imperative in Hong Kong and Seoul to restrain private vehicles and to promote the lowest impact modes. Bangkok also had very high traffic levels per hectare, resulting from moderate vehicle use per person combined with moderately high urban density. The American cities had relatively low vehicle use per hectare, despite their very high rates of vehicle use per person. This is related to their low urban densities.

The insights provided by this spatial perspective suggest that it will be very difficult for large, dense Asian cities to control vehicle-related air pollution problems without a much greater effort than any in the West. Even many American cities still have air pollution problems despite their relatively clean vehicles and lower levels of traffic per hectare. Therefore, it must be expected that dense Asian cities would face air pollution problems even if their vehicle fleets could be made as clean as the US fleet. High traffic intensities in the Asian cities underline the spatial imperative to restrain traffic in dense cities.

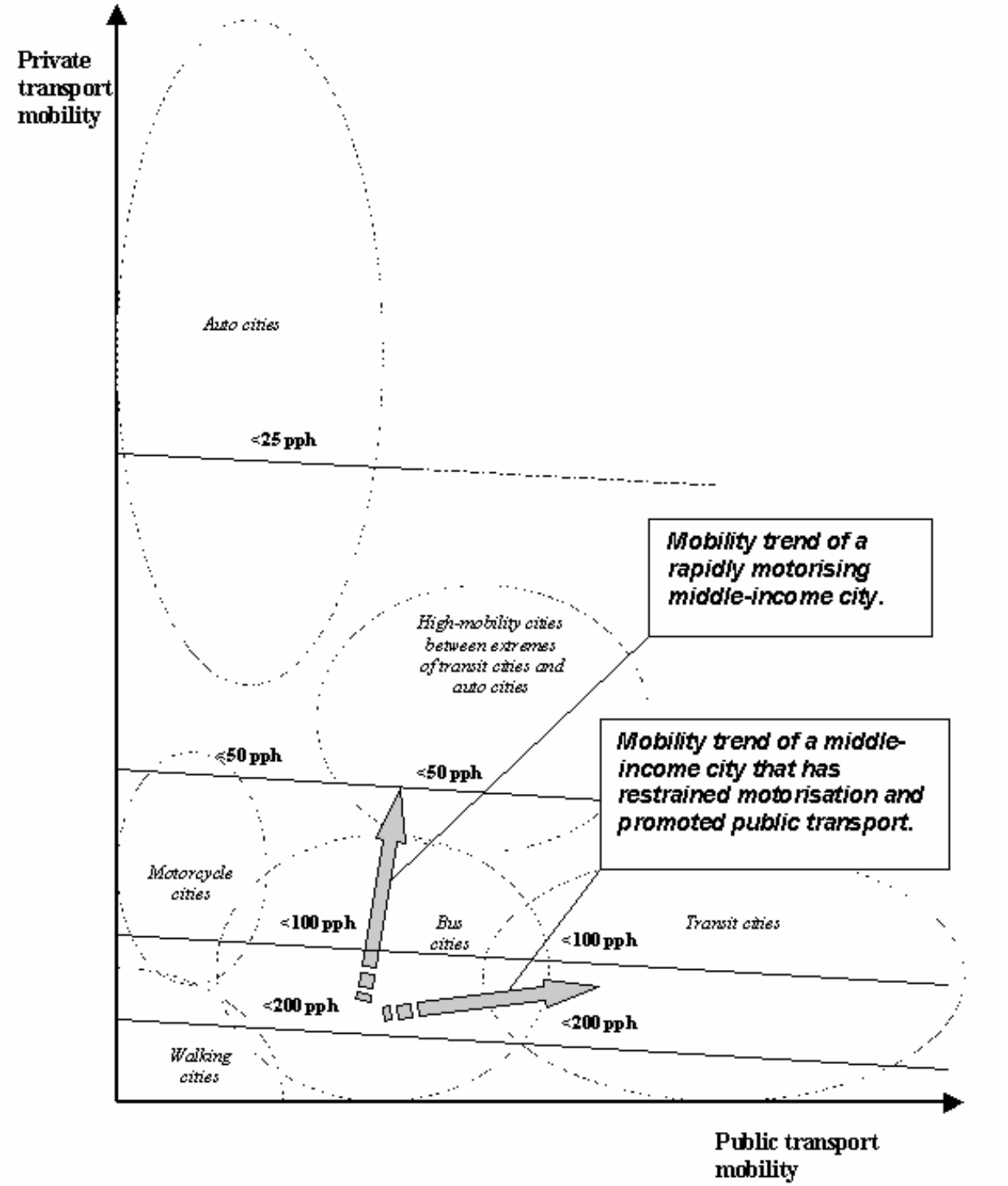
Imbalance between Transport and Land-use Patterns

It might be thought that it is unimportant to worry about the challenges and opportunities of high densities for transport, since land use patterns will adapt to whatever transport changes occur. However, that would overlook the slow rate at which land use patterns adapt to changed transport patterns. *In many of the Asian cities, rapid changes in transport over the last decade or two have led to a traumatic imbalance between new levels of mobility, especially private mobility, and many aspects of their existing urban fabric and transport infrastructure. This imbalance has emerged even though their levels of private mobility are still relatively low in an international context.*

Asian cities mostly had low mobility until recently and therefore needed to remain compact in order to maintain their accessibility and to remain amenable to non-motorised modes and public transport. The sudden emergence of higher mobility in some Asian cities, in the form of rapid increases in private vehicle ownership, creates strong pressures for changes in urban form, especially in the style of new development. However, large parts of these cities, housing many millions of people, are already built up with a high-density, non-automobile character. The wholesale demolition in such areas that would be required to adapt them to the space standards of mass ownership of automobiles is almost unthinkable.

Figure 9 suggests a graphical interpretation of how the imbalance between transport and land-use patterns arises in rapidly motorising cities, such as Bangkok. As incomes pass through a threshold range, of roughly US$3,000 to 5,000 at 1990 prices, a sudden increase in private motorised mobility becomes possible. Cities with high private vehicle mobility need to have lower densities in order to accommodate the greater spatial demands of private vehicles. However, the urban density of the rapidly motorising middle-income city cannot decrease quickly enough to make space for the new influx of vehicles. Lack of infrastructure is often blamed for the resulting problems, but a more fundamental cause is the fact that high private mobility is inherently incompatible with the pre-existing dense land-use patterns.

Fig. 9 Schematic diagram to illustrate connection between motorised mobility trends, city types and urban densities



Note:
The density values on the different parts of the graph are indicative only but they give an idea of the urban densities that tend to go comfortably with different transport patterns.

The issue of tight spatial constraints in dense cities is also probably a factor in the popularity of motorcycles in many Asian cities (Barter, 1999). Small motorcycles can manoeuvre through stalled traffic and park easily in busy areas where car parking is difficult. Motorcycles are not as space saving as public transport but can access congested centres more easily than cars and in direct competition with public transport.

Unfortunately, motorcycles contribute greatly to other problems such as road safety and air and noise pollution and their popularity is also associated with failing public transport systems.

This section has highlighted the urban transport challenge presented by high urban densities in Asian cities. These arguments have a wider relevance beyond this international sample, since inherently low levels of road capacity per person, high traffic intensity, and high impacts of traffic per hectare, are also likely to be common features of all high-density cities that motorise quickly.

Policy Choices in Dense Cities: Asian Examples

The Asian cities in this sample provide some evidence on some of the key transport policy choices that are open to dense cities as economic changes begin to release the potential for higher private vehicle ownership. The reactions to this challenge have varied enormously among the different cities. The most successful policy approaches in the region have been those that are most sensitive to the spatial realities of these generally high-density cities. The approaches of Kuala Lumpur and Bangkok, which have attempted to accommodate private vehicles, contrast strongly with those of Seoul, Hong Kong, Seoul and Tokyo, which have consistently restrained the ownership and use of private vehicles over several decades. Kuala Lumpur, with middle density, has faced moderate problems with motorisation whereas Bangkok, being much denser, has been in a "traffic crisis" since the early 1990s. Jakarta, Manila and Surabaya have not yet clearly adopted either of these two broad strategies. Obviously, it is easy to lecture cities on policy but we cannot ignore the political and social realities that must be confronted in policy-making. Unfortunately, in the space available here, it has not been possible to explore the reasons for, or barriers to, different policy choices in the different cities.

Private vehicles and private transport infrastructure

The main emphasis of urban transport policy and practice in both Kuala Lumpur and Bangkok has long been on efforts to increase the flow of traffic (Jamilah Mohamed, 1992; Poboon, 1997; Spencer, 1989). Vehicle ownership restraint has been rejected in both places. Proposals for traffic limitation measures for congested central areas were seriously considered then dropped by both in the 1980s (Spencer, 1989; Tanaboriboon, 1992; Wilbur Smith and Associates, 1974; Wilbur Smith and Associates and Jurutera Konsultant (S.E.A.) Sdn. Bhd., 1981). Public transport and non-motorised transport have been neglected in these two cities (Barter, 1996). Since the 1970s the Kuala Lumpur metropolitan area has had the highest level of expressway length per million people among the Asian cities in the sample (Barter, 1999).

In contrast, Hong Kong, Singapore, Seoul and Tokyo have restrained private vehicle ownership and/or use and have fostered high quality public transport. Expressway networks in each of these cities are relatively modest relative to population. In Japan, government policies in the post-war era restrained private spending on both cars and urban sprawl (Hook, 1994). Except for a spurt in the 1960s, motorisation in Tokyo has been relatively slow, despite Japan's high economic growth rates for several decades. In South Korea, restraint of car use and ownership was imposed over several decades until the mid-1980s through high gasoline prices, a

high yearly car ownership tax, and low availability of credit for private consumption although the motivation for these policies in Japan and Korea was the macro-economic strategy of promoting exports while constraining private consumption (Kim, 1991; World Bank, 1986).

In Hong Kong and Singapore, restraint on private car ownership began in the early 1970s in response to upsurges in traffic (from low base-lines). Usage restraints soon followed, such as increased petrol prices, area licensing (in Singapore), and parking restrictions. In both cities, restraint measures have been strengthened several times since they began (Ang, 1996; Hau, 1995; Pendakur, Menon, and Yee, 1989; Phang, 1993). These policies dramatically slowed motorisation in the two "city-states" despite tremendous increases in per-capita incomes. It is important to note that in each of the four wealthier Asian cities in this group, restraint on cars began early in the motorisation process. All began restraint before car ownership reached 70 cars per 1000 people.

Lower-middle income cities such as Manila, Jakarta and Surabaya may still be able to follow this example of restraint, if they choose to, although all three were by 1990 approaching 70 cars per 1000 persons. A number of reports on these cities have indeed recommended traffic restraint and warned that supply-side approaches are doomed to failure (Dorsch Consult, PT Pamintori Cipta, Colin Buchanan and Partners, SOFRETU, and IMK Consulting Engineers, 1996; Freeman Fox and Associates, 1977; Inter-Departmental Working Group, 1993; Jakarta Government, 1987). Jakarta and Manila have taken some tentative steps with traffic restraint (Villoria, 1996) but have not yet shown strong determination. Indonesia has long had the lowest gasoline prices of the Asian group (Dreesbach and Wessels, 1992).

Public transport

There are also important contrasts in public transport policies and trends within this Asian group of cities. For example, the above-mentioned restraint of private transport in Hong Kong, Seoul and Singapore helped to allow bus systems to retain their roles even as incomes rose. These cities also actively improved public transport. Until relatively recently, Seoul, Hong Kong and Singapore had bus-dominated public transport, but all have now built very significant mass transit systems. Nevertheless, buses remain important and there are now extensive bus priority systems in Hong Kong, Singapore and Seoul. Tokyo's public transport system was already rail-dominated by the 1950s and this was reinforced by further large investments in subsequent decades (Cybriwsky, 1991).

By contrast, in Kuala Lumpur and Bangkok, public transport has been very slow to improve. As congestion crises emerged in the early 1990s, public transport failed to offer an attractive alternative to the new cars and motorcycles of the emerging middle-class. There was no bus priority in Kuala Lumpur until 1997, contributing to buses becoming the "mode of last resort". In the 1980s, Bangkok had some success with giving buses priority (Marler, 1982) but did not persevere (Tanaboriboon, 1992). Significant urban rail investment in Kuala Lumpur and Bangkok has began in the 1990s but only after motorisation has already reached high levels.

Allport (1994) argues that a large part of the importance of mass transit investment is in making traffic restraint politically palatable. Kuala Lumpur and Bangkok rejected traffic restraint in the 1980s with the argument that public transport must improve first (Spencer and Madhaven, 1989). Similar arguments have been used in Jakarta (Forbes, 1990). However, the evidence from this sample does not support the argument that mass transit must precede restraint. In Seoul, Singapore and Hong Kong traffic restraint began many years before mass transit was built (Barter, 1999). In fact, it seems that traffic restraint policies in these cities had the effect of 'buying time' that allowed them to later be able to afford world-class public transport systems, the viability of which was not threatened too soon by rising private vehicle ownership. Public transport in these cities was able to retain the middle class as customers and cater to their rising aspirations for mobility by improving services gradually (eventually with urban rail systems).

Land-use policies

Exploring how developing cities can retain or reinforce transit-oriented urban land-use patterns, even as incomes rise, is an important area for study (Gakenheimer, 1995). The experiences of some of the Asian cities show that, even with their high-density land-use patterns, there is still potential and a need in dense cities for land use policies to explicitly favour public transport and non-motorised transport. This involves attention to the details of transit-oriented urban form. Unfortunately, there is not space to go into this in detail here. Suffice to say that explicit policies in Singapore, Hong Kong and Seoul are encouraging land-use patterns to become increasingly transit-oriented. In Tokyo, the land-use control system is relatively weak but nevertheless much new development is transit-oriented in its location and design (Hook, 1994), providing evidence that, in conditions of public transport dominance, transit-oriented land-use patterns can naturally develop as a market response.

In the other cities in the Asian group, there is a trend for the design details of much new development to be oriented to access by private vehicles, even though densities remain high overall. In Bangkok, Kuala Lumpur, Jakarta and Manila, many new housing, office or shopping complexes built in the recent boom decade (1986 to 1997), and targeted at the newly prosperous middle class, have designs predicated upon private vehicle access. These developing Asian cities run a risk of building traffic disasters into their urban fabrics. This is because densities are still too high to cope effectively with many private cars but the pro-car design features tend to encourage private transport and make the provision of public and non-motorised transport facilities somewhat difficult.

CONCLUSION

This paper has argued that in dense cities, which include most of the large cities of Asia (and of the South), public policy on transport needs a keen awareness of the transport implications of high density urban land-use patterns.

The high densities of many Asian cities provide transport planning with both challenges and opportunities. There are challenges because such cities are vulnerable to traffic saturation and can never provide high levels

of road capacity per person. There are opportunities because land-use patterns in Asian cities are potentially highly suited to the non-automobile modes of transport that can provide high accessibility at low-cost and in an ecologically sustainable way. Policy settings aimed at exploiting this opportunity are likely to reap rapid and significant benefits, as demonstrated to some extent by the experiences of Tokyo, Singapore, Hong Kong and Seoul in contrast especially with Bangkok. Densities in Seoul and Hong Kong are so high that even with strong restraint of private traffic, they face problems with very high traffic intensity. Bangkok also illustrates that a 'traffic disaster' can arise very quickly as motorisation increases in a dense city with no traffic restraint.

Ever increasing private vehicle use and unsustainable transport consumption levels are not necessarily the inevitable destiny of Asian cities, even if income levels rise dramatically. In fact, the cities of Asia face a choice, just as do cities everywhere. The choice is between two contrasting approaches towards transport: early restraint of private vehicles with promotion of the alternatives, or a dangerous and unsustainable path of unrestrained growth in private vehicle numbers and lagging public transport development.

Notes

[1] The Western cities in the study were Hamburg, Frankfurt, Zurich, Stockholm, Brussels, Paris, London, Munich, Copenhagen, Vienna, Amsterdam, Houston, Phoenix, Detroit, Denver, Los Angeles, San Francisco, Boston, Washington, Chicago, New York, Portland, Sacramento, San Diego, Sydney, Adelaide, Melbourne, Brisbane, Perth, Canberra, Calgary, Edmonton, Montreal, Ottawa, Toronto, Vancouver, and Winnipeg.

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