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SUSTAINABILITY AND CITIES

Overcoming Automobile Dependence

Peter Newman ♦ Jeffrey Kenworthy

ISLAND PRESS
Washington, D.C. Covelo, California

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For Sam and Nathanael

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Library of Congress Cataloging-in-Publication Data

Newman, Peter, Dr.


Sustainability and cities : overcoming automobile dependence /
Peter Newman and Jeffrey Kenworthy.

p. cm.

Includes bibliographical references and index.

ISBN 1-55963-660-2 (alk. paper)

1. Urban transportation policy. 2. Urban transportation—
Environmental aspects. 3. Sustainable development. 4. Land use,
Urban. 5. Automobile—Environmental aspects. I. Kenworthy,
Jeffrey R., 1955- . II. Title
HE305.N483 1998 98-42239
388.4—dc21 CIP

Printed on recycled, acid-free paper 

Manufactured in the United States of America

10 9 8 7 6 5 4 3

5. Larger cities in the United Kingdom were also found to have lower car use per capita (Smith, Whitelegg, and Williams, 1998). The role of density in reducing transportation energy use has been more well known. Density reduces transportation energy through several mechanisms: it shortens distances for all modes and makes transit, bicycling, and walking more viable as alternatives to the car; it also reduces the number of journeys, since when transit is used, many journeys are combined—for example, shopping on the way to or from the train. The data in Figure 3.3 show that gasoline consumption goes up by a factor of five between Manhattan and the outer New York suburbs as the density goes from 250 per hectare to 13 per hectare. See also Dunphy and Fisher (1996).
6. In Australia, the Better Cities program began to demonstrate the importance of this integrated planning process. It took professionals from water, transport, statutory planning, housing, and environment and facilitated a process of achieving a set of strategic, integrated goals for forty-five different areas across Australia. The process was often painful and challenging, but rarely were the results not something that everyone could see was contributing to sustainability as defined here. The program was dropped, however, so everyone in the higher levels of government went back to their isolated professions. Thus, integrated planning has not yet been grounded in professional praxis.

Chapter 2

The Problem of Automobile Dependence at the End of the Twentieth Century

What Shapes Cities?

If we are to address the application of sustainability to cities, we need to understand the forces that shape them. Only then can we begin to offer both local and global solutions with the potential to work. These forces are obviously very complex (Kostoff, 1991), but in this analysis three factors are considered to be the dominant forces that have shaped cities:

- *Transportation priorities*, in particular the extent of automobile infrastructure compared to transit
- *Economic priorities*, especially how new suburban infrastructure enables green-field growth to occur rather than redevelopment and renewal of present urban areas
- *Cultural priorities*, particularly perspectives on urban space

As shown below, these factors are linked. Together they help us to understand how we have developed the cities we have and hence how we can begin to contemplate changing them into more sustainable forms.

Transportation Priorities

One characteristic people have shown that has been important in shaping the nature of our cities is that they do not like to commute, on average, more than half an hour to major urban destinations (see Manning, 1978; Pederson, 1980; Zahavi and Ryan, 1980; Neff, 1996). In the United Kingdom, a government study found that travel time for work trips had been stable for six centuries (Standing Advisory Committee on Trunk Road Assessment, 1994). Thus it is possible to see how this has caused three types of cities to develop as transportation technologies have evolved toward greater speed and freedom.

The Walking City

Between 10,000 and 7,000 years ago, the first cities were settled in the Middle East. From then until the middle of the nineteenth century, the form of cities

everywhere was based on walking. Figure 2.1 shows the traditional Walking City characterized by high density (100 to 200 people per hectare), mixed land use, and narrow streets in an organic form that fits the landscape. In Walking Cities, destinations can be reached on foot in half an hour on average, and thus rarely are these cities more than 5 kilometers across (an average trip being 2.5 kilometers).

Many cities today have sections that retain historical walking characteristics—for example, the medieval core areas of many European cities. Much larger parts of Third World cities retain their high-density, mixed-land-use, walking characteristics.

The central parts of all American and Australian cities were once Walking Cities, but this characteristic has largely disappeared. Today, just a few historical neighborhoods retain this old form, including Society Hill in Philadelphia, the North End in Boston, the Rocks in Sydney, and the West End of Fremantle in Perth. For some who live in newer high-density neighborhoods in central parts of New York, San Francisco, Melbourne, or Sydney, it is possible to reach a majority of destinations by walking, but this is rare in U.S. or Australian cities.

It is feasible to re-create Walking City areas within modern cities. These “urban villages,” such as the new suburban centers along Stockholm’s rail system, or new district centers such as Arabella Park (Bogenhausen District Center) in Munich, are the focus of much design attention today. They are discussed later in this book.

The Transit City

From about the 1860s in Europe and the New World, the old Walking Cities began to collapse under the pressure of population and industry. A new city form developed that enabled the city to accommodate many more people at somewhat reduced densities while keeping to the half-hour average accessibility maxim. This was achieved through new transit technology. Cities pushed increasingly outward as the train (first steam and then electric) and tram or streetcar (first

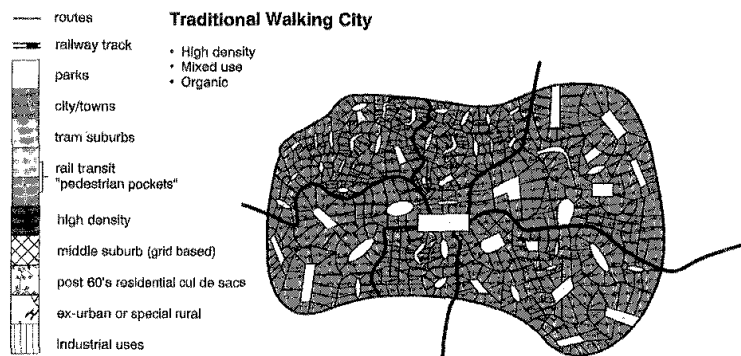


Figure 2.1 Traditional Walking City



Photo 2.1. Old Walking City centers like this one in Bern, Switzerland, work better environmentally, economically, and socially when given pedestrian-friendly characteristics.

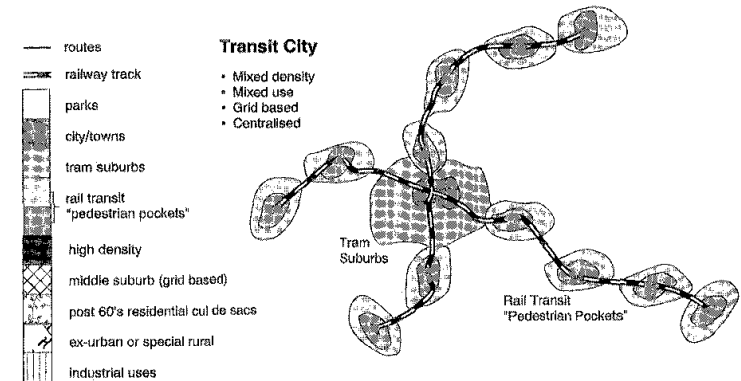


Figure 2.2. Transit City

horse-drawn, then steam, then electric) allowed faster travel to occur, creating the Transit City (Figure 2.2).

The trains generally created subcenters at railway stations that were small “cities” with walking-scale characteristics. Trams, on the other hand, created linear development that followed the routes in corridors or “main streets.” In both cases, medium-density, mixed-use areas were formed at the rail nodes and along the tram routes.



Photo 2.2. Transit corridors like those in Stockholm enabled development to be contained and the forest to be part of the city.

The Transit City could now spread twenty to thirty kilometers based on these technologies, and where the rail lines met at the city center, very intense activity resulted. The overall density of Transit Cities was between 50 and 100 people per hectare.

Most U.S. and Australian cities were formed during the train and tram era and retain characteristics from this period (Davison, 1978; Spearitt, 1978; Warner, 1968). Even the planned new city of Canberra, Australia's capital, was designed by American Walter Burley-Griffin as a tram-based garden city, though later his original design was transmuted into a city based almost solely around automobiles. Melbourne and Philadelphia retain their tram-based linear developments in the inner suburbs, and even though the trams were removed in most other cities, the basic form can still be seen even in many parts of Los Angeles, which had one of the most extensive streetcar systems the world has ever seen. Railway station subcenters are still very clear in all U.S. and Australian cities, and both tram-based "main streets" and high-density station nodes are prevalent in cities such as Toronto (see case study in chapter 4) and New York.

As noted above, Los Angeles once had one of the most extensive and efficient transit systems in the world (Wachs and Crawford, 1991). In the 1930s the famous Pacific-Electric red trolleys (along with streetcar transit systems in forty-four other cities) were bought up by a consortium, National City Lines, composed of General Motors, Firestone Tyres, Mack Trucks, and Standard Oil—and closed down. The L.A. Freeway era was born in the wake of this decision. It was not, however, a community decision—it was a commercial one, and illegal at that. National City Lines was found to have broken antitrust laws and was fined

\$5,000. However, this commercial decision basically ended the Transit City era in the United States, particularly once the Federal Highway System began in 1956.¹

European cities have tended to retain their transit-oriented form and tram systems, though in recent decades they have begun to disperse around their main corridors based on automobile travel. There is a powerful planning movement today that is trying to reemphasize the importance of transit-oriented development (TOD). Often it is part of what is now known as the New Urbanism. Both are discussed in Chapter 4.

The Automobile City

Beginning before the Second World War, but really accelerating after it, the automobile, supplemented by the bus, progressively became the transportation technology that shaped the city, particularly in North America and Australia. It became possible to develop in any direction, first filling in between train lines and then going out as far as fifty kilometers for the average half-hour journey (Figure 2.3). The Auto City was born.

Low-density housing became more feasible, and as a reaction to the industrial city, town planners began separating residential and business centers by zoning. This also helped to increase journey distances. The city began to decentralize and disperse. Overall density of the Auto City decreased to between ten and twenty people per hectare.

With the availability of cars, it was not necessary for developers to provide more than basic power and water services since people could make the transportation linkages themselves. As this "ungluing" process set in, the phenomenon of automobile dependence became a feature of urban life. Use of an automobile became not so much a choice but a necessity in the Auto City. And as

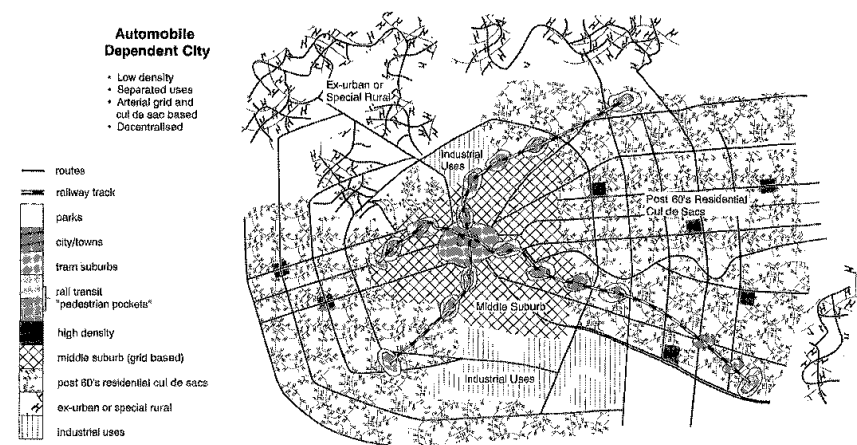


Figure 2.3. Automobile-dependent City

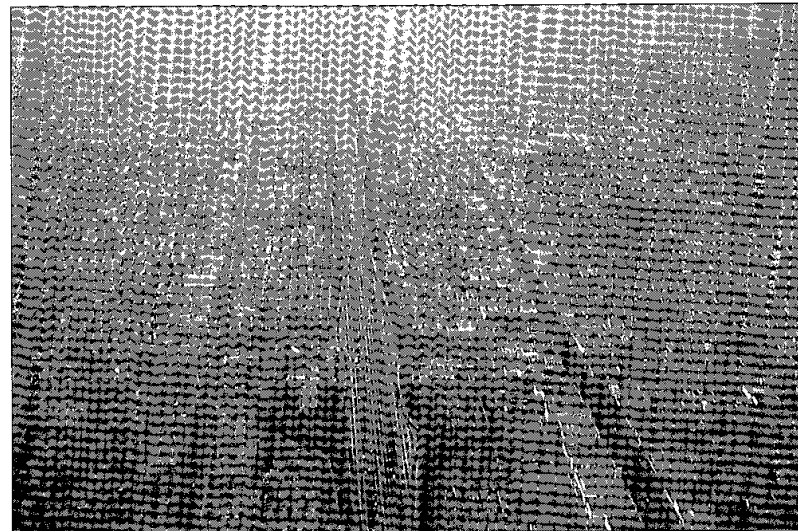


Photo 2.3. The Automobile City can spread in all directions, offering freedom over space and time. Los Angeles shows how such freedom is soon enslaved to the problems of automobile dependence.

automobile dependence became dominant, the Auto City began to lose much of its traditional community support processes.

Australian and North American cities have grown most of all in the automobile era. Cities such as Canberra and Phoenix have developed almost exclusively as Auto Cities; others, such as Denver, Houston, and Perth, are mostly Auto Cities. Now, after fifty years of automobile-based growth, such cities have spread almost to the limits of comfortable car commuting. Some cities are developing fast commuter trains that allow people to live up to eighty kilometers out of the city and still commute. But there is little else that people can reach easily in the rest of the city other than by car.

Many residents of the suburbs have known no other style of city. New suburbs beyond forty or fifty kilometers from the city center have an extra dimension of isolation from traditional urban functions. The level of automobile-based problems in such cities is growing rapidly. The next section of this chapter outlines these problems and then the book tries to show how such cities can begin to reverse their dispersed, car-dependent land use patterns.

Cities in the Third World have also grown dramatically in the post-1940s period, but most have not developed in the Auto City pattern, though many have automobile-dominated traffic systems. In general they have a more walking-and-transit-oriented urban form. There are exceptions such as Kuala Lumpur and Bangkok, which have large “footloose” residential areas many kilometers from the city center that have been formed and are accessed predominantly by car.

The reality of most cities today is that they contain some elements of all three city types, as distinguished by their different patterns of transportation and density. The data on New York, San Francisco, and Melbourne in Table 2.1 reveal that there are considerable variations in car use with density across these cities.

The good news in these data (and in data presented in Chapter 3) is that cities can choose to have a more sustainable transportation system if they choose to change their transportation priorities and start to reform their land use patterns. There are also diverse forces that are starting to reshape urban form away from the Auto City as its transportation and land use limits are being exceeded. These are discussed further under “Economic Priorities” and “Cultural Priorities.”

Table 2.1. Variations in Car Use with Urban Density Across Cities, 1980 (as Reflected by Gasoline Use per Capita)

City	Core Suburbs (Walking-oriented)		Inner and Middle Suburbs (Transit-oriented)		Outer Suburbs (Automobile-oriented)	
	Gasoline use (GJ per person)	Urban density (persons per ha)	Gasoline use (GJ per person)	Urban density (persons per ha)	Gasoline use (GJ per person)	Urban density (persons per ha)
New York	11.9	251	20.1	107	59.6	13
San Francisco	17.5	128	33.3	57	58.4	8
Melbourne	13.2	32	20.3	20	26.9	10

Source: Newman and Kenworthy (1989a).

Notes:

1. Core “suburbs” are those areas within a short distance of the city center. In the case of San Francisco, these are neighborhoods clustered around the central business district (CBD); in New York, it is New York County, also known as the Borough of Manhattan, and in Melbourne, core suburbs consist of the fifteen local government areas as of 1981 located, on average, about five kilometers from the CBD. They are always the densest neighborhoods in any city.

Inner and middle suburbs are those areas of each city that were built to a large extent in the transit era prior to the Second World War and that retain more transit-oriented characteristics, such as medium population densities. In San Francisco, they consist of the City of San Francisco, and in New York, the whole City of New York area (counties of New York, Kings, Queens, Richmond, and Bronx). Melbourne’s inner/middle suburbs consist of twenty local government areas as of 1981 that average fifteen kilometers in distance from the CBD.

Outer suburbs are the remaining parts of the urban region outside the inner/middle suburbs and extending to the fringes of the built-up area. These areas were mostly built in the era of the automobile, after the Second World War.

2. Urban density is the number of people per unit of urbanized land area. Urbanized land is land that is used for urban functions, including local open space, roads, industrial purposes, and so on, but not agricultural land, undeveloped urban land, regional-scale open space, or large water bodies.

3. GJ is gigajoules or 10⁹ joules. There are 0.0347 GJ in every liter of gasoline and 0.1313 GJ in every U.S. gallon of gasoline.

4. Variations in gasoline use per capita between the two U.S. cities and the Australian city are partly due to the very much higher fuel use of American vehicles in 1980.

Economic Priorities

The transportation priorities of a city will obviously be a major factor in shaping a city. However, to build any transportation infrastructure still requires commitment of economic resources. History shows that in some cities the Auto City kind of urban form was resisted and a more compact, less car-oriented city was facilitated, at least for a large part of this century. This was primarily due to an economic priority overriding the priority for road-based infrastructure.

Historical Economic Forces

Frost (1991), an Australian economic historian, shows there were two distinct types of Western city in the nineteenth century and into the twentieth century: (1) the “traditional” high-density cities of Europe, east coast North America, and east coast Australia (London, Paris, Berlin, St. Petersburg, New York, Philadelphia, Chicago, Sydney) and the low-density “new frontier” towns of western and southern North America and Australia (Los Angeles, San Francisco, Seattle, Denver, Melbourne, Perth, and Adelaide).

The reason for this difference is not just the time of development, since new cities in these regions followed both patterns. Frost suggests that the major difference was the way the two types of cities used their capital. The “traditional” city directed a high proportion of its capital accumulation into industrial plant and had little left for urban infrastructure; hence housing was dense. The “new frontier” city directed a far higher proportion of its wealth into suburban infrastructure, thus enabling low density to be the major form of housing.

The differences in capital availability came from the different wealth base: the “traditional” city developed wealth from an industrial base for import substitution and innovation; the “new frontier” city developed wealth by servicing a large rural hinterland.

As Frost says:

The enduring physical artifact of the great European grassland colonization is in fact the New Urban Frontier. Its cities were the product of an era when resource endowments and market conditions permitted easy, almost effortless development. (1991, p. 163)

Since that period the two city types have largely merged, with most urban development based around low-density, expensive infrastructure. Frost goes on to argue that there is a powerful lesson in this historical analysis:

For most of this century, economic growth has been sufficient to carry the level of investment required to provide most income groups with a detached house and a patch of suburban lawn. But the costs of sprawl are mounting. (p. 163)

This latter comment is the essence of our present sustainability problem. We are now faced with a simultaneous need to reduce environmental impacts while improving the economies of cities. New evidence is pointing more and more to the need to reduce spending on the Auto City kind of development if we are to achieve this dual objective. Some of this evidence will be presented later in this

chapter and some in Chapter 3, where a comparison of the economies in thirty-seven global cities is made.

Future Economic Forces

There is growing evidence that the impact of the Information Age on cities is not necessarily one of dispersal, but could assist reconcentration of cities. Early notions about information technology first suggested that its impact on cities would be to create “community without propinquity” to disperse people into “non-place urban realms,” or exurbs, where people only needed to telecommute (Webber, 1963, 1964, 1968). More recently, people have recognized that information technology has the ability to reform urban economies based on the simultaneous power to reduce some face-to-face interchanges (routine and follow-up communications) and the continuing and perhaps greater need for other face-to-face interchanges where creative interaction and sharing of skills are required (Castells, 1989; Castells and Hall, 1994). Hall (1997), after several years of being very equivocal on this, now states:

The new world will largely depend, as the old world did, on human creativity; and creativity flourishes where people come together face-to-face. (p. 89)

Evidence in this book on the reurbanization or recentralization of cities shows that new commercial development is concentrating, but not just in the central business district (CBD) and inner areas but in a series of nodes. The forces that



Photo 2.4. The historic purpose of cities—to enable face-to-face interactions for economic and social ends—is a critical element for sustainability in cities today. Utrecht, like all Dutch cities, retains the quality of street-based “accidental interaction.”

appear to be behind this are as old as the city: although we have the technological means to interact through computers and telephones, we still need personal contact as well. Thus businesses that are part of the new global Information Age need to interact with others that complement their skills. For example, professionals in architectural firms, engineering firms, graphic design firms, and computer firms all need to meet to plan business projects. Therefore professions with overlapping interests are clustering into nodes, with later additions of other services and even residences. Some nodes can be based on a dominant kind of industry, such as biotechnology; Willoughby (1994) calls this the development of “local millieux.”

At the same time as there has been a pressing need for face-to-face interaction in the new global cities, there has been a shift away from smokestack industries in cities, particularly in central and inner-city areas. This shift has meant that it is much more attractive for people who need to meet regularly in central or inner-city areas to locate their housing there as well as their business. Thus nodes of information-oriented work mixed with housing and recreation services are becoming a feature of cities in the last part of the twentieth century (Winger, 1997; Newman, Kenworthy, and Laube, 1997).

These nodes can form in the inner city or in the suburbs; in Europe and Australia they are mostly in the inner cities, while in the United States they tend to be forming in “edge cities” away from their inner cities. Data in Chapter 3 show that this concentrating force is now of considerable significance in all global cities. The same process that has revived the inner city in Europe and Australia appears to be beginning in U.S. inner cities as well, with a lag due to the social problems there (see Chapter 3 and 4).

On the other hand, the new information technology can leave large dispersed suburban areas with little of this new economy or its services. This is likely to be a growing social policy issue for cities in the Information Age (Castells, 1989).

It is important, however, to see that late-twentieth-century urban economies are not necessarily working against sustainability. People still need each other and want the personal contacts that cities can provide for their economic functions. Information technology in the electronic age does not necessarily lead to dispersal and continued growth in automobile dependence. Indeed it is possible to see an emerging new alignment of globalization, information technology, and the reduction in automobile dependence. The Future City (see Chapter 4) is likely to have a series of nodal/information centers that can, if designed properly, be much more transit- and walking-oriented. This should be good news for sustainability in cities if this new economic force can be aligned with the global need to reduce metabolic flows in cities.

Cultural Priorities

All cities have been shaped by transportation technology priorities and economic priorities. To this analysis should be added cultural priorities—in particular, the urban perspective on space.

The New World cities of America and Australia are generally low-density and are located largely in places where land has not been considered as a con-

straint to development. For example, Australia is a large country with a small population by any comparison; thus when people came to Australia from Europe or Asia, the one resource that seemed virtually endless was space.

Urban development in Australia in each of the above-noted transportation phases was therefore under cultural pressure to provide as much space as possible. So density tended to be relatively low in each historical period. The density of Sydney in the nineteenth century was more than 100 people per hectare, which is ten times the density being built in new suburbs today; however, densities in European cities at the same time were about 150 to 200 per hectare (Newman and Hogan, 1981).

The culture of space was also fed by a strong anti-city, pro-rural tradition that came largely from England in the nineteenth century. This pastoral tradition was partly a reaction to the “dark satanic mills” and polluted air of the uncontrolled industrial cities of England. Poets and authors writing in this tradition expressed the idea to the English-speaking world that the more space built into a city, the healthier and more socially adapted its citizens would be (Williams, 1985). This gave an ethical basis to modern town planning—a reformist movement designed to create “healthier” and more “morally upright” urban residents by imposing density standards and segregating land uses (Boyer, 1983; Boyer 1978).

The academic basis for the imposition of low-density standards on new suburban development is, however, very shaky. We have analyzed the data on health and social problems apparently associated with density and find no such correlation (see Newman and Hogan, 1981). In fact, the evidence, if anything, points in the other direction (e.g., crime rates are generally higher in lower-density cities; see the section “Dispelling the Myths about Automobile Dependence” in Chapter 4).

Nevertheless, the imposition of spatial standards had a ready acceptance in the New World cities of America and Australia (King, 1978). The British Town and Country Planning Association has pushed its slogan “Nothing gained by overcrowding” for most of this century. Thus English-speaking cities have had a long cultural tradition of residents desiring as much space (private and public) as possible to be planned into their urban environments. For example, local authorities throughout the English-speaking world have placed a strong emphasis on ensuring large spaces between buildings and setbacks from the street for “health” reasons based on this ideology, rather than on the quality of urban design involved. This has meant that streets have been increasingly seen as space for cars rather than as community space.

The culture of low density was not the only urban tradition in the English-speaking world. There has always been a strong urban culture in London that has rejoiced in the human qualities of compact human scale and well-designed streets and streetscapes (Williams, 1985). The urban culture that London has fed continues to be one of the most lively and creative in the world.

This urban pro-density tradition can be seen in all the cities of Australia and America. Despite the availability of cars and trains that allowed escape to the suburbs, the economic pressures of suburbanization and the influences of anti-urban culture, there has remained a strong pro-urban tradition. The dense centers of all major American cities have had their cultural support base (e.g., Allen,

1980). Despite the dominant suburban culture of Australian cities, there has been between 20 percent and 50 percent of the population who much prefer to be urbanites (Australian Bureau of Statistics, 1981), and recent trends show that the trend back to the city is accelerating in Australian cities and is beginning again in U.S. cities (see Chapter 3).

Thus transportation technology, economic forces, and culture do not necessarily lead to the Auto City. Indeed, the process of globalization, which is impacting on all technology processes, has the potential to help create nodal subcenters with reduced automobile dependence and to replace increasing numbers of trips as routine interactions are replaced by electronic communication. Also, globalization, according to Naisbett (1994) and Ohmae (1990), is stimulating local cultures to become more important sources of meaning and interaction as it makes national borders less relevant. Thus cities and communities within cities can become more significant and fuel the process of creating more vital and livable cities. In addition, global youth culture is increasingly very urban rather than suburban, thus providing a cultural opportunity to challenge the assumption of car-dependent suburbs as the only future for our cities. As will be shown in Chapter 5, sustainability for our settlements requires that our cities become more urban and our countryside more rural. Thus, as with economic and technological trends, there are cultural trends that can be seen as positive for city sustainability.

Cultural forces are played out in a different way in Asian cities. They do not have a history of cultural resistance to density as does the English-speaking world and so have willingly and eagerly built their cities at increasing densities. The resulting urban form is generally higher in density than the urban form of most global cities (see Chapter 3). This form leads these cities to walking and transit. Some Asian cities, including Singapore, Hong Kong, and Beijing, have transportation patterns that reflect this. Despite having the density of Walking and Transit Cities, however, some Asian cities, such as Bangkok and Jakarta, have transportation policies that are totally automobile-oriented. These cities have developed automobile dependence of a different kind than that of the Auto City. They do not have transit options other than buses, which become stuck in increasing car traffic. Nonmotorized transportation is unattractive and dangerous in such a traffic environment. People become dependent on automobiles because there are no real options. Thus, although cultural choices have led to this kind of automobile dependence (mostly due to city policies favoring automobiles rather than quality rail-system options), it is a lot easier to overcome automobile dependence in these Asian cities because no changes to urban form are required.

Conclusions to Priorities Shaping Cities

Transportation technology, economics, and culture are instrumental in shaping cities. Figure 2.4 shows how the priorities in all three can lead either to automobile dependence or to overcoming it. For example:

- High priority for the automobile in a transportation system would mean a high priority for new roads and parking. New roads create great pressure for new

suburban infrastructure at the fringe as the extra speed of travel enables greater distances to be traveled. Parking lots and roads take up considerable urban space that often replaces houses, and hence more housing is needed on the fringe. On the other hand, a lower priority for the automobile can mean less pressure for suburban infrastructure and less need to waste urban space.

- Low priority for transit (and walking) means that compact housing and other development that is built adjacent to stations also becomes a lower priority. As transit services decrease, there is a complementary lowering in value of urban

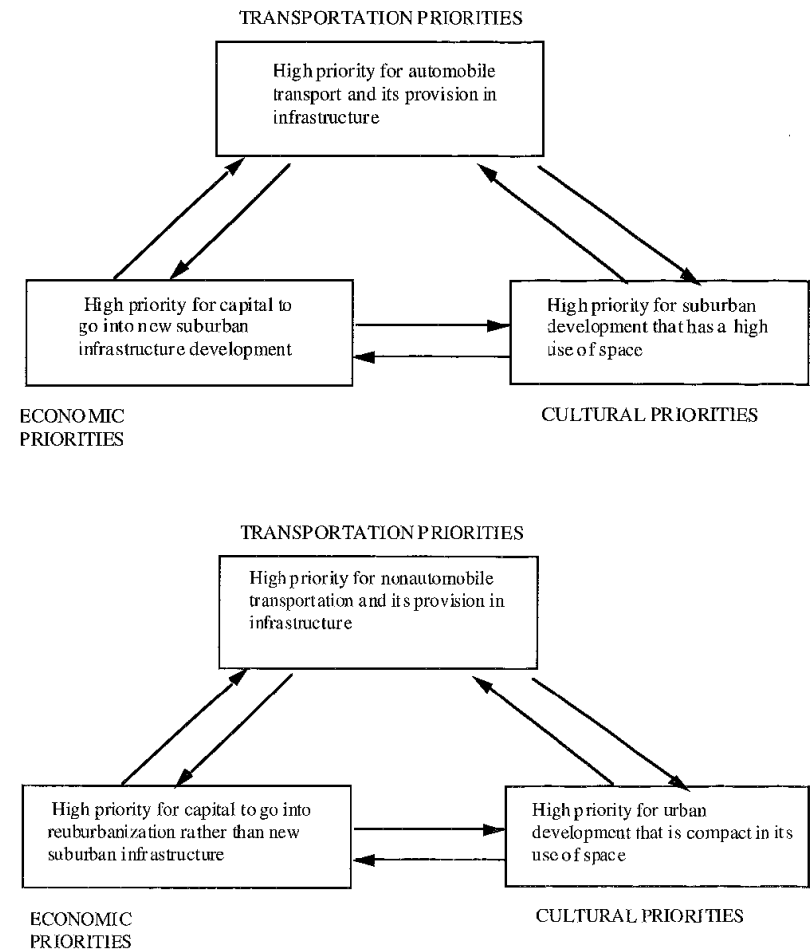


Figure 2.4. The interlinkage of transportation, economics, and cultural priorities in creating automobile-dependent cities (*top*). The interlinkage of transportation, economic, and cultural priorities in overcoming automobile dependence in cities (*bottom*).

development served by them. On the other hand, a reversal in these priorities can change development priorities since attractive transit systems facilitate walking-based urban villages around stations.

- High priority for the automobile creates traffic that requires large buffer zones and setbacks—that is, high use of space. Low priority for cars means less space for traffic is needed.
- High priority for capital investment in new suburban infrastructure creates low-density suburbs that are nonviable for transit, which in turn creates the need for high car priority. Low priority for suburban infrastructure capital links to low car priority. Such capital can then be used for economic and social development of cities.
- The priority for capital investment in new suburban infrastructure or redevelopment of the inner city is not just an economic decision but is based on cultural priorities about the spatial preferences for a city. It can now no longer be assumed that cultural priorities are automatically biased toward suburban rather than urban values.

Constraints on Automobile-dependent Cities

The 1890s was a decade of great change in the world's major cities. The Industrial Revolution had brought wealth, mobility, and diversity to urban citizens in ways that were impossible to dream about 100 years before. The old Walking Cities had been largely swept aside as trams and trains led new development patterns.

But with these changes had come great stresses and new challenges. Industry polluted the air and waterways. Workers were crammed into tenements, and streets were filled with uncollected garbage, animal waste, and kitchen water. Recession hit, and unemployment led to crime and vice of all kinds. A new century was coming, and for many it was a time of fear.

The writers and politicians of the day called out for reform. The visionaries of the 1890s dreamed of “Garden Cities,” and there was a move to vegetarianism, Eastern religions, cooperatives, eco-villages, education for the unemployed, public playgrounds and parks, and public health (Boyer, 1978; Girouard, 1985).

Perhaps one of the most enduring social institutions to have developed during that period was town planning. This did not mean a set of regulations for controlling land (at that stage), but a set of visionary concepts for laying out cities in a more orderly way, for taking hold of the apparently overwhelming problems of cities and saying, “Let’s change this for the better.” And so largely town planners did (Hall, 1988).

Today, in the 1990s, we face a range of constraints on the auto cities of the world (see Box 2.1). Each individual problem is not a constraint that by itself would warrant us to make the comparison with the need for change that manifested in the 1890s. But together they may lead us to consider whether we are not moving toward a similar need for change to a whole new way of managing our cities.

Box 2.1 presents the constraints on automobile-dependent cities in terms of economic efficiency, environmental responsibility, social equity, and human livability—all part of the sustainability agenda for cities.

Box 2.1: Constraints on Automobile-dependent Cities

Economic Efficiency

• **Infrastructure costs.** There are excessive costs for new suburban infrastructure (usually subsidized) while older city infrastructure is underutilized.

• **Transportation costs.** The total costs of the car transportation system exceed transit system costs by 30 percent to 40 percent and are not paid for by users (see “Approaches to Constraints”).

• **Time costs.** The more committed a city is to building its way out of congestion, the more it loses the battle to save travel time, as people just travel for their. In all cities, no matter what their infrastructure, people take about thirty minutes for the journey to work. Thus infrastructure justified on the basis of time savings (the main rationale for big roads) is not providing this benefit, but in general is time neutral.

• **Land waste.** The loss of land for parking and roads is greatly reducing the amount of productive land available.

• **Housing waste.** The mismatch of housing type and household need is increasing.

Environmental Responsibility

• **Oil vulnerability.** With global oil production peaking around 2005, there will be increasing vulnerability to oil shocks.

• **Greenhouse gases.** Pressures to reduce carbon dioxide will prompt leaders to turn to transportation for changes, since it is the fastest growing user of fossil fuels.

• **Smog.** Clean air is fundamental to a city's health, yet car-based cities are regularly exceeding smog limits.

• **Sprawl impacts.** The loss of countryside on the urban fringe is proceeding at a rate of 0.4 ha of land per new household in Australian cities and higher in U.S. cities. Sprawling cities have higher quantities of asphalt for their cars (about eight parking spaces per car in the United States, as well as more roads per capita) and hence there is more stormwater pollution.

• **Traffic impacts.** The noise, visual intrusion, community severance, road accidents (250,000 deaths per year globally), and parking blight caused by excessive traffic impacts cast doubt on the sense of a transportation system dominated by individual car use.

Social Equity

• **Inequities in being carless.** More than half the population in automobile-dependent cities do not drive because they are too young, too old, too poor, disabled, or just unwilling and are thus transportation disadvantaged.

• **Inequities in location.** Residents in middle, outer, and fringe suburbs built in the era of the car are access-disadvantaged due to the lack of transit.

(Continues)