Making Urban Transport Sustainable
Edited by Nicholas Low and Brendan Gleeson
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Is Urban Transport Sustainable?

Nicholas Low

Introduction

Once the privilege of the elite, personal mobility is a freedom bestowed by modernity on the general public through technology. The physical negotiation of space by people in pursuit of social values (access to work, friends, child care, education, recreation and supplying the home) is part of urban social life. Road freight vehicles provide a flexibility of supply that keeps profits up and costs down for businesses in the ‘consuming’ city. But the benefits of freedom and flexibility are illusory if the opportunity costs of providing for unending mobility are never considered, distances to be covered increase, travel becomes a compulsory, stressful, dangerous and expensive routine and the costs of mobility are merely shifted from the individual to society and the environment. This book explores how the real benefits of mobility can be protected and the costs properly allocated and contained.

The chapters examine the sustainability of the world’s urban transport systems, bringing a variety of perspectives from different nations and from different fields: engineering, sociology, critical geography, environmental economics, eco-politics, urban planning and transport planning.

What does ‘sustainability’ mean? The question will be approached from a familiar perspective, that of the triad – economic, social and environmental sustainability. In the ‘tripple bottom line’ variant, this perspective requires that corporations and governments seek the simultaneous achievement of three fundamental goals: economic profitability, social responsibility and environmental conservation (Elkington, 1998). Our analysis shows, however, that such an outcome is contingent on power and commitment. There is no necessary correspondence between economic, social and environmental sustainability. Useful though the triple bottom line framework is as an accounting tool, sustainability will require a massive and concerted effort of political will and technical ingenuity, and a true ‘paradigm shift’ in the belief systems and education of engineers, urban planners and economists - the professional shapers of the city.
That shift is already underway. Many of the new generation of engineers, planners and economists are developing a new way of thinking about the infrastructure of the city, and the connection between transport, land use, society and environment. The new paradigm is developing 'critical mass' (to use Whitelegg's expression), enough momentum to make a real difference to transport planning policy and practice. In this book we hope to help the shift along a little further.

The paradox of sustainability

As every engineer knows there is nothing more stable than a triangle in which the forces conducted through each member cancel each other out (Figure 1.1).

Unfortunately applied to 'sustainability' this figure is paradoxical because for the environment to be sustained, both society and economy have to change. They cannot therefore be sustained in their present form. Debates about sustainability are fuelled by the perception that we can't go on as we are (Bowers, 1995), that 'business as usual' can't continue (Athanasiou, 1998; Sachs, 1999), that society must find ways of curbing consumption even while spreading the capacity to consume more widely throughout the world (Daly, 1996). Peters (2000: 113) in a discussion of Europe's contribution to the 2002 Johannesburg Earth Summit writes: 'Accessibility and mobility gains are often reaped at the expense of severe damage to human health and global biodiversity, with problems accelerating for future generations. This clearly violates the sustainability principle.' White (2002: 57) citing research by Boardman et al. (1997) notes that by 2010, in the UK, carbon dioxide emissions from road transport are expected to rise to 27 per cent of total emissions, rivalling that of all industry. Urban transport is a key element in the structure of the city, and the city - and city network - is typically the geographical and social formation in which most people in the world are coming to relate to and consume the natural environment (Low et al., 2000).

As this book will show, much urban transport policy today defies sustainability. For the environment to be sustained, urban transport has to change.

But let us probe this paradox a little more deeply. It cannot mean that the natural environment is unchanging or ever should be. But normal evolutionary environmental change must be distinguished from catastrophic change. Evolutionary change moves extremely slowly by the measure of a human lifespan. The rate of species extinction and global warming over the last two or three hundred years is comparable with what are regarded by palaeontologists as catastrophic events in the geological record. The contemporary event, however, is being driven by human exploitation. It is because of our growing understanding of catastrophic environmental change that changes in society are necessary to slow it down. How far these changes must go is of course a matter of debate.

The global biosphere is a closed system with one absolutely predominant energy input: solar radiation, and no output for waste. This system is composed of a variety of natural ecosystems of different scales (Appin et al., 1999). Human beings cannot act significantly, individually and directly on the natural environment viewed as a system of ecosystems. The scale difference between a human individual and an ecosystem is just too big. Of course an individual may chop down a tree or recycle a can but, on its own, this act has little effect on the natural environment. Humans act collectively through society and its institutions, the most powerful of which are states and market economies (Lindblom, 1977; March and Olsen, 1989). These institutions organize and combine the many individual acts into social activity of such a scale that it leads to catastrophic deterioration of the environment.

The individual car driver is correct to conclude that one trip, even that individual's annual summation of trips in the car, will have an insignificant effect on the environment. Yet this one trip could not take place at all without society producing the wherewithal to make it: through mines, factories, machines, cars, roads, prices, taxes, regulations. And if society makes it possible for one individual. It also makes it possible for millions of others. The transportation patterns caused by the collective activity of millions of individuals feed back into other patterns created socially, for example patterns of land use, methods of distribution of goods, patterns of distribution of social opportunities, health, disease and death. Some patterns, especially patterns of production of goods and services and distribution of land uses, feed back into the means of transport. Worldwide, billions of trips in vehicles burning fossil fuel, are changing the Earth's climate, and therefore the environment of all species, including the human species (Whitelegg, 1997; IPCC, 2001).

The key to understanding sustainability is therefore twofold: first that it is through social institutions and mechanisms that individuals have a significant effect on the environment. Second, that humans are capable of changing society and its institutions. If society, and its mechanisms such as
urban transport, were not subject to human will in some sense, there would be little point in thinking about the future and sustainability. An orientation to the future and to deliberate social change is a central feature of modernity and the technical application of science. For this reason governments deliver 'policies' looking to the future on which they are publicly judged.

The paradox of sustainability emerges strongly in urban transport. Governments that espouse environmental sustainability also espouse transport policies that deplete and ruin the environment. All too often in policy documents where environmental sustainability is discussed the urgent necessity of social and economic change is glossed over in language designed to reassure the reader that the right trade-off (or balance of forces in the triangle of Figure 1.1) can be found between economic, social and environmental policies. With this magic mixture all will indeed be for the best in this, the best of all possible worlds. Such policies deserve the term 'greenwash' (see Athonasiou, 1998: 238). Whereas it is possible to trade off environmental and health benefits against economic growth (for that is what has always been done), it is logically impossible to trade-off environmentally unsustainable growth against environmental sustainability. Growth is either environmentally sustainable or it’s not.

Nevertheless, provided that the need for change of social and economic institutions is retained, the idea of the environmental, social and economic dimensions of sustainability is an important and fertile one. The order of consideration is significant. The economy is essentially a creation of society and should be understood as framed by rather than, as is more often assumed, framing society. Both operate within the context of a natural environment of limited capacity that can be reduced but not enlarged.

Urban transport and economic sustainability

Sustaining the economy has been the principal task of governments throughout the developed world since the end of the Second World War. It’s easy to see why investment in transport infrastructure is such an appealing way of spending taxes and borrowed funds. It addresses a very concrete problem experienced by voters: traffic congestion. It supports the growth of personal mobility. Investments in roads seem to realize, in an immediate sense, the potential of the private car which has acquired more than just practical value for its owner (Sheller and Urry, 2000). Investment in public transport can be argued to reduce road traffic congestion, as in the famous case of London’s Victoria Underground Line. Now ‘sustainability’ itself is being brought in to plead the case for new transport infrastructure.

Investment in transport supports business in two ways, it acts as a stimulus to the large sectors of industry involved in construction and transport. And it offers to reduce the costs of all businesses in transporting goods. It appeals to the orthodox economists who advise governments. It doesn’t require any real change in government thinking and therefore appears to carry minimum short-term political risk. In short, investment in transport infrastructure serves the immediate interests and beliefs of voters, businesses, bureaucrats and politicians. The support of professional engineers, trades unions, and sectors of the investment industry add further weight to the nexus of arguments in favour of transport investment as a means of sustaining the economy.

In order to sustain the economy and enhance the productivity of private capital, it is argued, there is a need for investment in transport infrastructure (see, for example, Aschauer, 1989, 1990; EC, 1993). Of course such investment has a multiplier effect from the construction involved, but theoretically the causal link between transport infrastructure per se and economic growth remains to be proved (Granich, 1994; Vickerman, 1998: 132). Rothengatter (1994: 116) claims as an external benefit of transport infrastructure: ‘improving accessibility to remote regions may foster regional development and produce interregional multiplier effects’. Vickerman (1998: 153) argues that the relationship between infrastructure and economic growth is a complex one: ‘Often it is intra-regional variations and access to local and regional networks which may be as critical for locations in peripheral regions as their actual peripherality’. But, as Whitelegg points out in Chapter 7, such empirical evidence as there is suggests no geographic link between transport investment and economic success. Black (2001: 2) regards the notion as a myth. While there are situations in the developing world (remote regions) where transport infrastructure investments may lead to economic growth ‘it is unlikely that these conditions exist any longer for [the developed world].’

The proposition that arguments in favour of transport investment are specious and contradictory tends to be eclipsed by the fact that, well, the world economy has been sustained. The world has not experienced a Great Depression on the scale of that of the 1930s, a global economic crisis with vast social and political repercussions - not yet. In view of that fact, and in view of the supporting interests of the key players in the economy and politics, what is perhaps surprising is that transport policy is changing, however slowly (see Chapters 2, 6, 13 and 14). It is changing at least partly because there is a dawning awareness in some departments of government and business that something is wrong with the economic calculations. The ‘something’ is the assumption underlying those calculations that the environment is an unlimited cornucopia. It is as if orthodox economists have looked at the environment through the eyes of an individual and have seen that its scale is so vast that nothing the individual can do will have any appreciable impact on it. The sustainability of an economy without environmental limits is one thing, but what if the economy as a social whole becomes so big that it actually presses up against the limits of what the environment can provide?
Transportation economics is concerned mainly with efficiency and allocation (Button, 1977; Small, 1992). An efficient allocation is one in which the kind of commodities, and how much of each, is produced coincides with what and how much is demanded under any given distribution of the capacity to pay in the population. Normatively speaking, what type of and how much transportation is provided should be no more than and no different from what is demanded by the aggregate of consumers (under budget constraints) when each weighs up all the benefits and costs to him or her individually. The problem is how to get all the costs bearing down on the individual (or organisation) who receives the benefits, that is to internalize the costs.

From the point of view of environmental sustainability, this sounds rather good in principle because it minimizes the use of resources for a given social outcome. Road pricing to internalize the costs of congestion is the classic case and has been praised by environmentalists (Jacobs, 1991: 146). Arguing in favour of the use of economic instruments in infrastructure provision (as opposed to infrastructure use), Rothengatter (1994) posits that transport infrastructure is a 'club good' in that its supply stimulates agents to seek additional 'rents' by free riding and 'as a consequence, excess demands for infrastructure capacity are generated' (122). This merely recognizes theoretically what has already been established empirically, which in turn was suggested by common sense that building better road systems generates additional demand to use them (see SACTRA, 1994).

However, there is a more compelling reason why economists applaud technical infrastructure solutions. The political value at the heart of microeconomics is the belief in the virtue of competition. Space limits competition and interferes with the perfection of the market. The larger the population that can be brought into competition, the better. The connection between transportation, the growth of business and the growth of cities was discussed in one of the seminal texts of urban geography The City by Park, Burgess and McKenzie. Transportation systems are seen naturally as a part of human ecologies. McKenzie quotes Hadley: 'It is this quickening and cheapening of transportation that has given such stimulus in the present day to the growth of large cities. It enables them to draw cheap food from a far larger territory and it causes business to locate where the widest business connection is to be had, rather than where the goods or raw materials are most easily produced' (McKenzie, 1967: 69 n2).

Transport negates the effect of space and enlarges the competing population of firms and households by bringing more people and products within reach of one another. This view of the world infuses the publications of the European Commission (see Chapter 13 of this volume). The American economist Paul Krugman (1999: 83) writes with delight about 'globalization' which puts fresh vegetables from Zimbabwe on the tables of Londoners. Whitelegg writes not with delight but dismay about the 150 gram pot of strawberry yoghurt which is responsible for moving one lorry 9.2 metres in the process of production (Whitelegg, 1997: 39 citing research by Böge, 1995). Both are tales of spatial expansion and flexibilisation, principles of the globalization of the market economy; the ever increasing choice of location of production of anything and everything.

Economic rationality contains two kinds of problem for transport sustainability, one external, to do with the subject matter (transport), and one internal to the theory of economics itself. The external problems have to do with the nature of transport. First, the disaggregation entailed in the market mechanism tends to work against the technical co-ordination (intermodal, intertemporal and geographical) required by an effectively functioning transport system. Rothengatter (1994: 125) points to the problem of natural monopolies in transport networks, but the matter goes deeper than that. The technical efficiency of a transport system depends on the smooth integration of all its elements (Vuchic, 1999: 295). For instance, feeder bus timetables must be co-ordinated with train timetables. Ticketing systems must be network-wide. Encouragement of transit use must be accompanied by encouragement of walking and cycling, and discouragement of car use for journeys where transit supplies a viable alternative.

Economically, while some parts of the use of transport systems can be subjected to market mechanisms, including the use of roads, the creation of transport systems cannot – or at least is not. Transport infrastructure investment is enormously lumpy, it has very long term effects on the land use and production process, social needs do not quickly adapt to changes in transport provision and, while benefits are individualized, transport systems incur huge external environmental costs, some of which are almost unmeasurable (the cost of greenhouse gas emissions for example). If all the social and environmental costs of road systems were actually internalized in a price for road use, the result would probably be that only the rich could use the roads, thus violating social sustainability (see below). Second, increasing transport infrastructure feeds back into more spatially dispersed patterns of land use. Land use patterns have been shaped over decades by government provision of infrastructure to accommodate motor vehicles. If economizing on transport is needed – as it is – it must be led by government with infrastructure and logistical policies which enable such economizing.

The second kind of problem is internal. Again it is twofold. At microeconomic level, the theory does not account adequately for time, nor does it acknowledge the ultimate limits imposed by the capacity of the environment. In the real world economic processes take time yet, as Keen (2001: 166) points out, economists don't consider time in analysing demand, supply, or any of their other key variables. The conventional economic approach to time goes no further than the rate at which individuals discount the future, and much space in environmental economics texts is taken up
with mathematical representations of this quite marginal theoretical problem (see for example Pearson, 2000, chapter 4).

It doesn’t take much thought to see that asking whether an actual person living now would rather have more mining and less coral reefs is not the most useful line of questioning from the viewpoint of global ecology and resource depletion. As Martinez-Alili (1987: 171) pointed out, the critique is that ‘economic theory is unable to deal with inter-generational allocation of exhaustible resources relying only on the exchanges between agents whose behaviour accords with the postulate of rationality and utilitarian calculus because non-born agents cannot bid in today’s market’. But then economists today do not usually ask people questions, they make assumptions and then carry out mathematical operations on the basis of those assumptions. One of the assumptions Pearson makes is that ‘avoiding current costs and securing near-term benefits frees up resources in the near term that can be reinvested at a positive rate, thus increasing the wealth of future generations’ (Pearson, 2000: 106). This ignores the distribution of benefits, and assumes both that human-made capital is a substitute for natural capital and that human benefit is the only benefit that matters ethically. For instance, no amount of human products like cars or trains can compensate for the death of a biological wonder such as the Great Barrier Reef. Of course this assertion may be disputed but the questions here are ethical not economic.

The discount rate merely considers preference from a static point, but the core theoretical economic issue is dynamic. Keen (2001) uses a vivid image to illustrate the problem. Imagine you have never seen or heard of a bicycle and that a bike guru convinces you that there are two steps to learning to ride: ‘in step 1, you master balancing on a stationary bike. In step 2, you master riding a moving bike, applying the skills acquired at step 1’ (165). Learn like that and the moment you try and change direction you fall flat on the road. The forces at work, and the skills needed to master them are different in a dynamic state from a static one. Sticking together a series of static analyses does not amount to dynamic analysis. Keen explains the problem very clearly and exhaustively in chapter 8 of his book (pp. 165–87; see also: http://bus.uws.edu.au/Steve-Keen/). The failure to deal with time means that microeconomics tends to ignore real feedback effects such as the land use dispersing effect of infrastructure.

Conventional macroeconomics ignores the limited capacity of the Earth’s environment. Overcoming space by technology is today stretching the capacity of the environment to absorb the wastes thereby produced. Daly explains in terms of a model of the economy in which raw material is taken in from the environment, put through the economic system, and transformed into non-material human satisfactions and material waste:

Ecological sustainability of the throughput is not guaranteed by market forces. The market cannot by itself register the cost of its own increasing scale relative to the ecosystem. Market prices measure the scarcity of individual resources relative to each other. Prices do not measure the absolute scarcity of resources in general. Ecological criteria of sustainability, like ethical criteria of justice, are not served by markets. Markets single-mindedly aim to serve allocative efficiency. Optimal allocation is one thing; optimal scale is something else. (Daly, 1996: 32)

Campbell draws attention to this point in Chapter 3 in relation to the oil resource. It seems that some economists would rather dispute the scientific understanding of oil formation than acknowledge that their discipline does not adequately treat the problem of finite natural capital. So economic sustainability (sustaining the economy) is a very different matter from social or environmental sustainability and their reconciliation poses serious problems.

Urban transport and social sustainability

The naturalistic social analysis of the city by urban geographers such as McKenzie (cited above) was replaced in the 1970s by the foreground of socialist thinking by Marxist class analysis (e.g. Harvey, 1973), only to be replaced in turn by a focus upon social networks as the key to understanding social structure (e.g. Soja, 1989). What has been termed ‘reflexive modernisation’ (Beck et al., 1994) implies that social change can be accomplished through appropriate critique. Indeed the market economy can only be justified (in the utilitarian philosophy on which it is based) if its operation contributes maximally to the good of all.

Social theory thus postulates that society is not the outcome of the economy, economies are ultimately products of society. But we are frequently told in public policy documents that cities and nations have to adapt to ‘globalisation’, as though globalization were a natural event beyond social control. Polanyi (1957 [1944]) and more recently, Hirst and Thompson (1996) have demonstrated by careful historical analysis that globalization is merely the continuing spatial expansion of market society driven by the governments of nation states. What then does ‘social sustainability’ mean when most of the key texts in social theory address not sustaining society but changing it?

Polèse and Stren (2000: 3) provide the clue. Social sustainability is defined as social integration: ‘integrating diverse groups and cultural practices in a just and equitable fashion’. This is to say that integration is implicit in the whole idea of society, but there are better and worse ways in which integration can be achieved. One would not want to recommend the kind of forcible integration that occurs under authoritarian regimes. Hence it is necessary to acid ‘just and equitable’. These are not facts of a particular society but values to be achieved. Social sustainability, therefore, is about sustaining progress towards the kind of fair society in which the good of each
individually) coincides with the good of all (collectively). The reason that social sustainability must be considered separately from economic sustainability is that markets can disrupt, sometimes violently, the cohesion of society, and negate the principles of justice that hold society together without the constant use of force. What then is the relationship between economic and social sustainability, and between social and environmental sustainability? And how does transport figure in these relationships?

Economists (e.g. Sims, 1992; Rothengatter, 1994) claim that marginal cost pricing of transport infrastructure use is not unfair to poorer transport users: The rich run a higher mileage than the poor, so they will have to pay more if user charges are introduced, based on mileage travelled’ (Rothengatter, 1994: 121). This is supposed to be an argument in favour of the ‘progressive’ effect of congestion charges. Under this sort of reasoning a ‘flat’ tax system in which all people pay the same proportion of their income in tax, would be regarded as progressive. This could only be true, however, if each dollar spent had the same value for everyone. But the extra dollar spent on travel by a poor person may mean the difference between having a job and not having one (i.e. in some cases between starvation and survival). Whereas the extra dollar spent by a rich person may mean the difference between drinking a more or less superior brand of wine for dinner. Keen explains why economists mostly ignore the implications of this intuitively obvious fact: to do otherwise would make it impossible to claim, as economists do, that individual utilities can be summed to yield social utility (Keen, 2001: 40–47).

If, as Keen argues, they cannot, then economic efficiency cannot be equated with social sustainability. In a functioning market economy (which certainly has many of the virtues claimed by economists) depends on an integrated and just society that cannot be sustained by markets alone.

Banister (1994) in analysing the distributional effects of policies to internalize the social and environmental costs of transport implicitly acknowledges this enormous gap in conventional economics and discusses the complex realities of interspatial and intergenerational equity. On road use pricing he concludes:

In affluent economies with high levels of car ownership, road-pricing is likely to lead to substantial sums being raised. Some road-users will be priced off the road, and the additional capacity may give benefits to those drivers continuing to use the road system until a new congested equilibrium is reached. The marginal low-income car owner will be the person to switch mode, destination, route, time or suppress the trip, whilst other users will choose to pay the charge. (Banister, 1994: 169)

Such a switch to alternative modes of transport may be desirable on environmental and health grounds. But, even in cities with an adequate alternative public transport system to switch to, the financial impact on poor and middle income groups is likely to be severe. Banister (1994: 170) suggests a 60 per cent rise in transport costs. In cities without adequate alternative transport the result would be socially disastrous and cannot be considered sustainable. Black (2000: 146) observes that while the rich will be able to buy the choice of continuing ‘unsustainable’ transport behaviour, lower income families will be the hardest hit by a move towards sustainable transport because they will be locked into current patterns. Mees (2000: 72) goes further: 'Given the difficulties with relatively inelastic demand, price setting, costing of the intangible and equity – problems for which [pricing] advocates have few answers and those generally risible – free market road pricing is unlikely to be the answer to urban travel problems'.

Is the environmental sustainability of cities conditional upon their social sustainability as argued by Polèse and Stren (2000: 15). Polèse (2000) observes that, in many of the case studies reported (in Polèse and Stren, 2000), public transport has increasingly been defunded in favour of road infrastructure spending; public transport is becoming the refuge of the poor and excluded; in short two systems of urban transport coexist: one for the owners of cars, one for everybody else... Two cities coexist in the same metropolitan area: the ‘modern’ city nurtured on the car; the ‘other’ city dependent on other, more traditional means of transport (including walking) (320). This is precisely the picture that emerges in Chapter 10 of this volume. Rather tragically as Banerjee-Guha shows, in India arguments in favour of spending on roads are being misleadingly coupled with environmental sustainability to legitimate external consultants’ advice (from the old paradigm) and redirect spending priorities from public transport to road infrastructure. At the same time a public transport solution that promises much better environmental outcomes and is consistent with both environmental sustainability and economic security is being ignored.

Rarely if ever are the opportunity costs of various forms of infrastructure investment considered. This is a matter of antiquated budgetary practice in developed countries. It is scandalous in poor ones. Road/car systems take up vastly more land and impose much greater social and environmental costs than fixed rail, cycling and walking. Yet in India, it seems, road systems are being built without any consideration of whether the community would rather have the money for flyovers spent on providing clean drinking water, safe sewerage infrastructure, education or health facilities. Even in Britain the wisdom of spending billions of pounds on new roads may be questioned when the public health system is on its knees.

If social sustainability need not coincide with economic sustainability, it may also conflict with the principle of environmental sustainability. From the viewpoint of ‘modernity’ the advantage of a city is that it brings a large number of people within rather close range of each other. The advantage is both economic and social: a large market and a complex, culturally diverse and educated society marked by a certain freedom to
doubt and challenge traditional norms. But once a city grows beyond a certain size the advantages of scale fall off rapidly—without transport. In the modern megacity transport is necessary for people to take advantage of the social, and economic benefits it offers. Takeda and Mizunaka in Chapter 9 show how modern Japanese society, both urban and rural in interaction, was built around a certain form of public transport. Indeed it has been argued that Japanese prosperity depended on it (Hook, 1994, cited in Chapter 14 of this volume). Changing the way transport is provided, for economic or environmental reasons, has major distributional and social effects. Such changes may not lead to social breakdown but they are not 'socially sustainable' unless they sustain the progress of the society towards prosperity, freedom and justice for all and not just the entrenchment of class privilege. It is too strong a requirement, however, to insist that environmental sustainability is conditional upon such progress. Often the ignored environmentally sustainable solution is most consistent with social improvement and long term economic security.

**Urban transport and environmental sustainability**

Urban societies and the economic systems they generate are, finally, subject to the limits of the 'natural' more-than-human environment. Environmental sustainability can be approached from a local and a global perspective. The local impacts of urban transport systems on human health are reasonably well known and some of these impacts are discussed in Chapter 7. Most of the negative local effects are associated with the mass use of private motor vehicles (both domestic and freight vehicles) on public roads. To a visitor from another planet it would seem astonishing that such a huge tally of human deaths and injuries from the crashes of private vehicle traffic is tolerated. Perhaps there is an underlying belief that such deaths and injuries are self-inflicted and thus avoidable, accompanied by the acceptance of the principle of individual responsibility or, in language closer to truth but more foreign to modernity, acceptance of fate. Yet many of those who die or are injured have no choice at all in the matter. There are few citizens who do not over a lifetime have a close encounter with death at the hands of another driver.

Somewhat less well tolerated by modern society are the impacts on health and life of atmospheric pollutants. These pollutants are unavoidable in that nobody living in cities can opt out of contact with them unless they seal off their faces in gas masks to filter the air they breathe. This is not just a matter of ambient air quality in cities. Every traveller on a busy arterial road breathes the undispersed pollution from hundreds of motor vehicles on the road ahead. But pollutants mostly do not have an immediate effect and their precise longer term impact in small doses on health is not widely understood. Ultimately, the cost to human health may be as great as, or greater than, that of motor accidents.

There are also indirect health effects of motor vehicle use. The private car/public roads solution to transport problems has two systemic effects: it leads both to a spreading out of interacting land uses and the reduction of walking as a component of journeys between them. People have to travel further and they get less physical exercise doing so. This loss of physical exercise in the normal course of daily life can itself make people less healthy. The private car is particularly to blame because it provides a door to door travel option and its engine pollutes the atmosphere with noxious chemicals. This is quite different from public transport systems which can more readily accommodate electric powered, non-polluting vehicles (both rail and road systems) and in which there is always a need to walk short distances.

Finally, the door to door conception of car/road transport tends to demote urban public space to the status of an awkward gap between domestic space and the car. Yet it is also well understood that some of the finest achievements of the great cities are the squares and boulevards designed for people on foot. When public space is occupied by masses of parked and moving vehicles its environmental quality is destroyed. The movement to reclaim public space for people on foot has made great progress, particularly in Europe where the cultural value of public urban space is well appreciated.

Transport systems therefore create local environments of varying quality for their human occupants. But an exclusive focus on the environment of humans is regarded by many environmental philosophers as 'anthropocentric': that is, the only reason for valuing the human species above all others is that we are members of it (see Eckersley, 1992). As an ethical position that is unsatisfactory and probably does even not correspond with most people's ethical regard for non-human species (Low and Gleeson, 1998). Prudentially also we need non-human species in many known ways and many ways that are not yet discovered. The urban environment, and especially the peri-urban environment on the edge of great cities provides a habitat for many rare and endangered species. The car/road solution sprawls the city further and further into the peri-urban region, damaging the habitats of these species and threatening in some cases species extinction.

Ha, in Chapter 11 points out that a country as populous as China cannot afford to lose land with good food production potential. Chinese cities, which are often situated in naturally fertile regions, cannot therefore adopt the low density form of their American or Australian counterparts. Indirectly too, taking valuable agricultural land around cities for urban use puts additional pressure on more distant and more fragile ecosystems which may be forced into food production.

There is little doubt that preserving or improving the local environment of cities requires both a high level of service from a well integrated public transport system, less road traffic and, especially, reduced dependence on
the private car. Even so, given the right sort of micro-climate that disperses photochemical smog, widespread and enthusiastic car ownership, and a basic level of public transport, car-dependent cities may still for the time being provide acceptable (if not particularly 'liveable' or socially just) urban environments for humans (for example the Australian cities discussed in Chapter 12 of this volume). But such acceptable cities are, nevertheless, far from environmentally sustainable. What citizens choose to do locally to the environmental quality of their cities is a different matter from 'environmental sustainability'. If the term is to mean something specific and different from 'environmental conservation' in general, sustainability has an irreducibly global dimension.

There are three global issues on which urban transport impinges: fuel, biodiversity and food, and the atmosphere. On the first issue, as Campbell points out in Chapter 3, the world is moving ever closer to a critical shortage of the one finite resource on which the world's transport systems, and therefore the production systems geared to them, depend: oil. This would hardly matter if there was an equally strong and far sighted effort under way world-wide to restructure transport systems away from fossil fuel dependence. Unfortunately there is not. There are technological advances in vehicle engines that would enable such a restructuring to occur. Dessefani and Skoer describe some of them in Chapter 5. But there are still major technical difficulties to be overcome and enormous costs in implementation. At present, in so far as they are conscious of the issue at all, the world's political and economic leadership seems to be relying entirely on the rising price of oil to stimulate restructuring over a relatively short period of time. Campbell concludes that the rising oil price is more likely to plunge the world into a global economic depression that will make the inevitable restructuring all the more painful and difficult. Will e-commerce be the solution? Stiller, in Chapter 4 does not conclude that either business to business or business to customer exchanges on the Internet are likely to lead to ecologically sustainable outcomes.

On the second issue, the earth's species do not belong to the nation in which they happen to be found but are part of a global human heritage. In less anthropocentric terms, the right of species not to be extinguished is a global right. 'Genocide' understood literally as the extinction of a species, whether by delibration or neglect, may in future be regarded as an unforgivable environmental crime. The spatial expansion of cities threatens both species habitats and food production for humans. The latter is beginning to be seen as problematic, especially for countries such as China and India which will have to feed huge populations from a diminishing supply of productive land as their cities grow. Brown (1999: 123) comments: 'The effects of the acute cropland scarcity emerging in some countries could affect many other areas of human activity. For example, it could fundamentally alter transportation policy, favoring the development of more land-efficient bicycle-rail transport systems at the expense of the automobile'.

The third issue is arguably the most serious and the least likely to be resolved peacefully and justly. It is also the most critically important for environmental sustainability. Global warming is happening because of the growth of the world's carbon based economy during the last two hundred years. There is an extraordinary degree of consensus on this. Very few scientists disagree, along with some commentators who tend always to cite the same sources. The Intergovernmental Panel on Climate Change (http://www.ipcc.ch/), its thousands of advising climatologists, and the Meteorological Offices of the USA, Britain (The Hadley Centre: http://www.met-office.gov.uk/research/hadleycentre/) and most other European countries believe that their research tells them that the Earth is warming and that human economic activity is responsible.

Global warming will affect just about every aspect of life on the planet both human and non-human. Many species will become extinct as their habitat is destroyed by the climate changing too rapidly for them to adapt. Coastal cities and low-lying regions (e.g. Bangladesh with 124 million people) will be threatened with rising sea levels. Climate change is perhaps the first truly global problem of environmental sustainability that human society has ever had to face. The world is at present ill equipped to do so. That the problem is deadly serious can be gauged from the following figures.

Climate change: business as usual

What will happen if we go on as we are? World emissions from burning fossil fuel in 1999 were 6.43 billion tons (International Energy Agency, 1999). The Intergovernmental Panel on Climate Change has concluded that to stabilise the Earth's climate system we must stabilise the amount of greenhouse gas in the atmosphere at about 450 parts per million of volume (ppmv). To achieve that figure we must in this century reduce carbon emissions by about 60 per cent. In terms of CO2 emissions from burning fossil fuel that means getting down to about 2,500 billion tons per year. Figures published by the International Energy Agency (http://www.iea.org/) show that, even on the most optimistic scenario, China and India together will be emitting more than 3,800 billion tons of CO2 within 50 years. This is certain to be an underestimate unless economic growth collapses in China, since it is based on the assumption that China will continue to reduce its fossil fuel dependence at the same rate as the last ten years (1989-99) when much of the old coal burning industry was being phased out.

A more likely – though still optimistic – scenario is that in which (by 2049) most developing nations can expect to reach the rate of fossil fuel dependence of the USA today, while the US continues to reduce its dependence at the same rate (1989-99), with rates of economic growth of the same period continuing. Under that scenario, China will be emitting 22,000 million tons, India 1,360 million tons, and the USA 2,900 million tons, totaling 26,264 billion tons. However, if China, India and the USA continue to grow
Economically at the rate they did between 1989 and 1999 but do not improve their carbon dependence much beyond that of today, then within 50 years their emissions will grow to a staggering 92,000 billion tons, nearly forty times what is required to stabilise the climate, and for just three nations.

The problem is not Chinese cities or Indian cities as they are today. American and European cities are much more problematic in their carbon emissions. The problem is the continuing growth of fossil fuelled energy consumption in North America, Europe and Australia and the wholesale transfer of the so called 'developed' way of life (the 'old paradigm' in both American and European variants), including its appetite for mobility, to cities of the developing world.

There are also many factors that will act in the next fifty years to alter projections. One is the rising price of oil (Chapter 3). But it is not a happy thought that the surest route to transport sustainability lies in global economic depression. Another is, as Hu describes in Chapter 11, that the deteriorating local environmental quality in mega-cities (in China) and the shortage of land for agriculture, coupled with tolerance of high population density and strong governmental regulatory capacity will simply rule out the pursuit of the car/roads solution. However, avoidance of such an urban disaster is hardly a foregone conclusion. Barter, Kenworthy and Laube in Chapter 15 note that both India and China appear to be in the early stages of a boom in motorisation which, if it continues over many years, will not only ruin the local environment of cities in those countries but threaten the global atmosphere.

In the USA transport rhetoric emphasizes sustainability, and there are signs of significant change in values at grassroots level (see Chapters 2 and 6). But investment continues to flow into infrastructure schemes: mostly new road projects. The state Departments of Transportation (state DoTs) still have much power to decide how funding for transportation is spent. For example, the Interregional Transportation Strategic Plan for California makes clear where its priorities lie: "To protect and realize the maximum benefit from our investment in the highway system, we must continuously maintain and rehabilitate it... The state highway system supports, directly and indirectly, the state's economy and its continuing growth" (Sels, 1998: 15). Meeting this goal entails vast investment not only in maintenance, but also in enlarging and upgrading the state's highway system. The New York Metropolitan Transportation Council espouses the goal of sustainable mobility but envisages a potential US$65 billion wish list of transport investment projects (NYMTC, 2000: 2). The road lobby is very powerful: the American Highway Users Alliance wants to force states to use 85 per cent of federal funding for highway projects and allow states to use the remainder for other projects at state DoTs discretion.

The last rail transport developments proposed for Europe add a further dimension to the problem: that of networked cities in which movement between cities escalates dramatically and entire regions are mobilized. While better public transport is necessary to improve local environmental quality, and is particularly needed in cities of the developing world, the huge investment in high speed trains in Europe does nothing for environmental sustainability at global level and will merely increase greenhouse emissions. What is needed, as Whitelegg argues (Chapters 7 and 14) is the management of demand to reduce unnecessary travel.

From the above discussion it will be clear that sustainability should not be portrayed as the outcome of the classic engineering triangle of forces, but rather as the outcome of a set of nested boxes: economic sustainability inside social sustainability inside environmental sustainability (Figure 1.2). This perspective does not imply that society and economy have to be sacrificed to the environment, merely that what goes on in society and economy is subject to the natural environment which supplies the inputs and absorbs the wastes. Also that what goes on in the economy is subject to the fairness, integrity and stability of society. The city, after all, is a geographical system that exploits the environment for human purposes. What has to be planned is responsible use of the environment in a way that is socially just and can continue indefinitely without running down the environment's capacity to provide inputs and absorb wastes, and without destroying the complexity of life evolved over millions of years.

**Ecosocialization**

If change to the world's transport systems to make them more sustainable is going to happen, how will it happen? Nothing less than a "paradigm shift" is entailed. Thomas Kuhn (1962), and his successors in the sociology of science such as Bruno Latour (1987) have shown that what counts as acceptable knowledge is embedded in the society of those possessing it, and certain key
assumptions determine how its members understand the object of knowledge. Such key assumptions, or ‘paradigm’ stand until they are replaced by an alternative set of assumptions – and there is a ‘paradigm shift’.

It is easy to see that the assumptions supporting current transport policy are deeply embedded not only in society at large but more specifically in the policy communities inside and outside government that create infrastructure and transport. This is shown most clearly in the Australian case discussed in Chapter 12, but it is also implicit in many of the other national studies. Following the work of Hajer (1995) we can call these sets of assumptions ‘storylines’.

Each of the storylines comprising the ‘old paradigm’ seems like common sense. Each is embedded in practices and institutions: bureaucracies, dominant professions, transport planning agencies, customary methods of funding infrastructure and apportioning costs (environmental and social as well as individual and governmental), media treatment of transport, advertising, production corporations, transport products and technologies, trade unions, highway service organisations, class power (which did not disappear even though marxism is unfashionable), racial and gender inscriptions, and a vast array of regulations. There is no conscious conspiracy, but providers of transport speak with a common vocabulary to define problems and create solutions. This is neither surprising nor evil but change cannot be postponed.

Some of the storylines, institutions and powers are revealed and challenged in this book. If there is to be a change of paradigm, common sense will have to be re-evaluated. How can freedom of movement be protected while forced movement (e.g. the irresistible commuter trip) is reduced? What about freedom not to move? What sort of cities do we want and what sort of transport system would deliver them? How can we plan and manage a transport system as a mutually supporting whole? What is sacrificed to permit unimpeded vehicle movement, and is unimpeded vehicle movement healthy for people? Does infrastructure bring rapidly diminishing economic returns – especially when the hidden costs are accounted for?

The paradigm shift will not come easily or quickly. But if it is true that the major technological systems of the world economy are severely eroding the environmental resource base of the planet, the ‘natural capital’ in Daly’s terms, then we need to consider a much longer term and even more profound process of societal change. We have elsewhere termed this process ‘ecosocialization’, drawing on the seminal work of Karl Polanyi (Low and Gleeson, 2001; Low, 2002). Polanyi described the social countermovement evolving over a hundred years or more in England to protect society against the destructive effects of expansion of the market promoted by national governments. The various institutions of transport (including public roads) are among the social supports resulting from that movement that today make life for humans in cities tolerable. They represent a trade-off between the market and society – but at cost to the environment.

The environmental crisis has provoked a new countermovement on the part of society to protect its ecological supports and adapt capitalism to its ecological limits (see Bernard, 1997). We term this movement ‘ecosocialization’. It is not a class movement (socialism), nor a ‘social movement’ like the ‘anti-war’ or ‘pro-life’ movement, though of course it may mobilize communities and groups into action. Ecosocialization springs up within society’s institutions and organizations as a new common sense (paradigm) establishes itself. New questions are posed and answered. New values superimpose themselves over the old. Existing institutions change their behaviour. New rules and procedures are introduced to implement the new common sense. New technologies are gradually embedded to deliver the new values. Ecosocialization is a change at the level of the cells and organs that make up the body of society. The ‘eco’ prefix signifies an awareness that the environment is at stake and must be protected in future human development.

Is ecosocialization taking place and what does it entail? Newman in Chapter 2 points out that changing social values driven by changing demographics are leaning to a more urban and less suburban lifestyle. His focus is the USA and Australia. This is reinforced by a changing nexus between the ‘knowledge economy’, communication technology and concern for sustainability. His focus (with an emphasis on the USA and Australia) is pressure for ecosocialization welling up from below. Unquestionably, also, automotive technology will be part of the solution to both global warming and the peak of oil but it cannot do much about the health effects of dispersed production and consumption. The rising price of fuel will accelerate technological change. But the difficulties should not be underestimated. As is evident from Chapters 4 and 5, technology is not a magic wand. All technologies involve difficulties, costs and contradictions: the popular beliefs that it will one day be possible to run cars on water or that economic interactions will mainly be conducted electronically are nothing more than myths.

The picture presented in Chapter 7 is dark – it may be too dark for some readers to accept readily, yet it is backed by evidence. Whitelegg depicts a developed world (Europe is the focus here) in which a health and environmental catastrophe is unfolding. Society is being spatially reorganized by central authority around a dispersed logistical model of production and distribution, the costs of which are being continuously loaded on to public III health, social injustice and environmental destruction. Vast sums are being spent to facilitate unnecessary movement of people and products. The failure to deal with the unintended effects of transport in the modern city today, he argues, is equivalent to the failure to deal with the unintended effects of deforestation in the city of the Industrial Revolution. The latter caused plagues of cholera and typhoid, the former is causing epidemics of death and disease every bit as severe. In many ways transport-generated
urban dysfunction is more severe, as well as more subtle, because of the global threat of climate change caused by the locally innocuous carbon dioxide emitted from the transport sector.

In Europe ecosocialization is proceeding slowly and can be found at government level in policy and rhetoric, but it is not yet influencing the crucial actions which cause the distance-intensive society and generate the social and environmental costs of transport. This is probably because the full impact of transport is only just beginning to be appreciated in central policy-making circles in terms of long term sustainability rather than short term economic growth. It seems that there are severe barriers to change created by existing paths of thought that are preventing paradigmatic shift.

Tengström's policy analysis in Chapter 8 of what can be regarded as the world's vanguard nations in transport sustainability (Denmark, the Netherlands and Sweden) provides a nuanced perspective on social change. He shows how, and considers why, different nations proceed at different rates and at different times with the change demanded by 'sustainability'. Reflecting on his observations he introduces a number of key concepts to explain the variance in policy change: the secular upswings and downturns of attention on political issues, or 'issue cycles' – the perception of crisis seems to play a part here; the discourse theoretic concept of storyline ('sustainability' and countervailing stories supportive of conventional transport planning); ecological modernisation (within the Netherlands as the outstanding model); varying political cultures and processes and geographical differences; government failure and acceptance failure (on the part of citizens).

Tengström's analysis and evidence does not contradict the picture presented by Whitelegg but provides an explanation and also a way forward via the simple but neglected process (even in vanguard countries) of real communication and dialogue between citizens and government.

Can we draw some hope from the experience of different regions? It is evident that change is gradually occurring in the United States – people are simply demanding something different from the car dependent non-place urban realms that American suburbs have become. The change is being driven from the bottom up (Chapters 2 and 6). In Europe there is a concerted push coming mainly from the neighbourhoods, the cities and their planners but finding expression and financial support at the level of the European Union. The range of policies is discussed in Chapter 13. There have been some striking success stories in demand management which show that economic growth can be decoupled from growth in movement (Chapter 14). Infrastructure investment policy, however, both in the USA and Europe remains fixed on maximising mobility and expanding the space of economic exchange under the assumptions of the old paradigm. It is grossly unsustainable and highly resistant to ecosocialization.

Asian cities face a critical choice. The varying experiences of cities of this vast region demonstrate that wealth and motorization do not correspond.

There are considerable differences in policy orientation, the more successful and cost-effective cities investing heavily in public transport as mode of choice and not allowing that mode to become a residual welfare service for the poor. The evidence presented strongly suggests that an early decision to prioritize public transport over private transport brings long-term benefits not only in environmental and social sustainability and improved public health but also in economic security (Chapter 15). Yet the lure of the old paradigm of growth and mobility American style remains powerful. It has been disseminated and promoted in Asia and India by consultants from the developed world (mostly from the USA) and it will take a long time and much continuing effort to overcome. Important is the development of critical, analytical and problem-solving capacity within the nations and cities themselves so that these cities can address their own problems with locally generated rather than imported solutions.

Conclusions

Cities gather people together for the purposes of social and economic interaction. But with increasing scale this gathering leads either to congestion – with too little space for living, or separation – with too much time spent in conducting exchanges over space. For a hundred years transport based on burning carbon fuels deposited in earlier periods of extreme global warming (millions of years ago) bridged the gap between congestion and separation. Extending personal mobility to the people was the freedom offered, and mobility and its symbols continue to exert a powerful hold over public perceptions. The technology of the motor car and the road, whatever one thinks of its social and environmental consequences, is a wonder of contemporary culture.

The bridging function of transport was not carried out without cost. The transport solution to population congestion led inevitably to congestion of the transport corridors. But the cost could be accepted because it was either placed on society as a whole in the form of massive expenditures on transport infrastructure, land and health, or distributed to the more powerless sections of society, or loaded on to the environment in the form of localized air and water pollution and the use of the whole atmosphere as a carbon sink. The result has been the growth of an extensive and highly sophisticated institutional system supporting the production, design and financing of transport infrastructure built on the assumption that fossil-fuelled mobility could continue for ever.

Urban transport today is not sustainable for reasons that will be developed fully in the chapters to follow. The situation is extremely serious and requires immediate action by governments, communities and businesses. The time of fossil fuel is rapidly coming to an end both because of the environmental consequences of returning fossil carbon to the atmosphere
and because the fuel itself is running out. Increasingly mobility will become a zero sum game. Mobility for some will be at the expense of immobility and disease for others. There will be distributional effects both within and between places (nations, regions, cities). Cities that have invested in diverse alternatives, especially in a well planned and high quality service offered by mass transit systems, will be in the best position to survive and prosper both socially and economically. Cities that are dependent on a single mode of transport, especially one based on private vehicles and roads, will face growing hardship, pollution and social strife.

Technological change will undoubtedly provide some solutions. But we must never be tempted to believe that technology will solve what are essentially problems of planning and management. Public expectations and demands may also have to change. But the biggest ‘roadblock’ to ecosocialization is likely to be the inertia of the institutional system and its beliefs which remain devoted to the pursuit of a worn out paradigm.

Notes

1. This is a longstanding line of argument. H.F. Storch in his ‘Course in Political Economy’ of 1823 writes: ‘Every detour, delay, intermediate exchange which is not absolutely necessary for this purpose, or which does not contribute to diminishing the circulation costs, harms the national wealth by uselessly raising the prices of commodities’ (cited by Marx, 1973: 636).

2. Many sociologists (since Max Weber) have observed that the growth of cities is associated with the advance of ‘modernity’ and its corresponding challenges to traditional forms of social integration. With such challenges, modernity has also brought certain freedoms and a relaxing of social control. We can follow van der Pijl’s characterisation of the dominant form of modern polity as ‘Lockean’ after the English Enlightenment philosopher, John Locke. The Lockean form admits of a wide range of variation from the social democracy of Sweden to the market society of the USA, from the state corporatism of Singapore to the consultative politics of the Netherlands, embracing republican, federal and monarchical constitutions. But modernity also brings new expressions of class power and new ideological structures associated with the ‘individual’, ‘private property’ ‘economic irrationality’, the ‘rule of law’ and the market. Of course one may reasonably question whether such ‘modernity’ is desirable. But the fact is that states all over the world from Brazil to Bangladesh, and South Africa to China have embraced modernity and fashioned their societies to a greater or lesser degree around the principles of Lockean politics.