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SOCIALLY AND ENVIRONMENTALLY APPROPRIATE FUTURES FOR THE MOTOR CAR

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1.INTRODUCTION

In its relatively short life, the automobile has provided western society with a level of mobility unlikely to have ever been feasible with a reliance on conventional forms of land based public transport. The automobile has contributed in both a positive and negative way to the quality of life. It has contributed to the transformation of our cities, to our way of life, and given us a greater command over time and space. Concern over the undesirable social and environmental impacts has increased over time, with calls for governments to take action to reduce the automobile's dominant role. New investment in fixed-track public transport together with strategies to discourage travel have been proposed to improve the positive contribution of transportation as a means of accessibility and as an aid to cleaning up the physical environment.

This paper documents some of the arguments on how society might progress as a whole to achieve an economically and environmentally sustainable future. A distinction must be made between what is likely to occur given knowledge of feasible technology, the willingness and ability of consumers to respond to change, political will, and what individuals with particular views would like to happen. Many commentators argue that governments and consumers will respond in ways which are not substantially different from the past (Schulz 1991). Governments face real challenges in the provision of appropriate incentives to enable early introduction of improved technology. The set of options include:

- road pricing (i.e. charging cars the economic cost of using the roads),
- spatial incentives to make public transport economically viable (i.e. changing urban densities),
- adjustments in the relative prices of location and transport,
- zoning/incentive changes to allow more infill,
- major improvements in the fuel efficiency of fossil fuelled vehicles, and
- alternative-fuelled vehicles ("clean-air vehicles").

2. POSITIONING THE AUTOMOBILE IN THE AUSTRALIAN TRANSPORT TASK

The Stock of Passenger Vehicles

Passenger vehicle registrations in Australia have grown from just under 4 million in 1975 through to 7.2 million in 1988, with expected growth to 10.3 million in 2005, on the assumption of a population of 20.4 million in 2005. This translates into a car ownership rate of 0.44 passenger vehicles per person in 1988 and 0.50 in 2005, well on the way to one car per person of driving licence age. There is no necessarily increase in annual vehicle kilometres per capita (with evidence in the USA suggesting a slowing down of the growth in kilometres of travel per person - Lave 1990). In 1988, 86 percent of cars operated in the capital and major provincial cities with 10.4 percent operated by businesses.

The Age of the Fleet

The automobile fleet has aged in recent years, increasing from an average of 6.4 years in 1980 to 8.6 years in 1988, in large part due to the price of purchasing a new vehicle, the quality of vehicle technology which is extending vehicle life, and the slowing down of the economy. It is not expected to change significantly in the next 15 years, unless governments introduce major changes in policy such as the elimination of sales tax on new vehicles and an age-related registration charging regime. The equity implications of the latter policy would need to be taken into account in recognition of the higher incidence of older vehicles in lower income households.

Sales of New Passenger Vehicles

The sales mix of new vehicles is an important issue from the viewpoint of environmental pollution, road space requirements and government revenue. This figure is expected to rise to 498,000 in 2005 (NELA 1991). Passenger cars represented 79 percent of new vehicle registrations in 1988, with 26.7 percent of passenger cars in the mini and small class, increasing to 35 percent in 1990. Sales of new passenger cars have fluctuated from 330,000 in 1965 to 510,000 in 1985, but declined to 410,000 in 1988, increasing to 450,000 in 1990.

Energy Consumed in the Transport Sector

Of the energy used in the transport sector in 1989-90, 81 percent is accounted for by road transport (DPIE 1991), of which nearly 80 percent is consumed by the passenger car. 78 percent of all passenger kilometres in Sydney in 1988 were by car (Hensher and Milthorpe 1989), with a national total of just over 70 percent. During the period 1976 to 1988 the fleet average fuel consumption fell steadily from 12.6 litres per 100 km to 11.8 litres per 100 km. During this same period the total distance travelled by cars and station wagons increased by 49 percent, total fuel use by 41 percent and petrol use by 34 percent.

The share of total gasoline consumed increased during 1976 to 1988 from 76.6 percent to 81.2 percent. The national average fuel consumption for new vehicles has declined through this period more or less linearly, achieving 9.2 litres per 100km or a 23 percent decrease by 1989, with an Australian Federal Chamber of Automotive Industry target of 8 litres per 100 km target for 2005. The target under the Toronto protocol is 6.5 litres per 100 kms.

The Challenge Facing Society in the Light of the Statistics on Automobiles

The car's role in providing high levels of mobility together with high energy use highlights the challenge to improve the automobile’s contribution to Australia’s social and environmental future. Incentives to reduce the automobile's negative impacts on society can result in substantial benefits, even with small changes in automobile use.

The statistics on trends in travel and car ownership provide a basis for alarm bells. In examining the future profile of automobile travel, it is important to consider the role of public transport as an alternative. The mix of modes will be influenced in large measure by land use strategies, wealth, incentives and disincentives (e.g. a move to cost-related pricing). It is within this context that we should evaluate the potential for viable public transport in metropolitan areas, especially light and heavy rail, both of which are being

promoted as new investment strategies to "save our cities" and as a contribution to "saving our universe".

3. PLACING THE DEBATE IN PERSPECTIVE: LAND USE, TRAVEL AND INDIVIDUAL BEHAVIOUR

Are there Land Use Patterns that Reduce Travel?

This is an important question, frequently asked, but not answered in the affirmative on a metropolitan-wide scale, primarily because the relationship is not clear (Brand 1991). There is a third dimension driving them both - the behaviour of individuals and firms that affects the demand both for land use and travel. The power of the consumer is central to the relationship between transport, urban form and the environment. Individuals have **information** about a set of opportunities to engage in activities at various locations, some of which involve travel (for eg. work-getting to work), the individual also has **needs** which condition how he/she chooses among various activity opportunities involving travel. He/she also has **resources** (time, money, effort) that affect response to opportunities to travel and the location of activities at various places and prices.

Individuals respond to opportunities, needs and resources to consume both land and travel. As personal and/or household incomes rise, individuals around the world have tended to consume both more land and more travel. The growing number of multiple worker households in Australia has had a major impact on the distribution of household income, questioning the view of defining the personal income in previous studies (as distinct from household income) as the basis of evaluating social disadvantage.

The Imbalance between Transport Prices and Location Prices

Land-based urban transport has, historically, been underpriced, giving a false impression as to an efficient mix of land use and travel. One can buy more house per dollar further from the city centre, giving households an incentive to live further away from the urban centre. The decentralisation of residential location has provided an incentive for greater suburbanisation of workplaces; both in some ordered manner (e.g. the planned growth of Parramatta) and in a random way (e.g. the widespread growth in low density industrial activity). The Sydney central business district and sub-centres such as Parramatta and Chatswood in Sydney account for only 25% of all jobs. In Melbourne, in 1986, less than 14% of employment was in the CBD, 30% was in the central region as a whole and the other 70% was located in the suburbs (Brotchie 1991).

The added satisfaction of less expensive land, housing and a pleasant environment farther from the city centre has tended to be greater for the majority of the urban population, regardless of their financial means (HALCS 1991), than the added dissatisfaction associated with the transport cost of travelling to and from dispersed housing, employment, shopping etc. Any attempt to reduce travel demand involves influencing individuals to reduce their consumption of both land and transportation. Importantly we must come to recognise the need to price land and transport appropriately and give

individuals a choice of alternative mixes of residential location and travel opportunities. We must also recognise that preferences change over time and are very conditioned by information and opportunities. High density development with associated lower travel requirements may appeal to a portion of the urban population - at appropriate prices including environmental charges - but so **may** low density development, also at appropriate prices including environmental charges.

The important issue is **choice** in the context of cost-related pricing, including a price component which allows for the cost which individual travellers impose on other travellers (e.g congestion) and the environment (e.g. chemical pollution and noise). The social costs of high density may be high relative to the environmental costs and vice versa for low density. The argument could run the other way with social alienation in low density fringe development settled by low income households. Likewise low-density fringe living usually provides relatively cleaner air and less traffic (in the absence of appropriate pricing of travel - HALCS 1991), and attracts change-over buyers of housing on relatively higher incomes.

Some people will choose density under certain conditions, others will not, so policy should provide opportunities and incentives for those who like urban living as well as city living, rich and poor.

The Role and Influence of Individual Preferences

The critical issue is a recognition of the intervening role of individual behaviour in the mix of land use and travel. Within any regime of prices and physical plans, the observation of individuals' preferences provides the guideline on what individuals as members of society deem to be socially desirable outcomes. Since the sum of individual preferences in an inefficiently priced transport environment does not necessarily add up to a situation which is conducive to representing the benefits to society as a whole, we would conclude that the failure is not due to individuals having preferences and making choices, but rather that the wrong **price and physical planning signals** are in place.

The lack of cost-related pricing is the great lesson from the past. Road pricing and an environmental levy which are both location based and, for the former, also time-based, are examples of pricing instruments.

We must recognise that any grounds for assistance to individuals on low incomes, regardless of where they live, through choice or otherwise, should be treated on equity merit (e.g. a compensation package) **once efficient pricing is in place**. It is likely that efficient pricing would contribute to containing urban dispersal, but not eliminate it. Having established an efficient pricing regime, the justification for community-service obligation directed to those with genuine social hardship is then quite transparent.

We must see both correct pricing signals and physical planning as complements and not as alternatives. The "dark green" end of the environmental spectrum tends to treat physical planning (constraints) as an alternative to failed pricing. Under the new realism banner, eloquently documented by Goodwin et.al. (1991), it is important to recognise that the huge revenue sums raised from any change in road user prices must be allocated in a transparent way which is consistent with the preferences of both society and transport

users. This must include at least (a) an improvement in road space (i.e. increased speeds), (b) priority to users of roads who have economic or other precedence (e.g. high occupancy vehicle, freight vehicles); and if less road space is required to satisfy (a) and (b) then an enhanced environment (e.g. more open space). The latter is essential for political acceptance. Road pricing differs from physical planning in one important aspect - it provides money. There is hence a need for having the raised revenue earmarked, and seen as the proceeds of a charge. It is not a tax, but a price in respect of **resources** consumed in the act of travelling.

The current subsidy paid to operators to benefit **all** users of government-provided public transport is quite inequitable, benefiting as much the higher-income white collar worker as it benefits the low income worker. The nature of employment of lower-income workers tends to make them somewhat more dependent on a car, and given the higher incidence of rented accommodation (compared to buying a house),often have adequate disposable income to acquire an automobile.

4. TRANSPORT PLANNERS PREPARE TO FIGHT THE LAST TREND!

"Generals prepare to fight the last war; urban planners prepare to fight the last trend" (Lave 1990)

In developing plans and forecasts, urban and transport planners may have relied too heavily on generalisations from a highly atypical period of our history. Simple trend extrapolation runs the danger of ignoring structural change. The structural shift is very demographic; the changing age structure of the population, the changing sex ratio of licensed drivers and commuters, and the growth in income. Australia is moving close to a situation where the population physically eligible to have a driving licence will have access to a vehicle. There will remain a small percentage of persons who will be solely dependent on public transport for financial reasons and/or an inability to obtain a driving licence. Holding net immigration constant, although the number of cars per driver may continue to grow, the growth rate of per capita vehicle use might be expected to decline - we can only drive one vehicle at a time. However, even with a slow down in the **average** growth rate, the nature of averages is such that there is likely to be above average growth in some areas, and stagnating growth in other areas, raising the issue of the equity gap.

The commuter trip, directly linked to traffic congestion is of particular interest. If we take Californian cities as an example (which are not too dissimilar to the larger Australian capital cities), the decade of the 1950's had a 30 percent growth in the ratio of cars to persons, followed by a 15 percent growth rate in the 1960's and a 5 percent growth rate in the 1980's. The period of high growth is nearly complete with automobiles and the population moving towards equal growth rates. Lave (1990) argues that this slow down is typical throughout urban USA. Vehicle use, however, is what is critical in considering traffic congestion (Hensher et. al 1992).

Destabilisers - Net Migration, Workplace Suburbanisation, Capacity Constraints and Pricing

An important influence on the distribution of travel times and role of public transport (rail in particular) is the dispersal of the combinations of residential and workplace locations. Suburbanisation of workplaces in particular has tended to result in a substitution of commuter travel out of the train and into the car. Average travel times have decreased as a consequence. This is a theoretically natural consequence of the spatial dispersal of workplaces and residential locations (Brotchie 1991). The higher incidence of travel which is not towards the central city makes public transport less attractive - transfers act as a major inhibitor to changing transport mode and tend to increase in number in contrast to centrally-oriented travel. This is a supply issue, but one which becomes increasingly expensive to accommodate through public transport, explaining the significant switch to the use of the automobile.

Although average distance may have decreased, average travel **time** has most likely increased due to the capacity constraint on infrastructure, both for roads and railways, and the continuing underpricing of transport services. Brotchie (1991) reports evidence that for Melbourne as a whole, commuting trip times increased slightly between 1976 and 1981, and decreased significantly from 1981 to 1986. The increased number of short intra-suburban trips was a major factor in reducing average commuting time. Brotchie suggests that within existing land use patterns, work trip time shortening by as much as 68% is possible. In evaluating the level of traffic congestion on the roads it is important to place it in the context of the level of congestion "within a train carriage during peak times", which might be described as less individually tolerable than the congestion on the roads. Both sources of congestion highlight the failure to implement appropriate pricing which not only can provide the correct signals for use, but can also provide the correct signals for the magnitude and timing of investment in capacity.

The urban planner and demographer has a responsibility to expose decision makers to these critical transport implications arising from large increases in urban populations and suburbanisation. It is always difficult to gauge the relative influence of population growth (and its composition) and associated suburbanisation on the levels of traffic congestion associated with **all** transport modes, but we can say with greater confidence that an appropriate cost-related pricing regime will go a long way to alleviating congestion for all means of transport. Population increases associated with any spatial setting will be automatically accommodated by any efficiently operating pricing regime - higher congestion levels will be handled by higher congestion charges.

If the additional revenue is earmarked for improvements in transport facilities, then the benefits become quite transparent to all. The opposition to earmarking charges in the past has stemmed from a "benevolent social planner" approach, whereas a different view of society - that voters with differing preferences attempt to arrive at a consensus to support alternative public expenditure - tends to support earmarking. Identifying charges with defined parts of public spending can assist in achieving a closer assessment of individual preferences, improve compliance, stabilise revenue flows in the transport sector, and protect valuable public spending areas against less socially productive projects which, in an undifferentiated tax system, may crowd them out.

5. WHAT ROLE FOR PUBLIC TRANSPORT AND ROAD PRICING: HOPE

SPRINGS ETERNAL!

A Real Cause of the Problem and the Realism of the Future

Much of the discussion thus far highlights the general failure of markets to establish suitable prices for all means of transport (cars, trucks, trains, buses etc.). This failure in large measure is due to the **nature** of interference of governments, which has resulted in the underpricing of **all** transport services and hence an incentive for greater suburbanisation than may have otherwise occurred with efficient pricing (i.e. prices which have some relationship to the cost of providing services). We argue that although there may be great merit in promoting improvements in public transport, and rail in particular, that realistic assumptions have to be made about the way our urban areas in particular are growing in terms of form and density, and what the costs are in attempting by transportation pricing and investment to change the direction. One must, in debate, distinguish what can be done with a greenfields site and what can be achieved with an established urban area. The need for a comprehensive spatial efficiency strategy is clear - transport pricing and investment alone will not guarantee efficient, equitable, and desirable urban shape and density. This strategy should include incentives for the physical provision of a wide range of transport and land use investments.

The Historical Decline in Public Transport

The decline in public transport is linked to affluence. Wealth also provided a reason for suburbanisation. As incomes have increased, people have opted for higher quality automobile transport as well as more residential space (Brand 1991), as part of the desire and ability to have greater command over time and space. Automobile ownership and income growth were the "mirror image" of public transport's decline. The decline was aided by attractive parking opportunities and workplace decentralisation. Even though road based public transport could benefit by the growth in highways, the great advantages of the automobile as a door-to-door mobility medium outweighed the contribution of the bus.

Localised traffic management schemes and major traffic calming initiatives, designed in part to promote public transport, "skirt-around" the big issues - what is needed is a close look at the major surgical opportunities rather than the proliferation of band-aid "solutions". The big issues include a preparedness to provide additional capacity in public transport where a reasonable expectation of a switch to public transport will generate sufficient patronage growth.

The Passenger Rail Debate

There is a large academic literature praising the virtues of **new** passenger rail investment (e.g. Newman and Kenworthy 1989); a central theme being the ability of light and/or heavy rail to act as a catalyst for the development of medium and high density residential and employment centres throughout a metropolitan area, not necessarily at or near the centre of urban areas with an established core. It is implicit in the literature that the resulting living and working environment is preferred to that of low density.

Limited consideration is given in this literature to incentives required to get people out of their cars and increase rail use to a level which does not require massive subsidy. There is a strong presumption that the argued merits of rail systems such as environmental-friendly high capacity with typically low fares will provide the necessary incentives. The failure in the last 20 years to attract significant levels of new patronage to rail is in large measure due to the lack of disincentive to using the car. Despite the best of intentions, and the wider support for considering all transport modes as having a role to play, be it light or heavy rail, without substantial subsidy the only way to make rail significantly more attractive is to make the car less attractive.

A recent study by the Texas Transportation Institute (1991), which evaluated levels of congestion in the 39 largest urbanised areas in the USA, suggests that road traffic congestion growth continued in US cities from 1982 to 1988 almost without regard to the existence of urban rail. Atlanta and Washington, for example, which expanded their heavy rail systems considerably during this period, had greater traffic congestion growth than the average. This raises the question as to the extent to which such congestion growth would have been even worse without the rail investment, and thus the contribution to containment which was achieved by rail. One view supported by this author is that rail impacts will always be minor in the absence of ways of making the car less attractive - by a combination of pricing and physical planning: the former to raise revenue, the latter to direct investment funded by the earmarked revenue.

There is a counter-literature doubting the benefits of new investment in rail (e.g. Richmond 1991), a literature heavily centred on evaluating the recent USA experience. Much of the debate on new rail systems in the USA has emanated from over-zealous forecasts of patronage at the time of seeking financial support from Capital Hill, which failed to recognise how difficult it is to get people out of their cars:

> *The impetus for building rail systems in the US has little if anything to do with passenger demand. It is largely related to the availability of federal money to build such rail systems" (W. Cox, memo, 20 July 1991).*

The USA experience is clouded by the availability of cheap money and the absence of any effort to provide incentives to attract patronage. The Portland-Oregon light rail line, for example, diverted 6,500 daily trips from the automobile out of a total of nearly 4 million daily trips. This is equivalent to less than 50 days of natural travel growth in total person trips over the last 10 years in the metropolitan area. In Los Angeles, the number of new rail transit trips since the entire Blue line opened is 21,000 out of 38 million daily trips (with 63% diverted from bus). The days gained from the Blue Line is estimated as equivalent to fewer than 5 days of natural travel growth over the last 10 years. The implication is that the entire proposed light rail investment of nearly $US2 billion in Portland and $US6 billion in Los Angeles might "buy" a year's growth (W.Cox, memo, 20 July 1991). The overriding evidence suggests that up to 70 percent of new rail ridership is diverted from bus (reminiscent of the Eastern Suburbs railway in Sydney), with buses rerouted to serve rail interchanges.

Newman (1991, 28) puts the view that good transit systems provide the opportunity for highlighting public values in ways which give a city new pride and hope for the future. He

cite's Portland's experience.

The substitution of rail public transport for the automobile, as the main line launch mode is not the complete story, because a high percentage of rail users use a car to access the station. Furthermore, with express rail services from the outer suburbs of many cities, the incentive to substitute high priced locations close to the centre (or in medium to high density locations anywhere in the urban area) for lower priced locations is reinforced. The breakdown of appropriate pricing signals and physical constraints on car use once again is evidenced, this time with respect to public rail transport.

Improved public transport should continue to be encouraged, provided the right pricing and physical planning signals are in place. A common conclusion from many investigations of further light or heavy rail in the major western capitals with densities typical of Australian cities **and** inefficient prices is:

> *"Unfortunately, the more we learned about the cost and ridership of this proposal, the more convinced we became that it does not deserve legislative or public support. Our opposition is dominated by one simple, general conclusion -- Metropolitan Council and Regional Transit Board projections establish clearly that LRT would attract so few people from driver-only cars that it could not significantly increase transit ridership". (Citizen's League, 1991).*

A comparison of the life cycle costs of providing bus services compared to light rail in Los Angeles (using the construction and budgeted operating costs of the LRT Blue Line) leads to a conclusion that for the same level of funding, Los Angeles can either afford to build and operate the Blue Line for 30 years or operate 430 buses for 33 years, including the cost of building the operating divisions to support these new buses. For the same cost, however, the buses would produce over four-and-one-half times as many passenger kilometres and over nine times as many passengers (Tom Rubin, memo June 2, 1991). This result is reached even though the assumptions made tended to favour the Blue Line on several important issues. The decision to go with rail transit appears to have little economic or social basis. One can only surmise that there may be a physical planners implicit assumption in the decision -- that rail systems, unlike bus systems, can shape land use and that this alone is sufficient reason for justifying high levels of rail subsidy. Newman (1991, 12) would ask -- "are there no options for managing cities other than charging correct prices?".

The crucial issue missing in the debate to date on the future of urban passenger rail is the future of the automobile in the context of alternative regimes of pricing and physical planning signals. Without this context, the whole debate is lopsided and unproductive.

What We Observe to Happen and What We Would Like to Happen

The only way to change consumer preferences is to implement appropriate positive and negative incentives at the time of promoting a particular land-use transport strategy for the future. These incentives however must be compatible with agreed objectives on what is a desirable social and environmental future. The evidence in the previous section on rail performance is a statement on actual behaviour. A distinction must be made between what

is desirable from the viewpoint of society and what is likely to be achievable in a society where consumer preferences ultimately win out. The concern with the approach to implementing new rail systems in the USA lies in the absence of any **direct** disincentive to the car user.

This raises the important issue of pricing and the failure of government to work with the market in establishing cost-related prices, with due consideration of the social and environmental impacts built into the fuller set of costs. Road pricing, together with physical planning assumptions, should contribute jointly to provide appropriate **investment signals**.

It seems illogical and self-defeating to insist that the principles of competition and market pricing should increasingly apply to public transport operators and not to their main rivals, car operators. If there is a concern for achieving economic efficiency in passenger transport in the wider sense of properly accommodating the social and environmental impacts, then by far the most important task is to remedy the lax and inefficient pricing of car use. A comprehensive road-use pricing system with proper safeguards for residential environments and traffic safety would go a long way to bring about a more efficient urban passenger transport system. Then society would be more confident in establishing the best role for all competing modes, including due allowance for special equity treatment, for a given density of urban activity. This latter qualifier is critical to the vision of a future.

6. SOME SPECIFICS ON DISPERSAL, COMMUTING, TRAFFIC CONGESTION AND IMPROVED PUBLIC TRANSPORT

The Important yet Difficult Questions to Answer

Although there is an extensive literature on the pros and cons of higher and lower urban densities, the planning community has not been successful in systematically developing a debate on what urban density patterns are in the best interest of the population from economic, social and environmental points of view. The key questions include:

- What is wrong with urban dispersal?
- Can we afford to "promote" the status quo?
- What is right with medium to high density living?
- Can we afford to "promote" more compact living?
- How effective can alternative forms of transport be in contributing to the shape and density of urban areas in a way which is deemed to be preferred by the community?

The outcomes of individual behaviour resulting from facing efficient social (i.e. full-cost related) prices, including environmental levies (Dixon 1992), and acceptable physical planning should ultimately provide guidelines tempered by accompanying equity treatment. The latter might be appropriately handled through a compensation package which includes direct financial assistance to low income travellers.

Urban Dispersal and Public Transport Are Complementary!

Some forms of urban dispersal can work **in favour** of public transport, especially rail. Provided travel is radial towards the city centre, it provides an efficient mechanism for moving commuters over long distances at marginal costs well below those associated with the short-haul commuter train service, even with cost-related prices. For example, the electrification of the Sydney to Gosford line and the introduction of medium-speed express services to the centre of Sydney, together with attractive fares, has enabled the growth in residential living well away from the centre of Sydney. It has however also resulted in high vehicle use over long distances out of peak hours with long-distance visiting by friends and relatives.

Urban Dispersal and Inter-Suburban Commuting

An observable feature of dispersal is the growth in inter-suburban commuting. It is a powerful basis for rejecting the traditional view of the suburb as predominantly residential. For example, in the six largest metropolitan areas in the northeast USA, the suburbs accounted for 55 percent of the population in 1984 and 57 percent of employment in manufacturing, retail, wholesale and selected services. In the six largest metropolitan areas in the south and west of the USA, suburban residential share still exceeded suburban job share, but the excess had shrunk from 16 percent in 1950 to 9 percent in 1984 (Heilbrun 1987). The traditional view of the suburb-to-central city commuter trip is being replaced at a rapid rate by the inter-suburban commuter trip. There are good examples in Sydney at North Ryde and Castle Hill. Suburban offices are a growing proportion of total metropolitan office stock in Melbourne (Bell 1990, Brotchie 1991).

The assumption that dispersal leads to greater commuting is open to question:

> *"....relocation and other spatial structure adjustments by households and firms have avoided severe traffic diseconomies in large metropolitan areas. " (Gordon et.al. 1989).*

Even if suburban growth influences employment and other non-work related development outward, it does not follow that average commuting distances will be increased and that average kilometres driven will be increased. It may however alter the modal split in a way that increases total car kilometres travelled even though average trip length in kilometres by car is reduced (as argued in Section 4 above). The observed resulting congestion with increased travel time per kilometre travelled however is the product of incorrect pricing signals (and hence investment triggers), and not the fault of dispersal per se. The important point here is that the dispersal which results from an environment in which transport services are priced to reflect the **full** costs of provision (with earmarking of the revenues raised) will together with physical planning policies and incentives "produce" the appropriate form of transport for the situation, be it car, bus or train. **We are looking to promote efficient outcomes regardless of their private or public nature, and regardless of the resulting densities of urban activity.**

Dispersal and Density

Dispersal is not necessarily synonymous with low density development. Peiser (1989) argues that a freely functioning urban land market with non-sequential patterns of development promotes higher density development by later infill. An example can be observed around Macquarie University in Sydney. McLoughlin (1991), however, analyses the relationship between densities and total land demand and shows that higher nett residential densities per se contribute very little to the restraint of dispersal.

Urban Density, Dispersal and Congestion

> ***Which is worse: increased centralised intensity and duration of congestion or congestion spreading?***

The links between urban density and traffic congestion have to be treated carefully. One way of "improving" the situation is to build more roads and encourage more dispersal, at a rate which exceeds the rate of growth in vehicle use. Houston adopted this strategy but combined a 43% increase in freeway capacity and a 32% increase in arterial capacity with a commitment to allocate 5% of the new capacity to transit ways for buses, carpools and vanpools. Congestion peaked in 1984 and has steadily declined since then until in 1990 it is back to the levels experienced in 1979. This is not necessarily a desirable way of "solving problems".

Fortunately planners do not have to resort to this strategy. The locational adjustments by both households and firms in policentric metropolitan areas may provide a more satisfactory means of achieving congestion relief (Gordon et.al. 1990), facilitating shorter work trips and generating more opportunities for nonwork travel. In the Sydney context, for example, the identification of the benefits of this strategy are difficult to separate out from the impact of the under-provision of under-priced road and rail capacity, which might lead the casual observer to conclude that the build-up of traffic congestion in the last 10 years is the product of the dispersal of residential and employment activity. The real test requires a comparison of centralised and decentralised activity, **holding transport capacity and prices constant.**

Less than one percent of the metropolitan area of Minneapolis's employment gain between 1970 and 1986 for example was in the central cities. This dispersal of employment tends to work in favour of the automobile. Light and heavy rail may actually be counterproductive, possibly working to support a return eventual to a monocentric state for cities (which may be preferred by some sections of society), with the centralised growth in severe road traffic congestion being a residual but significant effect. In such a situation, however, road pricing would have resulted in a very high congestion charge, in contrast to the charges associated with a multi-centred urban area. Once again we see the merits of properly pricing all transport services and then using the market (with support from physical planning policies) to identify viable public transport that can serve radial travel demands and capture a share of the growing car travel market as workplace opportunities suburbanise within metropolitan areas.

Information Technology as an Aid in Making the Car more Socially and Environmentally Responsible

There are a number of technological developments which can in the future contribute to maintaining urban mobility as well as improving the efficiency of both private and public transport. However, the time horizon for influencing urban form in association with transport planning is long.

Without adding capacity, advanced traveller information systems will allow individuals to make much more informed choices to avoid congestion. These systems will enable travellers to know in advance and hence to control the levels of congestion at which they will travel. The benefits will come from user interactions with the system rather than from increases in capacity. Together with advanced traffic control systems, there will be a new capability to respond more intelligently and make more efficient use of available capacity (Transportation Research Board 1991).

Importantly, the new information environment will allow the accurate identification of recurrent bottlenecks, enabling the most cost efficient capacity increases across all modes. New technology such as automatic vehicle control will also involve higher speeds and closer vehicle spacings, increasing system capacity (Davies et.al. 1991). This increase in capacity may have a major influence on urban form. Information technology development will provide users and managers with informed choices on using transport capacity more efficiently while still preserving an individual's freedom to travel when and where they want. It will also facilitate the practical introduction of efficient pricing. Finally, there is a possibility through telecommunications to provide travel substitution options that involve changing the location of activities and reducing or eliminating the travel required (Salomon et al 1991). A possible longer term impact of telecommuting however, resulting from its ability to reduce the constraints on residential location, is to enhance the rate of spread of suburbia (Nilles 1991).These are important messages for the future role of the automobile.

7. ENCOURAGING CLEAN(ER) FUELLED AUTOMOBILES

Imagine a time when all automobiles use clean fuels. The only environmental legacy is (under-priced) traffic congestion (even the manufacturing processes are environmentally friendly), the extent of additional traffic congestion due to clean-fuelled vehicles depending on the life cycle costs (the total costs over the life of the vehicle) of such vehicles and the attractiveness of public transport as a feasible alternative. The social costs of congestion on the roads and in public transport (i.e. the stress and accident factors) may increase, although slower traffic will tend to unexpectedly reduce the exposure to risk of a physical accident between vehicles and humans.

This clean-fuelled vehicle scenario is likely to be sometime away. It is unlikely that alternative fuels will have a significant influence on purchased fleets for many years. The popular view in Australia is no earlier than 2010, although this is still quite uncertain (Hensher 1991, Hillsman and Southworth 1990).

In the meantime, it is desirable to identify both technological and pricing/taxing

mechanisms and incentives for promoting the provision and use of more fuel efficient automobiles. Through the Committee on Ecologically Sustainable Development, the Australian government has evaluated a number of strategies, including the imposition of corporate average fuel efficiency (CAFE) standards (achieved by identifying maximum technology scenarios for fuel-efficiency related technology), the elimination of sales tax on non-luxury vehicles, a gas guzzler tax, and age-related vehicle registration charges, all designed to promote a move towards a more fuel efficient vehicle fleet of conventionally fuelled vehicles.

Any successes with these proposals may however provide an economic argument for further deferral of the introduction of clean-fuelled vehicles. The challenge for government is to find appropriate incentives which they are willing to introduce to accelerate more fuel efficient technology and a gradual substitution by clean fuels. California has taken the lead with a legislated requirement to have zero-emission vehicles by 1998 comprising 2 percent of all sales, increasing to 10% by the year 2003. In addition, much more stringent emission standards will apply for all other vehicles, with permissable emission trading (Sperling 1991).

The LA301 vehicle, available for the first time in 1992, the first electric vehicle with the potential to compete with conventional cars in comfort, ride and practicality, is dual fuelled. In its all-electric mode, the vehicle produces zero-emissions vehicle with a range sufficient for more than 90% of all trips in the greater Los Angeles area. For longer trips, the car will utilise its auxiliary power unit, extending the range to more than 240 kilometres. The power unit is a fuel-injected, four-cylinder internal combustion engine with a pre-heated catalytic converter. A microprocessor-controlled powertrain automatically provides blended power from both electric and gasoline power sources to minimise emissions. A complete battery charge will power the vehicle for an avergae cost of $US1, using low-cost energy during the off-peak hours. The battery system is maintenance free. The environmental impact will be less than that of fossil fuels.

8. CONCLUSIONS

The aim of this paper is to establish a series of positions in relation to the role of the automobile in a setting which will increasingly see more emphasis placed on the social and environmental impact of car-related activity.

In summary, some main points for continuing debate are:

- Urban passenger transport is under-priced. When combined with the relatively lower cost of housing further from the centre of urban areas, this under-pricing encourages greater suburbanisation than would otherwise occur.

- The crucial issue missing in the debate on the future of urban passenger rail is the future of the automobile in the context of alternative regimes of pricing and physical planning signals. Without this context, the whole debate is lopsided and unproductive. Without a major effort to make the car less attractive, the **economic** future of public transport (especially rail), in the absence of massive public subsidy, does not look good.

- In the absence of a cost-related pricing strategy for all means of passenger transport, net immigration in urban areas will be a major factor in determining the levels of congestion both on our roads and within public transport (especially rail services).

- All forms of transportation infrastructure and services are potential candidates for improvement. However they must be evaluated in a context of cost-related pricing (accommodating the fuller set of costs such as environmental pollution). Market forces are a very powerful feature of the process - the challenge is to establish appropriate pricing signals such that consumer preferences for transport and location result in choices being made which are socially and environmentally acceptable outcomes.

- The issue of the shape and density of urban areas should be an outcome of the pricing process (and associated resultant investment activity) and not a constraint on it. The density and dispersal characteristics of our cities do not have to necessarily change in any major way to create a circumstance more conducive to major social and environmental gains. Society will not benefit by a one-sided strategy to starve the suburbanisation preference any more than starving the urban consolidation desire. This will place increasing pressure on state and local governments to be more open and flexible in urban design.

- The move to suburbanise residential and employment activities has tended to reduce average trip distances, and to increase average trip travel times. The increase in trip times, however, is also a result of under-priced and consequently inadequate capacity, in part reflecting a lack of resources to finance new investment.

- The introduction of road congestion pricing must be accompanied by advanced planning for rail capacity expansion, otherwise the congestion on the roads will be transferred to the rail network, the latter already exhibiting high levels of within-train congestion in peak periods.

- Planning for the full spectrum of urban densities reflecting efficient social prices for land use and travel (i.e. a full set of spatial bundling choices) will assist in making public transport economically more attractive but not dominating the automobile except in selective market segments.

- If alternative fuelled vehicles are more expensive than conventionally-fuelled vehicles, there may be a delay in conversion rather than a reduction in automobile demand and hence use. It is in society's interest to legislate suitable incentives and discounts to manufacturers and consumers (e.g. rebates) to ensure that environmentally more friendly automobile technology is transferred into the market at a rate sufficient to remove the more environmentally unfriendly vehicles without causing social hardship.

- A fatal flaw in some of the contemporary debate on the future of our cities may be that healthy and vibrant cities should have a central core which is alive 24 hours a day. The brooding over the downtown's relative demise and to plan big to revive it may have little correlation with the virtues of a socially and environmentally preferable future.

- One should be cautious about downtown and public transport promoters who have chosen to depend upon the downtown "solution" rather than consider the merits of the arguments that fixed-rail alone cannot compete with efficiently priced and well-managed

automobile transport, sound bus systems and supplementary transit schemes like dedicated busways, transit lanes and super expresses. Some years ago Melvin Webber predicted that BART in San Francisco " may become the first of a series of multi-billion-dollar mistakes scattered from one end of the continent to the other" (Webber, 1979, 132). We must be wary of the view that a rail system is by definition a transport of delight, a symbol of progress at which all can marvel, whatever the reality of its actual performance in enhancing social mobility, alleviating congestion, or reducing pollution (Richmond 1991).

A Final Word: "Horses for Courses"

The challenge remains - to introduce the full set of "right price signals" so that individuals can respond in ways that ensure the best social and environmental outcome, and governments, in particular, are then placed in a financial position to respond appropriately with new transport investment and appropriate physical planning incentives. All forms of transport should be given serious consideration.

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