Counter-Reformation in Urban Transport: Seeking 'win-win' solutions.

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Abstract:

Concern over the environmental costs of urban transport in Europe and North America has produced a consensus in favour of a significant shift of passengers from automobiles to public transport. However, the massive capital cost of building mass transit systems in developed areas requires trade -offs to be made between these costs and environmental and social benefits. In Australia, the choice is frequently presented in similar terms.

In this paper we argue that transport reform in Melbourne need not involve trade-offs between economic, environmental and social objectives. Strategies can be devised which simultaneously improve public transport cost recovery, the urban environment and the service offered to disadvantaged groups.

Melbourne's public transport infrastructure is already among the most extensive in the world, but is under-utilised compared with other Australian and North American cities. Patronage is anomalously low, as is cost recovery, given the size, density and centralisation of Melbourne. A major mode shift would involve accommodating additional patrons on existing infrastructure, and the marginal capital and operating costs of doing so are much lower than the costs of opening new systems. The analysis is also valid for other Australian cities, to varying degrees.

We calculate the increased emissions and operating costs incurred in expanding Melbourne's public transport patronage to equal best practice in comparable overseas cities. These are compared with the emissions savings from reduced car use and the increased revenue generated. The result is a "win-win", rather than a trade-off.

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1. INTRODUCTION

Concern over the environmental costs of urban transport in Europe and North America has produced a consensus in favour of a significant shift of passengers from automobiles to public transport. In Australia, such a consensus seems more elusive, due in no small measure to widespread concern about the financial costs of existing urban public transport systems, and the potential for additional patronage to increase these costs. The political debate about urban transport in Australia is currently dominated by 'reform agendas' that emphasise deficit reduction, rather than the environmental benefits of public transport.

There are other possible strategies for reducing the adverse environmental effects of motor traffic. These have been reviewed in Moriarty (1994) and Moriarty & Beed (1992a). The conclusion was that attempting to ameliorate environmental problems solely by modifications to vehicles or their fuel systems will not be enough. Although car pooling is another possibility, the U.S. experience in this area has not been encouraging and the Australian trend for work trip car occupancy rates is still downwards.

Reductions in the amount of travel undertaken by car will be required as well as measures of the kind discussed in the previous paragraph. It seems clear that most of the growth in personal travel over the last half-century has been in discretionary, as opposed to non-discretionary, travel (Moriarty, 1992b). Although discretionary car travel can also be reduced by combining trips, and shifting shorter trips to non-motorised modes, decreasing non-discretionary car trips will need to rely heavily on a mode shift to public transport.

The massive capital cost of building new mass transit systems in developed areas in overseas cities requires trade offs to be made between these costs and environmental and social benefits. In Australia, the choice is frequently presented in similar terms. Anson & Evans (1991) argue that a mode shift could be achieved by adoption of "the 'Toronto' model", but would require "significant investment in public transport infrastructure", while Lennon (1992) argues that "we would have to double the [operating] subsidy".

But perhaps there is a "win-win" solution, or a "no regrets" option (cf. Evans, 1992). In this paper, we argue that in Melbourne such an option exists, and that public transport can be used to reduce the demand for car travel without massive trade-offs. The analysis can also be extended to other Australian cities.

2. BENCHMARKING

How are targets to be set for improved public transport performance, particularly in the area of patronage?

Traditional transport studies have relied heavily on techniques which extrapolate from current performance levels. An example is the use of elasticities of demand to estimate the effects of changes to fares, service and so on. Demand elasticities are particularly useful for forecasting the short-term impact of small changes in service levels. They require little mathematical effort and, by relying on figures established by previous research, can avoid the need for surveys altogether.

Used in this limited context, the technique can be a valuable aid to decision making. When the technique is used in strategic planning to predict the results of major policy shifts, such as a 200% increase in suburban bus services (Ministry of Transport, Victoria, 1982, p. 33-5), a halving of public transport travel times (R.J. Nairn & Partners, 1993, p. 38) or a doubling of fares (IC, 1994, p. A176), problems arise. Elasticities involve using "straight line" athematical functions as approximations to assumed, but unknown, "demand curves". For all it small changes, the straight line is not a good approximation to the curve. In addition, the ry concept of a demand curve is problematic, since it involves an assumption that traveller haviour follows a "regular" pattern with no "lumps" or discontinuities. Finally, changes in the hole strategic approach to service provision are not easily reduced to the precise mathematical rmulations required to use elasticity-based techniques effectively.

her traditional techniques, such as the use of aggregate and disaggregate or behavioural travel mand models, because of the assumption that both behaviour and changes to service follow gular patterns that can be expressed as mathematical functions of measureable variables, are o less useful when seeking to measure the effects of "paradigm shifts" in policy.

alternative source of information is 'real-world experience', seeking to learn from 'success ries' rather than simply continue possibly undesirable trends. 'Benchmarking' is a current siness management buzz-word that describes "the continuous process of measuring products, rvices, and practices against the toughest industry competitors or those companies recognized industry leaders" (Camp, 1989, p. 10). Benchmarking is seen as superior to older proaches, which were "essentially a projection of past practices into the future" (p. 7). nchmarking in urban transport planning might set a target for public transport patronage not the traditional approach of constructing a predictive model based on past trends, but by amining 'best practice' in comparable cities. "Benchmarking is basically an objective-setting ocess. Benchmarks, when best practices are translated into operational units of measure, are ojections of a future state or endpoint" (Camp, 1989, p. 15).

this paper, we use Benchmarking to set achievable targets for a mode shift from cars to blic transport in Melbourne and discuss the changes necessary to reach these targets. We then nsider the effects of these changes on emissions, capital expenditure and cost-recovery to ess whether trade-offs are involved.

lecting the 'industry leader'

ing benchmarks to assess Melbourne's present performance firstly involves selecting a 'peer oup' of broadly comparable cities. This obviously requires the exclusion of urban areas where bstantial numbers of people are precluded from travelling by car, either through low car nership - provincial cities in the United Kingdom, most of the Third World (including, alas, ritiba in Brazil - cf. Hensher, 1994) - or extremely high population densities (much of rope) or limitations on car parking (London). The cities remaining for comparison are those Australia, the USA, Canada and New Zealand.

thin this peer group, Melbourne is remarkable on two principal counts:

- it has by far the most extensive tram/light rail network
- it has the second-largest urban rail network* after New York, and the largest relative to pulation.

lbourne is unremarkable in the areas of freeway infrastructure (more than Sydney or ncouver, but less than US cities, Toronto and Montreal), population density (see below),

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s distinguished from "interurban" or "commuter" rail systems such as the ctrified lines from Sydney to the Blue Mountains (beyond Penrith), Newcastle yond Ku-Ring-Gai) and Wollongong (beyond Waterfall); the 'GO Transit' system in onto and the Long Island Railroad in New York - cf. Vuchic, 1981, p92-4. In bourne, diesel-hauled "V-Line" services and the Dandenong-Pakenham electrified have been classified as "commuter" services incomes and car ownership (Newman & Kenworthy, 1989). Melbourne is also unremarkable in terms of current public transport patronage, measured either by annual trips per capita, overall mode share (passenger-kilometres) or mode share for the journey to work, being considerably below the Canadian average, but above the US average.

However, Melbourne stands out dramatically when one examines patronage trends over time, having the most dramatic fall in per capita journeys in the last three to four decades of any city in the peer group for which figures are available. Melbourne has performed poorly even relative to other Australian cities, having actually been overtaken by Brisbane (Table 1).

Table 1. Public transport in Australian cities, 1947-90.

City	Public transport use (pass-km per capita per annum)					Retention ratio*
	1947	1960	1970	1980	1990	
Melbourne	2900	1740	1220	780	740	26%
Sydney	3500	2160	1860	1510	1530	44%
Brisbane	2100	1350	955	745	810	39%
Adelaide	1600	890	570	655	705	44%
Perth	1500	910	730	590	470	31%

*1990 as a percentage of 1947.
Sources: IC (1993); Newman & Kenworthy (1989); Moriarty & Beed (1992b)

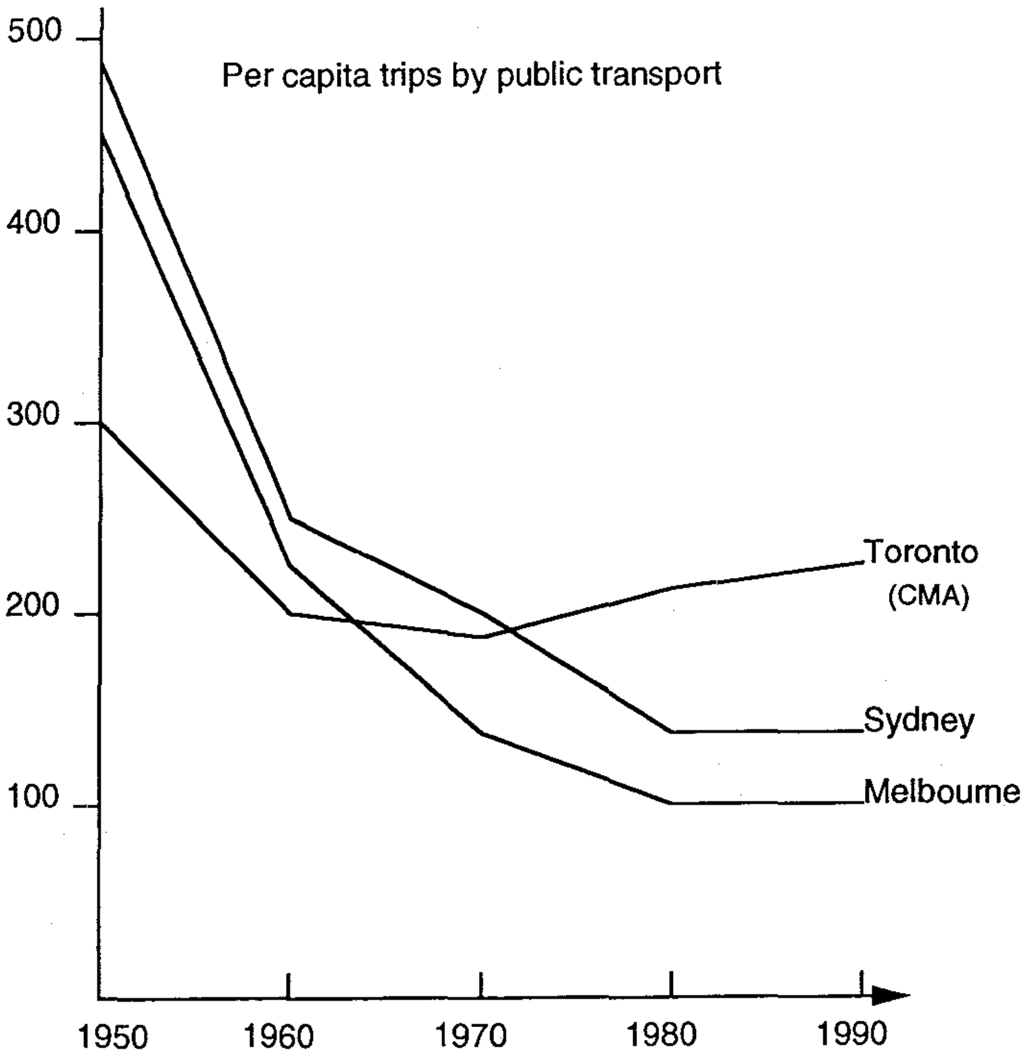
In terms of current patronage levels (however measured), the clear leaders in our peer group are Toronto and Montreal, with New York some distance behind, followed by Sydney and Vancouver (Table 2).

Table 2. Cities with highest public transport trip rates, and Melbourne.

City (Metro. area)	**Population** (million)	**Rapid transit** (route km)	**Unlinked trips/annum** (million)	**Per capita trips/annum**	**Source**
Toronto (CMA)	3.9	62	860	220	Bushell (B)
Montreal (CMA)	2.8(1980)	65 (1994)	512 (1980)	189 (1980)	Cervero
New York (Region)	18.0	443	2790	155	B, N-K
Sydney (SD)	3.6	286	500	139	B (see note)
Vancouver (CMA)	1.6	25	207	129	B
Ottawa (Region)	0.67	0	80	119	B
S. Francisco (SMSA)	3.5	114	407	116	B
Edmonton (CMA)	0.7	14	73	104	B
Melbourne (SD)	3.1	288	292	94	B

Notes:
Data is for 1990-91 or closest available figures. CMA = Census Metropolitan Area. SD = Statistical Division. SMSA = Standard Metropolitan Statistical Area. N-K = Newman & Kenworthy. Sydney patronage figure is an estimate, derived from Bushell and N-K, but reduced to exclude rail and bus services outside the Sydney S.D (e.g. Newcastle).

trends over time, Toronto stands out within this group of five, being the only city to close to maintaining modal share and per capita trip rates over the last three decades re 1). Given that Toronto lacks the very high-density core of New York (Thomson med that there were more journeys by taxi on Manhattan Island than by private car) ower density and higher car ownership than Montreal (Evans, 1989), it would appear trong claim to international benchmark status for public transport patronage trends.



. **Public transport patronage 1950-1990**
e, Sydney and Toronto - Unlinked trips per capita per annum.
Mees, 1994a).

ng showing of Canadian cities is consistent with the observations of other tors that a number of cities in Canada appear to be resisting the trend to declining nsport found in the USA, Australia and New Zealand:

> he situation in Canada is particularly interesting, since suburban development... is ry much in the North American, car-oriented pattern, yet public transport use is at ropean levels, and the trend is strongly upwards..." (Webster et al, 1985, p. 43)

Vuchic also regards Toronto as a benchmark of sorts:

> "Another interesting comparison is between several U.S. cities and Toronto... In 1950, Toronto had a similar transit service to that in U.S. cities; it had a simultaneous increase in auto ownership, it experienced urban sprawl (it has even fewer space limitations), and it constructed some of the widest freeways in the world. The drastic difference is that, unlike most U.S. cities, Toronto made a serious commitment to continuous improvement of transit. It constructed a rapid transit system and introduced numerous operational innovations. The consequences of this policy are clear: between 1961 and 1976 transit ridership in Toronto increased by 46%. During the same period ridership in most U.S. cities... continued to decline..." (Vuchic, 1981, p. 110)

Hutchinson, an Australian transport planner now based in Canada, confirms Toronto's status as a success story:

> "The Toronto experience has demonstrated that it is possible to maintain a high-quality public transport system in an urban society with very high levels of private car ownership, a changing social structure, a shifting economic base, and to derive about 75% of the operating costs from fares. The experience in many cities in Canada, the U.S.A., Western Europe and Australia with similar economic and social conditions has not been as favourable. Public transport use has declined substantially and governments struggle to finance systems with deteriorating levels of service.... The decline in public transport use in Toronto was not as severe as in other Canadian and most cities in the U.S.A. because of the sustained expansion of the system by the Toronto Transit Commission and sound land use planning." (Hutchinson, 1986, p. 326, 317)

At this point, it may be appropriate to dispense with two 'red herrings' that frequently arise when Canadian cities are cited in transport debates. The first is the suggestion that Toronto is "above the snow line . for a considerable period each year" (Ministry of Transport, Victoria, 1993, p. 4), and that residents are forced to use the subway system because driving is so difficult. Toronto's climate is "the same as in the northern United States" (Garrard et al, 1992, p. 13), with similar weather to neighbouring Detroit, and less snow than Minneapolis-St Paul (Statistics Canada, 1983).

The second is the proposition that Toronto has a phenomenally high population density, closer to that of European cities than Australian cities. In fact, most of the difference cited between Toronto and Australian cities results from inconsistent definitions of:

- urban boundaries (the Municipality of Metropolitan Toronto, covering the innermost two-thirds of the metropolitan area, has been compared with the whole of Melbourne and Sydney); and
- density measurements ('net' figures for Toronto have been compared with 'gross' figures for Australian cities).

Comparing 'like with like', we find that Toronto has a slightly higher population density than Melbourne now (about the same as Sydney's), but a much greater decline since the 1950s (Mees, 1994a; Appendix I).

When other background factors affecting the relative attractiveness of car and public transport travel are compared with Melbourne, Toronto shows:

- a wider and more extensive freeway and arterial road system (Brindle, 1992)

- similar levels of CBD car parking provision (Newman & Kenworthy, 1989) and, as observed by one of the authors on a recent visit, similar parking costs
- cheaper petrol
- higher incomes and car ownership levels
- a much smaller urban rail and tram network.

But public transport patronage shows a strikingly different trend, with Toronto having held market share constant for three decades and overtaken Melbourne, where mode share has been in free-fall.

We propose to use Toronto's public transport performance to set benchmarks for improved public transport performance in Melbourne.

3. INCREASING PUBLIC TRANSPORT PATRONAGE

What changes would be necessary to bring Melbourne's modal split to the same level as Toronto's?

The necessary overall patronage increase is approximately 150%, but different kinds of patronage will have greater or lesser rates of increase than the overall figure. While the number of work trips made by public transport would need to rise by only about 110%, the number of non-work trips would have to increase by about 200%. Patronage would need to rise some 90% in the inner suburbs, but 180% in middle and outer suburbs (cf. Figure 2, next page). The bulk of the increase in travel (passenger-km) would need to be accommodated on Melbourne's heavy rail system, which is much more extensive than Toronto's, but the greatest increase in trip numbers would be on buses, which would assume a much more pronounced rail- and tram-feeder role (see below). The smallest increase in trips would be for trams, which currently perform closest to the benchmark of Melbourne's three modes (see Table 3).

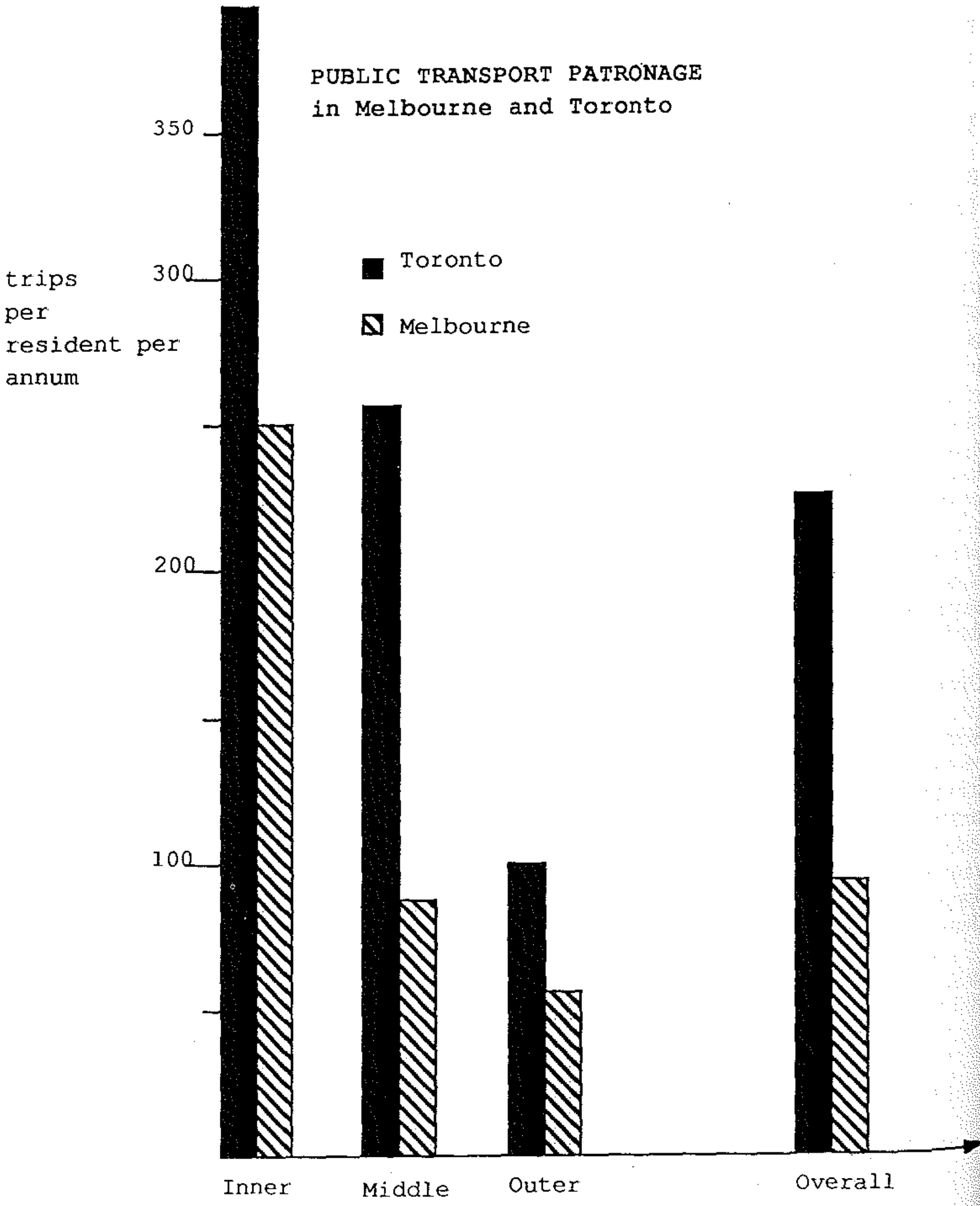
We have shown that, by relevant Australian and international standards, Melbourne's patronage is anomalously low, and have used Toronto as a benchmark of 'world's best practice' to set targets for improvement. We will now consider what would need to change in Melbourne for the benchmark to be achieved.

Organizational and operational changes

Some trips in Melbourne are difficult to make by car (the most obvious example being peak-period trips to the CBD), while others are difficult to make by public transport (e.g. long cross-suburban trips in the outer suburbs). In between these two extremes lie a large range of trips, currently made mostly by car, for which public transport could potentially be competitive for at least a significant minority of patrons. This will not occur, however, until Melbourne's transport planners and providers begin to strive for first-rate, car-competitive service, as opposed to residual services for "niche markets" like school children and pensioners (cf. Hensher, 1994).

> "The fundamental issue is very simple: a city must ask itself why it wants a transit system. Is the transit system intended mainly as a social service, aimed at those who have no other transportation options? ...[I]n such cities the transit system is peripheral to the community as a whole, which will be almost totally auto-oriented. ...The other option... is to make transit part of the fabric of the community. The marketing and service are targeted at "choice" riders as well as "captives", and the transit system is in competition with the car by providing safe, speedy, comfortable, clean and reliable transportation service" (Pill, 1988, p. 7).

Figure 2. Public transport patronage in Melbourne and Toronto
Unlinked trips per capita per annum. Source: Mees, 1994a.



Toronto stands out even in Canada as having achieved the apparently impossible task of providing high quality, cost effective public transport in a sprawling city. The secret of success is service and integration. Trains are fast, safe and clean, running every few minutes until 1:30 am. Buses and trams operate as feeders to the rail system, with frequent services and 24-hour coverage on trunk routes, and changing modes is easy. The excellence of the rail system draws passengers to the feeder buses, which also serve local and cross-suburban travel. The buses generate patrons for the rail system, completing the "virtuous circle". Public transport has been supported by a two-decade moratorium on freeway construction, except in outer areas, limits on downtown car parking (similar to those seen in Melbourne) and supportive land-use policies (Mees, 1994b).

Comparison with Toronto and other successful public transport systems shows that Melbourne currently performs poorly in terms of service coverage (the share of the population provided with "regular transit" service - cf. Vuchic, 1981, p. 105), coordination, reliability and frequency, although it does provide an integrated fare system. Public transport <u>service</u> in Melbourne has been deteriorating for decades. Frequencies have been cut and trains are no faster than when the first electric services commenced in the 1920s. Even the current State government acknowledges that service reliability is poor. New trams and buses have hardly affected operating speeds, which are determined mainly by traffic conditions. Buses are not timetabled to connect with trains or trams, despite scheduling having been under the control of a single authority since 1982, so nothing has changed since 1953, when Melbourne's planning authority lamented:

> "A few... buses run to and from the city, but in most cases they act as feeders to the rail and tram services... On account of infrequent service and poor co-ordination... there are relatively few who can save much time by using these services" (MMBW, 1953, p.184).

Very substantial improvements in all these areas will be required if patronage is to increase. Personal security is also a key factor in people's willingness to use public transport, and Melbourne's rail system is not perceived as safe, again in marked contrast to Toronto (which relies on train guards, first-to-last staffing of all stations and video surveillance, and where the rail system is perceived as one of the safest parts of the community - Pill, personal communication).

Changes external to the PTC

Travel demand management policies will be essential if public transport is to achieve its full potential. This is likely to involve restraint of new road-building, or even moratoriums (as seen in the City of Zurich and the Municipality of Metropolitan Toronto), and restrictions on car parking, especially in the central city and other areas well-served by public transport. Parking restrictions are recommended as an interim alternative to road pricing in the Industry Commission's Draft Urban Transport Report (IC, 1993).

The Victorian government has announced its intention to increase the population of all local government areas in Melbourne to regain the highest population achieved since 1971. The greatest increases, up to 50% in some cases, will be required in inner area LGAs (Burke, 1993). The area bounded by Footscray, Coburg, Box Hill and Brighton LGAs would require an additional 200,000 residents to meet the target. Importantly, these 20 or so (prior to completion of the current restructuring of local government in Victoria) municipalities are those with the best public transport service and highest levels of per capita patronage. While many are sceptical about the chances of meeting the government's targets, any significant increases in these areas would help increase public transport patronage.

The Industry Commission (IC, 1994) recommends the introduction of congestion-based road pricing in major Australian cities. Road pricing has the potential to increase the relative attractiveness of public transport, although this may not occur under the Commission's proposal that the income raised from road pricing be reimbursed to motorists by way of reductions in federal petroleum excise, ensuring no overall increase in costs to motorists. Higher road costs do not appear to be a factor in Toronto's superior performance relative to Melbourne, however, as both cars and petrol are less expensive in Toronto.

The increasing concern for the environment seen across the developed world in recent years suggests that a concerted strategy aimed at encouraging a shift of travel from motor vehicles to public transport has the potential to attract public support, an essential ingredient in its success.

4. WILL INCREASING PATRONAGE INVOLVE TRADE-OFFS?

Emissions

A shift to public transport of some existing car travel can only be justified on environmental grounds if public transport can demonstrate superior performance in this area. Appendix II shows that such a shift would produce significant reductions in greenhouse emissions, oil consumption and urban air pollution. Importantly, it can provide all these benefits - and others including reductions in traffic accidents, noise pollution and vehicular intrusion - without the need for trading off one environmental benefit against another. In contrast, recourse to biomass-based fuels or electric cars, for example, reduces urban air pollution and oil dependency, but increases greenhouse emissions (Moriarty, 1994).

Appendix II also shows that an important reason for public transport's environmental benefits is the potential for increasing existing low occupancy levels. At present less than a quarter of all seats on Melbourne's public transport are filled. If overall patronage doubled, but was accommodated through higher occupancies, rather than by providing twice the present number of seats at existing occupancy levels, increases in emissions would be minimal. As Table 3 shows, current occupancies are lowest on those modes which require the greatest increase in patronage - train and private bus (occupancy rates in both cities will have changed since the figures in Table 3 were prepared, but more up-to-date information is not currently available).

Table 3. Public transport occupancy rates*

	Melbourne, 1986.	Toronto, 1981.
Train (urban)	21 %	50 %
Tram	44 %	65 %
Bus	19 %	53 % (TTC only)
Government bus	30 %	n/a
Private bus	15 %	n/a
Average (all modes)	23 %	52% (TTC only)

* Passenger-km/ seat-km.
Sources: MTA (1987), p. 33 ; Newman & Kenworthy (1989); TTC (1982).

Toronto's superior performance is a result of higher overall patronage (especially on non-peak services), the use of more appropriately sized vehicles and the efficiency of a fully-integrated network. In contrast, occupancy rates of cars are very difficult to increase, because of declining household sizes, increased car ownership and the diversity of trip patterns (car-pooling is the least flexible form of urban transport).

Costs

A benefit of increased public transport patronage is the savings in expenditure for increased road capacity. Recently, the Victorian government has announced proposals for a massive road construction program, including freeway links in inner Melbourne. Growth in public transport patronage would remove the need for much of this expenditure.

It is not enough that increased public transport use should lead to unambiguous environmental benefits, even when combined with large savings in road expenditure. If increased patronage requires substantially increased subsidies, it would be necessary to ask whether there are cheaper ways of bringing about, for example, a reduction in greenhouse emissions. To answer this question, it is necessary to look at the capital and operating cost implications of increased patronage.

We have already noted that Melbourne has, by world standards, an unusually comprehensive fixed rail network, coupled with low existing patronage. Mees (1993) has demonstrated that the spare capacity of the heavy rail system is large even at the point of maximum peak-direction demand in peak period, when several times the existing volume could be accommodated. Even in peak period, there is spare capacity on many existing services, as well as surplus train sets (Melbourne has 50% more urban rail cars than Toronto - MTA (1987); TTC (1992) - but these carry only a third the level of patronage). There are also a large number of mothballed trams. At off-peak times, it is even clearer that there is surplus capacity.

A small number of additional vehicles may be required to accommodate the predicted increase in patronage, principally on the bus system, but the majority of the increase can be accommodated by raising vehicle occupancy to similar levels to those seen in Toronto. The total capital cost of the additional vehicles would be equivalent to a few kilometres of Melbourne's proposed freeway network.

Operating cost increases would also be modest, since the marginal costs of providing additional services on existing networks are low, as compared with the average costs. Operating costs for the Melbourne urban rail system are not available, but approximate figures can be estimated on the basis of its labour force. In 1991/2, Metrail employed 6302 staff (IC, 1993) out of a total PTC workforce of 18,667 (PTC, 1992). Total PTC operating costs in 1991/2 (all costs and revenues in this section are 1991/2 figures) were $ 1,185 million, excluding private bus contract payments. Apportioning costs on the basis of workforce shares gives approximately $ 400 million operating costs for Metrail. Metrail seat-kilometres in 1991/2 totalled 5,553 million (IC, 1993), giving an average operating cost of 7.2 cents per seat-km, or 34.3 cents per passenger-km, on the occupancy figures shown in Table 3. The reforms agreed between the Victorian Ministry for Transport and the Public Transport Union (PTU) in 1993 should reduce this figure to a little over 20 cents. This compares with PTC earnings of approximately 10 cents per passenger-kilometre (PTC, 1992), including reimbursement for concessional travel. If marginal costs increased at the same rate as average costs, as Lennon (1992) assumes, this would imply a "loss" of at least 10 cents for each additional passenger-kilometre.

But marginal costs per additional seat-kilometre are much lower than average costs, as can be seen from the authors' calculations for Melbourne's Upfield line (Moriarty, Donath & Mees, 1993). On this line, 3-car consists operate a 'flat' 20-minute service from about 6 am to 7 pm Mondays to Saturdays. Marginal operating costs for one extra seat-km on a new service during these hours are calculated as 1.2 cents for a 6-car consist and 1.6 cents for 3 cars, comprising only train crewing and running (including cleaning and maintenance) costs, but incorporating efficiency improvements agreed between the Ministry for Transport and the PTU. An allowance must also be made for infrastructure maintenance, station staff and overheads. Increased traffic will not significantly increase infrastructure maintenance costs (tracks, overhead, stations) since most are time- rather than distance- based. Station staff increases are more problematic, since most staff are to be replaced by ticket vending technology, on current proposals, but costs vary more according to the number of stations open than the number of passengers passing though them, regardless of the method of staffing. Finally, overheads are conservatively assumed to be 20% of direct costs. Total marginal costs rise to approximately 1.5 to 2.0 cents per seat-kilometre, so revenue is sufficient to cover costs (outlined above) even on current occupancy rates. Similar conclusions also apply to the tram and bus systems.

These findings are confirmed by returning to our benchmark for comparison. The two largest public transport operating authorities in Toronto (TTC and GO Transit) both recover 65-70% of operating costs from fares (IC, 1994) without concession recoupment, compared with around 30% currently in Melbourne.

5. CONCLUSIONS

Excessive use of cars in Australian cities is creating a variety of environmental problems, including smog and greenhouse emissions. Efforts to solve these problems by modifications to vehicles themselves, or their occupancy rates, will be insufficient. Reductions in car travel are required, which in turn requires substantial improvements in public transport patronage.

Comparison of Melbourne's public transport with that in comparable cities reveals that both patronage and cost-recovery are below the expected level. These comparisons suggest that suitable changes to public transport services and operating environments in Melbourne can produce gains in both patronage and cost-recovery. Toronto, the current 'industry leader', has been used as a benchmark to set targets in both these areas.

The necessary changes to public transport services include improvements in reliability, frequency, connectivity and safety. Changes to the environment in which public transport operates may include efforts at urban consolidation and measures to discourage automobile use, such as congestion pricing, parking controls and limitations on road-building

Public transport in Melbourne is well-placed to simultaneously improve patronage, cost-recovery and the environment because of the physical scale and carrying capacity of existing infrastructure and vehicle fleets. Patronage increases will add to revenue, while creating only small increases in operating costs.

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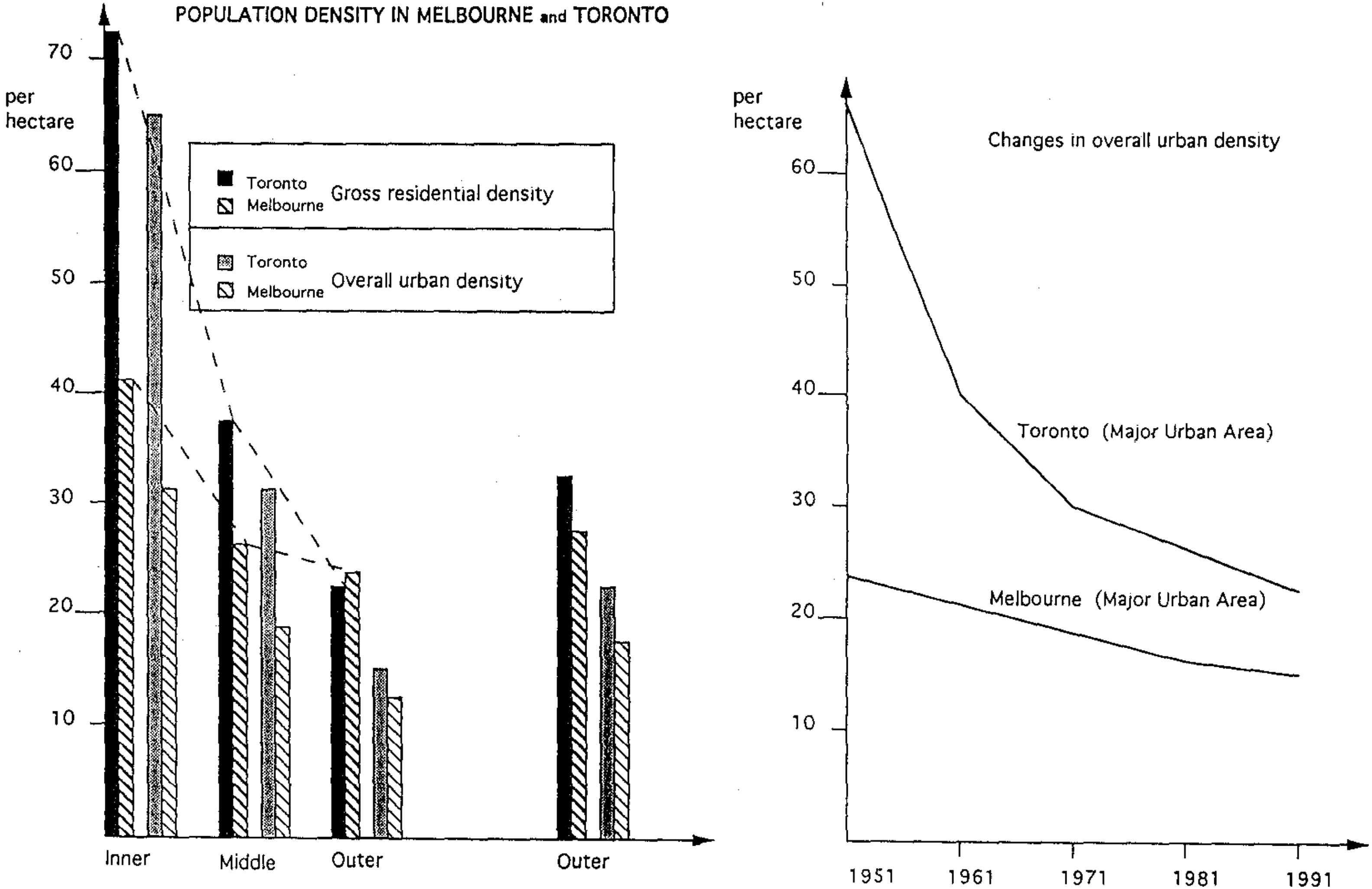

Appendix I.
Population density in Melbourne and Toronto (from Mees, 1994a)

Appendix II.
Environmental effects of higher public transport patronage.

Increased use of public transport would bring a variety of environmental benefits, including reduced urban air pollution, greenhouse gas emissions and oil use. We can quantify these gains by deriving a simple equation relating reductions in emissions (or oil use) and increased use of public transport. The equation is first derived for greenhouse emissions and later applied to reductions in oil use and air pollution.

Let V = total volume of vehicular passenger travel in Melbourne (passenger-km).

p_1 = present proportion of this travel carried on public transport.

p_2 = new proportion of travel to be carried by public transport

C = annual average car CO_2 emissions (in kg. CO_2/pass.-km)

f_1, f_2 = existing and new ratio of weighted average CO_2 emissions for public transport to those for car travel.

E_1, E_2 = existing and new total passenger transport CO_2 emissions (in kg).

Then, $$E_1 = (1 - p_1).C.V. + p_1.f_1.C.V \qquad (1)$$

For constant V (i.e. straight mode-substitution), then

$$E_2 = (1 - p_2).C.V + p_2.f_2.C.V \qquad (2)$$

Subtracting (2) from (1) and dividing by (1), gives

$$\frac{E_1 - E_2}{E_1} = \frac{(p_2 - p_1) + (p_1.f_1 - p_2.f_2)}{(1 - p_1) + p_1.f_1} \qquad (3)$$

In 1991, p_1 was approximately 0.08. As discussed earlier, this must be increased by 150% to meet the Toronto benchmark, i.e. $p_2 = 0.20$. The value of f_1 is 0.77 (Moriarty & Beed, 1992a). To demonstrate the importance of higher public transport occupancy rates, we will use two values of f_2; a "conservative" value in which $f_2 = f_1$, and a "best case scenario", $f_2 = 0.4 f_1$, meaning that all new patronage is accommodated within existing seat-kilometre levels, through higher occupancies. The Melbourne occupancy rates in Table 3 would increase from 23% to 57%, an achievable figure only slightly higher than the current rate in Toronto. The "conservative" assumption gives a reduction in CO_2 emissions of around 3% of current levels; the alternative scenario gives a reduction of some 12%, making a substantial contribution to the transport component of Australia's international climate change treaty obligations. Including other greenhouse gases has a negligible effect on the results. Note that for other Australian public transport systems, f_1 is much lower, because their black coal-generated power and diesel fuels are more efficient than Victorian brown coal- generated power.

When equation (3) is adapted to oil consumption savings, C is now read as average car fuel consumption (litres/ pass-km); f_1 and f_2 now refer to weighted average oil consumption ratios; and E_1 and E_2 to total oil consumption. Since the use of oil for generating electricity is negligible in Victoria and buses account for only 20% of public transport travel, then f_1 falls from 0.77 to 0.15. Thus, the percentage reduction in oil use ranges from approximately 11% to

13%. In contrast to CO_2 emissions, the effect of public transport occupancy rates on oil consumption is much smaller.

If equation (3) is used for evaluating air pollution, rather than CO_2, then C, f_1, f_2, E_1 and E_2 now refer to urban air pollution emissions. But unlike greenhouse emissions or oil use, air pollution health effects vary over the Melbourne region, being more serious closer to the city centre. Assume, for example, that all adverse health effects occur in the inner zone of several hundred square kilometres gross area and that 20% of vehicular travel there is by public transport. With $p_1 = 0.2$ and $p_2 = 0.4$ (not 0.5; see section 3 above) and f_1 again equal to 0.15, the urban air pollution reduction derived from equation (3) ranges from approximately 21% to 24%. These figures are only estimates, but it is clear that potential air pollution reductions in the worst affected areas are greater than for greenhouse emissions and oil consumption.