To:
The Chairman,
Rural and Regional Affairs and Transport Committee
The Australian Senate

3 March 2009

Re: Inquiry into Investment of Commonwealth and State Funds in Public Passenger Transport Infrastructure and Services

Dear Sir,

With regard to the Terms of Reference for the above Inquiry, I would wish to make a number of points, using Sydney as a case study to illustrate more general issues which apply t all the State Capital cities.

Term of Reference

(a) Audit of State of Public Transport

With regard to an audit of the state of public transport in Australia, I would suggest that this include such issues as:

- Overall travel patterns and trends, with specific reference to recent trends (which have shown a strong increase in public transport use in moist cities) as well as to patterns of travel within cities (since these vary substantially from the average for a given city)
- Data on passenger-kms of use, not simply trips. This is important for a full understanding of the role of different modes.
- Data on capacity and utilisation of different systems (e.g. seat-kms versus passenger kms; maximum network capacity (for rail) based on use of all potentially available train paths etc. This is important to gain an understanding of the scope for increasing services and patronage before major infrastructure upgrades are required.
- Infrastructure and rollingstock audit, including such issues as average ages of different types of infrastructure, percentage of fleet with air conditioning etc. These are important indicators of the quality of a network and of potential upgrade costs.
- Service quality indicators including not only basic data such as percentage of services on time, but other data such as average speed of services.

To take Sydney as an example, Glazebrook (2009) analyses the heavy rail system and identifies scope for a 27% increase in peak period trains to the CBD (with higher increases off peak or to other locations) assuming all effective capacity were utilised.

(b) Current and Historical Levels of Public Investment

As the Committee would be aware, Federal funding for public transport has been very limited since the elimination of the Building Better Cities Project, which had provided some funding for such projects as the Gold Coast Rail line and the Light Rail system in Sydney. (In this context, the author conducted an evaluation on the Employment Benefits from Expenditure in the Building Better Cities Program, including transport infrastructure components, in the 1990's).

Public transport in this country has therefore remained almost entirely a State responsibility, with limited involvement also by local government (with the major exception of Brisbane City Council, and individual initiatives by Councils such as Parramatta City Council which recently implemented a Central Area Shuttle Bus service).

With regard to investment in Sydney, Glazebrook, (2009b) undertook a detailed analysis of expenditure on public transport for the main modes (bus, rail) as well as for car, and analysed the relative costs per passenger kilometre for each mode including externality costs and subsidies. Summary results of some of this material is available in Glazebrook (2009a). A copy of the article is attached as it has not yet been published. This found, for example, that cars are the most expensive mode overall (per passenger-km), trains are the cheapest, and that Sydney spends approximately $22.9 billion pa on urban travel by car compared with approximately $3 billion on public transport.

These relativities may be if interest to the Committee in putting public transport in context (see summary data in Glazebrook 2009a, pp9-10).

(c) Benefits of Public Transport, including integration with bicycle and pedestrian facilities.

Comments on these issues in the case of Sydney are provided in Glazebrook, 2009a (pp 11-12, 18-20 and 43-45).

(d) Measures by which the Commonwealth could facilitate improvement in public passenger transport services and infrastructure

It is understood that the Commonwealth Government will shortly be allocating funds from the Building Australia Fund for major transport and other infrastructure, including public transport. This will be a key way in which the Commonwealth can contribute to improving the environmental, economic and social sustainability of our cities, and their resilience to peak oil and climate change.

However it is considered that such funding should require States to undertake a **public planning process which generates a long term agreed public transport plan** as a condition of receipt of such funds. Ideally the plan should be agreed by all major parties in the relevant State, or should otherwise be subject to approval by the residents by means of an appropriate voting system. This would guarantee that Commonwealth funds were not wasted or allocated on the basis of partisan politics or marginal seat considerations. The issue of the costs which can arise from the failure to have an integrated plan are discussed in Glazebrook 2009a.

In addition, Commonwealth seed funding should be made available to accelerate the introduction of such things as integrated ticketing and information systems (operable across States), innovations such as Bike Park and Ride facilities to widen the catchments of the public transport network, and additions to vehicle fleets (trains, trams, buses, ferries etc) not simply to fixed infrastructure.

(e) Role of Commonwealth legislation etc

Recommendations have been made in numerous reports for rationalisation of the taxation system in areas such as Fringe Benefits Taxation on cars. These should be implemented as the current arrangements lead to substantial distortions in travel behaviour with undesirable effects on the viability of public transport in our cities and on sustainability generally.

In addition, consideration should be given to allocating any proceeds from carbon trading (or carbon taxes) on motor vehicles in major urban areas to a **sustainable transport fund** to be used purely for improving public transport to cycling / pedestrian infrastructure in the city concerned. As discussed in Glazebrook 2009b, the failure of our current pricing systems to incorporate external costs is one of the key factors leading to unsustainable transport systems in our cities.

(f) Best Practice

A number of examples of this and of trends overseas are outlined in Glazebrook 2009a. Australia faces a particular problem of cultural isolation in that our decision makers and transport professionals tend to focus on developments in the United Kingdom and the United States, which are not always at the forefront of developments in public transport. We need a process for incorporating the latest developments in cities in Europe, Asia and other countries which tend to have much more substantial public transport systems and in many cases far better technological sophistication, as well as planning and management practices. Obvious examples include:

- Singapore (metros, automated light rail, financing techniques, long term integrated land use-transport planning)
- Hong Kong (metros, integrated development above stations, minibus systems, smart card ticketing)
- Paris and France generally (High speed rail, RER, modern light rail networks etc),
- Karlsruhe and Germany generally (tram-trains; integrated cycleway networks, land use planning)
- Bogota and Curitiba (high capacity busways)
- Switzerland and Austria (integrated timetabling, high capacity rail scheduling systems, integrated fares, parking and other policies to reduce car use)
- Singapore, Stockholm, London (road pricing)

To this end, the Federal Government should consider establishing a small but highly expert agency whose role is to monitor the latest developments in public transport and best practice around the world, and to run programs designed to accelerate the implementation of these (as appropriately modified for Australian conditions) into our

city planning and urban transport agencies and into the public transport and related industries in Australia.

This could be done through such measures as:

- funding study tours (including taking politicians and opinion leaders from business, the media etc as well as bureaucrats) overseas on a regular basis
- training programs in Australia at tertiary level to develop our skill sets in planning, engineering, management practices etc
- Funding programs to accelerate the adoption of innovations in Australia in best practice public transport systems – this could range from technological developments such as advanced passenger information systems, to innovations in financing such as land value capture techniques from transit oriented developments, to adoption of congestion or road pricing schemes to the development of local manufacturing capability for public transport vehicles.

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References

Glazebrook, G. (2009a): "Designing a Thirty Year Public Transport Plan for Sydney", University of Technology, Sydney, available at http://www.dab.uts.edu.au/built-environment/research/outcomes/.

Glazebrook, G. (2009b): "Taking the Con out of Convenience: The Real Cost of Modes in Sydney". Urban Policy and Research, forthcoming.

TAKING THE CON OUT OF CONVENIENCE: THE TRUE COST OF TRANSPORT MODES IN SYDNEY

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TAKING THE CON OUT OF CONVENIENCE: THE TRUE COST OF TRANSPORT MODES IN SYDNEY

ABSTRACT

There has been growing interest internationally in the development of comprehensive estimates of the costs of urban transport, fuelled in recent years by concerns over global warming, peak oil, road congestion, tolls and public transport subsidies. This paper examines the internal and external costs of major modes in Sydney. In terms of total costs, trains are the cheapest (47c/pass-km), followed by buses (57c/pass-km) with cars the most expensive (86c/pass-km). However the “out-of-pocket costs” of petrol, tolls and parking paid by motorists at the time of making a trip are only 14c/pass-km, less than one-sixth of total costs. This suggests rational individual travel choices do not add up to rational travel patterns for the city, and that we are paying heavily as a society for the convenience of cars. It also suggests that governments need to give higher priority for public transport and to change pricing for urban travel, if we are to develop more sustainable cities. Finally the analysis suggests that rail, which carries 70% of public transport passenger-kilometres in Sydney and has the lowest overall costs of any mode, deserves high priority for future public investment.

MAIN ARTICLE

1 INTRODUCTION

There is growing academic, government and public interest in the cost of urban transport. For example, a number of studies have looked at road congestion (BTRE 2000, NCHRP 2001, VCEC, 2006) and parking (Shoup 2005, Litman 2006) while road pricing has become a topic of popular debate after a congestion charging zone was introduced in central London. In Sydney, there has also been rising concern at the financial impact of tolls on motorists and over the financial sustainability of public transport subsidies (NSW Government, 2003b).

This issue is part of a wider debate on the environmental, social and economic sustainability of our cities (Newman and Kenworthy, 1999; Warren Centre, 2002; Centre for International Economics, 2005). Recently this has been fuelled by concerns about global warming (IPCC, 2007, H.M. Treasury, 2007), peak oil (Duffeyes, 2003; Simmons, 2005, ASPO, 2006), and rising petrol prices. In Australia, petrol reached $1.40 per litre in mid 2006, compared with less than $1.00 in early 2005, resulting in rising use of public transport. For example in Victoria, public transport increased by 6.2% in 2005/6, with car and petrol prices being cited as the most common reason for changed travel behaviour (Metlink, 2006), while bus patronage in Brisbane 2005/6 was 12.6% higher than in the previous year (Transit Australia, 2006).

In response, there are increasing attempts to develop standardised accounts covering all costs and output measures for transport modes on a uniform basis (Delucchi, 1996, Banfi et. al., 2000). For example, Table 1 shows summary pilot data for Switzerland (UNITE, 2002).

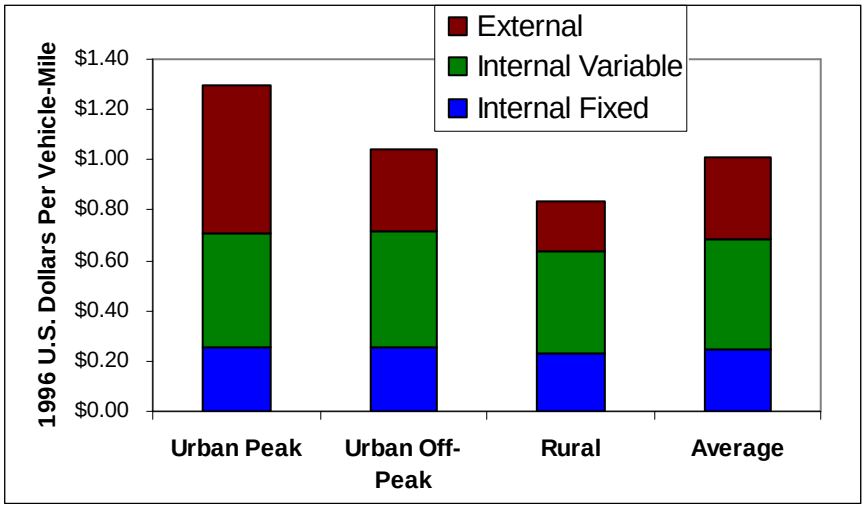
Table 1
Pilot Mode Comparison Data for Switzerland (1998)

Mode	Passenger Cars	Trains Passenger	Non-Rail Pub Trans (Regional)	Non-Rail Pub Trans (Urban)
Pass-Km (Billion)	**77.19**	**14.10**	**1.60**	**3.09**
Veh - km (Million)	**47,554**	**132**	**147**	**124**
COST (1998 Euro million)				
Infrastructure (a)	3036	1220		
Operating (b)		1999	492	778
Internal Accident (c)	3102	22		
External (d)	2095	116	27	83
TOTAL Public and External	**8233**	**3357**	**519**	**861**
User Payments	**3391**	**1441**	**243**	**432**
User payments as % of Total	41%	43%	47%	50%
Ext costs (Eurocents/ pass-km)	2.72	0.83	1.71	2.67

Source: UNITE (2002). Notes:
(a) Infrastructure costs for non-rail PT included with roads
(b) Operating costs for cars as well as other costs (eg space for parking) ***not included***
(c) Included with road for non-rail PT
(d) Includes external accident costs, environmental, delay and certain other costs

Similarly, the New Zealand Ministry of Transport has produced estimates of the total cost of road, rail and public transport, finding that cars pay an estimated 64% of their costs, trucks 56% and buses 68% (NZMOT, 2005), while Litman (2006) reviewed a large number of studies and provided estimates for a number of cost components and modes (Figure 1).

Figure 1
Cost Components for US Cars (US $ 1996 per passenger-mile)



Source: Litman (2006)

In the case of Sydney, there have been various studies focusing on specific cost components, such as private costs for new cars as published by NRMA (2006), resource costs for road transport (Centre for International Economics, 2005) or government costs for public transport (NSW Government, 2003b).

However comparative information across modes is scarce. This paper aims at a comprehensive analysis of the internal and external costs of the major modes in Sydney, including often over-looked components such as parking, with the aim of providing a solid basis for formulating appropriate pricing and other policies.

Definitions and Methodology

Litman (2006) provides a useful discussion of the differences between internal and external costs, fixed and variable costs, and market and non-market costs. For this paper, the following classification is used (see Figure 2):

- External Costs include both subsidies to road and public transport agencies and environmental and other externalities such as pollution, noise, congestion etc.
- Internal costs include “Out-of-pocket” or “Variable User” costs which the motorist or public transport user typically faces at the time of making a trip (petrol, paid parking, road tolls and public transport fares) and “Other User” costs typically paid every few months or annually, including vehicle registration, insurance, maintenance and depreciation.

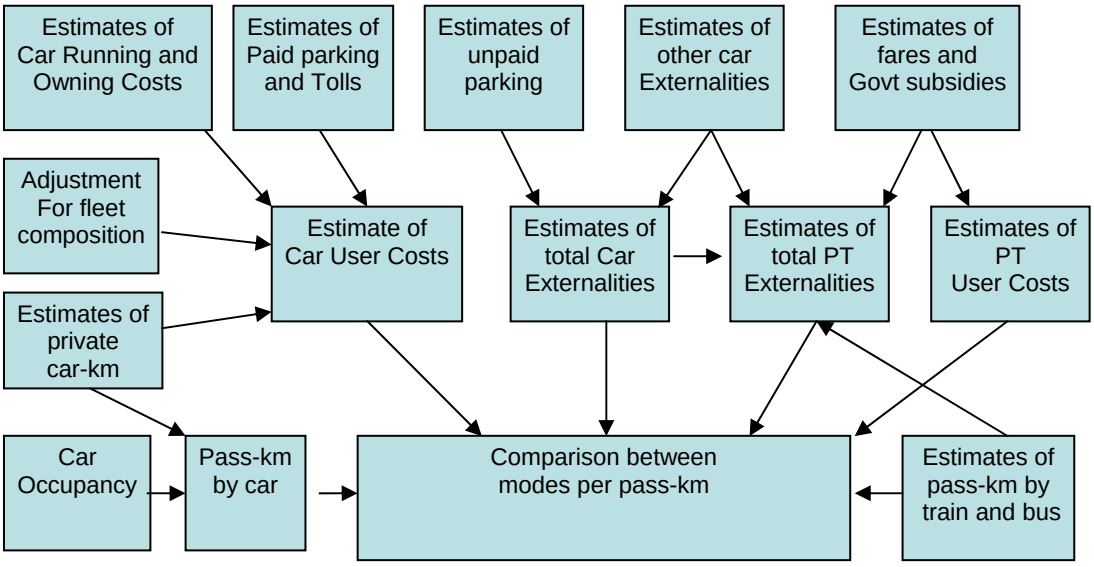
Figure 2

Classification of Costs

		Private Transport (Cars)	Public Transport (Train, Bus)
Total External Costs	Environmental and other Externalities	Pollution, noise, congestion, accidents costs above insurance, "free" or subsidized, parking etc	Pollution, noise, accident costs, contribution to congestion etc
	Government Subsidies	Payments to RTA from general revenue, Local Govt Rates used on Roads	Government subsidies to Operators
"Internal" or Total Direct User Cost	Other User Costs	Registration, Insurance, Depreciation, Maintenance	
	"Out-of-Pocket" or Variable User Costs	Petrol, tolls, paid parking	Fares paid by users

The methodology adopted has been to combine estimates of actual usage of different modes in Sydney with estimates of particular cost components and per-km costs into a framework which allows meaningful comparisons (Figure 3). This has inevitably involved a variety of published data together with some estimates made by the author in areas where limited published data exists, such as parking costs.

Figure 3
General Methodology Adopted



The rest of the paper is structured as follows. Sections 2, 3 and 4 analyse the internal, external and total costs of private motor vehicle use while section 5 covers public transport costs. Section 6 then provides a comparison between modes, and a discussion of the key policy implications.

2 PRIVATE CAR COSTS IN SYDNEY

Car Usage

In 1999, Sydney residents made just over 14 million trips per day. Approximately half were car driver trips, and 23% by car passengers. The average car trip was just over 10km, generating 26.6 billion car-km, with average car occupancy of 1.45 (NSW Transport Data Centre, 2002). More recent estimates (Centre for International Economics, 2005) indicate that cars travelled an estimated 32.8 billion km in Sydney in 2005, forecast to increase to nearly 40 billion km by 2020 (Table 2).

Table 2
Forecast Increase in Road Traffic for Sydney, 2005-2020

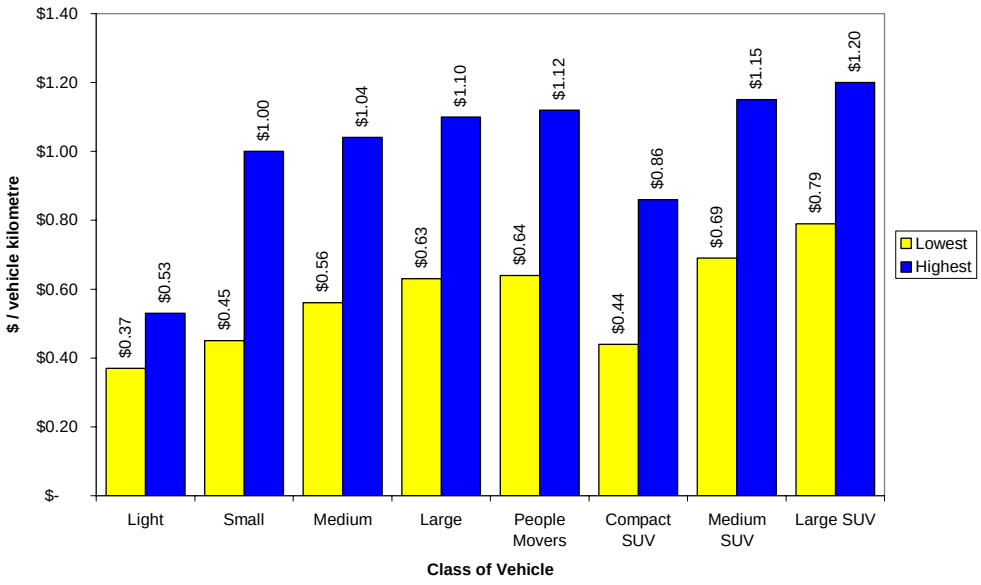
	Billion Veh-km		Percent of Total	
Type of Vehicle	**2005**	**2020**	**2005**	**2020**
Cars (a)	32.8	39.8	77.2%	72.4%
Light Commercial Vehicles	7.3	12	17.1%	21.9%
Trucks, Buses & Motorcycles	2.4	3.1	5.7%	5.7%
Total	**42.4**	**54.6**	**100.0%**	**100.0%**

(a) Incudes passenger cars and SUV's. Source: Centre for International Economics (2005).

Costs of Owning and Running a Car

Figure 4 shows estimates of the overall cost of operating different types of **new** cars in NSW, using NRMA data.

Figure 4
Cost per Vehicle-Km for new Cars in NSW in 2005



Source: NRMA (2006). Based on analysing 400 vehicles across eight classes. Costs include petrol and other running costs, registration, insurance, depreciation and financing, and assume that the vehicles are driven an average of 15,000 km per year and that the cost of capital is 5.2%.

There has been a rapid rise in sales of vehicles overall in Australia, especially 4WDs, otherwise known as Sports Utility vehicles or SUV's, which accounted for almost 23% of the market in 2005 (Federal Chamber of Automotive Industries , 2006). Table 3 shows ownership and operating cost estimates per vehicle km and per pass-km for newer and older vehicles in Sydney, and as estimated across the overall fleet. These were based on the NRMA figures adjusted as follows:

- A weighted average total private running cost for "newer" vehicles (less than 5 years old) in 2005 was made by averaging the cost for each category in Figure 1, and weighting across categories using new vehicle registration data.
- It was assumed that 60% of depreciation occurs in the first five years.
- Fuel costs for each class of vehicle were estimated for 2005 based on detailed highway and urban fuel consumption estimates from NRMA, estimates of fuel costs per litre in 2005, and 70% urban driving.
- For "newer" vehicles (less than 5 years old) estimated depreciation, petrol, parking and toll costs were subtracted from overall NRMA estimated costs to estimate remaining private costs (registration, insurance, maintenance etc)
- For older vehicles, the remaining value (40%) was depreciated over 15 years, and other private costs were increased slightly to allow for higher maintenance costs. Older vehicles were assumed to travel slightly less pa than newer vehicles.

Table 3
Estimated Average Ownership and Operating Costs of Cars in Sydney, 2005

Age of Cars	Km/Veh	% of Annual Veh Km	2005 Cost / Veh-Km	2005 Cost / Pass-Km
"Newer" Cars (0-5 yrs)	15,000	28%	$0.76	$0.53
Older Cars (older than 5 years)	13,000	72%	$0.55	$0.38
Av Car Op Costs / Veh Km	**13,500**	**100%**	**$0.61**	**$0.42**

Source: NRMA (2006) for newer vehicles, plus author's calculations as described in text.

Tolls

Sydney has an extensive toll road network (Figure 5).

Figure 5
Sydney's Motorway Network (2006)

Source: RTA Website (2006).

It is estimated that over 600,000 vehicles per day used the facilities, generating estimated revenue of the order of $450 million, of which an estimated 70% is due to cars and SUV's (Table 4).

Table 4
Estimated Toll Revenue for Major Toll Roads in Sydney (2006)

Facility	Two-way Traffic Volume Veh/day	Toll Charged		Length (km)	Lanes (i)	Annual Revenue $m	Year
		Cars	Trucks				
M1 (ED) (a)	75,000	$4.50	$9.00	6.0	6	$57	2004/5
M2 (b)	45,000	$3.00	$7.40	21.0	4	$49	2001
M4 (c)	90,600	$2.20	$6.00	12.5	6	$81	2004/5
M5 (d)	88,000	$3.30	$7.70	22.0	4	$122	2004/5
H Tunnel (e)	87,500	$3.00	$3.00	2.3	4	$24	2002
H Bridge (f)	157,000	$3.00	$3.00	2.3	7	$43	2002
CC Tunnel (g)	30,000	$3.50	$7.00	2.1	4	$38	2005/6
M7 (h)	30,000	$3.00	$3.00	40.0	4	$33	2005/6
Total	**603,100**			**108.2**		**$446**	

(a) Traffic data for 2000/2001. Revenue data from MIG. Northbound toll only.
(b) Tolls vary between $2.20 and $3.80 for cars and $4.90 and $9.90 for trucks (June 2006).
(c) Traffic data for 12 months from June 2000 (Zeibots, 2006). Revenue and other data from MIG.
(d) Traffic data for 12 months from June 2000 (Zeibots, 2006). Revenue and other data from MIG.
(e) Traffic data for 2002 (RTA Traffic Volume Data for Sydney Region). Southbound Toll Only.
(f) Traffic data for 2002 (RTA Traffic Volume Data for Sydney Region). Southbound Toll Only.
(g) Tolls have fluctuated since opening, most recently set at $3.50. Revenue approximate only.
(h) Tolls are 30c/km (cars and trucks), capped at $6.00. Author's estimate for Av Toll and Revenue.
(i) Number of lanes varies in some cases along the facility.

Paid Parking

In recent years there has been a significant growth in the number of commercial parking facilities. For example Wilson Parking, Australia's largest operator, has 190 sites across Australia, serving 240,000 vehicles per day, and generating annual revenue of $200m. Thirty-eight of these parking stations are in Sydney. Other large private companies managing car parking facilities include Secure Parking and Premier Parking, with a total of 116 facilities between these three major operators located in Sydney. (Source: Company websites). Most are in the CBD and other key office and retail centres, or in specialised locations such as Sydney Airport.

Parking charges vary significantly between locations; the main car park at Sydney airport charges $6.00 for the first half hour, while major shopping centres generally provide 2-3 hours free parking. All-day parking typically costs $10 to $40. There is no comprehensive data on revenues for parking operators, but the State Government collected around $44m in 2002/3 through its parking space levy which covers some 60,000 commercial car parking and other office spaces (but not retail or residential) parking in the CBD, North Sydney, Chatswood, Bondi Junction and Parramatta. Analysis of the above data suggests that private motorists probably pay of the order of $150m - $250 pa in car parking fees to commercial operators. Much of the private parking provided for office workers is paid for by employers rather than employees.

In addition, an increasing number of Councils charge for on-street parking (Table 5). Motorists also pay for parking at some other times, such as at major sporting events. Estimates of the number of events, the number of spaces likely to be used and typical parking charges suggests that total parking charges at events are of the order of $15 - $20m pa. This suggests that Sydney motorists pay a total approximately $300m pa for parking. More precise estimates would require an extensive study, but the figures whilst significant, are relatively minor compared with other motoring-related costs.

Table 5
On-Street Parking Charges in Key Sydney Councils, 2004

LGA	Rate / Hr	Gross Revenue $m	No of Meters	Revenue / Metre
Sydney	$4.40	$16.00	1300	$12,308
North Sydney	$5.00	$4.40	388	$11,340
Waverley	$3.00	$4.20	342	$12,281
Woollahra	$3.20	$1.00	76	$13,158
Willoughby	$4.40	$1.20	136	$8,824
Leichhardt	$2.20	$2.60	290	$8,966
Parramatta*	$2.20	$11.00	836	$13,158
Total		**$40.40**	**3368**	**$11,995**

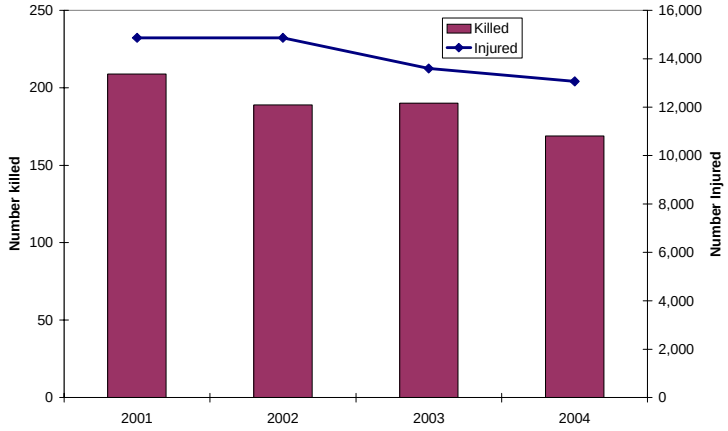
*Source: Parramatta City Council, 2004. * Actually introduced in late 2005*

3 EXTERNAL COSTS OF CAR USE IN SYDNEY

Types of Externality

In addition to the private costs paid directly by individual motorists analysed above, car usage gives rise to a range of external or social costs, which are imposed on other motorists, commercial vehicle operators, residents, pedestrians, ratepayers and others (Pratt, 2002). For example approximately 190 people were killed, and 14,000 injured, on Sydney's roads per annum over the 2001 – 2004 period (Figure 6).

Figure 6
Deaths and Injuries from Road Accidents in Sydney, 2001 - 2004



Source: NSW RTA (2001 – 2004), table 24. Figures include all SLA's in Sydney Statistical Division and include pedestrians and cyclists as well as drivers and passengers of motor vehicles.

The Victorian Department of Infrastructure estimates the economic cost of car crashes at $1.6 million per road accident death, $350,000 per serious injury and $17,000 for other injuries (Department of Infrastructure, 2005). Another example is air pollution, including ultra fine particles (mostly due to vehicle exhausts), which have been implicated in contributing to 600 – 1400 deaths per annum in Sydney (NSW Parliament, 2006b, p16). The main categories of externality include:

- Congestion
- Accidents (over and above insurance premiums)
- Greenhouse Gas emissions
- Air Pollution
- RTA Subsidies (in excess of that met by registration charges)
- Local Government Expenditure on Roads
- Space used for Roads
- Subsidized or Free parking
- Noise and Other Impacts

Externality Estimates

The economic costs of the first five of these categories have been analysed recently by the Centre for International Economics (2005) (Table 6). The estimate of $0.28 per vehicle kilometre for congestion costs is comparable with Melbourne, which ranges from $1.03 for heavily congested areas in peaks, to $0.68 for moderately congested peaks, and $0.18 at other times (Department of Infrastructure (2005). For this study, expenditure on local government roads (sourced mainly from rates) and the economic costs of road-space will be ignored, as they require a significant study in themselves.

Table 6
Selected Social Costs Due to Cars in Sydney (2005)

Social Costs Category	Total Road $ million	Due to Cars $ million	Cost / Veh - Km	Cost / Pass-km
Congestion	$12,072	$9,320	$0.28	$0.20
Accidents	$3,864	$2,983	$0.09	$0.06
Greenhouse Gas Emissions	$148	$114	$0.00	$0.00
Air Pollution	$1,223	$944	$0.03	$0.02
RTA Subsidies	$741	$572	$0.02	$0.01
Total	**$18,048**	**$13,933**	**$0.43**	**$0.29**

Source: CIE (2005).Note that this table uses CIE estimates of the share of social costs which are due to cars (as opposed to other road vehicles). Per pass-km estimates in last column are by the author.

Noise, Water Pollution, and Other Impacts

The RTA Economic Analysis Manual provides values for the economic cost per vehicle kilometre for noise, water pollution, nature and landscape impacts, and urban separation. These total $0.0204 per veh-km. (NSW RTA (2006b).

Unpaid Parking

A number of studies have identified that parking involves large hidden subsidies to car users. For example Shoup (2005) concluded that in US cities:

- There are at least three parking spaces for every vehicle, and drivers can park free for 99% of their trips. The cost of parking space has grown faster than the cost of cars in many places (Shoup, 2005, p211).
- The cost of "free" parking at work reduces the perceived cost of automobile commuting by 71%.
- Parking codes add to housing costs and reduce housing affordability, and also impact adversely on urban amenity and urban design quality.

Litman (2006) also examined the cost of free or subsidised parking in detail, while Hensher and King (1999) examined parking demand and responsiveness to supply, price and location in Sydney CBD, concluding that drivers who do not have access to parking paid by their employer are highly sensitive to parking prices.

In Sydney, as in the US, most parking is provided free (to the motorist), including residential parking provided in response to Council car parking codes; almost all on-street and retail parking; and most used for entertainment / sporting purposes and at workplaces. For example in 2002, there were some 138,000 parking spaces provided at some 234 shopping centres in Sydney, a growth of 54% since 1991 (NSW Property Council, 2002).

Table 7 provides estimates by the author of the number of parking spaces in Sydney. The total of approximately 2 spaces per vehicle is conservative when compared with US estimates. At an average of 25 sq. m. per space, this represents an area of almost 100 sq. km.

Table 7
Estimates of Car Parking in Sydney (2005)

Type of Parking	At Grade	Multideck / Uground	Total	Notes
Retail - Major	70,000	70,000	140,000	(b)
Retail - Minor	45,000	5,000	50,000	(b)
Centres - Employment	75,000	75,000	150,000	(c)
Other Locations - Employment	864,000	96,000	960,000	(d)
Recreational Facilities	90,000	10,000	100,000	(e)
Unis/Tafe/Schools/Hospitals	90,000	10,000	100,000	(f)
Commuter Rail	28,000	12,000	40,000	(g)
At Home	1,710,000	90,000	1,800,000	(h)
Total Off-Street	**2,972,000**	**368,000**	**3,340,000**	
On-Street	600,000	0	600,000	(h)
TOTAL	**3,572,000**	**368,000**	**3,940,000**	**(a)**

Source: Author's estimates unless otherwise indicated. Notes:
(a) Assumes a total of 2 spaces per car.

(b) NSW Property Council data indicates that there were 69,700 open (at grade) and 68,900 closed (multi-deck / underground) car parking spaces in 2002 at the 234 major shopping centres in their database (Glazebrook, 2004). Estimates for minor shopping centres by author.
(c) There were 60,000 leviable spaces in the six centres covered by the Parking Space Levy, which between them had 455,000 jobs in 2001; most of these spaces would be for commercial/office use. In addition there were 308,000 jobs in 2001 located in the 21 other centres identified in the Metro Strategy, such as Liverpool, Penrith, Norwest. It is assumed that 50% of these jobs had a car space.
(d) For the remaining 1.2 million jobs in Sydney, it is assumed that 80% have a car space available.
(e) Includes major sporting facilities (see earlier discussion) as well as golf clubs, swimming pools, bowling alleys, squash courts, netball courts, ovals etc.
(f) In 2001 Sydney had 25 major hospitals with nearly 8,000 beds and 38,000 staff, the five major universities had 150,000 enrolled students spread across 18 campuses, while in addition there are large numbers of TAFE colleges, schools etc. (Glazebrook, 2004).
(g) In 1998-2000, 13.1% of peak and 11.2% of off-peak rail passengers accessed their station by car and parked near the station (Cityrail, 2001). This amounts to approximately 55,000 boarding passengers. The estimate of 40,000 spaces allows for on-street parking, and for car occupancy of 1.2.
(h) Assumes a car parking space is available for every car at home or nearby on-street. In addition assumes 20% additional spaces which are not fully occupied.

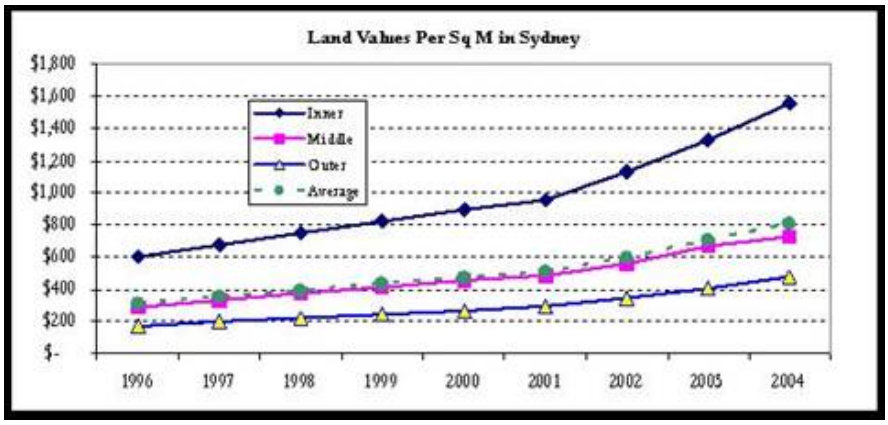
Use of this space carries an economic cost. Land values have been rising rapidly in Sydney, as shown in Figure 7. As a consequence it is estimated that the land allocated to parking in Sydney has a value of around $68 billion, with an additional $7.3 billion tied up in multistorey or underground car parks. Assuming a real rate of return of 4% this equates to a subsidy of $2.7 billion after allowing for paid parking (Table 8). Thus only around 10% of the true cost of parking is actually paid by the motorist. The remaining costs are externalised in higher housing prices, retail prices, or office space rents.

Table 8
Estimated Economic Cost of Car Parking in Sydney

Type of Parking	**Land $/Sqm**	**At Grade $m**	**Multideck / Under-ground $m**	**Total Value $m**
Retail - Major	1600	$4,200	$1,400	$5,600
Retail - Minor	600	$775	$100	$875
Centres - Employment	1600	$4,500	$1,500	$6,000
Other Locations - Employment	600	$14,880	$1,920	$16,800
Recreational Facilities	400	$1,100	$200	$1,300
Unis/Tafe/Schools/Hospitals	800	$2,000	$200	$2,200
Commuter Rail	400	$520	$240	$760
At Home	700	$29,925	$1,800	$31,725
Total Off- Street		**$57,900**	**$7,360**	**$65,260**
On-Street	700	$10,500	$0	$10,500
TOTAL		**$68,400**	**$7,360**	**$75,760**
Assumptions		**Results**		
Sq. m per car space	25	Economic Cost p.a.		**$3,030**
Cost / Multideck Space	20,000	Already Paid		**$300**
Real Return on Assets	4%	**Estimated Subsidy**		**$2,730**

Source: Author' estimates.

Figure 7
Land Values for Vacant Residential Land in Sydney: 1996-2004



Source: Valuer-Generals' Department, 2005. Analysis by author.

4 OVERALL COSTS OF CAR USE IN SYDNEY

Combining all the private and social costs, Table 9 shows the estimated costs of cars in Sydney in 2006.

Table 9
Overall Annual Costs of Cars in Sydney (2006)

COMPONENT	$ million	$ / Veh-km	$ / Pass-km	% of Total
Petrol/ fuel (at $1.40 / litre)	$5,886	$0.18	$0.12	14.3%
Tolls	$319	$0.01	$0.01	0.8%
Paid Parking	$309	$0.01	$0.01	0.8%
Private Out-of-Pocket	**$6,515**	**$0.20**	**$0.14**	**15.9%**
Other User Costs	$16,370	$0.50	$0.34	39.9%
Total User Costs	**$22,885**	**$0.70**	**$0.48**	**55.8%**
Congestion	$9,597	$0.29	$0.20	23.4%
Accidents	$3,072	$0.09	$0.06	7.5%
Greenhouse Gas Emissions	$118	$0.00	$0.00	0.3%
Air Pollution	$972	$0.03	$0.02	2.4%
RTA Subsidies	$589	$0.02	$0.01	1.4%
Unpaid Parking	$2,803	$0.09	$0.06	6.8%
Noise, Water Pollution, Other	$1,001	$0.02	$0.02	2.4%
Total External Costs	**$18,152**	$0.55	**$0.38**	**44.2%**
Total Costs	**$41,037**	**$1.25**	**$0.86**	**100.0%**

Note: All costs except petrol from previous estimates adjusted for inflation (ABS CPI). Petrol costs in Sydney peaked in 2006 at over $1.40 per litre, but subsequently fell in late 2006 to approximately $1.10 per litre, and have since risen again to approximately $1.30 per litre (April 2007).

These should be considered as conservative for several reasons. Firstly, no allowance has been made for subsidies to car users from spending by local government or for the cost of road-space, or for health costs associated with obesity (which has been linked

to high levels of car use). Secondly, as noted, the estimate of parking costs was conservative. Finally, greenhouse gas emission costs are relatively small; depending on the significance of climate change, these could prove to be very conservative. At this stage it is considered too early to make reliable estimates for these given the uncertainties surrounding the cost of global warming and the price likely to emerge for CO_2 emissions. However the analysis shows that:

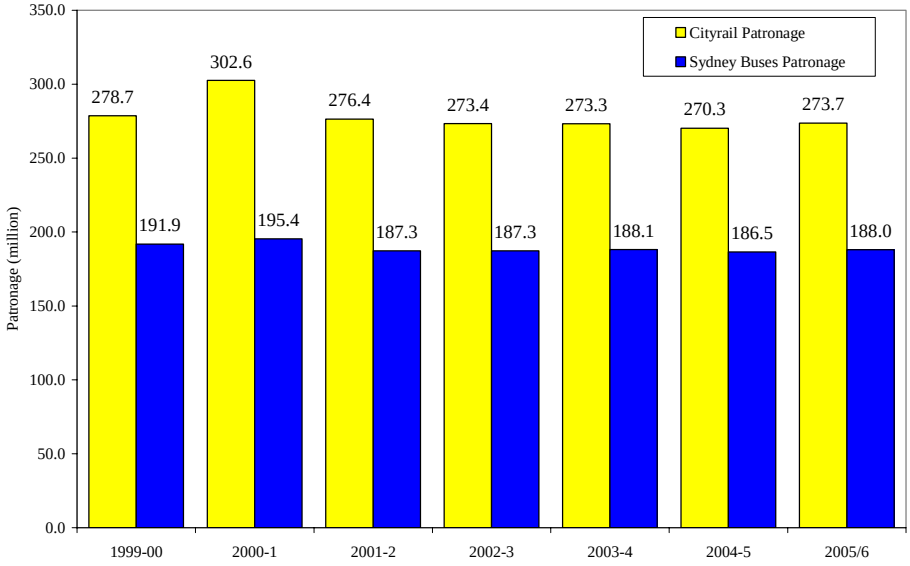
- Total user and external costs of cars in Sydney were $41 billion per annum in 2006. This is $1.25 per vehicle km, or $0.86 per pass-km.
- Private "out-of-pocket" costs are 20c / per vehicle-km, or 14c / pass-km. These are the costs most likely to be perceived by the motorist when making trip choices.
- Other user costs are approximately 50c / vehicle-km. or 34c / pass-km.
- Public costs or externalities are estimated at 55c /vehicle-km or 38c / pass-km.
- Private out-of-pocket costs represent less than a third of total private costs, and less than a sixth of total private and external costs.

5 COSTS OF PUBLIC TRANSPORT USE IN SYDNEY

Travel by Mass Transit in Sydney

Sydney has an extensive public transport system; Cityrail operates some 1500 rail cars and 300 stations, State Transit operates some 1700 buses under its "Sydney Buses" business while private bus operators provide most bus services in outer Sydney. Ferries, light rail and the monorail together account less than 4% of total patronage for mass transit; this analysis will therefore focus on rail and bus. Figure 8 shows Cityrail and Sydney Buses patronage figures since 1999/2000, which have remained roughly constant apart from the "Olympics" effect in 2000/2001.

Figure 8
CityRail and Sydney Bus Patronage: 1999/2000 – 2005/6



Source: Railcorp (2006), p6; Cityrail data exclude Countrylink patronage; Kleweg (2007) Table 12, based on data from State Transit and State Rail Annual Reports; note includes patronage for Western Sydney Buses (a division of STA) as well as Sydney Buses from 2004/5.

Table 10 provides estimates of total trips and trip-km for Cityrail, as well as State Transit and Private Buses in Sydney in 2005/6. Note that rail trips are much longer than bus trips and that private bus trips are somewhat longer than STA bus trips. Hence Cityrail accounts for 48% the trips, but 70% of total passenger-km by these modes. Other data (NSW Department of Planning, 2005) indicates that rail accounted for around 16% of total morning peak pass-km in Sydney in 2003, and bus 6%.

Table 10
Trips and Pass-km by CityRail, STA and Private Buses in Sydney, 2005/6

Mode	Rail	Bus			Total	Notes
	Cityrail	STA	Private	Total		
Annual Trips (Million)	274.4	189.3	112.5	301.7	576.1	(a)
Average Trip Length (km)	18.5	6.2	8.8	7.2		(b)
Pass-Km (billion)	5.1	1.2	1.0	2.2	7.2	(c)
Share of Trips	**48%**	**33%**	**20%**	**52%**	**100%**	
Share of Pass-Km	**70%**	**16%**	**14%**	**30%**	**100%**	

Notes: (a), (b): From earlier estimate and from NSW Transport Data Centre (2002), p2., also NSW Department of Planning (2005). (c): Product of (a) and (b)

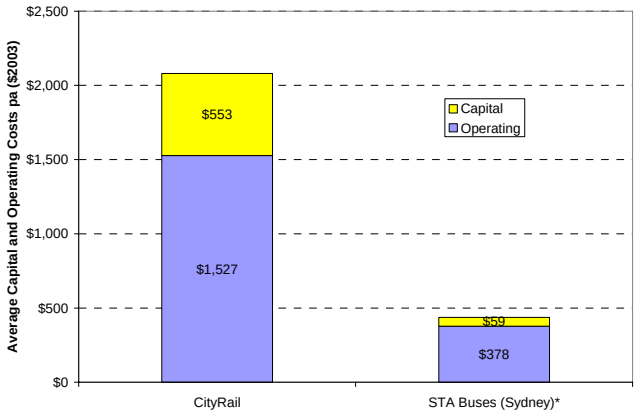
Direct Costs of Public Transport

Sydney's public transport is currently undergoing a major upgrade. For rail, this includes the $1 billion "Rail Clearways" Program designed to improve reliability and increase capacity; the $2.8 billion Epping – Chatswood rail line, due to be opened in 2008, new rolling-stock to replace older cars and expand the fleet by 16% (NSW Parliament, 2006a, p18) and the planned $8 billion NW-SW and cross-city line announced for completion by 2017. For buses, this includes the $520m Parramatta to North-West Bus Transitway, opened in 2007; new cross-regional bus routes and bus priority measures; and 1,000 new buses, costing $500 million.

Accordingly, expenditure on public transport has risen significantly in recent years and is expected to remain at historically high levels. Figure 9 gives estimated average annual expenditure required for Cityrail and Sydney Buses over the 2003/4 to 2010/11 period. The Cityrail data is comparable with that from Railcorp's annual report (Railcorp, 2005) when allowance is made for inflation and for part of Railcorp's budget for maintenance of the metropolitan freight rail network.

Comparable expenditure data for private buses in Sydney does not appear to be publicly available. However the Parry Report (NSW Government, 2003b) provided comparative cost structures for STA and private operators, while the Unsworth Review of Bus Services in NSW (NSW Government, 2003a) identified levels of government support and patronage for both STA and private operators (Table 11). For both State Transit and private buses, there are additional expenditures by the Roads and Traffic Authority for bus-lanes, construction of transitways, and provision of bus priority at intersections (Table 12). It should also be noted that buses do not contribute to the general cost of roads over which they travel, other than through any fuel taxes payable to the Commonwealth Government.

Figure 9
Estimated Av Annual Expenditure: Cityrail and STA Buses, 2003/4 – 2010/11



*Source: NSW Government (2003b) Tables 3.2, 3.3. * Excludes STA Buses in Newcastle.*

Table 11
State Government Support for State Transit and Private Operators, 2002/3

Item	STA	Private	Total	Non-Comm-ercial.	Total
Funding $million					
SSTS (School Student Transport Subsidy)	$38.1	$232.4	$270.5	$114.4	$384.9
Concession Re-imbursements	$26.8	$27.9	$54.7	$0.0	$54.7
Pensioner Excursion Tickets	$79.0	$0.0	$79.0	$0.0	$79.0
Community Service Obligations	$95.2	$0.0	$95.2	$0.0	$95.2
Nightride	$0.0	$3.6	$3.6	$0.0	$3.6
TOTAL	**$239.1**	**$263.9**	**$503.0**	**$114.4**	**$617.4**
Patronage (million)					
Adult	91.8	24	115.8		
SSTS	35.9	88.1	124		
Pensioner	37.6	21.3	58.9		
Child / Concession / Other	33.3	8.5	41.8		
Total	**198.6**	**141.9**	**340.5**	**n.a.**	**na**

Source: NSW Government (2003a), p7. Non-commercial category is primarily dedicated school buses.

Table 12
RTA expenditures ($m) to support bus operations in Sydney, 2002/3 – 2004/5

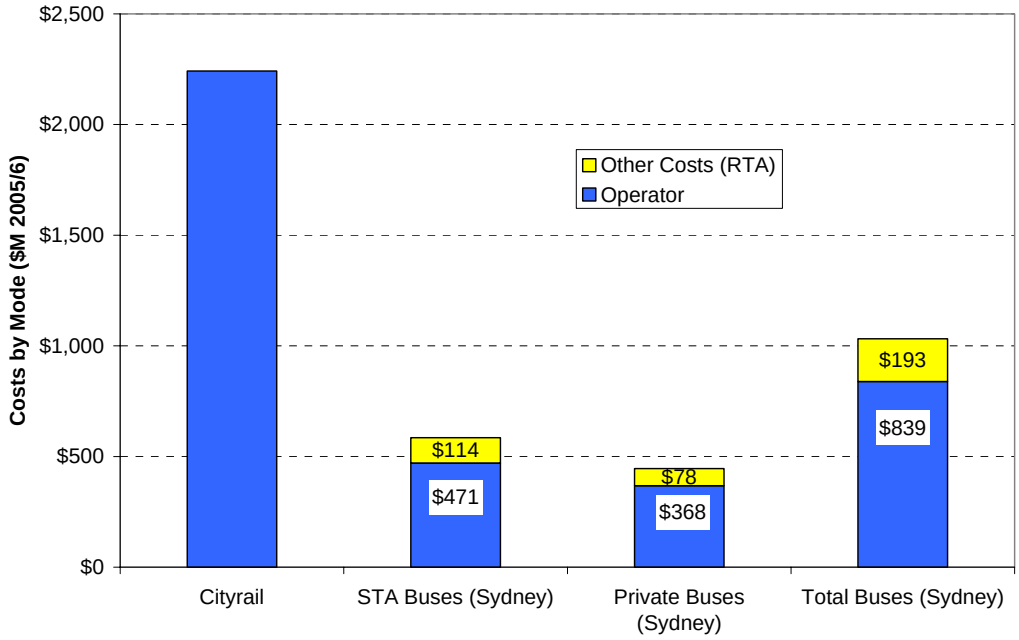
Item	2002/3 (b)	2003/4 (c)	2004/5 (d)	Average p.a.	Est. Total
Bus Lanes (a)	$15.0	$15.0	$15.0	$15.0	
Liverpool - Parramatta Transitway	$18.1	$54.5		$36.3	$315.0
North-West Transitway	$166.6	$108.1	$67.9	$114.2	$524.0
Other Transitways	$3.1	$30.7		$16.9	

Sub-Total	**$202.8**	**$208.3**	**$82.9**	**$182.4**	**$839.0**

Sources: (a) NSW RTA (2006) p 41; (b) NSW RTA (2004) p 121; (c) NSW RTA (2005) p 116; (b) NSW RTA (2006) p 112

Figure 10 calculates the overall estimated costs for CityRail, Sydney Buses and Private Buses in Sydney, based on the above data and updating to 2005/6 by the CPI.

Figure 10
Estimated Costs (Capital plus Recurrent)
For Major Public Transport Modes in Sydney, 2005/6



Externality Costs for Public Rail and Bus

Estimated externality costs for trains and buses are shown in Table 13, based on the earlier estimates of externalities for cars, together with the following assumptions:

- It is estimated that buses create around 10% (State Transit) -15% (Private) of the road congestion for cars on a per-pass-km basis, based on their size, loadings and operating conditions.
- Both rail and buses in Sydney are approximately 2.8 times more energy-efficient than cars in primary energy per passenger-km (Glazebrook, 2002). Rail uses electricity generated principally from coal-fired power. Accordingly greenhouse gas emissions per pass-km are estimated at approximately 50% of those for cars. Buses generate their emissions within the Sydney urban area, significantly on major arterial roads and in areas with high pedestrian concentrations such as the CBD, with some 7,600 State Transit buses driving through the CBD on a typical weekday (City of Sydney, 2005). Greenhouse emissions are estimated at approximately one-third those for cars on a per-passenger-km basis based on primary energy efficiency and CO_2 emissions for diesel vs petrol.

- Total rail fatalities are approximately 30 per annum in NSW. Unfortunately, most are a result of suicide – for example in 2005, these accounted for 31 of the 35 fatalities recorded. While detailed breakdowns within the Sydney metropolitan area are not available, the data indicates that the cost / pass-km for rail accidents, excluding suicide, is approximately 25% of that for cars. Accident data for NSW indicate that buses account for an average of 15 deaths and 636 injuries pa over the 2001-2004 period *(NSW RTA (2006c), Table 10)*, which represents approximately 2.7% of road fatalities in the State and 2.1% of road injuries. Allowing for estimates of passenger-km by bus compared with cars, this indicates a somewhat lower overall accident cost per pass-km for than for cars.

Table 13
Total Costs of Rail and Bus in Sydney (2005/6)

Mode/Operator	Cityrail	Sydney Buses	Private Buses	All Buses
Farebox Revenue $m (a)	$531	$228	$180	$408
Total Costs (2005/6) $m	$2,242	$585	$446	$1,031
Pass-km (billion)	5.1	1.2	1.0	2.2
User Costs / Pass-km	$0.11	$0.20	$0.18	$0.19
Direct Cost / Pass-km	$0.44	$0.50	$0.45	$0.48
Externality Cost / Pass-km	$0.03	$0.10	$0.09	$0.09
Total Cost / Pass-km	**$0.47**	**$0.60**	**$0.54**	**$0.57**

(a) Cityrail and STA estimates based on NSW Government (2003b). Private Operators based on earlier estimates of total revenues and shares covered by SSTS and Concessions.

6 COMPARISON BETWEEN MODES

Summary Results for Sydney

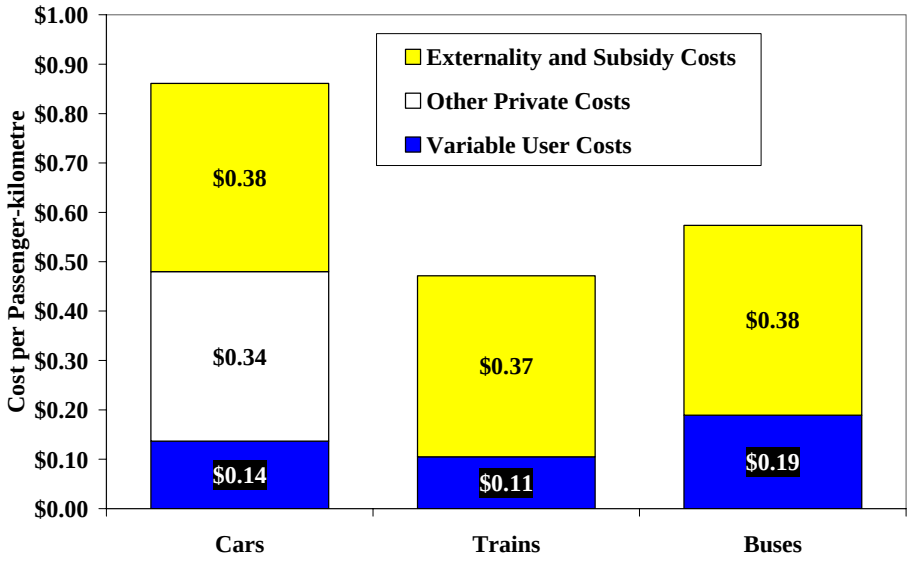
The figure below compares the estimated costs per passenger-kilometre for cars with public transport in Sydney. The comparison shows that:

- Cars are the most expensive mode in Sydney, with an estimated total cost of 86c / passenger-km.
- Despite its high visible cost to Treasury, Cityrail has the lowest overall cost per passenger-kilometre of any of the major modes in Sydney, estimated at approximately 47 cents per passenger-km.
- Bus is the next lowest cost mode, at approximately 57c / passenger-km on a similar cost basis.
- Rail cost recovery is lower than bus primarily because rail trips are much longer than bus trips on average, and per-kilometre fares decline with trip distance. This gives rise to higher subsidies for rail per trip than for buses, which leads some commentators to claim rail is too expensive. In fact buses are more expensive overall than rail per passenger kilometre, and the advantage for rail would be even greater if buses fully covered the cost of their infrastructure as rail does.
- All modes generate significant costs which are borne generally by society, either in the form of subsidies (eg rail and bus subsidies from government, or hidden

parking subsidies for car users) or in the form of externalities (including pollution, congestion, accidents etc).

- The perceived costs for car and rail are similar, but cars also generate significant other private costs (depreciation, registration, insurance etc) which motorists may not take into account at the point of making individual trips.

Figure 11
Costs per Passenger-kilometre for Cars and Public Transport in Sydney (2005/6)



In comparing the modes, it is also worth remembering that car externality costs were conservatively estimated, and that the costs per passenger-km by public transport may reduce in future if the large investment in public transport currently underway leads to increased patronage in future.

Policy Implications

A clear conclusion of the analysis for Sydney is that while cars provide greater individual flexibility and accessibility than public transport they do so at higher overall cost (per passenger-kilometre). The analysis suggests that cars are in fact subsidised by society to a similar level to that of public transport, when environmental and other externalities are considered and not just financial subsidies to operators.

It also suggests that governments need to consider the overall economic, social and environmental costs of all modes when considering transport policy, not simply the immediate financial costs to Treasury. This is at the core of the ongoing debate about how to make our cities more sustainable. Those arguing for greater emphasis on public transport often come up against the financial arguments that public transport is a large drain on taxpayers.

In addition to consideration of average costs and subsidy levels, other factors need to be considered when analysing urban transport, such as the need to provide mobility for people with a disability or who cannot or do not wish to own and operate a private automobile. However, as these issues are extensively covered in the literature on

accessibility (for example Imrie, 2000 or Hine and Mitchell, 2001), they will not be canvassed further here.

As noted earlier, our individual travel choices are influenced by the perceived or "out of pocket" costs of a trip. If the full costs were faced at the time of a trip, travel choices could be quite different. This implies a need to consider road and congestion pricing, as well as measures to convert private costs such as insurance and registration to per-km costs, to better align the private and public costs of car use. Were this to occur, public transport fares could be raised to more realistic levels, reducing total government requirements for subsidy.

The analysis also highlights the key role played by Cityrail in Sydney, as the backbone of the public transport system, carrying 70% of passenger-kilometres on mass transit, and 16% of the total morning peak period transport task. Furthermore its overall costs are lower than buses, indicating the need to take the long view in designing Sydney's future transport system.

Directions for Further Research

The results reported here for Sydney are broadly compatible with those results reported earlier for New Zealand and Switzerland, although precise comparisons are difficult, given differences in data availability and scope of analysis. Nevertheless the available evidence from a range of sources suggests that the full social costs for all modes of urban passenger transport are significantly higher than the apparent costs, and users do not directly meet the full social costs for any mode. This suggests a need for more research on the possible implications of full user-cost pricing.

While public transport subsidies are relatively visible to policy makers and governments who fund them directly through transport budgets, the hidden costs for car-based urban transport (such as the effects of air pollution, accidents, greenhouse gas emissions and wasteful land use) are less so. This helps explain why public transport provision in countries such as the USA and Australia remains politically difficult. More research on the evaluation techniques used by governments both explicitly and implicitly would also be useful.

Given the growing debate on the impacts of global warming, further research is needed into the long term costs of greenhouse emissions from urban transport.

Finally, it is considered that the development of more accurate, comprehensive and standardised measures of the true cost of different modes under different situations should help in developing more appropriate transport solutions for our cities, which take into account their full social costs.

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