Contract Report

Preliminary Evaluation of the Financial Impacts and Outcomes of the TravelSmart Individualised Marketing Program - Update

by Ian Ker

for WA Department for Planning and Infrastructure

RC 07339- 11 November 2002

Transport Research

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Reviewed	
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Executive Summary

TravelSmart Individualised Marketing (TSIM) has substantial benefits that were not quantified in the original evaluation of the South Perth Pilot Project. These include morbidity and mortality improvements from more adequate levels of physical exercise.

In addition, substantial actual and potential financial benefits to State government have been identified and estimated in a number of areas (See table overleaf):

- Public transport fare revenues and operating costs
- Public transport capital costs
- Improved health and fitness due to exercise
- Users' and others' exposure to air pollutants
- Greenhouse gas emissions
- Road capacity requirements
- Road trauma
- Government tax revenue

Area of Impact	Stages 3 to 7 544,000 population (Present Value @ 8% discount)	Financial Benefit per $1 million dollars invested in TSIM (Present Value @ 8% discount)
Public Transport Net Fare Revenue	$31.7 million	$1.45 million
Public Transport (bus) Capital Cost	($1.1 million) Additional cost	($0.05 million) Additional cost
Health Service Costs (State): Improved Health and Fitness	$2.0 - $5.3 million	$0.09 - $0.25 million
Health Service Costs (State): Exposure to Air Pollution	$12.9 - $19.4 million	$0.60 - $0.90 million
Greenhouse Gas Abatement	Not estimated	Not estimated
Road System Costs: Traffic Signals	$5.6 million	$0.25 million
Road System Costs: Road Construction	$15.1 – $39.4 million	$0.70 - $1.85 million
Road Trauma	Not estimated	Not estimated
State Government Tax Revenue	No impact on revenue from Goods and Services Tax	Nil
TOTAL financial impact	**$66.2 - $100.3 million**	**$3.09 - $4.70 million**

The financial impacts above are expressed as the savings to the State Government alone and are the sum of 25 years of annual savings discounted at 8%. TSIM returns to the State 3.1 to 4.7 times the initial investment over a 25 year period.

The first year financial savings flowing to the State from a once only investment of $1 million to TSIM are (lower estimates):

Public Transport Net Fare Revenue	$170,000
Public Transport (bus) Capital Cost – additional cost	-$5,000
Health Service Costs (State): Improved Health and Fitness	$20,000
Health Service Costs (State): Exposure to Air Pollution	$70,000
Road System Costs: Traffic Signals	$65,000
Road System Costs: Road Construction	$170,000
Total First Year Revenue/Cost Reduction	**$490,000**
First Year Rate of Financial Return	**49%**

TSIM also contributes very substantially to the achievement of objectives in other areas of government, including air quality, greenhouse and health.

TSIM can achieve a very substantial part of the WA Physical Activity Taskforce objective of increasing the proportion of sufficiently-active people in WA from 56% to 61%. However, better information on the actual physical activity consequences of TSIM, including an in-depth survey of one or more TSIM interventions, is necessary to confirm this result.

In some areas, the broader, socio-economic evaluation of TSIM should be upgraded and updated:

- to update costs and other relevant values (specifically the Road Safety Council valuation of fatalities and serious injuries from road crashes) to current (2002) levels;
- to include an additional sensitivity test to include the ‘willingness to pay’ value for fatality reduction in road trauma; and
- to include health and fitness benefits not previously quantified.

The development, implementation, monitoring and evaluation of TSIM should be more comprehensively documented in a structured way that allows for continual improvement and updating. This will provide much more effective support for informed decision-making.

Minor enhancements and updates to the socio-economic evaluation of TSIM performed for this report demonstrate a cost benefit ratio of 77 to 1 over 25 years (44 to 1 over 10 years).

Summary of Financial Impact Assessments (TSIM stages 3 to 7 – 544,000 population)

Item	Qualitative/Quantitative Estimation	Next Steps
Public Transport Fare Revenues and Operating Costs	There would be a net revenue gain of $3.5 million per year to government from conversion of trips from car to bus through TSIM. Present Value (25 years discounted @ 8%) for 5-year TSIM implementation program: $31.7million.	Further investigation is required to assess impact of trips converted to train.
Public Transport Capital Costs	An additional 3.2 buses will be required to carry additional passengers in peak periods in inner areas, at a cost of $1.0 million. Present Value (25 years discounted @ 8%) for 5-year TSIM implementation program: $1.1 million. The re-allocation of all existing railcars to the Fremantle, Midland and Armadale lines will provide capacity for additional rail demand in those corridors.	Develop a bus service enhancement strategy to ensure no loss of level of service in inner areas.
Improved Health and Fitness Due to Exercise	Conservatively estimated initial annual health service cost (financial) benefits: ♦ $0.40-0.72million would accrue to the Commonwealth; ♦ $0.23-0.40million to the State; and ♦ $0.27-0.48million to the non-government sector. Present value of State financial saving (25 years @ 8% discount): $2.0 - $5.3 million.	More specific research into TSIM impacts on mode, trip purpose, trip length and duration and pre-existing physical activity levels.
Exposure to Air Pollution: Impact on Health Service Costs	Estimated initial annual health service cost (financial) benefits: ♦ $2.65 million would accrue to the Commonwealth; ♦ $1.47 million to the State; and ♦ $1.77 million to the non-government sector. The present value of State financial saving (25 years @ 8% discount): $12.9 - $19.4 million.	
Greenhouse Gas Emissions: cost of Government Commitments	No reliable estimates – depends on developing policy on government responsibility for greenhouse gas abatement.	Revisit when government commitments to funding greenhouse gas abatement are clearer.
Impact on Road Construction (Network Capacity Expansion) Costs	1. Intelligent Transport Systems Greatest where technical and community difficulties of physical capacity expansion greatest, where, traffic management and ITS will be main tools to increase effective capacity. Traffic reduction impact on traffic signal requirements alone could be $7 million, spread over the period of TSIM implementation. Present value $5.6 million. 2. Road Building TSIM will reduce the rate of road traffic growth, allowing road capacity expansion to be deferred. Present Value (25 years discounted @ 8%) for 5-year TSIM program: $15.1 - $39.4 million.	Develop modelling and programming procedures for road and public transport investments that adequately takes account of the potential impacts of TSIM on levels of demand and usage.
Road Trauma: Impact on Health and Disability Service Costs	No reliable estimates other than those already included in cost of road trauma.	
Government Tax Revenue	No net impact on State Government.	

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1 Introduction

The WA Department for Planning and Infrastructure has developed a successful travel behaviour change program (TravelSmart Individualised Marketing - TSIM) with demonstrated impacts on personal travel patterns. A socio-economic evaluation of the initial pilot has been completed (Ker and James, 2000) and updated for assessment of larger-scale application of TSIM.

Evaluations to date have focussed on the socio-economic impacts, with the exception of the financial impacts on public transport (fare revenues and government payments to operators). However, there are other financial impacts on State government through a range of consequences of reduced car use.

This report presents a supporting analysis and preliminary assessment of those financial impacts on the WA State Budget that may be expected form further application of TSIM.

There are also other Government strategies and policy objectives that TSIM can contribute to, although it might not be possible to put a value on that contribution at this stage for evaluation purposes. This report provides an assessment of TSIM in the context of some key Government strategies, including contribution to stated targets where feasible.

2 Background to TravelSmart Individualised Marketing (TSIM) Evaluation

TravelSmart Individualised Marketing was initially evaluated at the level of the South Perth Pilot Project (Ker & James, 2000). Whilst details of specific quantification and estimation of evaluation parameters have been progressively refined, the basic framework has remained unchanged. The evaluation framework has also been applied to the proposed *TravelSmart 10-Year Plan* program, which is intended to reach 640 000 people in the Perth Metropolitan Area.

The principal evaluation frameworks, each of which is useful in different contexts, were:

- Socio-economic - to guide the overall allocation of resources to achieve the most beneficial outcomes for society.
- Public sector finance - to assist in the assessment of the impacts of the program on public sector expenditure requirements.
- Private (User) - to demonstrate the value to the individual.

Each framework treated some impacts differently. For example:

- Transfer payments are not usually estimated in socio-economic evaluation since they are, by definition, a cost to one group of those impacted and an equal benefit to others. Transfer payments are financial transactions only and do not represent a net use of resources.
- Public sector financial evaluation does include one part of a transfer payment (eg increased fare revenue) where it accrues to government.
- Private (user) evaluation also includes include one part of a transfer payment (eg increased cost of public transport fares) where it accrues to or is paid by the user.

The original evaluation framework is outlined in Table 1 (Costs), Table 2 (Benefits) and Table 3 (Transfer Payments).

Table 1 Evaluation Framework for Individualised Marketing: Costs (Source: Ker & James, 2000, p5)

	Socia	***Govt***	***User***	***Comment***
Individualised marketing	✔	✔	✗	Upfront 'Capital' cost to undertake individualised marketing
Individualised marketing maintenance	✔	✔	✗	Not undertaken. Potentially reduces decay of all cost and benefits over time.
Public transport capacity: capital	✔	✔	✗	Additional demand might require additional buses for peak period. Still subject to decay function, as buses can be used to meet other demand growth.

Table 2 Evaluation Framework for Individualised Marketing: Benefits

(Source: Ker & James, 2000, p6 – underlining is for the purposes of this present report)

	Social	***Govt Fin***	***User***	***Comment***
Private vehicle operating costs	✔	✗	✔	Valued as resource cost (8.3 cents/km - net of taxation) for 'social', but at market prices (13.8 cents/km) for 'user financial'.
Public transport services: operating	✔	✔	✗	Only applies where additional services have to be run. In conventional economic analysis, operating costs are treated as 'benefits' (which may be positive or negative), but it is arguable that if public expenditure as a whole is constrained, this should be included as part of the cost.
Increased walking/cycling costs to user	✔	✗	✔	Costs are small except where new equipment is purchased. Cycling cost estimated at 2.75cents/km. Walking cost not estimated.
Travel time	✔	✗	✗	Induced mode changes result in small initial increases in travel time, even after substitution of closer destinations. Road investment project evaluation in WA excludes the value of private/commuting.
<u>Improved health and fitness due to exercise</u>	✔	(✔)	✗	Increased life expectancy (socio-economic). Reduced health system costs (government - not quantified). Improved quality of life (user - not quantified)
<u>User exposure to air pollutants</u>	✔	(✔)	✗	Cyclists, pedestrians & bus passengers less exposed to exhaust pollutants than car users (ETA, 1997, p2). Not quantified.
<u>Air pollution</u>	✔	(✔)	✗	Motor vehicle exhaust emissions reduced pro-rata with traffic volumes. Likely to be more than proportionate impact if traffic conditions improved.
<u>Greenhouse gas emissions</u>	✔	(✔)	✗	Motor vehicle greenhouse gas emissions reduced pro-rata with traffic volumes. Likely to be more than proportionate impact if traffic conditions improved.
<u>Road congestion</u>	✔	✗	✗	Lower time and vehicle operating cost for <u>other</u> road users, both private and commercial.
<u>Road trauma (community) – related to car use</u>	✔	✗	✗	Pro rata with change in motor vehicle traffic volumes. No estimates for non-hospitalised injuries or property-damage-only accidents.
<u>Road trauma (users who change modes) – related to use of other (vulnerable) modes</u>	✔	✗	✗	Increased exposure (amount of walk/cycle travel - calculated for cycle only). Reduced accident rates for walking and cycling with fewer motor vehicles (not calculated). Impact on trauma could be low as historical trends in Perth show cyclist hospitalisations increase at only one-third the rate of increased cycle usage in the presence of other cycle programs. Values as above.
Traffic noise	✔	✗	✗	Pro rata with motor traffic volumes.
Water Pollution	✔	✗	✗	Pro rata with motor traffic volumes.
Conflicts on Walk/Cycle facilities	✔	✗	✗	Real, in centres and on busy shared paths, but not quantified. Not a significant issue in South Perth.
Improved security and safety in the community	✔	✗	✗	A demonstrable benefit through 'eyes on the street' and enhanced social interaction, but virtually impossible to quantify.
Viability of local shops and businesses	✔	✗	✗	Benefits to existing customers, especially those who walk or cycle. Difficult to quantify, but nevertheless real.
Synergy with other marketing initiatives.	✔	✔	✗	Spin-off benefits for cycling, walking and public transport, through 'word-of-mouth'. Real, but not quantifiable.

Note: (✔) Benefits to government accrue outside the transport sector.

In Table 2, those items denoted as 'benefits to government that accrue outside the transport sector are categorised as 'cross-sectoral' benefits, where transport contributes to the achievement of objectives in another sector. These will have government/public sector financial as well as socio-economic impacts that will be considered later in this report.

Table 3 Evaluation Framework for Individualised Marketing: Transfer Payments

(Source: Ker & James, 2000, p7 – underlining is for the purposes of this present report)

	Socia	*Govt*	*User*	***Comment***
Car parking costs	✗	✗	✔	Unless car parking is congested, the savings to the user are offset by reduced income for the car park operator. Except where there is an impact on the parking supply – likely to be long term and hence low present value
Car parking revenue	✗	✗	✗	See 'car parking costs', above.
Public transport fare cost to user	✗	✗	✔	Cost to user. Also a financial benefit to public transport provider.
Public transport fare revenue	✗	✔	✗	Benefit to public transport operator (part accrues to Transperth and part to private operators of bus services). Also a cost to user
Fares foregone during incentive period	✗	✔	✗	Should be zero if individualised marketing targeted and implemented effectively.
<u>Government tax revenue</u>	✗	✔	✗	Assumed to be net zero. Alternative commodities are also taxed. Money returned to roads assumed to be offset by reduced road expenditure needs.

Table 3 does not include any impacts outside the transport sector.

The primary focus of this report is on identifying the public sector financial impacts of those items that have been underlined in Tables 2 and 3:

- Improved health and fitness due to exercise – reduced health system costs;
- User exposure to air pollutants – reduced health system costs from differential exposure rates between modes;
- Air pollution – reduced health system costs from lower ambient levels of air pollution;
- Greenhouse gas emissions – impact on cost of meeting government commitments to reduction through other initiatives;
- Road congestion – reduction of which reduces or defers the need to spend money on additional road capacity;
- Road trauma (community) related to car use – reduced medical and emergency service costs through lower incidence of road trauma;
- Road trauma (users who change modes), related to use of other (vulnerable) modes – impact on medical and emergency service costs through increased use of vulnerable modes.

These are considered in Section 4 of this report.

The report also reviews a number of aspects of the original evaluation framework to identify improvements in terms of concepts, information and values, that will enhance the current validity and robustness of the evaluation outcomes.

3 Extension and Clarification of the Evaluation Framework

3.1 Government Financial Impacts

The previous evaluation framework did not cover all government financial impacts. Whilst there will be direct and indirect impacts from most outcomes of travel demand management, the following are the most likely to be important:

- Public transport operating costs and fare revenues (previously estimated, but methodology updated)
- Public transport capital costs (previously included, but better information now available suggests lower costs on the evidence from two project areas to-date)
- Improved health and fitness due to exercise (not previously estimated, but impact on health service costs)
- Users' and others' exposure to air pollutants (not previously estimated, but impact on health service costs)
- Greenhouse gas emissions (previously estimated as a socio-economic impact only, but impact on financial cost of government commitment to greenhouse gas abatement targets)
- Road construction requirements (not previously estimated, but financial impact through deferral of need for additional road capacity)
- Road trauma (previously estimated as socio-economic impact only)
- Government tax revenue (previously assumed to be net zero, but needs more specific assessment in the context of GST and Commonwealth/State funding arrangements).

Each of these will be reviewed in this report. In addition, the basis for some other estimated values will be further refined.

3.2 Socio-Economic Evaluation Enhancements

Some components of socio-economic evaluation are subject to particular difficulties of either methodology or valuation for any given methodology. These include most of the so-called externalities of transport, such as health impacts, road trauma, traffic noise, water pollution (for which value estimates were adopted in the original framework, but are even more intractable in the case of those aspects that are more difficult to quantify in any sense (such as conflicts on paths, safety/security and viability of local businesses).

In terms of the TSIM evaluation, the most substantial of these are:

- Health and fitness (mortality); and
- Road trauma.

The basis for valuation of these components is reviewed in section 4.2 and enhancements to the evaluation framework are proposed to take account of recent developments.

3.3 Other Government Objectives, Strategies and Targets

To a significant extent, the impacts of TSIM accrue in the area of the so-called externalities of transport. The initial TSIM evaluation recognised the need to include these externalities in the evaluation framework and estimated values for some of them.

The major such externalities relate to health, greenhouse and air quality.

These externality impacts also affect the achievement of other government objectives and contribute to the implementation of government strategies in a range of areas.

4 Preliminary Evaluation

4.1 Financial Impacts

Financial impacts on government may occur within the transport sector (public transport fare revenue and operating costs; additional bus capacity; road programs) or in other areas of government, principally the health sector through increased physical activity and reduced air pollution.

Estimates have been made on the basis of the spreadsheet provided by DPI and values derived from the literature review (Appendix B) and as outlined in the following text.

Present values of financial impacts have been calculated with an 8% real discount rate.

4.1.1 Public Transport Fare Revenues and Operating Costs

There would be a net revenue gain of up to $3.5 million per year to government from progressive conversion of trips from car to bus through TSIM.

Present Value (25 years discounted @ 8%) for 5-year TSIM implementation program: $31.7 million

Further investigation is required to assess the impact of trips converted to train.

Using fare levels prior to the increase in July 2002, it was estimated that full implementation of TSIM (Stages 3 to 7, or 544 000 people in the Perth Metropolitan Region) would increase public transport fare revenue by $9.8 million per year, with a corresponding increase of $6.3 million in the payments to the private operators of Transperth bus services to meet operating cost parameters in accordance with the contract specifications. In other words, there would be net financial benefit to the State government of $3.5 million per year.[1]

There are a number of assumptions underlying this that may require further assessment and investigation, including:

- That peak period bus services would only have to be increased to accommodate the increase in peak passenger travel in inner areas, in order to ensure the maintenance of the level of service for existing patrons. This reflects the fact that a large proportion of peak period services do not operate with full passenger loads, so some additional demand can be handled without adverse impact on existing patrons.

  Correspondingly, an increased frequency of service whilst maintaining current capacity utilisation (translates into probability of getting a seat on the bus) would in fact provide an enhanced level of service for existing users – a benefit that has not been valued.

- That each bus, on average, makes two trips during the peak period. In practice, peak loadings occur only on certain stages of the route, usually closest to activity centres such as the Perth CBD, and frequency here can be increased at a lower cost by operating shorter-distance shuttle services over those parts of routes.

- That all trips converted to public transport will be undertaken by bus. In practice, in areas served by suburban passenger rail lines, some of these trips will be made by train. Trains

[1] The initial TSIM evaluation, as report, used an incorrect representation of these contractual arrangements, based on the information available at the time. This indicated that 30% of additional fare revenue would be retained by Transperth (Ker & James, 2000, Table 9, p21). The contractual relationship is more complex than this, with approximately 66% of fare revenue accruing to the operator plus payments for additional service kilometres run.

have a different cost structure, with higher capital[2] and lower operating costs, but the balance would need to be established by a more detailed assessment of public transport trip patterns in those areas.

The impact of this cannot be determined without further information on rail cost structures and the extent of additional rail use (TravelSmart travel surveys will provide a reasonable basis for assessment of use). However, it should be noted that some elements of cost for additional services would be lower than for current operations where these services are provided by running 4-car instead of 2-car trains.

In practice, bus services are the most readily responsive to short and medium term demand increases, whereas more strategic influences, such as the Perth-Mandurah railway dictate changes in rail capacity (see Section 4.1.2, below).

4.1.2 Public Transport Capital Costs

An additional 3.2 buses will be required to carry additional passengers in peak periods in inner areas, at a cost of $1.0 million.

Present Value (25 years discounted @ 8% real) for 5-year TSIM implementation program: $1.1 million.

A further reduction may be achievable, post-2006, through reallocation of buses previously providing services in areas then served by the Perth – Mandurah railway.

The re-allocation of all existing railcars to the Fremantle, Midland and Armadale lines will provide ample capacity for additional rail demand in those corridors.

Where existing public transport services are operating at or near capacity, it will be necessary to increase the number of services through additional buses or trains. The issues raised in 4.1.1, above, apply also to the requirement for additional capital investment in bus or train capacity.

Neither system as a whole is operating so close to capacity, even in the peak periods, that major additional infrastructure would be required. Any additional capacity could be provided through additional vehicles.

An early version of the present evaluation spreadsheet assumed that all new peak period trips would require new capacity – after allowing for multiple trips per vehicle within the peak. On this basis 49 additional buses, with a total cost of around $15 million would have been needed.

A closer look at the level of utilisation has demonstrated that only a small proportion of buses operate at or near capacity, and these are mainly in the inner areas, including the city-end of longer-distance routes. **It is estimated that 3.2 additional buses would be necessary to service additional peak-period passenger loading in inner areas, through the use of 'shuttle' services to complement longer-distance services.**

The actual cost could be lower than this as a substantial amount of bus capacity in the southern suburbs will be freed up by the construction of the Perth –Mandurah railway.[3]

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[2] In the medium to long term, there are not likely to be any rail capital costs as railcars will be freed up by the establishment of through-running of new railcars on the Mandurah – Perth – Currambine/ Clarkson lines (see 4.1.2, below).

[3] Total public transport system patronage is estimated to increase by around 6000 journeys per day, in 2006, with the Perth-Mandurah railway (PCRAC, 2002, Table 2, p26). The demand modelling (unpublished figures from Future Perth Strategic Transport Evaluation Group) also show 23 600 boardings per day at stations on the Perth-Mandurah line and implies a total 41 500 passenger journeys per day. It follows that a substantial part (but not all, as some previously all-bus trips will become bus/train, so still require buses for part of the journey) of the bus capacity associated with 35 500 passenger journeys per day will be freed up.

With regard to train trips, it should be noted that a contract has been let for new, higher-speed railcars to operate the Mandurah – Perth – Currambine/Clarkson line. This will leave the existing railcars to service the Fremantle, Midland and Armadale lines. Demand modelling for the proposed Mandurah railway indicates that these lines account for less than two-thirds of the 2006 estimated patronage for the four existing lines – releasing all existing railcars for the Fremantle, Midland and Armadale lines would, therefore provide ample additional capacity to cope with TSIM-related demand.

With regard to the Perth – Mandurah – Currambine/Clarkson railway, this is effectively a new service and it will not be possible to distinguish the extent to which capacity is provided for ''existing' users and the extent to which it is for TSIM-related demand. Any requirement for additional capacity as a result of TSIM will depend upon how accurate the forecasting has been to determine the current order for new railcars.

4.1.3 Improved Health and Fitness Due to Exercise: Impact on Health Service Costs

Potential full TSIM Financial Benefit to the WA State Government: $0.4 million/year at current costs.

The Present Value (25 years discounted @ 8% real) for 5-year TSIM implementation program: $2.0-3.5 million ($0.23-0.40 million/year with no real escalation in health costs) to $3.0-5.3 million ($0.23-0.40 million/year with 4% pa real escalation in health costs).

Further investigation of the nature of trips converted to active modes by the TSIM intervention is necessary to provide firmer estimates of physical activity benefits.

There is a wide divergence of the apparent estimates of the avoidable health care costs of inadequate physical activity. However, the WA Physical Activity Taskforce has confirmed that the best (if conservative) estimate is as follows.

Direct health care costs due to physical inactivity associated with the six major diseases (coronary heart disease, stroke, diabetes, colon cancer, breast cancer and depressive disorders)*have been reported as approximately $377 million per year nationally* . (PATF, 2001a, p30)

If we assume that all this cost is attributable to the 42% who are not 'sufficiently active', this is equivalent to $9 million in direct health care costs for each percentage point ($0.9 million for Western Australia).

In broad terms, the funding for health care services is provided 45% by the Commonwealth, 25% by the States and 30% from non-government sources[4] (AIHW 2000, Table 5.2, p 235).

Real outlays on health increased by an average of 4.0% per year during the 1990s (AIHW, 2002, Table S44, p 397).

TSIM achieves its impact almost entirely through the group of households that are neither regular users already of public transport, walking or cycling, on the one hand nor have travel patterns that make change in travel behaviour unlikely.

Modelling of TSIM implementation has estimated an increase of 38 000 hours per day of active transport (walking or cycling, in their own right or in conjunction with other modes of transport) across a target population of 710 800 people. This increase will largely, but not entirely, be among the 43 per cent 'interested' who are the target of TSIM – the result is a net increase of 7.4 minutes active transport per day for each individual in this group.

[4] These figures pre-date the 30% tax rebate on private health insurance, so will understate the Commonwealth contribution and overstate the non-government contribution. The State contribution share is unaffected.

NPHP and SIGPAH (2001, p5) defines 'sufficiently active' as accumulating, on most days, 30 minutes or more of moderate-intensity physical activity (such as brisk walking) that can be accumulated in bouts of approximately 10 minutes'. To effectively contribute to 'health-enhancing physical activity dose it has been estimated that a person needs to walk at five or six kilometres per hour and cycle at about 16 kilometres per hour' (p12). Data from the 1986 Perth Travel Surveys indicate the following average speeds for walking and cycling as sole trip mode.

Mode/Trip Purpose	Average Trip Length (km)	Average Trip Duration (min)	% Greater than 10 minutes	Average Speed (km/hr)
Walk				
Shopping	0.6	8	28	4.5
Work	0.8	10	37	4.9
Other purposes	0.8	11	42	4.4
Cycle				
Shopping	1.0	7	21	9
Work	6.0	19	65	19
Other Purposes	2.0	12	46	10

Both the times and distances in this table suffer from estimation errors that could be significant. In general, however, people tend to over-estimate the time it takes them to walk or cycle to a destination and such error would lead to an underestimation of speed. It should also be noted that there are substantial variations around the means for trip length and trip duration and people will also be travelling faster than the trip mean for some part of any trip.

Nevertheless:

- it appears likely that many shopping trips by walk or cycle would not count substantially towards the required physical activity level, both because of the short duration and their low travel speed[5];
- most work trips by bicycle and a substantial proportion of those by walk would contribute; and
- a proportion of education trips by walk or cycle would also contribute.

Overall:

- 35% of walk trips exceeded 10 minutes duration; and
- 45% of cycle trips exceeded 10 minutes duration.

More needs to be known about the nature of trips previously undertaken by car, especially in terms of mode, trip purpose, trip duration and trip length, as well as the overall level of transport-related physical activity for individuals. The 2002-2006 Perth Travel Survey will provide useful population-wide data that might be used as proxy for some components, but a special in-depth survey of one or more TSIM interventions would be better.

Even so, it would not be unreasonable on the basis of the known data to assume that 10 to 15 per cent of the 'Interested' group (equivalent to 4.3-6.5% of the target area population, or 1.3 to 2 per cent of the total WA population) would increase their physical activity levels to the required level as a result of TSIM stages 3 to 7. At $800 000 in direct health care cost savings per 1 per cent, this equates to $0.9m-$1.6m saving per year, of which:

[5] However, '*walking has the potential to influence health in a variety of ways. These include the potential benefit of walking as enjoyment and in providing contact with natural environments, social contact, economic benefits through promotion of local economies*' in addition to the physical exercise impacts (HAD, 2001, p1).

- $0.40-0.72million would accrue to the Commonwealth;
- $0.23-0.40million to the State; and
- $0.27-0.48million to the non-government sector.

The present value of State financial saving (25 years @ 8% discount; 4% per annum growth in real health outlays; benefits accruing proportionate to TSIM implementation over ten years) is $3.0-5.3 million. Without the real increase in health service costs (ie if we assume that these are totally exogenous to this area of health services and that air pollution exposure makes no contribution to the real increase in health service costs), the present value is $2.0-3.5 million (see Attachment A for workings)**.**

4.1.4 Exposure to Air Pollution: Impact on Health Service Costs

Potential full TSIM Financial Benefit to the WA State Government: $1.5 million/year at current costs.

Present Value (25 years discounted @ 8% real) for 5-year TSIM implementation program: $12.9 – $19.4 million.

Further investigation of the benefits to those who change modes (not included here) would be desirable.

Reduced motor vehicle travel will benefit all Perth residents, irrespective of whether they are among those who change from car to active modes, as individual exposure to air pollution will decrease correspondingly

Estimates based on Eyre et al (1997), indicate health costs due to air pollution of 2.5 cents (Australian; 2002 prices) per car kilometre for petrol vehicles in urban areas.[6] This value is comparable to the central value of 2.0 cents (1996 prices – 2.4 cents in 2002 prices) recommended by Bray and Tisato (1997).

Seethaler (1999) indicates that 73% of the cost of health impacts relates to mortality and 27% morbidity. The costs of health services primarily relate to morbidity, for which they represent over 80% of costs (based on Seethaler, 1999, Tables 6.4.1-3 to 6.4.3-3, costs for respiratory and cardiovascular hospital admissions).

On the basis of these values, the impact on health service costs, for each kilometre reduction in car use, is around 0.54 cents **[=2.5cents*0.27*0.80]**.

In broad terms, the funding for health care services is provided 45% by the Commonwealth, 25% by the States and 30% from non-government sources (AIHW 2000, Table 5.2, p 235). TSIM has the potential to reduce car travel by 1.1 billion kilometres per year with a total health care benefits of $5.9 million **[=0.54cents/km * 1.1 billion kilometres]**, of which:

- $2.65 million would accrue to the Commonwealth;
- $1.47 million to the State; and
- $1.77 million to the non-government sector.

The present value of State financial saving (25 years @ 8% discount; 4% per annum growth in real health outlays; benefits accruing proportionate to TSIM implementation over ten years) is $19.4 million. Without the real increase in health service costs (ie if we assume that these are totally exogenous to this area of health services and that air pollution exposure makes no contribution to the real increase in health service costs), the present value is $12.9 million.

[6] The value is lower for gas vehicles and substantially higher for diesel. Most private vehicles are petrol-powered, with the remainder being a mix of gas and diesel.

This value is conservative, as it does not take account of direct additional benefits, through lower exposure, of those who change from car to public transport, walking and/or cycling (ICTA, 2000).

4.1.5 Greenhouse Gas Emissions: Impact on Cost of Government Commitments

Potential TSIM Financial Benefit to the WA State Government: not estimated.

This issue should be revisited when it becomes clear what governments are committing to in greenhouse gas abatement and how much they are intending to spend to assist the achievement of those targets/objectives.

This has not been estimated here, as it is not clear at this stage what level of financial responsibility (as distinct from regulatory responsibility) Commonwealth or State governments are likely to accept for achieving greenhouse gas abatement targets under the Kyoto protocol.

The Commonwealth's Greenhouse Gas Abatement Program provides some threshold values for what the Commonwealth government is willing to pay for abatement, but there is no certainty that these values represent any long term acceptance of financial responsibility.

There are no corresponding values for State Government.

In any case, as Allen (2000) points out greenhouse gas abatement benefits are often a joint product with many other externalities and there is no unique way of apportioning costs to joint products.

This issue should be revisited when it becomes clear what governments are committing to in greenhouse gas abatement and how much they are intending to spend to assist the achievement of those targets/objectives. These will allow an opportunity value of greenhouse gas emissions abatement to be estimated – in effect, an estimate of what government will <u>not</u> need to spend on other abatement measures if TSIM is implemented.

4.1.6 Impact on Road Construction (Network Capacity Expansion) Costs

The TSIM program is primarily aimed at existing developed areas of the Perth Metropolitan Region rather than managing the travel demand generated by new development. By itself, it will have little, if any, impact on the demand for network expansion to serve newly-developing areas. However, as a component of a suite of strategies aimed at developing more efficient urban form and curbing urban sprawl, TSIM will have an indirect impact.

Within the areas targeted by TSIM, there are few reservations for new roads other than Stevenson Highway and extensions to Roe, Tonkin and Reid Highways. Only Stevenson Highway is unambiguously within the TSIM area. The Stephenson Highway Review Committee has concluded that a substantial part of the reservation can be dispensed with and that the remainder of the road may be built to a lesser standard than originally planned, but no decision has yet been made by the Minister for Planning and Infrastructure (Transport, 2001).

Other arterial roads in the inner and middle parts of the Perth Metropolitan Region are already built, but have widening reservations under the Metropolitan Region Scheme. Many of these roads are in sensitive areas, where widening would be both technically difficult and raise substantial community opposition. Capacity expansion in such areas is more likely to be through traffic management and intelligent transport systems (ITS) strategies.

It is unlikely that Perth will be in the vanguard of 'early-adopters' for widespread and comprehensive ITS, priorities are likely to relate to *the further development and integration of existing traffic management systems, with functions directed towards traffic responsive operation of traffic control facilities, road safety, incident management, demand responsive public transport management, data collection for planning and network management, real time information to the public and freight management systems* (MRWA & Transport, 2001).

4.1.6.1 Intelligent Transport Systems: Traffic Signals

Potential TSIM Financial Benefit to the WA State Government: $1.4 million/year for 5 years.

Present Value (25 years discounted @ 8% real) for 5-year TSIM implementation program: $5.6 million

In the absence of detailed strategies and justified programs, there is no reliable estimate of the likely cost (or benefits) of ITS in Perth. It is clear, however, that pressure for adoption of ITS technologies is related to traffic growth and inability to increase capacity through conventional building infrastructure strategies.

We can, however, take traffic signalised intersections as an example:

- The requirement for traffic signals is strongly related to intersection capacity, even though the primary driver is safety;
- There are currently 676 traffic signal installations in the Perth Metropolitan Region and the number is increasing at around 20 per year (information from Main Roads WA);
- Each installation costs, on average, $120 000 plus any civil engineering works that might be required (information from Main Roads WA);
- Traffic signals are most heavily concentrated in the inner and middle areas, likely to be targeted by TSIM;
- According to application of the Future Perth Strategic Transport Evaluation Model, TSIM will achieve an overall 5.6% reduction in car-kilometres of travel, across the Perth Metropolitan Area.

  Alternatively, the spreadsheet provided for this study indicated a 16.7% car km reduction in the South Perth full implementation and potential reductions up to 22% in other areas of application. 16.7% across 640 000 people is broadly equivalent to 7.6% across the whole Metropolitan Area (based on population).
- If road traffic is increasing by 2.2% per year across the metropolitan region, a 6-7% reduction in traffic equates to a 2.9-year wind-back of growth over the 5-year implementation period – or a 58% reduction in the rate of traffic growth;
- A 58% reduction in traffic growth would reduce the need for traffic signals over that period by 58%;
- Assuming a reduction of 11.6 per year (=58% of 20 per year), at $120 000 per installation, there would be a saving of $1.4 million per year for five years (at 2002 prices). The present value of this is $5.6 million (25 years @ 8% discount rate)

4.1.6.2 Deferring Road Capacity Increases

TSIM will reduce the rate of road traffic growth over the five-year implementation period. This will allow road capacity expansion projects to be deferred.

The present value of this deferral (25 years @ 8% discount; benefits accruing pro rata to TSIM implementation over ten years) could be in the range $15.1 million - $39.4 million.

Statewide, around $200 million[7] per year is available for road network expansion excluding local government and Commonwealth projects (Martin, 2000, slide 4). Over a period of years, road expenditure is typically one-third in the Perth Metropolitan Area and two-thirds in non-metropolitan WA (Martin, 2000, slide 6).

[7] This figure predates the 2002/3 WA State Budget.

In broad terms, $65-70 million is spent annually on metropolitan networks expansion, although there has been a bias towards the metropolitan area in recent years with the implementation of some major projects such as the Graham Farmer Freeway and the duplication of the Narrows Bridge. Some of this is required for geographical expansion of the network, as Perth continues to spread outwards. However, a significant proportion is the result of general traffic growth pressures in existing developed areas.

If we assume that between one-tenth and one quarter of the network expansion figure ($6.5 – 17 million) relates to the impact of traffic growth generally, as distinct from physical expansion of the metropolitan area, then part of this amount can be deferred through an effective 1 percentage point per annum reduction in traffic growth, from 2.2% to 1.0%. **The present value of this deferral is between $15.1 million and $39.4 million (25 years @ 8% discount; benefits accruing pro rata to TSIM implementation over five years)**

4.1.7 Road Trauma: Impact on Health and Disability Service Costs

Potential TSIM Financial Benefit to the WA State Government: Not separately estimated

In principle, the direct impacts of road trauma on health costs are incorporated in the estimation of values for fatalities and injuries.

In practice, fatalities and injuries may have consequences for people not directly involved in the crash (ie suffering the fatality or injury) that are not taken account of, including loss of support for disabled or frail-aged people (now or in the future), who have to rely more heavily on public services.

4.1.8 Government Tax Revenue

The original evaluation of TSIM argued that there would be no net change in State Government tax revenue or revenues related to taxation. The introduction of the Goods and Services Tax does not change the validity of this conclusion.

The principal tax revenue impacts of changes in the level of car use are through the taxes on fuel, namely the Commonwealth Excise and the Goods and Services Tax (GST). Both these are Commonwealth taxes.

The GST applies to most goods and services other than basic foodstuffs. Assuming, therefore, that the financial savings to individuals are used for other consumption, rather than for saving/investment, any transfer of expenditure from motor vehicle fuel to other GST-taxed items (ie anything other than basis foodstuffs) would still produce the same GST revenue.

The Commonwealth Government, however, would be worse off to the extent of the previous excise revenue from fuel The excise duty on fuel is currently $0.38143 per litre (equivalent to around 4.2 cents per vehicle kilometre at average fuel consumption rates for cars).

Under the Intergovernmental Agreement that accompanied the introduction of the GST, the Commonwealth passes on all of its GST revenue collections (other than from fuel) to the States as general purpose grants. The distribution between States is based on recommendations by the Commonwealth Grants Commission.[8]

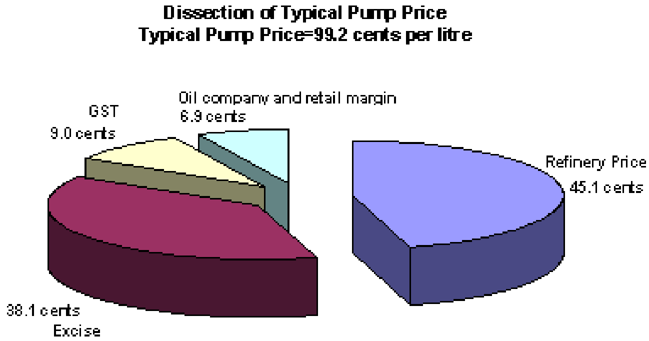
As compensation for the High Court's declaring the State Fuel Franchise Fee unconstitutional, the Commonwealth Government returns the 10 per cent GST on motor vehicle fuel to the States as an untied grant, but because the Commonwealth has ceased to index the Excise rate to the

[8] Although the Commonwealth Grants Commission arrangements do not guarantee that changes in GST revenue collections will flow entirely to the State in which they arise (Government of WA 2002), it has been assumed here that this will be the case.

consumer price index, the total amount of GST so-returned varies only with the non-excise component of the fuel price.

Taxation and the Price of Petrol

In broad terms, the dissection of the price of petrol has been estimated as below (Webb, 2000):



At 90 cents per litre pump price, the GST component would be 8.18 cents.

For every litre of fuel not used:

- Consumers would save 90 cents
- Commonwealth Excise would reduce by 38.1 cents
- GST would reduce by 8.18 cents

Assuming that 90 cents was then spent on goods and services attracting GST:

- GST would increase by 8.18 cents

4.1.9 Summary of Financial Impacts on State Government

The foregoing assessments demonstrate that there are substantial financial benefits to State Government from the implementation of the full 10-Year TSIM program (Table 4.1).

Table 4.1 Summary of Financial Impacts of TSIM

Area of Impact	Stages 3 to 7 544,000 population (Present Value @ 8% discount)	Financial Benefit per $1 million dollars invested in TSIM (Present Value @ 8% discount)
Public Transport Net Fare Revenue	$31.7 million	$1.45 million
Public Transport (bus) Capital Cost	($1.1 million) Additional cost	($0.05 million) Additional cost
Health Service Costs (State): Improved Health and Fitness	$2.0 - $5.3 million	$0.09 - $0.25 million
Health Service Costs (State): Exposure to Air Pollution	$12.9 - $19.4 million	$0.60 - $0.90 million
Greenhouse Gas Abatement	Not estimated	Not estimated
Road System Costs: Traffic Signals	$5.6 million	$0.25 million
Road System Costs: Road Construction	$15.1 – $39.4 million	$0.70 - $1.85 million
Road Trauma	Not estimated	Not estimated
State Government Tax Revenue	No impact on revenue from Goods and Services Tax	Nil
TOTAL financial impact	**$66.2 - $100.3 million**	**$3.09 - $4.70 million**

The first year financial savings flowing to the State from a once only investment of $1 million to TSIM are (lower estimates):

Public Transport Net Fare Revenue	$170,000
Public Transport (bus) Capital Cost – additional cost	-$5,000
Health Service Costs (State): Improved Health and Fitness	$20,000
Health Service Costs (State): Exposure to Air Pollution	$70,000
Road System Costs: Traffic Signals	$65,000
Road System Costs: Road Construction	$170,000
Total First Year Revenue/Cost Reduction	**$490,000**
First Year Rate of Financial Return	**49%**

4.2 Socio-Economic Issues

4.2.1 Health and Fitness (Mortality)

The original assessment of health and fitness (mortality) benefits of TSIM does not need revision, other than to update the estimates of fatality costs.

In the original evaluation of TSIM, the value of health and fitness benefits related solely to changes in mortality and was estimated through the relativity of life-years lost (through increased road trauma) and life years gained (through improved health and fitness) (Ker and James, 2000, p12). The relativity used was that derived by Hillman (1997) based on a study for the British Medical Association (BMA, 1992, esp. pp 111-131).

The relativity was applied to the full economic cost of a road crash fatality. It has since been pointed out (verbally) that the relativity should be applied to the costs associated with the life-years gained or lost, not to those associated with the management of the immediate road trauma event. According to Andreassen (1992), the costs of managing the immediate trauma event are less than two per cent of the estimated economic costs of a road traffic fatality, so in practice there is no significant error introduced given the range of uncertainty surrounding this type of valuation.

4.2.2 Road Trauma: Willingness to Pay vs Economic Costs

The socio-economic evaluation of TSIM should include an additional sensitivity test to include the 'willingness to pay' value for fatality reduction in road trauma.

Valuation of road trauma, including traffic fatalities, in Australia is undertaken according to the 'ex-post' (also known as 'human capital' or 'economic') approach. This is entirely appropriate in the context of accounting-related assessments (including the financial impacts on government, but is not appropriate for the 'ex-ante' evaluation of a policy change or a proposed initiative, for which the correct approach is to value the 'willingness to pay' for the outcomes (Ker, 1980).

Whilst this was mentioned in the original TSIM evaluation (Ker and James, 2000, p14), this was solely to emphasis that the benefit calculations were conservative.

Cameron (2002) estimated (based on work undertaken by the Bureau of Transport and Communications Economics) that the 'willingness to pay' estimate could be as much as 2.6 times the 'human capital' valuation for fatal crashes. Cameron did not find a large difference between the respective values for serious injury crashes, but considered this most likely to be due to methodological differences between the two BTCE studies. In principal, one would expect the willingness to pay estimates to be significantly greater on the basis that the potential victim personally suffers with severe injuries.

In view of the substantial net road trauma benefit from TSIM, the socio-economic evaluation of TSIM should include an additional sensitivity test to include the 'willingness to pay' value for fatality reduction in road trauma.

4.2.3 Road Trauma: Cost per Fatality

The socio-economic evaluation of TSIM should be reworked with the more recent, higher, value of fatalities and hospitalisations/serious injuries.

The original TSIM evaluation was based on a cost per fatality of $0.78 million (Transport 1998, p99).

More recently, the WA Road Safety Council (2000, Table 3, p7) has estimated a 'human capital' value of $1.808 million per fatality crash, based on the BTCE work also used by Cameron (2002). With 87 fatalities in 74 crashes in the Metropolitan Area in 2000 (Tables 3 and 5), this is equivalent to around $1.5 million per fatality, nearly twice the value reported in 1998.

Similarly, the Road Safety Council (2000) has estimated the cost of a 'hospitalisation' crash as $446 320. With 1 266 hospitalisations from 1 028 'hospitalisation crashes', this implies a value of around $360 000 per person hospitalised, 2.6 times the $140 000 reported in Transport, 1998.

Fatality crashes may also involve hospitalisation of one or more people, so these estimates will tend to overstate the cost per fatality and understate the cost per hospitalisation. However, the extent of this is not likely to be large.

In view of the substantial net road trauma benefit from TSIM, the socio-economic evaluation of TSIM should be reworked with the more recent, higher, value of fatalities and hospitalisations/serious injuries.

4.2.4 Congestion Cost Reduction

Congestion reduction benefits of TSIM have been revised downwards from $165 million to $50 million (present value - 25 years discounted @ 8% real). The socio-economic benefit-cost ratio for TSIM is correspondingly reduced from 83.9:1 to 80.5:1.

The substantial downward revision of the extent to which conversion of trips from car driver to other modes occurs during the peak periods, from 67% to 20%, has a major impact on the congestion reduction impact of TSIM, since congestion reduction primarily occurs from peak period traffic reduction.

4.2.5 Adjustment to 2002 Costs and Prices

The evaluation of TSIM should be reworked on the basis of current, 2002, prices and costs to provide a complete up-to-date assessment to support informed decision-making.

The original evaluation of TSIM was undertaken on the basis of 1996 prices and costs. Whilst the cost of the TSIM program has been updated on the basis of experience, contract prices and general price/cost levels, the benefit analysis has not.

The evaluation has also been updated with respect to the effectiveness (proven and prospective) of TSIM as an intervention and some technical aspects including the contractual arrangements relating to fare revenue and costs for bus service provision.

The evaluation of TSIM should be reworked on the basis of current, 2002, prices and costs to provide a complete up-to-date assessment to support informed decision-making.

4.3 The Evaluation Spreadsheet

The TSIM evaluation spreadsheet has progressively developed from one originally devised for the evaluation of the South Perth Pilot Project, reported in Ker and James (2000).

Inevitably, as the purpose and the program to which the evaluation is applied have developed, there has been an increase in complexity and, in some cases, errors have crept in. Whilst these errors should be corrected, the overall evaluation results are so overwhelmingly positive that it is highly unlikely that correction would make more than a small change to the overall outcomes.

Four areas of 'error' have been identified in this review:

- Specification errors in the calculation of additional bus capacity requirements and the corresponding additional bus operating requirements, including lack of updating to the most recent information.
- Duplication and/or omission of a small number of local governments in the aggregation of results.
- Over-estimation of the peak-period component of trips converted to non-car modes. The original evaluation worked on the basis of one third of the car use reduction occurring in each of the peak periods and the remaining one-third in the inter-peak period (Ker & James, 2000, p12). Experience with the broader-scale implementation of TSIM indicates that only 42% of the reduction in car use was in the two peak periods, even when these were relatively broadly defined (5.00-9.00am and 3.00-7.00pm).

  For the purposes of estimating costs and benefits related to car use and public transport at peak times, the critical period is substantially less. After discussion with Colin Graham of the Department for Planning and Infrastructure, a value of 20% has been adopted as being relevant to:

  - Congestion reduction; and
  - Additional public transport capacity and operating costs.

These three have been corrected in the evaluation spreadsheet and a revised copy provided to the client. The changes in results are shown in Tables 4.3.1 (a), (b) and (c). The main differences are in the additional public transport capacity and operating costs and in the congestion cost savings (but see 4.2.4, above).

- The further source of 'error' is that the spreadsheet is based on a five-year implementation program, rather than the 10-years now envisaged. This has not been corrected in this current study, as it would require a concerted effort to ensure the integrity and completeness of links between all worksheets and would need time beyond that available at present. However, the magnitude of the evaluation outcomes is such that overall conclusions will not be significantly affected.

Table 4.3.1(a) Net Changes to Socio-Economic Evaluation Summary for TSIM 10-Year Program

Benefit-Cost Evaluation of Individualised Marketing: Financial & Socio-economic Evaluation
Stages 3 to 7

Discount Rate: 8%

Item	Present Value (25 years - to 2027/28)	Present Value (10 years - to 2012/13)	Present Value (15 years - to 2017/18)
Capital Costs			
Cost of individualised marketing	$0	$0	$0
Additional public transport capacity: capital	$109,825	$95,706	$95,706
Benefits			
Private vehicle operating costs (net of tax)	$0	$0	$0
Additional public transport services: operating	-$435,932	$36,341	-$183,959
Increased walking/cycling costs to user	$0	$0	$0
Improved health and fitness due to exercise - reduced mortality	-$8,630,457	-$5,291,835	-$6,849,190
Air pollution costs to community	$0	$0	$0
Greenhouse gas emissions	$0	$0	$0
Road Congestion	$115,736,363	$65,824,545	$89,106,736
Road trauma (reduced car use)	$0	$0	$0
Road trauma (increased cycle/walk use)	$8,369,577	$5,272,601	$6,717,237
Traffic noise	$0	$0	$0
Water Pollution	$0	$0	$0
Net Present Value	-$115,149,376	-$65,937,358	-$88,886,530
Benefit-Cost Ratio	-6.2	-3.5	-4.8

Note: Negative values indicate an increase in benefits or decrease in costs

Public Transport Financial Evaluation of Individualised Marketing: Summary
Stages 3 to 7

Discount Rate: 8%

Item	Up-front[a]	First Year[b]	Present Value (25 years - to 2026/27)	Present Value (10 years - to 2011/12)	Present Value (15 years - to 2016/17)
Capital Costs:					
Cost of individualised marketing	$0	$0	$0	$0	$0
Additional public transport capacity: capital	-$13,313	$0	$109,825	$95,706	$95,706
TOTAL	-$13,313	$0	$109,825	$95,706	$95,706
Funding:					
Public Sector: Transport WA	$0				
Public Sector: Transport WA - Buses	-$13,313				
Public Sector: Local Government	$0				
Private Sector	$0				
TOTAL	-$13,313				
Operating Costs:					
Additional public transport services: Public Sector		$0	$0	$0	$0
Additional public transport services: Private Sector		-$21,106	-$435,932	$36,341	-$183,959
TOTAL Additional Operating Costs		-$21,106	-$435,932	$36,341	-$183,959
Operating Revenues:					
Public transport fare revenue: Transperth		$0	$0	$0	$0
Additional revenue: Private Operator		-$387,547	-$3,700,598	-$2,173,156	-$2,885,656
First year financial rate of return: Public Sector		1.8%			
First year financial rate of return: Private Sector		-33.6%			
OVERALL First year rate of return		0.1%			
AS FULL PRIVATE SECTOR PROJECT		-1.6%			
Financial Net Present Value: Public Sector			$3,590,773	$2,077,449	$2,789,950
Financial Net Present Value: Private Sector			-$3,264,666	-$2,209,497	-$2,701,698
OVERALL Financial Net Present Value			$326,108	-$132,047	$88,252
AS FULL PRIVATE SECTOR PROJECT			-$3,374,491	-$2,305,203	-$2,797,404
Internal Rate of Return: Public Sector			1%	3%	2%
Internal Rate of Return: Private Sector			-14%	-14%	-14%
OVERALL Internal Rate of Return			-2%	-1%	-1%
AS FULL PRIVATE SECTOR PROJECT			-3%	-3%	-3%

Table 4.3.1(b) Revised Socio-Economic Evaluation Summary for TSIM 10-Year Program

Benefit-Cost Evaluation of Individualised Marketing: Financial & Socio-economic Evaluation
Stages 3 to 7

Discount Rate: 8%

Item	Present Value (25 years - to 2027/28)	Present Value (10 years - to 2012/13)	Present Value (15 years - to 2017/18)
Capital Costs			
Cost of individualised marketing	$19,067,995	$19,067,995	$19,067,995
Additional public transport capacity: capital	$1,099,497	$872,750	$872,750
Benefits			
Private vehicle operating costs (net of tax)	-$962,935,681	-$547,665,412	-$741,375,080
Additional public transport services: operating	$4,194,011	$2,462,910	$3,270,411
Increased walking/cycling costs to user	$14,097,766	$8,188,726	$10,945,095
Improved health and fitness due to exercise - reduced mortality	-$39,016,559	-$22,662,875	-$30,291,321
Air pollution costs to community	-$170,431,094	-$96,931,931	-$131,216,828
Greenhouse gas emissions	-$170,431,094	-$96,931,931	-$131,216,828
Road Congestion	-$49,601,299	-$28,210,519	-$38,188,601
Road trauma (reduced car use)	-$208,027,154	-$118,314,524	-$160,162,461
Road trauma (increased cycle/walk use)	$51,893,562	$29,430,163	$39,908,586
Traffic noise	-$25,564,664	-$14,539,790	-$19,682,524
Water Pollution	-$12,782,332	-$7,269,895	-$9,841,262
Net Present Value	$1,548,437,046	$872,504,333	$1,187,910,067
Benefit-Cost Ratio	77.78	44.75	60.57

Note: Benefits are shown as 'net change' - positive values are disbenefits

Public Transport Financial Evaluation of Individualised Marketing: Summary
Stages 3 to 7

Discount Rate: 8%

Item	Up-front[(a)]	First Year[(b)]	Present Value (25 years - to 2026/27)	Present Value (10 years - to 2011/12)	Present Value (15 years - to 2016/17)
Capital Costs:					
Cost of individualised marketing	$21,760,000		$19,067,995	$19,067,995	$19,067,995
Additional public transport capacity: capital	$965,246		$1,099,497	$872,750	$872,750
TOTAL	$22,725,246		$20,167,492	$19,940,746	$19,940,746
Funding:					
Public Sector: Transport WA	$18,500,000				
Public Sector: Transport WA - Buses	$965,246				
Public Sector: Local Government	$2,170,000				
Private Sector	$1,090,000				
TOTAL	$22,725,246				
Operating Costs:					
Additional public transport services: Public Sector		$0	$0	$0	$0
Additional public transport services: Private Sector		$382,330	$4,194,011	$2,462,910	$3,270,411
TOTAL Additional Operating Costs		$382,330	$4,194,011	$2,462,910	$3,270,411
Operating Revenues:					
Public transport fare revenue: Transperth		$9,773,716	$88,971,723	$50,450,466	$68,419,341
Additional revenue: Private Operator		$6,283,036	$57,295,016	$32,531,616	$44,082,912
First year financial rate of return: Public Sector		16%			
First year financial rate of return: Private Sector		541%			
OVERALL First year rate of return		41%			
AS FULL PRIVATE SECTOR PROJECT		26%			
Financial Net Present Value: Public Sector			$13,679,215	$148,104	$6,565,684
Financial Net Present Value: Private Sector			$50,931,005	$27,898,706	$38,642,502
OVERALL Financial Net Present Value			$64,610,220	$28,046,810	$45,208,185

Table 4.3.1(c) Previous Socio-Economic Evaluation Summary for TSIM 10-Year Program (for comparison with 4.3.1(b)

Benefit-Cost Evaluation of Individualised Marketing: Financial & Socio-economic Evaluation
Stages 3 to 7

Discount Rate: 8%

Item	Present Value (25 years - to 2027/28)	Present Value (10 years - to 2012/13)	Present Value (15 years - to 2017/18)
Capital Costs			
Cost of individualised marketing	$19,067,995	$19,067,995	$19,067,995
Additional public transport capacity: capital	$989,672	$777,044	$777,044
Benefits			
Private vehicle operating costs (net of tax)	-$962,935,681	-$547,665,412	-$741,375,080
Additional public transport services: operating	$4,629,944	$2,426,569	$3,454,369
Increased walking/cycling costs to user	$14,097,766	$8,188,726	$10,945,095
Improved health and fitness due to exercise - reduced mortality	-$30,386,102	-$17,371,041	-$23,442,131
Air pollution costs to community	-$170,431,094	-$96,931,931	-$131,216,828
Greenhouse gas emissions	-$170,431,094	-$96,931,931	-$131,216,828
Road Congestion	-$165,337,662	-$94,035,064	-$127,295,337
Road trauma (reduced car use)	-$208,027,154	-$118,314,524	-$160,162,461
Road trauma (increased cycle use)	$43,523,985	$24,157,562	$33,191,350
Traffic noise	-$25,564,664	-$14,539,790	-$19,682,524
Water Pollution	-$12,782,332	-$7,269,895	-$9,841,262
Net Present Value	$1,663,586,422	$938,441,692	$1,276,796,597
Benefit-Cost Ratio	83.94	48.29	65.34

Note: Benefits are shown as 'net change' - positive values are disbenefits

Public Transport Financial Evaluation of Individualised Marketing: Summary
Stages 3 to 7

50% New Capacity Requirement in Peak
Discount Rate: 8%

Item	Up-front[(a)]	First Year[(b)]	Present Value (25 years - to 2026/27)	Present Value (10 years - to 2011/12)	Present Value (15 years - to 2016/17)
Capital Costs:					
Cost of individualised marketing	$21,760,000		$19,067,995	$19,067,995	$19,067,995
Additional public transport capacity: capital	$978,559		$989,672	$777,044	$777,044
TOTAL	$22,738,559		$20,057,667	$19,845,039	$19,845,039
Funding:					
Public Sector: Transport WA	$18,500,000				
Public Sector: Transport WA - Buses	$978,559				
Public Sector: Local Government	$2,170,000				
Private Sector	$1,090,000				
TOTAL	$22,738,559				
Operating Costs:					
Additional public transport services: Public Sector		$0	$0	$0	$0
Additional public transport services: Private Sector		$403,435	$4,629,944	$2,426,569	$3,454,369
TOTAL Additional Operating Costs		$403,435	$4,629,944	$2,426,569	$3,454,369
Operating Revenues:					
Public transport fare revenue: Transperth		$9,773,716	$88,971,723	$50,450,466	$68,419,341
Additional revenue: Private Operator		$6,670,583	$60,995,614	$34,704,771	$46,968,569
First year financial rate of return: Public Sector		14%			
First year financial rate of return: Private Sector		575%			
OVERALL First year rate of return		41%			
AS FULL PRIVATE SECTOR PROJECT		28%			
Financial Net Present Value: Public Sector			$10,088,441	-$1,929,345	$3,775,733
Financial Net Present Value: Private Sector			$54,195,671	$30,108,203	$41,344,199
OVERALL Financial Net Present Value			$64,284,112	$28,178,858	$45,119,933

4.4 Other Government Objectives, Strategies and Targets

To a significant extent, the impacts of TSIM accrue in the area of the so-called externalities of transport. The initial TSIM evaluation recognised the need to include these externalities in the evaluation framework and estimated values for some of them.

The major such externalities relate to health, greenhouse and air quality.

These externality impacts also affect the achievement of other government objectives and contribute to the implementation of government strategies in a range of areas. Some of the more immediately relevant of these are outlined below.

4.4.1 Health

4.4.1.1 Physical Activity Taskforce (PATF 2001)

The Physical Activity Taskforce was established with the overall goal of increasing (from 58% to 63% over 10 years[9]) the proportion of Western Australian who are sufficiently active according to national recommendations. The PATF (2001b) identifies four key challenges:

- Health
- Transport and the Environment
- Workplace
- Young People and Schools

Its recommended strategies include (current author's emphasis):

- Re-orienting public health, education, transport and sport and recreation policies and funding to prioritise physical activity as part of achieving healthy and active lifestyles, and to simplify access at community level (PATF, 2001b, p20)
- Promoting children's mobility, independence and sense of adventure (PATF, 2001b, p20)
- Establishing a statewide community-based walking movement (PATF, 2001b, p28).
- Active multi-media promotion to support a statewide community based walking movement (PATF, 2001b, p21)
- (Local Government) developing local policies that support physical activity (walking, cycling and public transport (PATF, 2001b, p22)
- (Schools) implementing active transport policies encouraging active commuting by students and teachers (PATF, 2001b, p27)
- (Employers) encouraging physical activity as a form of transport to and from the workplace and implementing transport plans that encourage a physically active workplace (PATF, 2001b, p27)

TSIM is entirely consistent with and supportive of these strategies.

Other PATF strategies include matters relating to urban planning and design and to provision of appropriate infrastructure (including for walking and cycling). These are complementary to and would enhance the effectiveness of TSIM.

The PATF also notes (PATF, 2001b, p24) that *societal perceptions of crime and safety keep people inside and restrict outdoor physical activity opportunities*. More people walking and cycling (more 'eyes on the street') can help break this vicious circle.

The PATF uses the same data on costs of disease and ill-health as NPHP & SIGPAH (2001) to conclude, inter alia, that *If the proportion of sufficiently active people increased Australia-wide*

9 In the main text of the report (PATF 2001a), the reference is to 56% to 61%, but this does not affect the arguments here.

by 5% from 56% to 61%[10]*, the costs savings associated with reducing the 6 major diseases … have been estimated at $36 million* (PATF, 2001a, pp31/2).

On the basis of the analysis of TSIM impacts outlined in Section 4.1.3, it appears that TSIM can achieve 40-80% of the PATF objective. However, better information on the actual physical activity consequences of TSIM is necessary to confirm this result.

4.4.2 Sustainability

4.4.2.1 WA Sustainability Strategy

This strategy is currently under development. Whilst the discussion paper (DPC, 2001) makes little specific mention of transport, it clearly identifies the importance of TSIM and related initiatives to the sustainability objective in the context of land use and community planning when it asks, under the heading of 'Economic Strategies for Sustainability':

How can Perth and regional towns become more sustainable? Can we use urban design, public transport, travel demand management, waste and water management more effectively to reduce our ecological footprint? How can we manage urban development so bushland can be conserved? (DPC, 2001, p14)

4.4.3 Greenhouse

The Australian transport sector accounts for 73.9 million tonnes of Australia's total net greenhouse gas emissions, representing just over 16.1 per cent of Australia's total emissions. About 90.2 per cent of these emissions come from road transport, including cars, trucks and buses.

Greenhouse gas emissions from the transport sector are also the fastest growing emissions of any sector, rising by 20.3 per cent from 1990 levels. The Bureau of Transport Economics projects that, without reduction measures, emissions from the transport sector will rise by 38 per cent between 1990 and 2010.

Under the Kyoto Protocol to the United Nations Framework Convention on Climate Change, Australia is committed to a target for national greenhouse gas emissions of eight per cent above 1990 levels by 2008-12. This represents about a 22 per cent reduction from current business-as-usual projections of greenhouse gas emissions for 2008-12.

TSIM generates a wide range of benefits, not just greenhouse, and would fall into the category of 'no regrets' measures that should be undertaken irrespective of any uncertainty that might exist about greenhouse processes and impacts. The impacts of TSIM for 640 000 people is projected to achieve a reduction of 0.318 Mega tonnes (318 000 tonnes) per year in CO2e, as compared to 'business as usual' for the Kyoto period 2008-2012.

Overall, the equivalent cost per tonne of CO2e abatement is under $10. The true cost, allowing for the substantial other financial benefits is substantially less.[11]

4.4.3.1 National Greenhouse Strategy (AGO, 1999)

The National Greenhouse Strategy (NGS) recognised the importance of reducing the demand for travel as a key element in limiting greenhouse gas emissions from transport (p59). However, it regarded travel demand management as an 'existing measure', rather than 'additional measures' to be actively supported and developed under the NGS.

[10] This is more correctly a *5 percentage point* increase - actually an 8.6% increase on existing.

[11] The actual extent depends upon the model used to distribute joint benefits and what are regarded as core 'products' of TSIM and what as 'by-products'. The total value of non-greenhouse financial benefits greatly exceeds the cost of TSIM.

The NGS Taskforce on Measure 5.3, 'Promoting Best Practice in Transport and Land Use Planning', recognised the importance of travel demand management to complement and reinforce the initiatives it developed.

4.4.3.2 WA Greenhouse Strategy

The WA Greenhouse Strategy is currently under development. Whilst there is a key issue of setting targets for abatement, travel demand management is a cost-effective approach to abatement and, from the perspective of the community as a whole, does not rely solely on greenhouse benefits for its justification.

4.4.4 Air Quality

4.4.4.1 Perth Air Quality Management Plan

The Perth Air Quality Management Plan was released in December 2000. It was developed 'to ensure that clean air is achieved and maintained throughout the Perth metropolitan region over the next 30 years'. An implementation plan (DEWC (2002) includes, amongst its 'Actions and Programs for the First Year' (p5), that 'the TravelSmart program will continue to be expanded in Perth's suburbs' (referring to the area-based TSIM program).

Most targets in DEWC (2000) are related to timelines for initiatives (TravelSmart Individualised Marketing is simply denoted as 'ongoing' under 'Initiative 1, Community Education – Program 3: Influence the community's travel behaviour through implementing TravelSmart, teleworking and other travel behaviour change programs'.

The only quantitative target in respect of transport is the Metropolitan Transport Strategy target of increasing public transport usage from 6.4% to 12.5 percent of trip by 2029, with an intermediate target of 8% by 2007.

Extrapolation of the South Perth broadscale results indicates that TSIM would increase public transport's mode share by 1.5 percentage points across the whole population (or 3.2 percentage points among the target population). **This indicates that a 10-year TSIM program would achieve:**

- **half the increase in public transport usage required by the target for 2007 (bearing in mind that only half the program would have been delivered by 2007); and**
- **one quarter of the increase required for the 2029 target**.

Looking at the MTS targets in another way, the objective is to reduce car-driver trips from a forecast 70% in 2029 to 46%. Extrapolation of the South Perth broadscale results indicates that TSIM would reduce the car driver mode share by 3.7 percentage points across the whole population (or 8 percentage points among the target population). **This indicates that a 10-year TSIM program would achieve around one-seventh of the 2029 target implicitly adopted by the Perth Air Quality Management Plan.**

4.4.5 Environmental Performance of the Transport System (National Transport Secretariat)

The National Transport Secretariat was established by the Australian Transport Council of Ministers to provide independent advice to the ATC on transport issues of strategic and national importance across all modes and jurisdictions. One of its primary areas of focus has been on 'improving the environmental performance of the transport system'.

In the first instance, the NTS focussed on transport-generated emissions from urban congestion, through the development of a national abatement package for further development and for implementation by Commonwealth, State and Territory agencies (NTS, 2001). One of six key outcome areas that formed the package was 'Smarter Decisions about Available Choices', which included the following actions:

- Identify and document best practice methods for travel behaviour change programs;
- Develop, and seek jurisdictional agreement to, a national policy on travel behaviour change programs;
- Adoption of best practice methods in the management of travel behaviour change programs;
- Promote behaviour change principles and best practice methods to transport and other government agencies; and
- Expand current travel behaviour change programs or implement new programs.

5 Documentation

Documentation of interventions, impacts and evaluations, including the details of evaluation model, should be more systematic and able to be updated as necessary.

There are a number of documents relating to the effectiveness and evaluation of TSIM. These have different dates and purposes and they incorporate different underlying information on the effectiveness of TSIM.

The core of the evaluation consists of:

- Information on effectiveness from monitoring of implementation through successive interventions; and
- The analytical model for translating effectiveness into benefits and costs.

Decision-making will be best-supported by better-structure documentation of the core elements, including:

- Standard format reporting on interventions; and
- Documentation of the specification and application of the analytical model for benefit-cost analysis, including subsequent modifications to either structure or content.

In particular, it has not been possible, within the time and resource constraints for this present report, to fully document the analysis and calculations that underly the estimates of costs and benefits reported herein.

6 Conclusions and Recommendations

TravelSmart Individualised Marketing (TSIM) has substantial benefits that were not quantified in the original evaluation of the South Perth Pilot Project. These include morbidity and mortality improvements from more adequate levels of physical exercise.

In addition, substantial actual and potential financial benefits to State government have been identified and estimated in a number of areas (Table 6.1):

- Public transport fare revenues and operating costs
- Public transport capital costs
- Improved health and fitness due to exercise
- Users' and others' exposure to air pollutants
- Greenhouse gas emissions
- Road capacity requirements
- Road trauma
- Government tax revenue

TSIM contributes very substantially to the achievement of objectives in other areas of government, including air quality, greenhouse and health.

TSIM can achieve a very substantial part of the WA Physical Activity Taskforce objective of increasing the proportion of sufficiently-active people in WA from 56% to 61%. However, better information on the actual physical activity consequences of TSIM, including an in-depth survey of one or more TSIM interventions, is necessary to confirm this result.

In some areas, the broader, socio-economic evaluation of TSIM should be upgraded and updated:

- to update costs and other relevant values (specifically the Road Safety Council valuation of fatalities and serious injuries from road crashes) to current (2002) levels;
- to include an additional sensitivity test to include the 'willingness to pay' value for fatality reduction in road trauma; and
- to include health and fitness benefits not previously quantified.

The development, implementation, monitoring and evaluation of TSIM should be more comprehensively documented in a structured way that allows for continual improvement and updating. This will provide much more effective support for informed decision-making.

Table 6.1 Summary of Financial Impact Assessments (TSIM stages 3 to 7 – 544,000 population)

Item	Qualitative/Quantitative Estimation	Next Steps
Public Transport Fare Revenues and Operating Costs	There would be a net revenue gain of $3.5 million per year to government from conversion of trips from car to bus through TSIM. Present Value (25 years discounted @ 8%) for 5-year TSIM implementation program: $231.7million.	Further investigation is required to assess impact of trips converted to train.
Public Transport Capital Costs	An additional 3.2 buses will be required to carry additional passengers in peak periods in inner areas, at a cost of $1.0 million. Present Value (25 years discounted @ 8%) for 5-year TSIM implementation program: $1.1 million. The re-allocation of all existing railcars to the Fremantle, Midland and Armadale lines will provide capacity for additional rail demand in those corridors.	Develop a bus service enhancement strategy to ensure no loss of level of service in inner areas.
Improved Health and Fitness Due to Exercise	Conservatively estimated initial annual health service cost (financial) benefits: ♦ $0.40-0.72million would accrue to the Commonwealth; ♦ $0.23-0.40million to the State; and ♦ $0.27-0.48million to the non-government sector. Present value of State financial saving (25 years @ 8% discount): $2.0 - $5.3 million.	More specific research into TSIM impacts on mode, trip purpose, trip length and duration and pre-existing physical activity levels.
Exposure to Air Pollution: Impact on Health Service Costs	Estimated initial annual health service cost (financial) benefits: ♦ $2.65 million would accrue to the Commonwealth; ♦ $1.47 million to the State; and ♦ $1.77 million to the non-government sector. The present value of State financial saving (25 years @ 8% discount): $12.9 - $19.4 million.	
Greenhouse Gas Emissions: cost of Government Commitments	No reliable estimates – depends on developing policy on government responsibility for greenhouse gas abatement.	Revisit when government commitments to funding greenhouse gas abatement are clearer.
Impact on Road Construction (Network Capacity Expansion) Costs	1. <u>Intelligent Transport Systems</u> Greatest where technical and community difficulties of physical capacity expansion greatest, where, traffic management and ITS will be main tools to increase effective capacity. Traffic reduction impact on traffic signal requirements alone could be $7 million, spread over the period of TSIM implementation. Present value $5.6 million. 2. <u>Road Building</u> TSIM will reduce the rate of road traffic growth, allowing road capacity expansion to be deferred. Present Value (25 years discounted @ 8%) for 5-year TSIM program: $15.1 - $39.4 million.	Develop modelling and programming procedures for road and public transport investments that adequately takes account of the potential impacts of TSIM on levels of demand and usage.
Road Trauma: Impact on Health and Disability Service Costs	No reliable estimates other than those already included in cost of road trauma.	
Government Tax Revenue	No net impact on State Government.	

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Attachment A: Present Value Calculations

Inflation	0%
Discount Rate	0.08
Real inc/yr	4%

Year	Health Costs (Exercise)				Air Pollution Exposure			
	Real Growth in health costs		No Real Growth		Real Growth in health costs		No Real Growth	
	Actual	PV	Actual	PV	Actual	PV	Actual	PV
1	$0	$0	$0	$0	$0	$0	$0	$0
2	$83,200	$77,037	$80,000	$74,074	$305,760	$283,111	$294,000	$272,222
3	$173,056	$148,368	$160,000	$137,174	$635,981	$545,251	$588,000	$504,115
4	$269,967	$214,309	$240,000	$190,520	$992,130	$787,585	$882,000	$700,160
5	$374,355	$275,162	$320,000	$235,210	$1,375,754	$1,011,220	$1,176,000	$864,395
6	$486,661	$331,213	$400,000	$272,233	$1,788,480	$1,217,209	$1,470,000	$1,000,457
7	$486,661	$306,679	$400,000	$252,068	$1,788,480	$1,127,046	$1,470,000	$926,349
8	$506,128	$295,321	$400,000	$233,396	$1,860,019	$1,085,303	$1,470,000	$857,731
9	$526,373	$284,383	$400,000	$216,108	$1,934,420	$1,045,107	$1,470,000	$794,195
10	$547,428	$273,850	$400,000	$200,100	$2,011,797	$1,006,399	$1,470,000	$735,366
11	$569,325	$263,708	$400,000	$185,277	$2,092,268	$969,125	$1,470,000	$680,894
12	$592,098	$253,941	$400,000	$171,553	$2,175,959	$933,232	$1,470,000	$630,458
13	$615,782	$244,535	$400,000	$158,846	$2,262,997	$898,667	$1,470,000	$583,757
14	$640,413	$235,478	$400,000	$147,079	$2,353,517	$865,383	$1,470,000	$540,516
15	$666,029	$226,757	$400,000	$136,184	$2,447,658	$833,332	$1,470,000	$500,478
16	$692,671	$218,359	$400,000	$126,097	$2,545,564	$802,468	$1,470,000	$463,405
17	$720,377	$210,271	$400,000	$116,756	$2,647,387	$772,747	$1,470,000	$429,079
18	$749,192	$202,483	$400,000	$108,108	$2,753,282	$744,127	$1,470,000	$397,295
19	$779,160	$194,984	$400,000	$100,100	$2,863,414	$716,567	$1,470,000	$367,866
20	$810,327	$187,762	$400,000	$92,685	$2,977,950	$690,027	$1,470,000	$340,617
21	$842,740	$180,808	$400,000	$85,819	$3,097,068	$664,470	$1,470,000	$315,386
22	$876,449	$174,112	$400,000	$79,462	$3,220,951	$639,860	$1,470,000	$292,024
23	$911,507	$167,663	$400,000	$73,576	$3,349,789	$616,162	$1,470,000	$270,393
24	$947,968	$161,453	$400,000	$68,126	$3,483,781	$593,341	$1,470,000	$250,363
25	$985,886	$155,474	$400,000	$63,080	$3,623,132	$571,365	$1,470,000	$231,818
	$14,853,752	$5,284,110	$8,800,000	$3,523,630	$54,587,538	$19,419,105	$32,340,000	$12,949,341
	$400,000				$1,470,000			

Inflation	0%
Discount Rate	0.08

Year	Traffic Signals		Road Project Deferral			
			10 % Traffic induced		25% Traffic induced	
			Actual	PV		
1	$0	$0	$0	$0	$0	$0
2	$1,392,000	$1,288,889	$3,770,000	$3,490,741	$9,860,000	$9,129,630
3	$1,392,000	$1,193,416	$3,770,000	$3,232,167	$9,860,000	$8,453,361
4	$1,392,000	$1,105,014	$3,770,000	$2,992,748	$9,860,000	$7,827,186
5	$1,392,000	$1,023,162	$3,770,000	$2,771,063	$9,860,000	$7,247,394
6	$1,392,000	$947,372	$3,770,000	$2,565,799	$9,860,000	$6,710,550
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
	$6,960,000	$5,557,852	$18,850,000	$15,052,517	$49,300,000	$39,368,121
	Annual (2002)	$1,392,000		Annual deferral (10%)	$3,770,000	
				Annual Deferral (25%)	$9,860,000	

Attachment B: Literature Review

This literature review is inevitably selective and incomplete, given the limited scope of this study. Nevertheless, the issues identified are significant in terms of future transport policy, planning and implementation (including funding). They would benefit from a substantially more comprehensive investigation, perhaps as part of the development of an integrated transport planning and evaluation methodology.

Demand and Road Capacity

Road planning has long been based on the ‘predict and provide’ model which attempts to accommodate projected increases in the demand for car and truck travel by increasing the level of supply of roadspace or, particularly where there are major constraints on roadway expansion, increasing the efficiency with which roadscape is used.

More recently, the somewhat circular nature of this approach has been recognised through the demonstration that ‘induced demand’ is real and significant (SACTRA, 1994). In the United Kingdom, it is now a requirement of road project evaluation that demand estimation takes into account induced demand (Highways Agency, 1997).

It has also been demonstrated that the converse is often the case – that reductions in road capacity cause traffic to ‘disappear’ (Cairns, et al – get the reference)

Cervero and Hansen (2000) have estimated both the elasticity of demand (vehicle miles of travel) with respect to road capacity (lane-miles of road) and the simultaneous elasticity of road capacity with respect to demand. The latter is potentially useful in estimating the potential impact on road system requirements (and costs) of reductions in vehicle travel as a result of demand management initiatives such as TSIM.

Transport and Health

Health Impact Assessment

The Transport and Health Study Group in the United Kingdom has listed the health effects of transport as follows (THSG, undated):

Health Promoting	*Health Damaging*
♦ Enables access to ➢ employment ➢ shops ➢ recreation ➢ social support networks ➢ health services ➢ countryside ♦ Recreation ♦ Exercise ♦ Economic Development	♦ Road Traffic Injuries ♦ Pollution ➢ particulates ➢ carbon monoxide ➢ nitrogen oxides ➢ hydrocarbons ➢ ozones ➢ carbon dioxide ➢ lead ♦ Noise ♦ Stress and anxiety ♦ Danger ♦ Loss of land and planning blight ♦ Severance of communities by road ♦ Constraints on mobility access and independence ♦ Reduced social use of outdoor space due to traffic and streets

Amongst other things, the THSG notes that:

- The impacts of individual transport modes can be positive (enhance the 'health promoting' or reduce the 'health damaging') or negative (reduce the 'health promoting' or increase the 'health damaging'). Most of these health impacts are not specifically calculable but can either be estimated or are definite but unquantifiable.
- *Air Pollution*. Episodes of high air pollution are associated with rises in deaths and hospital admissions, but even 'contemporary ambient levels of air pollution' (in the UK) are also associated with raised morbidity and mortality.
- *Road Trauma*. Transport accounted for 39% of accidental deaths (in the UK) in 1992, accounting for almost 6% of years of life lost before the age of 70. Even more people are injured, causing both short- and long-term morbidity.
- *Road Traffic and Physical Activity*. Perceived danger from traffic leads to restrictions on children's independent mobility, with consequent decreases in the fitness and psychological well-being of children who no longer walk or cycle.
- *Physical Activity*. Physical activity reduces the risk of heart disease, stroke, diabetes, hypertension, depression, cancer (especially of the colon) and osteoporosis as well as improving well-being.
- *Community Severance*. The number and frequency of social contact falls as traffic volumes increase. People without such social support have higher mortality rates.
- *Noise*. Noise from traffic contributes to stress-related health problems such as hypertension and minor psychiatric illness. Traffic noise can also impair health by causing loss of sleep.
- *Access and Mobility*. Access to education, work, shops , healthcare and social networks often requires transport. Those without [direct access to] a car, including the elderly and people with disabilities have reduced access to facilities designed assuming car use. The health effects are definite but unquantifiable.

Physical Activity and Health

Getting Western Australians More Active (PATF, 2001b)

The Physical Activity Taskforce was established with the overall goal of increasing by five percentage points the proportion of Western Australian who are sufficiently active according to national recommendations. The PATF (2001b) identifies four key challenges:

- Health
- Transport and the Environment
- Workplace
- Young People and Schools

Among the trends and influences that have impacted on physical activity over the past 50 years, the PATF identifies:

- Urban and transport planning – smaller house blocks and apartment style living has lead to less usable open space; and
- Increasing car dependency reduces physical activity. (PATF, 2001b, p15)

Its recommended strategies include:

- Re-orienting public health, education, transport and sport and recreation policies and funding to prioritise physical activity as part of achieving healthy and active lifestyles, and to simplify access at community level (PATF, 2001b, p20)

According to the PATF, an increase of 5 percentage points in people who achieve 30 minutes of exercise a day would save $44 million in health care costs each year (Premier of WA, 2002).

Physical Activity and Health (US Surgeon General, 1996)

The most comprehensive study of physical activity and health was reported by the US Surgeon General in 1996 (Surgeon General, 1996). The major conclusions (p4) included:

- People of all ages, both male and female, benefit from regular physical activity.
- Significant health benefits can be obtained by including a moderate amount of physical activity (eg 30 minutes of brisk walking or raking leaves, 15 minutes of running, or 45 minutes of playing volleyball) on most, if not all days of the week. Through a modest increase in daily activity, most Americans can improve their health and quality of life.
- Physical activity reduces the risk of premature mortality in general, and of coronary heart disease, hypertension, colon cancer, and diabetes mellitus in particular. Physical activity also improves mental health and is important for the health of muscles, bones and joints.
- More than 60% of American adults are not regularly physically active. In fact, 25% of all adults are not active at all.
- Nearly half of American youths 12-21 years of age are not vigorously active on a regular basis. Moreover, physical activity declines dramatically during adolescence.
- Research on understanding and promoting physical activity is at an early stage, but some interventions to promote physical activity through schools, worksites and health care settings have been evaluated and found to be successful.

Physical Activity and Disease Prevention (USDHHS, 2002)

The US Department of Health and Human Services (USDHHS, 2002, p2) states that:

Regular physical activity has been shown to reduce the morbidity and mortality from many chronic diseases. Millions of Americans suffer from chronic illnesses that can be prevented or improved through regular physical activity:

- *12.6 million people* [4.4% of the population] *have coronary heart disease;*
- *1.1 million people* [0.4% of the population] *suffer from a heart attack in a given year;*
- *17 million people* [5.9% of the population] *have diabetes; about 90% to 95% of cases are type 2 diabetes, which is associated with obesity and physical inactivity; approximately 16 million people* [5.6% of the population] *have 'pre-diabetes';*
- *107 000 people are newly diagnosed with colon cancer each year;*
- *300 000 people* [0.1% of the population] su*ffer from hip fractures each year;*
- *50 million people* [17.4% of the population] *have high blood pressure; and*
- *50 million people* [17.4% of the population] *(between the ages of 20 and 74) or 27 % of the adult population are obese; overall more than 108 million, or 61% of the adult population are either obese or overweight.*

The USDHHS reports other research showing:

- 14 per cent of all deaths in the United States attributed to activity patterns and diet (p2);
- sedentary lifestyles linked to 23 per cent of deaths from major chronic diseases (p2);
- the US national cost of illness in 2000 was:
  - US$117 billion [US$408 per person] for overweight and obesity;
  - US$183 billion [US$638 per person] for heart diseases;

- US$157 billion [US$547 per person] for cancer;
- US$100 billion [US$350 per person] for diabetes; and
- US$65 billion [US$226 per person] for arthritis (p4).

- Increasing regular moderate physicalactivity among the more than 88 million inactive Americans over the age of 15 years might reduce the annual national direct medical costs by as much as US$76.6 billion in 2000 dollars (p7).

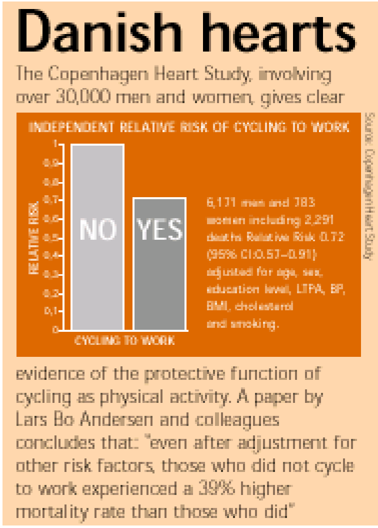
THE USDHHS (2001, pp4-7) also reports that 'Medicare and Medicaid programs currently[12] spend US$84 billion annually on five major chronic conditions that could be significantly improved by increased physical activity', specifically:

- Diabetes (US$10.4 billion in 2000);
- Heart disease (US$34.9 billion in 2000);
- Depression (US$ 2.1 billion);
- Cancer (US$ 15.2 billion in 2000); and
- Arthritis (US$5.8 billion in 2000).

Mortality and Physical Activity (Andersen et al, 2000)

A study of 13 375 women and 17 265 men in Denmark (randomly selected from ages 20 to 93 years), which followed participants for an average of 14.5 years, concluded that leisure time physical activity was inversely associated with all-cause mortality in both men and women in all age groups. Benefit was found from moderate leisure time physical activity, with further benefit from sports activity and bicycling as transportation.

In particular, the study found that bicycling to work decreased the risk of mortality by approximately 40%, after controlling for other factors, including leisure time physical activity.



7.1.1.1 Childhood Obesity (Ebbeling et al, 2002)

Researchers from Boston Children's Hospital in Massachusetts have found that children as young as five years old are showing early signs of cardiovascular disease, including high blood pressure and thickened arteries as a result of bad diet and lack of exercise. The authors argue that fundamental changes in the social environment are needed to combat this emerging public health crisis.

The urban poor in developed countries might be especially vulnerable because of poor diet and limited opportunity for physical activity.

A lifestyle characterised by lack of physical activity and excessive inactivity (particularly television viewing) is one cause of obesity in children. Moreover, social support from parents and others correlates strongly with participation in physical activity.

According to the authors, with respect to physical activity, many studies have used conventional programmed exercise prescriptions, although increasing lifestyle activity or reducing sedentary behaviours might be better for long-term weight control.

The authors argue that:

[12] The value of US$84 billion actually applies to projected 2004 estimates. The total for 2000 is US$68.4 billion.

Opportunities for physical activity have decreased for various reasons. Physical education, typically considered less important than academic disciplines, has been eliminated in some school districts. In schools that do offer physical education, large class size and lack of equipment present barriers to successful programme implementation. After-school participation in unstructured activities can be limited, because of absence of pavements (sidewalks), bike paths, safe playgrounds, and parks in many neighbourhoods. Moreover, our culture places a premium on convenience: the car is preferred to walking, the lift to stairs, and the remote control to manual adjustment. These cultural forces arguably culminate in the drive-through window of fast-food restaurants, where a maximum of energy can be obtained with a minimum of exertion.

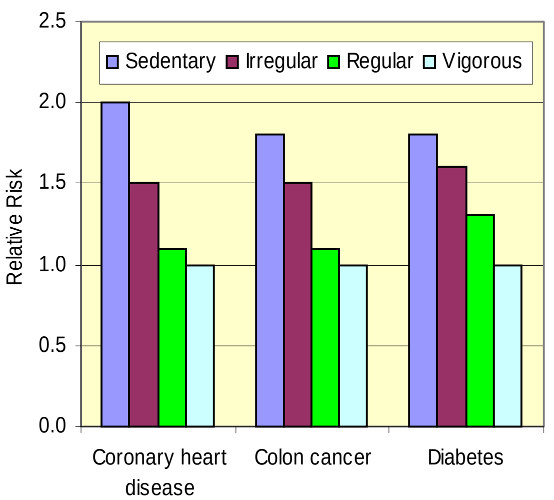
A common sense approach to prevention and treatment of childhood obesity

Home	Set aside time for ♦ Healthy meals ♦ Physical activity
	Limit television viewing
School	Fund mandatory physical education
	Establish stricter standards for school lunch programmmes
	Eliminate unhealthy foods--eg, soft drinks and candy from vending machines
	Provide healthy snacks through concession stands and vending machines
Urban design	Protect open spaces
	Build pavements (sidewalks), bike paths, parks, playgrounds, and pedestrian zones
Health care	Improve insurance coverage for effective obesity treatment
Marketing and media	Consider a tax on fast food and soft drinks
	Subsidise nutritious foods--eg, fruits and vegetables
	Require nutrition labels on fast-food packaging
	Prohibit food advertisement and marketing directed at children
	Increase funding for public-health campaigns for obesity prevention
Politics	Regulate political contributions from the food industry

Source: Ebbeling et al (2002)

Walking and Health

The Health Development Agency (2001) states that: *Walking has the potential to influence health in a variety of ways. These include the potential benefit of walking as enjoyment and in providing contact with natural environments, social contact, economic benefits through promotion of local economies, exposure to environmental (including road traffic) danger and the influence of physical activity*. (HDA, 2001, p1)



The HDA also quotes research that estimates the relative risk of coronary heart disease, colon cancer and diabetes for people with various activity levels (left), which indicate a risk reduction of over 25%, for both coronary heart disease and colon cancer, and nearly 20% for diabetes, in making the transition from ‘irregular’ exercise to ‘regular’ exercise. Higher levels of risk reduction (up to 50%) are quoted for the change from ‘sedentary’ to ‘vigorous’.

The *World Health Organisation* (1999, p34) quotes comparable estimates of health benefits of physical activity in the following terms:

- 50% reduction in the risk of developing coronary heart disease (ie a similar effect to not smoking);
- 50% reduction in the risk of developing adult diabetes;
- 50% reduction in the risk of becoming obese;
- 30% reduction in the risk of developing hypertension10/8 mmHg decline in blood pressure in hypertensive subjects (ie a similar effect to drug treatments)
- reduced osteoporosis;
- relief of symptoms of depression and anxiety; and
- prevention of falls in the elderly

Transport and Health in London (Glaister et al, 1999)

Glaister and his co-authors looked more specifically at the health impacts of air pollution in London. The estimate that, in 1998, the costs to the National Health Services directly attributable to traffic in London were of the order of:

- Accidents: 94 million pounds sterling – about 1/50th of the London NHS medical budget
- Pollution: 7 million pounds sterling – about 1/600th of the London NHS medical budget

They observe that there is *a fair quantity of data available but it is not easy to deduce unambiguous conclusions from it …* [even] *… where careful statistical work has been carried out in various parts of the world it has proved difficult to make estimates with a high degree of confidence* (page 3). *Where adverse health effects have been identified, the uncertainty around the 'damage' or 'cost' estimates of emissions is typically large* (page 4).

Furthermore, they state that *where authors have reported 'best' estimates of the external costs associated with road transport emissions these are often very small* (page 4). However, the authors' main context for this statement is that *internalising, or making the polluter pay these costs* [would be] *unlikely to have a noticeable effect on road use or fuel consumption* (page 55). It does not follow that the costs, in aggregate, are not substantial.

Despite a sceptical view of the health impacts of exhaust emissions as a driver for transport policy, Glaister et al do conclude that:

…worthwhile improvements to the health of individuals would be achieved by the promotion of a modal shift from the use of the car to walking or cycling, especially if this can be achieved without an undue increase in the numbers of road traffic accidents (page 6).

Air Quality and Health

There are few substantial quantitative estimates of the health impacts of road traffic-related air pollution. In part, this is a consequence of road traffic being only one source of air pollution and the number of different exhaust pollutants produced by motor vehicles. However, a number of recent studies have attempted estimation that is useful for evaluation purposes.

World Health Organisation (Seethaler, 1999; Sommer et al, 1999)

The World Health Organisation has placed a major focus on transport and health in recent years. Most importantly, it has sponsored research that has produced quantitative estimates of road traffic-related health impacts, and attempted to place a value on them, in the context of all sources of air pollution.

Seethaler draws attention to the difference between commonly-calculated market-based costs and the community willingness to pay, a concept most commonly recognised in relation to road trauma reduction. Willingness to pay has the advantage of including the 'intangible costs' which 'may be considerably higher than the material costs of a disease' but does not include those costs covered collectively, for example through insurance.

Willingness To Pay

Willingness to pay is the correct methodology to use in benefit cost analysis (BCA), being consistent with the welfare economics derivation of BCA. This has not yet been adopted for BCA in transport in Australia, but can provide a useful sensitivity test for results. Typically, willingness to pay values are 2 to 3 times the economic costing for transport fatalities.

Seethaler (1999) reports the results of studies carried out in Austria, France and Switzerland (Sommer et al, 1999) that include both mortality and morbidity impacts of air pollution. In each country, the mortality costs were predominant, amounting to more than 70% (Seethaler, 1999, p78).

Whilst traffic-related costs were a larger proportion of the total in France (56%, compared to Austria (43%) and Switzerland (53%), there is a striking similarity in the road traffic-related air pollution health costs per capita (Seethaler, 1999, p79).

Air Pollution-related Health Costs per Capita (based on Willingness to Pay)

	Euros (1996)			**Aus $ (2002)**		
	Austria	France	Switzerland	Austria	France	Switzerland
All Air Pollution						
Central Estimate	830	667	589	1743	1401	1237
Range	426 - 1251	344 - 1004	297 - 893	895 - 2627	722 - 2108	624 – 1875
Road Traffic-Related Air Pollution						
Central Estimate	359	371	313	754	779	657
Range	184 - 540	191 - 558	158 - 474	386 - 1134	401 - 1172	332 – 995
Road Traffic-Related %	**43%**	**56%**	**53%**			
Mortality (Road Traffic)						
Central Estimate	269	272	224	565	571	470
Range	163 - 377	165 - 381	134 - 314	342 - 792	347 - 800	281 – 659
Morbidity (Road Traffic)						
Central Estimate	90	99	89	189	208	187
Range	21 - 163	26 - 177	24 - 160	44 - 342	55 - 372	50 - 336

Source: Seethaler, 1999, p77-79 (Australian dollar 2002 estimates by author)

Economic Costs

The same studies that produced estimates of willingness to pay in Seeethaler (1999) also provided estimates based on a ‘gross production/consumption’ foregone basis.

It should be noted that, despite the emphasis that has been placed on willingness to pay in respect of fatality reduction in the transport literature, the relative difference between ‘willingness to pay’ and ‘economic’ costs is greater for morbidity than for mortality. This is, in fact, consistent with Cameron’s (2002) finding with respect to fatal crashes (factor of 2.6) and ‘non-serious’ injury crashes (factor of 5.7).

Air Pollution-related Health Costs per Capita (based on gross production/consumption foregone)

	Euros (1996)			**Aus $ (2002)**		
	Austria	France (a)	Switzerland	Austria	France	Switzerland
All Air Pollution						
Central Estimate	135	72	162	284	151	340
Range	79 - 192	42 - 103	95 - 230	166 - 403	88 - 216	199 - 483
Road Traffic-Related Air Pollution						
Central Estimate	59	41	86	124	86	181
Range	34 - 84	24 - 59	51 - 122	71 - 176	50 - 124	107 - 256
Road Traffic-Related %	**44%**	**57%**	**53%**			
Mortality (Road Traffic)						
Central Estimate	53	38	82	111	80	172
Range	32 - 75	23 – 54	50 - 115	67 - 157	48 - 113	105 - 241
Morbidity (Road Traffic)						
Central Estimate	6	3	4	13	6	8
Range	2 - 9	1 - 5	1 - 7	4 - 20	2 - 11	3 - 14

Note (a): The low values for France are attributed to methodological differences rather than to real differences of this magnitude (Sommer et al, 2000, p67)
Source: Sommer et al, 1999, p65-67 (Australian dollar 2002 estimates by author)

Eyre et al (1997)

Eyre et al attempted to extrapolate from the monetary valuation of emissions in the electricity generation sector to similar emissions in transport. They noted, in doing so, that:

- Electricity sector emissions are mainly from high stacks, whereas road transport emissions are close to the ground; and
- Electricity emissions are concentrated at a few locations, largely in rural areas, whereas, motor vehicle exhaust emissions occur in a range of environments from open country to city centres.

Nevertheless, the extrapolation is based on dose-response functions, not simple averages. The authors then went on to develop monetary valuations, which for urban areas totalled 0.797 UK pence/km for petrol vehicles – equivalent to 2.49 Australian cents at June 2002 prices and exchange rates. Not surprisingly, urban cost estimates for all fuels were substantially higher than for rural areas. For petrol-engine vehicles, urban cost estimates were more than double those for rural areas.

	Petrol	Gas	Diesel
Particulates	0.003	0.000	1.692
Sulphur Dioxide	0.173	0.001	0.182
Sulphur aerosol	0.038	0.001	0.027
Oxides of nitrogen	0.076	0.054	0.113
Nitrate aerosol	0.163	0.103	0.219
Ozone from NO_x	0.073	0.046	0.098
Benzene	0.126	0.001	0.052
Ozone from VOC	0.145	0.018	0.041

	Petrol	Gas	Diesel
Totals (UK pence/km; 1997))	**0.797**	**0.224**	**2.424**
Rural	***0.500***	***0.211***	***0.723***
Urban	***1.060***	***0.375***	***2.717***
Approx Aus cents/km 2002	**2.49**	**0.70**	**7.59**
Rural	***1.56***	***0.66***	***2.26***
Urban	***3.31***	***1.17***	***8.49***

Of the impacts costed by Eyre et al, health was by far the largest, especially in urban situations where the number of people exposed to any given level of air pollution is inevitably larger than in rural areas.

	Rural			Urban		
	Petrol	Gas	Diesel	Petrol	Gas	Diesel
UK pence/km; 1997						
Global Warming	0.100	0.082	0.069	0.121	0.098	0.098
Health	0.341	0.109	0.565	0.797	0.224	2.424
Other	0.060	0.020	0.088	0.139	0.053	0.196
Approx Aus cents/km 2002						
Global Warming[13]	0.31	0.26	0.22	0.38	0.31	0.31
Health	1.07	0.34	1.77	2.50	0.70	7.59
Other	0.19	0.63	0.28	0.44	0.17	0.61

Bray and Tisato (1997)

The previous evaluation of TravelSmart Individualised Marketing adopted a value of 2.0 cents per vehicle-kilometre for air pollution, based on Bray and Tisato's interpretation of a variety of sources, most notably Luk and Thoresen (1996). Neither report includes any identification of the extent to which the costs are health costs, but updating the Bray & Tisato recommended value by CPI to March 2002 gives a value of 2.3 cents/km, which is consistent with the Eyre, et al value for health costs (see 4.2.5.2, above), suggesting that health costs are the major component.

International Centre for Technology Assessment

According to the International Centre for Technology Assessment the annual health costs attributable to motor vehicles are in the range US(1996)$29.3 to $542.4 billion, even excluding those caused indirectly, for example through the contribution to the greenhouse effect and damage to the ozone layer (skin cancer causative factor) (ICTA, undated post-1997). The wide range is largely attributed to the uncertainty surrounding the effects of particulate matter (PM10), but even the lower figure is equivalent to US(1996)$110 per head of population (approximately Aus(2002)$230 at current prices and exchange rates). The top end figure is equivalent to US(1996)$2020 (Aus(2002)$4250). ICTA does not provide a 'best estimate', but the values, whilst the range is larger, are broadly consistent with the WHO estimates for Europe.[14]

13 It is worth noting that Eyre et al's estimate of the global warming cost is almost an order of magnitude lower than those derived by Bray and Tisato (1997). However, in this instance, the monetary value is readily derivable from the carbon-dioxide emission rate of burning fuel and the dollar value attached to carbon dioxide emissions (per tonne). Whilst there is no consensus on the dollar value of carbon dioxide, the Bray and Tisato values are more consistent with the commonly espoused range than those of Eyre et al. Each litre of petrol produces 2.234kg of carbon dioxide (Thoresen et al, 2000, Table 10, p54), equivalent to around 0.25kg per kilometre of travel for the average car. Estimates of the cost of global warming range from US$20 – 120 per tonne (A$35 – 210), equivalent to 0.5 to 3.0 US cents per kilometre (0.9 – 5.3 Australian cents).

14 This is not necessarily what one would expect given that US transport energy usage per capita is much higher than Europe. However, there might well be compensating factors at work in that the non-transport source of emissions will tend to be more dispersed in the USA because land use is generally at lower densities than in Europe.

Looked at another way, the ICTA estimates are equivalent to US(1996)$143 to $2645 per registered motor vehicle (Aus(2002)$300 to $5555). At 20 000km/yr per vehicle, this equates to 0.7 to 13.2 US(1996) cents per kilometre (1.5 to 27.8 Aus(2002) cents).

Another study by the International Centre for Technology Assessment has concluded that occupants of cars are exposed to much higher levels of air pollution than those who ride buses or trains and those who walk or cycle (ICTA, 2000 -see box). This confirms the findings of the Environmental Transport Association (ETA, 1997).

It follows that, in addition to the benefits of lower air pollution for all the community directly resulting from a reduction in car travel with TSIM, there are further benefits to those individuals who change from car driving to using another mode, because their exposure to ambient levels of pollution is lower as a result.

Consequently, any estimate of health benefits from reduced pollution that is calculated on the basis of the change in vehicle-kilometres of travel will be conservative and understate the true level of benefits.

Studies conducted over the past two decades conclusively demonstrate that the shell of an automobile does little to protect the passengers inside from the dangerous air pollutants, including respiratory irritants, neurological agents, and carcinogens, commonly found in the exhaust of gasoline and diesel vehicles. In fact, the levels of exposure to most auto pollutants, including potentially deadly particulate matter, volatile organic compounds, and carbon monoxide, are generally much higher for automobile drivers and passengers than at nearby ambient air monitoring stations or even at the side of the road.

Similarly, drivers™ exposures to these pollutants significantly exceed the significant exposures endured by bicyclists, pedestrians, and public transit riders. The amount of time Americans spend in their cars is increasing - not only are they driving more miles, but they are taking longer to get where they want to go. Several of the in-car pollution studies also considered pollution exposure in other environments and found that a person who commutes to and from work in a car each day may amass nearly a quarter of his or her total daily exposure to VOCs, PM, and other pollutants during those few hours he or she spends in the car.

Source: ICTA (2000, Executive Summary)

Transport and Greenhouse

Bray and Tisato (1997)

The previous evaluation of TravelSmart Individualised Marketing adopted a value of 2.0 cents per vehicle-kilometre for greenhouse gas emissions, based on Bray and Tisato’s interpretation of a variety of sources, most notably Luk and Thoresen (1996).

Transport and Energy

There is a consensus emerging around the inevitability of the so-called ‘Big Rollover’, the point at which oil (and subsequently gas) production will peak and start to decline, occuring in within the next decade (Magoon, 2000). Globally, even if a return to the 1990 level of consumption were achieved as response to Kyoto targets, the world would be living beyond its oil means – in other words, the price of oil will rise substantially to ration supply and to encourage the development of alternatives. Supply is also likely to become more volatile asAustralia is forced to import more and more of its requirements and, globally, an increasing proportion of supply is dependent upon the Middle East/Persian Gulf (Figure 4.4.1).

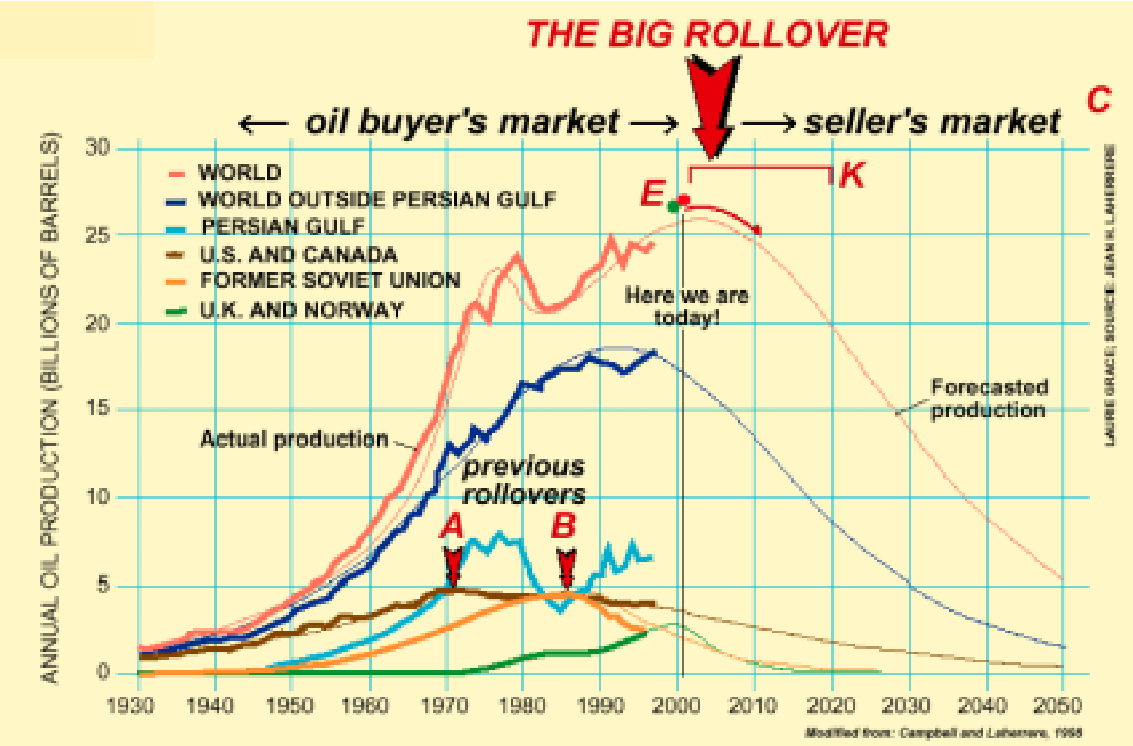


Figure 4.4.1 Oil will become a seller's market (Source: Magoon 2000, Figure 1)