Cost and health benefit of active transport in Queensland

Stage 2 Report

Evaluation Framework and Values

September 2011

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Consulting in Applied Transport Access and Land use sYSTems

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Executive Summary

Active transport refers to walking, cycling and other forms of human-powered mobility. Walking and cycling for transport offers a range of public policy benefits in terms of population health, greenhouse gas emissions, congestion relief and urban liveability. In the last three decades, rates of walking and cycling—particularly among school-aged children—have reduced significantly. Some seven out of 10 Queensland adults "exercise very little or not at all" (Queensland Government, 2008, p. 32). This is considerably more than the national average.

Walking and cycling have untapped potential to reverse this worrying trend towards sedentary lifestyles and chronic disease. However, conventional transport planning tends to undervalue non-motorised transport, in part because these health benefits are not considered in the economic evaluation of transport policies and projects. To address this problem it is important to develop practical tools for more comprehensive evaluation of active transport benefits, including public fitness and health benefits.

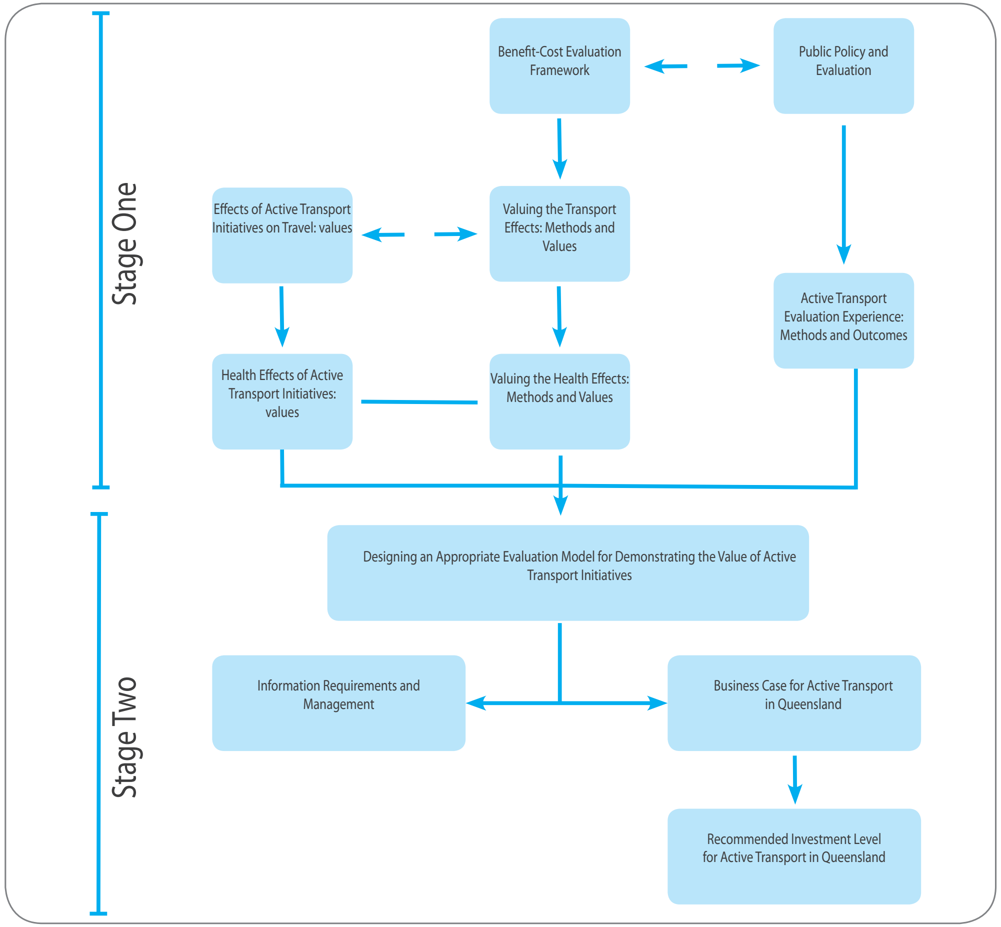
Any evaluations that fail to appreciate the co-benefits of active transport will significantly understate the value to the community of active transport programs and may hinder the widespread adoption of effective active transport programs.

The aim of this project is to develop a comprehensive, accurate and practical framework for evaluating the full benefits and costs of active transport. This includes monetised estimates of health benefits, as well as other economic, social and environmental outcomes, based on existing research, calibrated to the Queensland context.

This project will provide Queensland Health and the Queensland Government more broadly, with the information and tools to support public policy decisions that will enable active travel programs to become an effective part of the public policy mix and achieve more desirable outcomes in a broad range of areas, including health, transport and the environment.

The Stage One report of this study reviewed and assessed experience with active transport programs and the evaluation of those programs, including methodologies for deriving values for use in benefit-cost evaluation:

- evaluation principles and practice
- the process of public policy decision-making
- active transport costs and benefits, including a critique of valuation and modelling methods
- impacts of previous active transport encouragement programs
- monetised costs and benefits of transport modes, with a particular focus on active transport.



Project overview

This review drew heavily on international experience as well as that in Australia in general and, where possible, Queensland in particular.

This second report outlines the framework and values appropriate for evaluation of an active transport program for Queensland. This report draws heavily on the Stage One report and, particularly in terms of the values, it draws most heavily on Australian and New Zealand practice. This is desirable to ensure comparability with evaluation of other transport initiatives and projects that will compete for funding.

Evaluation Framework

Benefit-cost analysis (BCA) is the conventional way of evaluating transport and related proposals. Benefit-cost analysis compares the investment cost of a proposal with the stream of benefits it generates for the community and provides a straightforward means of comparing projects that require investment of resources. Benefit-cost analysis does, however, have its limitations, principally in dealing with emerging issues that either cannot be quantified or, more particularly, are unable to be given reasonable monetary values. Impacts of active transport that can be covered by BCA are outlined in the table below.

NET CAPITAL COSTS	BENEFITS
Costs of active travel program	Reduced private motor vehicle operating costs
Cost of associated infrastructure or service improvements	Increased public transport operating costs—where public transport use is an important outcome
	Reduced congestion costs
	Reduced car parking costs—where demonstrable impact on parking requirements and provision is found
	Travel time—private and commercial
	Road trauma—net effect of reduced car crashes and increased walking cycle incidents
	Reduced transport contribution to climate change
	Reduced air pollution costs
	Reduced water pollution costs
	Improved health and fitness not already included in air, noise and water pollution costs. This primarily relates to extent of transfer from car (driver or passenger) to active modes (walking and cycling)

Socioeconomic benefit-cost analysis

Various forms of multi-criteria or goals achievement approaches are increasingly applied to supplement BCA. This complementary approach is encompassed in what is termed an *appraisal summary table*, which supplements, but does not replace BCA. Its primary purpose is to identify where negative outcomes may arise and provide the opportunity for the project to be defined in such a way that these are wholly or partially avoided.

OBJECTIVE	CRITERION	DESCRIPTION/ MEASUREMENT	ASSESSMENT		
			Short- Medium Term	Medium-Long Term	Rating
Strategic alignment	Towards Q2	Strong; green; smart; healthy; fair			
	South East Queensland Regional Plan	Consolidation; reduce car use; fight congestion; strong, healthy communities			
	Queensland Cycle Strategy	Safety/security of users; integrate policy and practice; effective encouragement			
	The Health of Queenslanders	Individual and community health; Active, healthy communities			
	Office of Sustainable Transport	Access; equity; affordability; choice; convenience; minimise adverse environmental, economic, and social impacts			
Economic and financial	User cost of transport	Financial cost of transport for households			
	Cost of transport infrastructure	Financial cost of roads and car parking			
	Transport energy use: fossil fuels	Extent of private car use; vehicle fuel efficiency			
	Economic sustainability	Extent of reliance on fossil fuels for transport			
Environment	Climate change	Greenhouse gas emissions from transport			
	Air pollution	Motor vehicle exhaust			
	Water pollution	Any special issues/sensitivity			
	Noise pollution	Any special issues/sensitivity			
	Sensitive location	Any special issues/sensitivity			
Social: Amenity, People & Communities	Stakeholder impacts: school community	Extent of support in school community			
	Stakeholder impacts: local community	Extent of support in local community			
	Community interaction	Extent of involvement of local community			
	Health and fitness	Physical activity through walking and cycling; reduced exposure to motor vehicle exhaust pollutants			
	Social equity	Accessibility for people without cars			
Safety	Road safety: motorised modes	Impact on motor vehicle road safety—less car use; less conflict around schools			
	Pedestrian/cyclist safety	Improvement to pedestrian and cyclist safety—less conflict around schools			
	Personal security	Perception of personal security, especially while walking or cycling			
Governance	Long-term certainty and assurance	Statutory or regulatory formalisation			
	Extent of approvals needed	State and/or local government approvals required			
	Stakeholder consultation	Extent of support from stakeholders			

Proposed triple bottom line evaluation framework—appraisal summary table

It is also important that initiatives be assessed in terms of their impacts on public finances. Even though there is no direct revenue stream resulting from active transport in schools, there will be reductions in health system financial costs and in GST revenue from motor vehicle fuel sales, although GST is likely to be raised from redistributive impacts in other areas of the economy.

In primary school, active transport will primarily be walking and cycling. Longer-term (i.e. in high school and beyond) active transport initiatives will also enhance willingness to use public transport, which has direct financial consequences (operating costs and fare revenues) for the service provider, which is largely state government.

COST TO GOVERNMENT	BENEFITS (MAY BE NEGATIVE)
Cost of active travel program (including any infrastructure improvements identified as necessary to support active transport	Change in GST revenue from the state (GST on motor vehicle fuel is returned directly to the state)
	Reduced health system costs
	Longer-term, net additional public transport operating costs and fare revenue. This will vary with circumstances beyond primary school, so it not estimated for this study

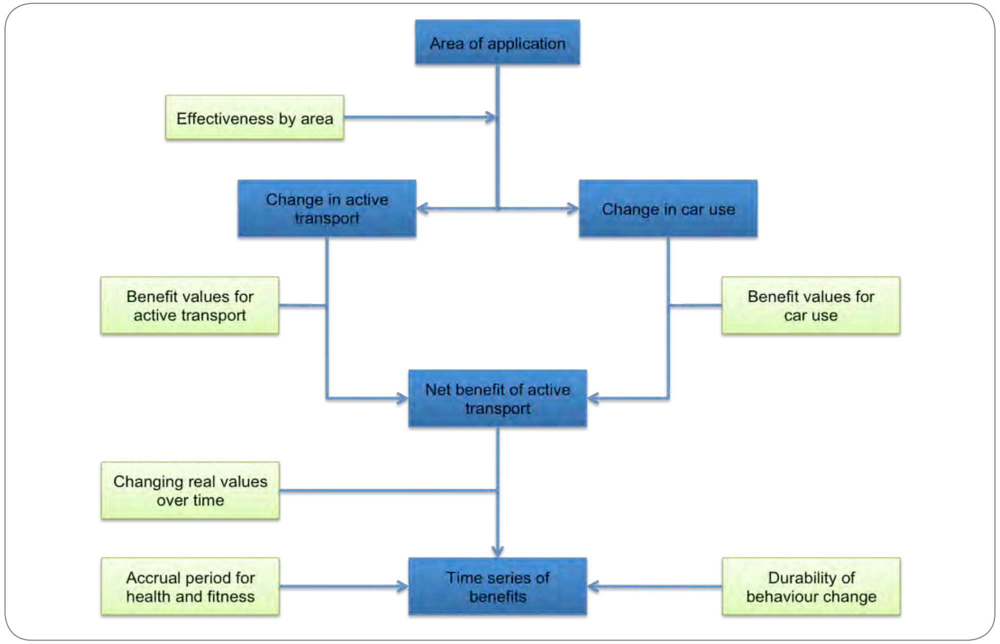
Public sector discounted cash flow (financial benefit-cost) analysis

The largest financial benefits, however, accrue to those who choose to change from driving cars to using active modes of transport. These are primarily in terms of the saving in car operating costs, but also include savings in health care costs as a result of their being fitter and healthier.

Applying Benefit-Cost Analysis to Active Transport

Using BCA to evaluate a potential active transport program requires:

- estimates of the changes in travel behaviour, including reductions in car use and increases in active transport. Both are needed because some of the benefits relate to reduction of the (largely) negative impacts of car use while others relate to increases in the (largely) beneficial outcomes of active transport.
- estimates of how these effects may change over time. For example, some may take time to be fully realised (e.g. health effects of active transport) and there are durability and lifestyle change factors that may affect the longevity of travel outcomes.
- unit values to apply to the changes in car use and active transport.



Framework for benefit estimation for active transport

The values for BCA of active transport in Queensland are summarised below.

It is often a concern that cycling and walking crash and injury rates are higher than for car travel. However, active transport achieves health and fitness benefits that substantially exceed any net increase in road trauma (de Hartog, 2010). Even allowing five years for health and fitness benefits to accrue progressively, these benefits more than offset the net road trauma increase for cycling from the beginning of this period and, by the time the full level of health and fitness benefits is achieved after five years, they will offset the increase in net road trauma by a factor of more than four. For walking, the health and fitness benefits immediately more than offset the net road trauma increase (by a factor of eight) and when the full level of health and fitness benefits is achieved after five years the trauma is offset by a factor of more than 40.

ITEM	APPLICATION	2010	2021	2031
Car operating costs	Financial: per car-km	18.4 cents	23.4 cents	26.2 cents
Car operating costs	Resource cost (a): per car-km	13.56 cents	18.42 cents	21.60 cents
Public transport operating costs (b)	Bus: per passenger-km (c)	12.6 cents	12.6 cents	12.6 cents
	Train: per passenger-km (c)	8.6 cents	8.6 cents	8.6 cents
Congestion	Peak/heavy traffic: per car-km	34.6 cents	62.0 cents	62.0 cents
	Moderate traffic: per car-km	24.6 cents	44.1 cents	44.1 cents
	Off-peak/light traffic: per car-km	6.5 cents	11.7 cents	11.7 cents
Car parking	Not valued for this project			
Travel time (e)	Commuting: per person-hour	$13.02	$13.02	$13.02
	Other purposes: per person-hour	$11.10	$11.10	$11.10
Road trauma (f)	Car travel: per car-km	6.5 cents	6.5 cents	6.5 cents
	Public transport: per passenger-km	0.85 cents	0.85 cents	0.85 cents
	Cycling: per cycle-km	18.2 cents	18.2 cents	18.2 cents
	Walking: per walk-km	10.7 cents	10.7 cents	10.7 cents
Climate change	Car travel: per car-km	2.00 cents	1.80 cents	1.40 cents
	Bus: per bus-km	11.79 cents	10.61 cents	8.25 cents
	Train: per passenger-km	0.08 cents	0.08 cents	0.08 cents
	Walking and cycling	0	0	0
Air pollution (g)	Car travel: per car-km	2.81 cents	2.53 cents	1.97 cents
	Bus: per bus-km	31.69 cents	28.52 cents	22.18 cents
	Train, walking and cycling	0	0	0
Noise pollution	Car travel: per car-km	0.91 cents	0.91 cents	0.91 cents
	Bus: per bus-km	2.22 cents	2.22 cents	2.22 cents
	Train, walking and cycling	0	0	0
Water pollution	Car travel: per car-km	0.42 cents	0.42 cents	0.42 cents
	Bus: per bus-km	4.75 cents	4.75 cents	4.75 cents
	Train, walking and cycling	0	0	0
Health and fitness (d)	Walking: per walk-km (benefit)	104-207 cents		
	Cycling: per cycle-km (benefit)	52-104 cents		
	Car, bus and train	0	0	0

Values for Benefit-Cost Evaluation: Real Prices (resource costs(a) unless otherwise stated)

(a) Distinguished from financial cost by exclusion of indirect tax (excise on fuel; Goods and Services Tax).

(b) Only for use where there are specific situations in which increased public transport use is likely to be a substantial outcome of a school active transport program.

(c) Values as used in the evaluation of the 20-Year Public Transport Plan for Perth, Western Australia (Transport WA, 2010). No increase with higher fuel prices, as fuel costs are smaller proportion of total costs than for car driving and public transport is able to use a wider range of fuels so is less exposed to increase in oil prices.

(d) Ultimate values accruing progressively over a five year period following the intervention.

(e) Only for use if there is evidence of a substantial change in travel times to and from school.

(f) All values subject to sensitivity test for willingness to pay (WTP)—WTP values are 1.85 times resource cost (see Section 4.1.6).

(g) Largely health costs—changes assumed to accrue progressively over five years to full value.

Benefit Evaluation

Taking a 10-year evaluation period and a 10% reduction in car driver/sole-passenger trips to and from school (all converted to active transport), the benefits of a school-based active transport program are estimated to have a value of between $109 000 and $134 000 for an inner urban school and $80 000 and $100 000 for an outer suburban school.

These ranges depend upon the discount rate applied to future benefits. The higher values are reached by using a 2.5% per annum discount rate, derived as required by the Queensland Project Assurance Framework (Department of Infrastructure and Planning, 2010). The lower values are reached by using a 7% per annum discount rate, commonly used in other Australian jurisdictions (see Section 3.3 below).

The difference between the inner urban and outer suburban values is a consequence of the higher levels of traffic congestion in inner urban areas.

These results are based on the same level of car use reduction and active travel increase being maintained throughout primary and high school.

The Community Value of Active Transport

The *appraisal summary table* is a means of acknowledging the extent of impacts that cannot be fully captured by benefit-cost analysis.

An important purpose of the *appraisal summary table* is to identify where negative or poor outcomes may arise and provide the opportunity for the project to be modified in such a way that these are wholly or partially avoided. Although these assessments should be regarded as indicative rather than precise, no negatives have been identified.

OBJECTIVE	CRITERION	DESCRIPTION/MEASUREMENT	ASSESSMENT		
			Short-Medium Term	Medium-Long Term	Overall Rating
Strategic Alignment	Towards Q2	Strong; green; smart; healthy; fair	+++++	+++++	+++++
	South East Queensland Regional Plan	Consolidation; reduce car use; fight congestion; strong, healthy communities	++	++++	++++
	Queensland Cycle Strategy	Safety/security of users; integrate policy and practice; effective encouragement	+++	++++	++++
	The Health of Queenslanders	Individual and community health; active, healthy communities	+++	+++++	++++
	Office of Sustainable Transport	Access; equity; affordability; choice; convenience; minimise adverse environmental, economic, and social impacts	+++++	+++++	+++++
Economic and Financial	User cost of transport	Financial cost of transport for households	+++++	+++++	+++++
	Cost of transport infrastructure	Financial cost of roads and car parking	++	++	++
	Transport energy use: fossil fuels	Extent of private car use; vehicle fuel efficiency	+++++	+++++	+++++
	Economic sustainability	Extent of reliance on fossil fuels for transport	+++++	+++++	+++++
Environment	Climate change	Greenhouse gas emissions from transport	+++++	+++++	+++++
	Air pollution	Motor vehicle exhaust emissions	+++++	+++++	+++++
	Water pollution	Any special issues/sensitivity	None identified		
	Noise pollution	Any special issues/sensitivity	None identified		
	Sensitive location	Any special issues/sensitivity	None identified		
Social: Amenity, People & Communities	Stakeholder impacts: school community	Extent of support in school community	++++	+++++	+++++
	Stakeholder impacts: local community	Extent of support in local community	+++	+++++	++++
	Community interaction	Extent of involvement of local community	++	++	++
	Health and fitness	Physical activity through walking and cycling; reduced exposure to motor vehicle exhaust pollutants	++++	+++++	+++++
	Social equity	Accessibility for people without cars	+++	+++	+++
Safety	Road safety: motorised modes	Impact on motor vehicle road safety—less car use; less conflict around schools	+++++	+++++	+++++
	Pedestrian/cyclist safety	Improvement to pedestrian and cyclist safety—less conflict around schools	+++++	+++++	+++++
	Personal security	Perception of personal security, especially while walking or cycling	+++++	+++++	+++++
Governance	Long-term certainty and assurance	Statutory or regulatory formalisation	++++	++	+++
	Extent of approvals needed	State and/or local government approvals required	++++	++	+++
	Stakeholder consultation	Extent of support from stakeholders	++++	++++	++++

Appraisal summary table for active transport

Financial Evaluation

Increases in active transport have financial implications for governments and for those who make the change from car to active modes. The most substantial benefits accrue to those who change their travel behaviour, largely through savings in car operating costs, but the financial effects on both federal and state governments are also strongly beneficial, largely through reduction in health system costs.

DISCOUNT RATE	2.5%			7%		
	Federal	State	Private	Federal	State	Private
5 Years						
Health system cost saving: health & fitness	$272	$161	$199	$243	$144	$178
Health system cost saving: air pollution	$14	$9	$10	$13	$8	$10
Vehicle operating cost saving	-	-	$956	-	-	$879
Net GST revenue	$10	-$10	-	$10	-$10	-
TOTAL FINANCIAL EFFECT	$296	$160	$1165	$266	$142	$1067
10 Years						
Health system cost saving: health & fitness	$679	$402	$496	$545	$323	$399
Health system cost saving: air pollution	$27	$16	$20	$23	$14	$17
Vehicle operating cost saving	-	-	$1898	-	-	$1578
Net GST revenue	$23	-$23	-	$19	-$19	-
TOTAL FINANCIAL EFFECT	$729	$395	$2414	$587	$318	$1994
25 Years						
Health system cost saving: health & fitness	$1 637	$971	$1 197	$1 024	$608	$749
Health system cost saving: air pollution	$57	$34	$42	$37	$22	$27
Vehicle operating cost saving	-	-	$4427	-	-	$2830
Net GST revenue	$69	-$69	-	$42	-$42	-
TOTAL FINANCIAL EFFECT	$1763	$936	$5566	$1103	$588	$3606

Financial effects of active transport (1000 km annual car reduction): present value

Developing and Evaluating a Program

Not all schools will be equally enthusiastic about active transport or have the capability to implement an active transport program. An effective program will need to devote resources to the engagement and selection of schools, acknowledging that it would not be desirable to mandate such a program for all schools. For many schools, the best method of engagement will be demonstration of the value and benefits received by schools already participating in the program.

An effective program should contain the following elements:

- engagement and selection of schools
- implementation (over a period of one school year)
- ongoing support, to maintain the achievements of the first year and to include new students
- 'transition to high school' component to maximise the extent to which active travel is carried over from primary school to high school.

YEAR	ENGAGE AND SELECT SCHOOLS	IMPLEMENT	SUPPORT	TRANSITION TO HIGH SCHOOL PROGRAM	PERCENT-AGE OF PRIMARY SCHOOLS IN QLD	PERCENTAGE OF STATE PRIMARY SCHOOLS IN QLD
1	20	-	-	-	-	-
2	50	20	-	-	1.6%	1.9%
3	100	50	20	-	5.5%	6.8%
4	100	100	70	20	13.3%	16.4%
5	100	100	170	50	21%	26.1
6	100	100	270	100	28.8%	35.7%

Indicative program for active travel in primary schools (number of schools)

This program would reach nearly 30% of Queensland primary schools over a five-year implementation period (six years including program development and engagement/ selection of the first schools).

The cost of active transport programs for schools can vary substantially. Using indicative costs from the Brisbane City Council pilot program, with allowance for development of program resources and materials, suggests a level of resourcing that ramps up to $2.25 million by year four, with a slower rate of increase thereafter to provide ongoing support for schools that have participated in the program.

YEAR	DEVELOP PROGRAM	ENGAGE AND SELECT SCHOOLS	IMPLEMENT	SUPPORT	TRANSITION TO HIGH SCHOOL PROGRAM	REVIEW	TOTAL
1	$100 000	$20 000	-	-	-	-	$120 000
2		$25 000	$500 000	-	-	-	$525 000
3		$50 000	$1 000 000	$60 000	-	$25 000	$1 135 000
4		$50 000	$2 000 000	$140 000	$50 000	-	$2 240 000
5		$50 000	$2 000 000	$340 000	$50 000	-	$2 440 000
6		$50 000	$2 000 000	$540 000	$100 000	$50 000	$2 740 000
						TOTAL	**$9 200 000**

Indicative program costs

NOTE: These costs are indicative only, based on experience with the Brisbane City Council Active School Travel program, and would need to be verified during program development.

The benefits of this program would exceed costs by a substantial margin in all scenarios. Even the poorest result (BCR 2.8:1 for 10 years at 7% discount rate) is competitive with results from evaluation of most transport infrastructure projects.

EVALUATION PERIOD	10 YEARS		25 YEARS	
Discount rate	**2.5%**	**7.0%**	**2.5%**	**7.0%**
Present value of costs	$10.6m	$8.8m	$10.6m	$8.8m
Present value of benefits	$37.0m	$24.9m	$89.1m	$46.4m
Benefit-cost ratio	**3.5**	**2.8**	**8.4**	**5.2**
Net Present Value	**$26.3m**	**$16.0**	**$78.5m**	**$37.5m**

Benefit-cost evaluation

Monitoring the Program

The long-term effectiveness of school-based travel programs depends to a large extent on the continued participation of schools and parents in the program in subsequent years. The extent to which this happens depends as much on perceptions of the program and its activities as it does on the measurable achievements in terms of increases in active travel or reduced car use for travel to and from school.

Indicators of program performance must include, therefore, measures of participation and of teacher and parent responses to the program and its activities.

The primary means of monitoring actual achievement of school-based programs is a hands-up survey in classrooms undertaken early in the school year (before any active transport activities) and late in the year (long enough after the last active transport activity for its immediate effects not to affect results). It is important that this should be in terms of actual travel on the days of the survey, rather than 'usual' mode of travel, which requires interpretation and will vary between children.

Hands-up surveys should be on the basis of more than one day per week, as single-day surveys are subject to a much larger range of influences (including weather and parental circumstances) than multi-day surveys. Surveys should ideally be over the full five days of the week, but if this is not possible, Tuesday to Thursday are the days most likely to be reasonably representative of student travel overall.

Simple and consistent end-of-year surveys of parents and teachers will provide information on perceptions of the active transport program. This will help identify aspects of the program that could be improved, but also help establish support for continuation in future years.

Survey design and the recording of daily hands-up results should be as simple as possible and provide prompt feedback opportunities to the school community.

A monitoring and evaluation plan should reflect:

- Overall project goals: the strategic orientation to which the project will contribute.
- Project purpose: the intended near-term effects on the users of the project as a result of using the project's outputs.
- Component objectives: the specific effects that will support the overall objective of changing travel behaviour.

Data collection related to the above evaluation activities can be achieved through surveys (student hands-up surveys, parent and teacher surveys) and recording of student and parent participation in active transport initiatives.

The clearest and most effective way of presenting the results of the surveys is in graphical form.

For the student hands-up surveys, this can be done by means of a simple spreadsheet with embedded graphics, used for:

- entering the data for each class
- entering before and after survey results
- automatically generating simple graphics for immediate feedback to the school community
- aggregating across classes and grades to give a whole-school picture.

A similar approach can be used for the parent and teacher surveys, but based on a single end-of-year survey rather than measuring change during the year, and for measures of participation in active transport program activities.

It is also important to monitor the process of development and implementation of the active transport program generally and in individual schools, to identify desirable process improvements and any factors that might affect outcomes in individual schools.

Contents

1 Introduction

Active transport refers to walking, cycling and other forms of human-powered mobility. Walking and cycling for transport offer a range of public policy benefits in terms of population health, greenhouse gas emissions, congestion relief and urban liveability. In the last three decades, rates of walking and cycling have reduced significantly, particularly among school-aged children. Some seven out of 10 Queensland adults exercise "very little or not at all" (Queensland Government, 2008, p. 32). This is considerably more than the national average and this has significant negative implications for population health in Queensland.

Walking and cycling have untapped potential to reverse this worrying trend towards sedentary lifestyles and chronic disease. However, conventional transport planning tends to undervalue non-motorised transport. This is, in part, because conventional economic evaluation of transport policies and projects does not take the health benefits of active transport into proper consideration. To address this problem it is important to develop practical tools for more comprehensive evaluation of active transport benefits, including population health benefits.

Any evaluations that fail to appreciate the co-benefits of active transport will significantly understate the value to the community of active transport and may hinder the widespread adoption of effective active transport programs.

The aim of this project is to develop a comprehensive, accurate and practical framework for evaluating the full benefits and costs of active transport. This includes monetised estimates of health benefits, as well as other economic, social and environmental outcomes, based on existing research, calibrated to the Queensland context.

Figure 1 below outlines stages one and two of the project.

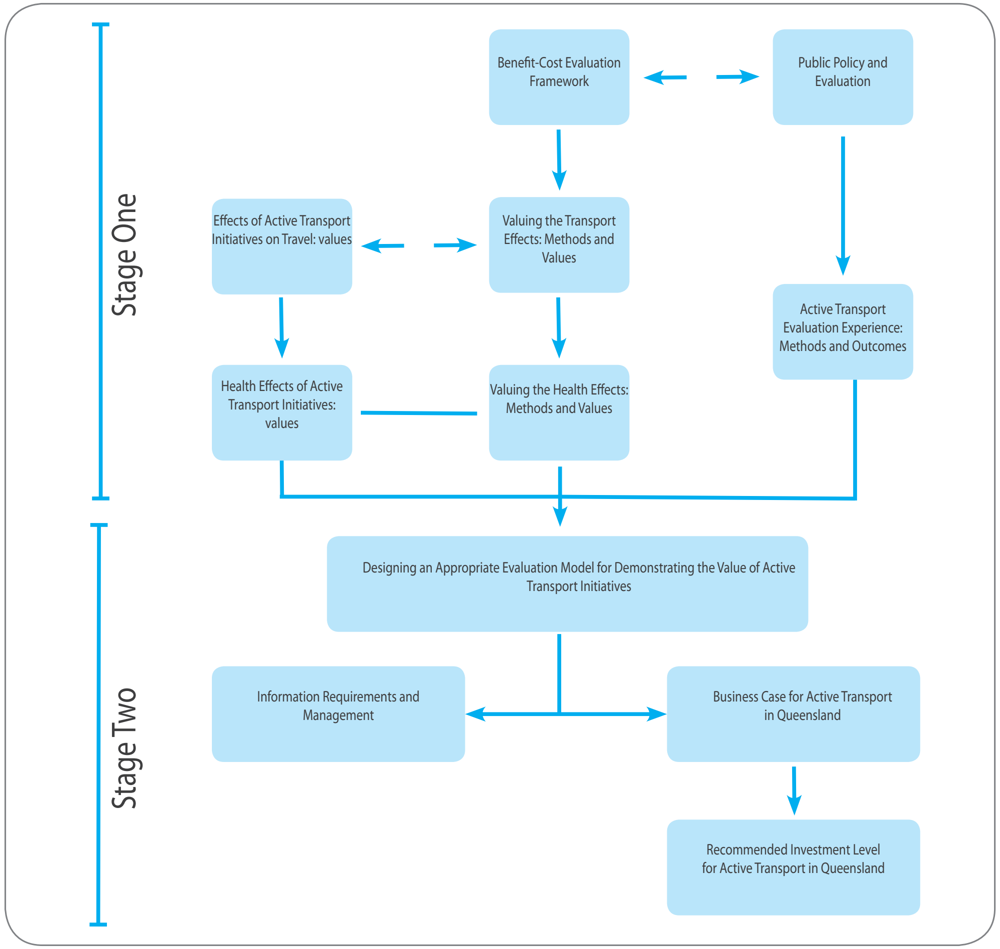


Figure 1: Project overview

The Stage One report of this study reviewed and assessed experience with active transport programs and the evaluation of those programs, including methodologies for deriving values for use in benefit-cost evaluation. Topics covered in the Stage One report included:

- evaluation principles and practice
- the process of public policy decision-making
- active transport costs and benefits, including a critique of valuation and modelling methods
- impacts of previous active transport encouragement programs
- monetised costs and benefits of transport modes, with a particular focus on active transport.

This review drew heavily on Australian and international literature. Where possible, Queensland data was used.

This second report outlines the framework and values appropriate for evaluation of an active transport program for Queensland. This report draws heavily on the Stage One report and, particularly in terms of the values, it draws most heavily on Australian and New Zealand practice. This is desirable to ensure comparability with evaluation of other transport initiatives and projects that will compete for funding.

This project provides Queensland Health and the Queensland Government with the information and tools to support public policy decisions that enable active travel programs to become an effective part of the public policy mix, which would in turn achieve more desirable outcomes in a broad range of areas, including health, transport and the environment.

2 Proposed Evaluation Framework

Benefit-cost analysis (BCA) is the conventional way of evaluating transport and related proposals. Benefit-cost analysis compares the investment cost of a proposal with the stream of benefits it generates for the community. Typically, both the costs and the benefits would be positive (i.e. additional cost/investment produces positive benefits—for example, in terms of cost reduction) and the result is expressed in terms of:

- the ratio between them—the benefit-cost ratio
- the difference between them—the net present value (NPV).

For example, an investment of $100 that produces benefits worth $400 would have a benefit-cost ratio of 4:1 ($400/$100) and a net present value of $300 ($400-$300). Through these measures, BCA provides a straightforward means of comparing projects that require investment of resources.

Whilst BCA is the conventional way of evaluating transport and related proposals, this is increasingly being supplemented by various forms of multi-criteria or goals-achievement approaches in an attempt to capture effects that are beyond the scope of BCA. In the United Kingdom, where this multi-criteria approach was developed and first adopted, and in Australia, where the approach has been adopted by the Australian Transport Council of Ministers (Australian Transport Council, 2006), the various forms of evaluation are encompassed in what is termed *the appraisal summary table*. The proposed appraisal summary table for active school transport is shown in Table 1 below.

The appraisal summary table supplements, but does not replace, BCA (Table 2). Its primary importance is to identify where negative outcomes may arise and to provide the opportunity for projects to be defined in such a way that these outcomes are wholly or partially avoided. Values for benefit-cost analysis are discussed more fully in sSection 4.

It is also important that initiatives be assessed in terms of their impacts on public finances (Table 3). Even though there is no direct revenue stream resulting from active transport in schools, there will be reductions in health system financial costs and in GST revenue from motor vehicle fuel sales. These are discussed more fully in Section 5.

In primary school, active transport will primarily be walking and cycling. Longer-term (i.e. in high school and beyond) active transport initiatives will also enhance willingness to use public transport, which has direct financial consequences (operating costs and fare revenues) for the service provider, which is largely state government.

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	South East Queensland Regional Plan	Consolidation; reduce car use; fight congestion; strong, healthy communities			
	Queensland Cycle Strategy	Safety/security of users; integrate policy and practice; effective encouragement			
	The Health of				
Queenslanders	Individual and community health; Active, healthy communities				
	Office of Sustainable Transport	Access; equity; affordability; choice; convenience; minimise adverse environmental, economic and social impacts			
Economic and financial	User cost of transport	Financial cost of transport for households			
	Cost of transport infrastructure	Financial cost of roads and car parking			
	Transport energy use: fossil fuels	Extent of private car use; vehicle fuel efficiency			
	Economic sustainability	Extent of reliance on fossil fuels for transport			
Environment	Climate change	Greenhouse gas emissions from transport			
	Air pollution	Motor vehicle exhaust			
	Water pollution	Any special issues/sensitivity			
	Noise pollution	Any special issues/sensitivity			
	Sensitive location	Any special issues/sensitivity			
Social: Amenity, People & Communities	Stakeholder impacts: school community	Extent of support in school community			
	Stakeholder impacts: local community	Extent of support in local community			
	Community interaction	Extent of support in local community			
	Health and fitness	Physical activity through walking and cycling; reduced exposure to motor vehicle exhaust pollutants			
	Social equity	Accessibility for those without cars			
Safety	Road safety: motorised modes	Impact on motor vehicle road safety—less car use; less conflict around schools			
	Pedestrian/cyclist safety	Improvement to pedestrian and cyclist safety—less conflict around schools			
	Personal security	Perception of personal security, especially while walking or cycling			
Governance	Long-term certainty and assurance	Statutory or regulatory formalisation			
	Extent of approvals needed	State and/or local government approvals required			
	Stakeholder consultation	Extent of support from stakeholders			

Table 1: Triple Bottom Line Evaluation Framework – Appraisal Summary Table

NET CAPITAL COSTS	BENEFITS
Costs of active travel program	Increased public transport operating costs—where public transport use is an important outcome
Cost of associated infrastructure or service improvements	Reduced congestion costs
	Reduced car parking costs—where demonstrable impact on parking requirements and provision is found
	Travel time—private and commercial
	Road trauma—net effect of reduced car crashes and increased walking cycle incidents
	Reduced transport contribution to climate change
	Reduced air pollution costs
	Reduced water pollution costs
	Improved health and fitness not already included in air, noise and water pollution costs. This primarily relates to extent of transfer from car (driver or passenger) to active modes (walking and cycling)

Table 2: Socioeconomic Benefit-Cost Analysis

COST TO GOVERNMENT	BENEFITS (MAY BE NEGATIVE)
Cost of active travel program (including any infrastructure improvements identified as necessary to support active transport	Change in GST revenue from the state (GST on motor vehicle fuel is returned directly to the state)
	Reduced health system costs
	Longer-term, net additional public transport operating costs and fare revenue. This will vary with circumstances beyond primary school, so it not estimated for this study

Table 3: Public Sector Discounted Cash Flow (Financial Benefit-Cost) Analysis

3 Benefit-Cost Analysis

Benefit-cost analysis (BCA) is a well-accepted means of demonstrating the value to the community of changes in public policy or transport systems, as well as in many non-transport areas of public policy. However, it is only relatively recently that BCA has been applied to non-motorised transport and the emerging area of voluntary travel-behaviour change (Litman, 2010).

A more detailed discussion of BCA in the context of active transport can be found in Section 4 and 9 of the Stage One report.

3.1 Evaluation Framework

Socioeconomic evaluation—whether of policies, programs or projects—is designed to operate with what are essentially marginal changes to an existing situation. At the project level, for example, evaluation of transport infrastructure is much more straightforward and robust where there is an existing network in place and the project either adds to the opportunities for movement or makes some journeys cheaper, faster or more convenient.

In the case of active transport, the key impacts are:

- increase in active transport
- decrease in car use[1].

Benefits are usually modally specific, so we need to estimate the effects of active transport programs by mode, which will vary by such factors as location, the availability and convenience of alternatives to car driving, and distances people need to travel.

Figure 2 outlines the framework used to estimate benefits. The basis for estimating benefits is outlined in this section. The appropriate values are outlined in Section 4 and derivation is discussed in the appendices.

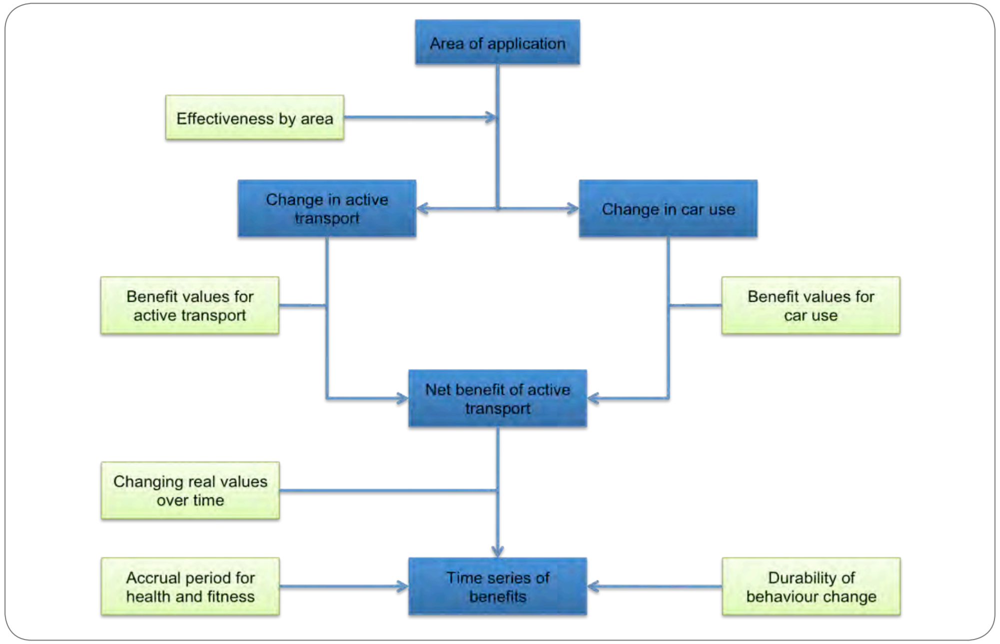

Figure 2: Framework for benefit estimation of active transport

[1] Much of the discussion of active transport and other travel-behaviour change initiatives relates to the twin outcomes of reducing car use and increasing the use of active transport modes (principally walking and cycling). In this report, the term 'car' has been used to cover all private motor vehicle modes of transport, including utility vehicles, panel vans, SUVs and other light vehicles used for personal travel.

3.2 Conceptualising Benefits

In cases where the initiative has an effect on the level of demand (usage), there is a rule of thumb (called the 'rule-of-half') that new users will derive, on average, half the benefit that existing users do (Figure 3). This is on the basis that the new users will range from those that required only a small reduction in cost to change their behaviour to those for whom the change in cost is *just* sufficient to make them do so.

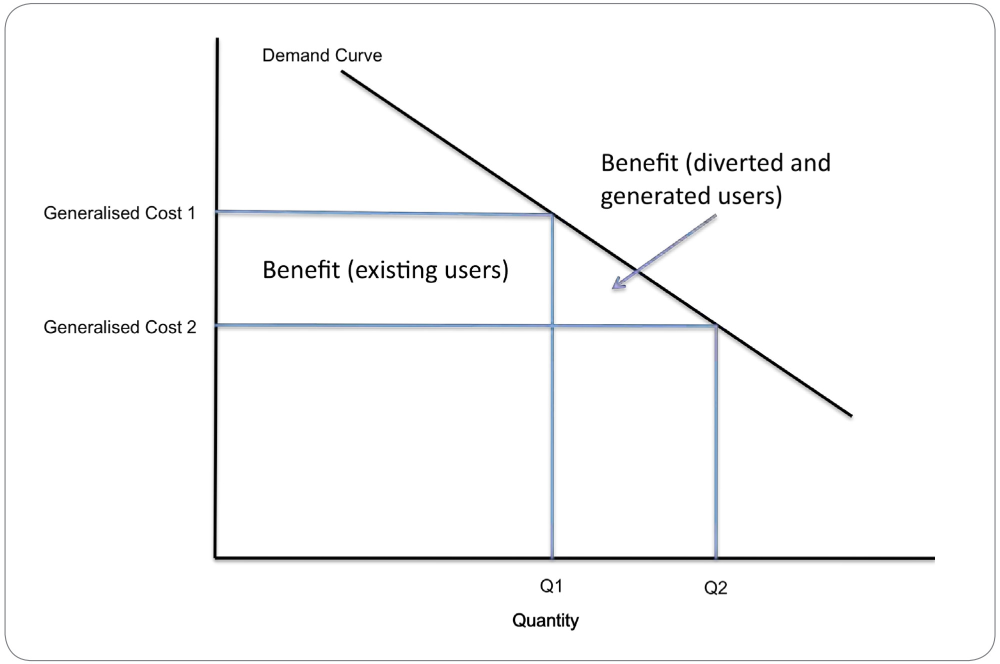

Figure 3: Benefit assessment with consumer surplus

Using Figure 3 above as an example, if a user changes from their previous product only when the generalised cost gets down close to 'Generalised Cost 2', then the change will only give them a small benefit. However, a user who only requires a small reduction from 'Generalised Cost 1' in order to change from their previous product gets almost the whole benefit. Taking the full spectrum of users who convert, the benefit to users who change as a result of the reduction in generalised cost is represented by the triangle, the area of which is (Q2-Q1) x (Generalised Cost 1-Generalised Cost 2)/2—hence the 'rule-of-half'.

The rule-of-half is a simplification because demand curves are not necessarily straight lines, but it is quite reasonable over most values for evaluation. It becomes more complex when there is a divergence between the cost perceived by the user and the resource cost[2] to the community, as is the case with transport (Australian Transport Council, 2006). It has been demonstrated, for example, that people typically:

- *underestimate* the time and cost of travel by car
- *overestimate* the time and cost of travel by public transport, often through a lack of familiarity with routes, schedules and fare structures (Figure 4).

Many people overestimate at least the time required for walking and cycling along with some other negatives such as safety and personal security (Bauman et al, 2008).

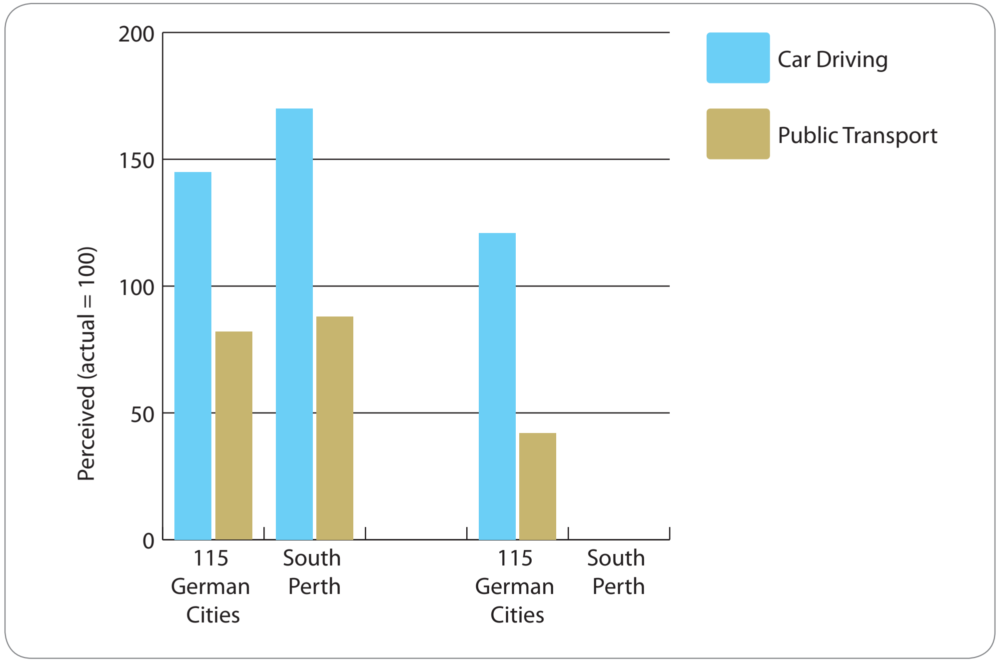

Figure 4: User perceptions of travel time and cost by car and public transport

If the costs of transport (as perceived by the user) are unaffected by the initiative being evaluated, adjustments can be made to the benefits estimation. If the way in which users actually perceive the costs is not affected by the initiative being evaluated, adjustments can be (but rarely are) made to benefit estimation (Australian Transport Council, 2006). Active transport initiatives, however, specifically aim to reduce such differences between perceived cost and actual cost rather than changing the resource cost of any mode of travel, although minor infrastructure or service improvements may be undertaken to this

[2] Resource cost is the real value of resources used in or by a project or activity, including both costs and benefits and including those costs and benefits incurred directly by the user as well as those imposed on other users, on the community or on the environment (see Glossary of Terms).

end at some locations. In such circumstances, in addition to the net change in resource costs resulting from the behaviour change:

- There will be no resource cost benefits in respect of existing users (of active transport), but existing users may receive a consumer surplus[3] benefit to the extent that they also have their perceived costs of active transport reduced. In simple terms, this can be described as their feeling better about what they are already doing.
- Those who drive their children to school may suffer a consumer surplus disbenefit if they continue to do so despite becoming more aware of the resource and community costs of car driving (i.e. their perceived cost increases). In simple terms, this can be described as their feeling less good about what they are doing, but not sufficiently so to change their behaviour.
- Those who change from car driving to active transport may do so partly because they become more aware of the resource and community costs of car driving. To the extent that this is so, they will receive an additional consumer surplus benefit (Figure 5).

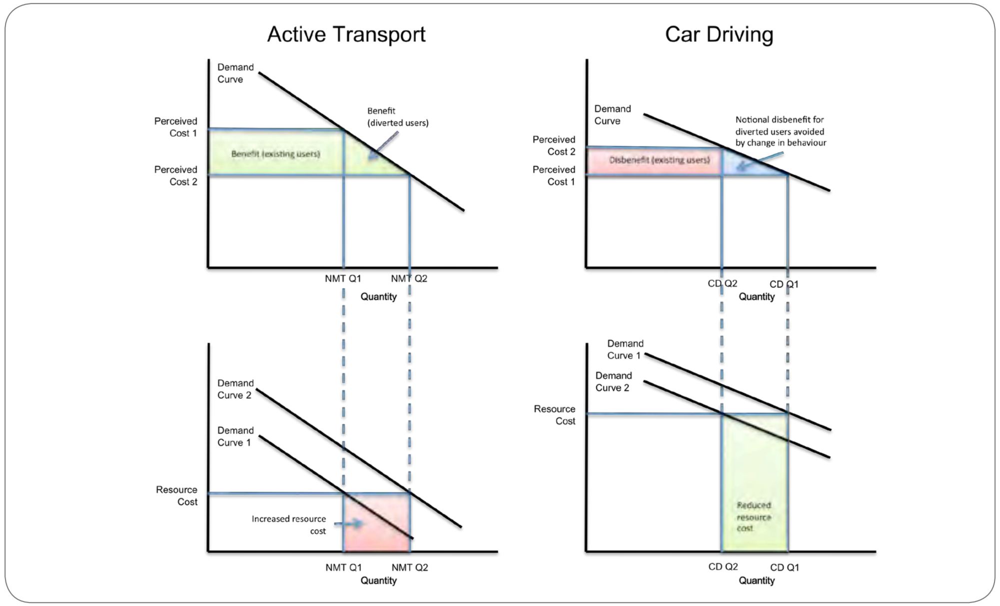

Figure 5: Benefit assessment for change in perceived cost only

No inference should be drawn from the relative scales of the components of Figure 5 above, as values will depend upon circumstances. However:

- The resource cost of car driving is many times that of active transport.
- The resource cost of driving is higher than the perceived cost (see Figure 4).
- The resource cost of active transport is lower than the perceived cost, largely due to misperception of safety, security and convenience factors.
- The change in car driver trips will be greater than the change in active transport trips where some car driver trips are converted to car passenger or public transport instead.

The change in perceptions brings about a shift in the demand curve related to resource cost as well as the more conventional move along the curve with respect to the (financial and other) cost perceived by the user.

Whilst the principal means of increasing active transport participation in active travel programs is by reducing the misperception (overestimation) of its actual costs, especially non-financial costs and attributes such as safety and security, (Figure 5, top left), there is also likely to be a similar element of reducing misperception of car costs. Since users underestimate the costs of car driving, this potentially makes those who continue to drive cars feel worse about doing so (Figure 5, top right). These two elements will offset each other, the net effect being the difference between the two.

The change in travel behaviour, even without any change in the unit resource cost of any mode (e.g. cost per person per kilometre of travel), brings about a change in the overall resource cost of travel, through an increase in the total cost of active transport and a reduction in the total cost of car driver transport (Figure 5, lower). As the unit resource cost of car driving is many times that of active transport, the net effect of this will be a reduction in resource cost.

In practice, we can reasonably estimate the changes in resource costs (see Section 4.1). This is the core basis of conventional BCA in transport, with the exception of the health and fitness benefits (see Section 4.1.11). However these estimates are still limited in scope and reliability because they are relatively new additions to the calculus.

The consumer surplus effects of changes in perceived costs are considerably more difficult to estimate. For example, we have no reliable means of estimating the extent to which perceived costs do actually change and, to add a further complication, both current perceived costs and the extent of change in them are likely to vary considerably between individuals.

Consequently, whilst recognising the existence of consumer surplus benefits or disbenefits, we are unable to estimate them in this evaluation.

[3] Consumer surplus is the amount that consumers benefit by being able to purchase a product for a price that is less than the most that they would be willing to pay

3.3 Discount Rate

Benefit-cost evaluation requires that the future be given a lower value than the present, through the application of a discount rate that reflects a combination of community time-preference (for having something now rather than later) and opportunity cost (what else could be done with the resources).

According to the Australian Transport Council (2006, p. 74):

> Discounting is necessary because a dollar of benefit in the future is worth less than a dollar of benefit today. [The Bureau of Transport and Regional Economics] recommend[s] that the level of the discount be set at the long-term government bond rate…
>
> [T]he most appropriate discount rate to use for BCA is the government bond rate [which] provides a ready measure of the cost of capital free of any risk premium. The nominal bond rate needs to be adjusted for inflation to obtain the real rate. …The private sector practice of adding a risk premium to the discount rate is not appropriate for evaluation of public sector initiatives. (2006b, p. 84).

The long-term government bond rate is currently (January, 2011) 5.65% with a 10-year mean of around 5.5% (Figure 6).

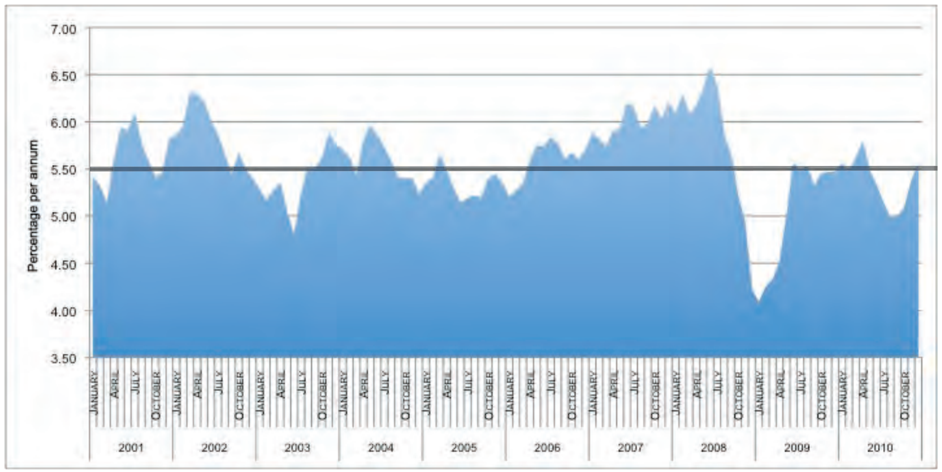

Figure 6: Long-term bond rate (% per annum), Australia, 2000–2011
Source: Trading Economics, Bloomberg

Over most of the same period, inflation, as measured by the Consumer Price Index (CPI), has been running at around 3.1% per year (Figure 7), implying a real discount rate of around 2.5% per annum.

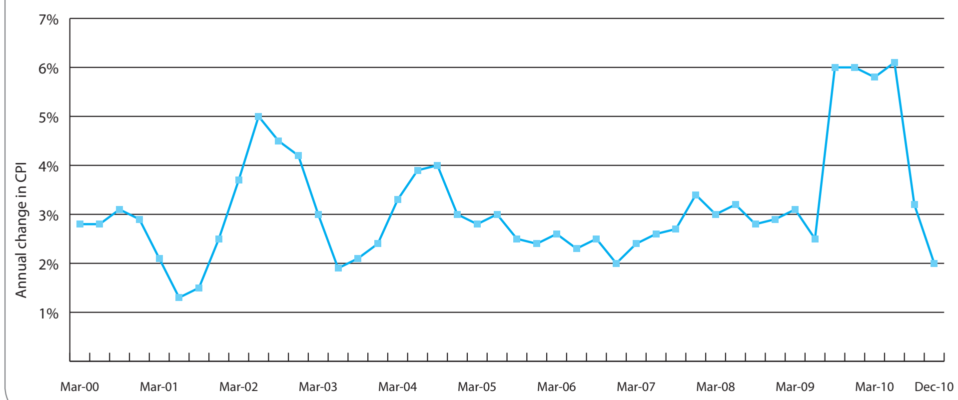

Figure 7: Annual inflation Australian capital cities, 2000–2010
Source: Australian Bureau of Statistics, 2010b

In practice, the discount rate is nominated by the funding jurisdiction. Most Australian jurisdictions currently specify a rate of 7% per annum. The Queensland Government, however, requires discount rates to be set on the basis of:

> ...the interest rate for government borrowings for a term relevant to the expected duration of the project with an allowance for inflation deducted from this rate, as costs and benefits are to be expressed in real terms. (Department of Infrastructure & Planning, 2010, p. 37)

This is consistent with the Australian Transport Council advice and, as noted above, the appropriate discount rate on this basis is around 2.5% per annum.

Using a lower discount rate is more consistent with long-term sustainability concerns and increases the value of benefits more than it does costs, because most costs are incurred up-front and therefore receive little or no discounting, but benefits occur later and over a longer period of future years.

The UK Treasury specifies a real discount rate of 3.5% to be used in benefit-cost evaluation (Department for Transport, 2010b). The United States also requires that a real discount rate be used in benefit-cost analysis (Kokoski, 2010) with a specified value of 2.7% per annum for long-term projects and lower rates for programs below 10 years (US Office of Management and Budget, 2009a). The US revises the specified discount rates every year, in line with variations in government bond rates and inflation, which has led to some substantial variations, from a high of 7-8% in the early 1980s to the current low of 2.7%, but there has been relative stability for the past decade with values below 4% (US Office of Management and Budget, 2009b).[4]

Although a discount rate is appropriate for economic impacts, critics argue that it is not appropriate to discount human lives or ecological integrity (Quiggin, 2006).

3.4 Real Values over Time

For benefit-cost evaluation purposes, costs are required to be expressed in constant value terms, this is usually interpreted in terms of the prices in the year of analysis. Unit costs, therefore, are constant over the evaluation period. However, there are some instances where the real value of resources is expected to increase (in practical terms, the price will increase more rapidly than the general rate of inflation because of increasing scarcity and/or increasing demand for a resource). This is most clearly the case for transport fuels as global oil production peaks[5] and starts to decline while demand continues to increase, placing upward pressure on fuel prices.

Increases in the real cost of motor vehicle fuels directly affects the vehicle operating cost component of benefits in the evaluation (see Section 4.1.1 and the appendices). Fuel is also a component of congestion costs and this component should be escalated on the same basis as for motor vehicle operating costs (see Section 4.1.3 and the appendices).

In the case of health costs, real outlays on health increased by an average of 4% per year during the 1990s (Australian Institute of Health and Welfare, 2002), implying a substantial rate of increase in real unit costs that would need to be taken into account in BCA. However, more recent experience shows that both health and general inflation averaged 3.4% a year between 1997–98 and 2007–08 (Australian Institute of Health and Welfare, 2010), implying no real increase in unit costs.

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[4]At the height of the hyperinflation in Australia in the mid 1980s, the real rate of interest on government borrowings was negative, but this was clearly not a long-term sustainable position. This points to concerns about using real interest rates at a point in time as the discount rate (as the US Office of Management and Budget does) but the stability in Australia over the past decade lends confidence to the use of a value of around 3% per annum.less than the most that they would be willing to pay

[5]Peak oil describes the period of maximum oil production. Australian oil production peaked in 2000. The International Energy Agency and other organisations have growing doubts regarding the capacity for existing oil supplies to meet demand. For more information, see:
http://www.sensibletransport.org.au/sites/sensibletransport.org.au/files/Lake%20Mac_01.12.pdf
http://www.sensibletransport.org.au/sites/sensibletransport.org.au/files/Oil%20Vulnerability%20in%20Melbourne%20Feb%202010.pdf

4 Benefit and Costs for Benefit-Cost Analysis

In a conventional transport benefit-cost analysis, an investment (the cost) creates an asset that in turn creates a continuing stream of benefits[6], which may include:

- private vehicle operating costs
- public transport operating costs, where there is an impact on public transport usage
- traffic congestion
- car parking—where there is a demonstrable impact on parking requirements and provision
- travel time—private and commercial
- road trauma
- climate change
- air pollution
- noise pollution
- water pollution
- health and fitness.

Of these, car parking and health and fitness are relatively recent additions. Car parking can be valued relatively easily, because there is a market for both its products (parking) and its inputs (land, construction and operation/maintenance). Health and fitness is more problematic and is often ignored in transport evaluations. Where health and fitness is taken into account, it is usually only mortality (deaths) that is valued, as the evidence base for morbidity (wellbeing) is less substantial (Cavill et al, 2008).

Benefit-cost analysis, as its name suggests, requires estimates of both costs and benefits. This benefit-cost framework and values was used to evaluate an active travel to school initiative in Brisbane (Ker, 2008). This evaluation demonstrated benefits exceeding costs by a factor of between 2.6 and 4.2. The composition of those estimated benefits is illustrated in Figure 8.

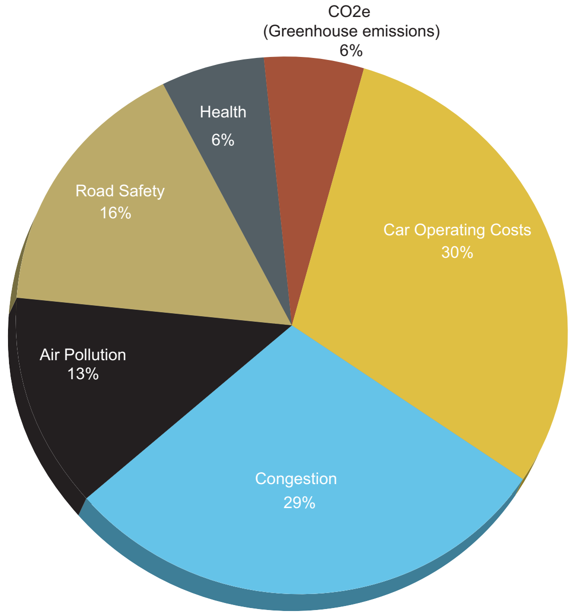


Figure 8: Composition of benefits from active transport in Brisbane schools
Source: Ker, 2008

At a lower discount rate than the 7% per annum used by Ker, 2008, (see Section 3.3), congestion will provide a larger part of the overall benefit, as the real unit cost of congestion increases over time, with increasing traffic relative to road capacity and higher real fuel costs (see Section 4.1.3). Other benefits for which real values are expected to increase over time are:

- car operating costs (see Section 4.1.1), with fuel cost increase
- health and fitness benefits, as health services become more resource intensive and the incidence of overweight and obesity in the population increases (see Section 4.4.11).

[6]Benefits include reductions in the costs of an activity (such as transport) that result from the initiative. Increased active transport will reduce the amount of car travel and, hence, reduce the negative externalities of car use, such as congestion, air pollution and greenhouse emissions. These reductions are counted as benefits.

4.1 Values for Evaluation

The values for use in the benefit-cost evaluation are summarised in Table 4, with an outline of their derivation in Sections 8.1.1 to 8.1.10. More detailed material and source referencing is in the appendices to this report.

ITEM	APPLICATION	2010	2021	2031
Car operating costs	Financial: per car-km	18.4 cents	23.4 cents	26.2 cents
Car operating costs	Resource cost (a): per car-km	13.56 cents	18.42 cents	21.60 cents
Public transport operating costs (b)	Bus: per passenger-km (c)	12.6 cents	12.6 cents	12.6 cents
	Train: per passenger-km (c)	8.6 cents	8.6 cents	8.6 cents
Congestion	Peak/heavy traffic: per car-km	34.6 cents	62.0 cents	62.0 cents
	Moderate traffic: per car-km	24.6 cents	44.1 cents	44.1 cents
	Off-peak/light traffic: per car-km	6.5 cents	11.7 cents	11.7 cents
Car parking	Not valued for this project			
Travel time (e)	Commuting: per person-hour	$13.02	$13.02	$13.02
	Other purposes: per person-hour	$11.10	$11.10	$11.10
Road trauma (f)	Car travel: per car-km	6.5 cents	6.5 cents	6.5 cents
	Public transport: per passenger-km	0.85 cents	0.85 cents	0.85 cents
	Cycling: per cycle-km	18.2 cents	18.2 cents	18.2 cents
	Walking: per walk-km	10.7 cents	10.7 cents	10.7 cents
Climate change	Car travel: per car-km	2.00 cents	1.80 cents	1.40 cents
	Bus: per bus-km	11.79 cents	10.61 cents	8.25 cents
	Train: per passenger-km	0.08 cents	0.08 cents	0.08 cents
	Walking and cycling	0	0	0
Air pollution (g)	Car travel: per car-km	2.81 cents	2.53 cents	1.97 cents
	Bus: per bus-km	31.69 cents	28.52 cents	22.18 cents
	Train, walking and cycling	0	0	0
Noise pollution	Car travel: per car-km	0.91 cents	0.91 cents	0.91 cents
	Bus: per bus-km	2.22 cents	2.22 cents	2.22 cents
	Train, walking and cycling	0	0	0
Water pollution	Car travel: per car-km	0.42 cents	0.42 cents	0.42 cents
	Bus: per bus-km	4.75 cents	4.75 cents	4.75 cents
	Train, walking and cycling	0	0	0
Health and fitness (d)	Walking: per walk-km (benefit)	104-207 cents		
	Cycling: per cycle-km (benefit)	52-104 cents		
	Car, bus and train	0	0	0

Table 4: Values for benefit-cost evaluation: real prices (resource costs[(a)] unless otherwise stated)

(a) Distinguished from financial cost by exclusion of indirect tax (excise on fuel; Goods and Services Tax).

(b) Only for use where there are specific situations in which increased public transport use is likely to be a substantial outcome of a school active transport program.

(c) Values as used in the evaluation of the 20-Year Public Transport Plan for Perth, Western Australia (Transport WA, 2010). No increase with higher fuel prices, as fuel costs are smaller proportion of total costs than for car driving and public transport is able to use a wider range of fuels so is less exposed to increase in oil prices.

(d) Ultimate values accruing progressively over a five year period following the intervention.

(e) Only for use if there is evidence of a substantial change in travel times to and from school.

(f) All values subject to sensitivity test for willingness to pay (WTP)—WTP values are 1.85 times resource cost (see Section 4.1.6).

(g) Largely health costs—changes assumed to accrue progressively over five years to full value.

4.1.1 Vehicle Operating Costs

Car operating costs have been derived from RAC Queensland estimates for 2010 (see Appendix A1, 'Vehicle Operating Costs'). For car operating costs (Table 5), there is a very substantial indirect cost component (fuel excise duty and GST) that must be removed in order to appropriately estimate the resource costs for benefit-cost evaluation (Table 6).

	2010	2021	2031
Petrol price at the pump (a)	$1.25	$2.89	$6.05
Petrol price: real 2010 prices	$1.25	$2.00	$3.00
Fuel efficiency gains	0	10%	30%
Fuel	11.4 cents/km	16.4 cents/km	19.2 cents/km
Tyres	1.0 cents/km	1.0 cents/km	1.0 cents/km
Servicing	6.0 cents/km	6.0 cents/km	6.0 cents/km
Total Running Cost	18.4 cents/km	23.4 cents/km	26.2 cents/km

Table 5: Future car running costs (2010 prices): cost to the user

(a) Assuming continuation of recent rate of inflation (3.4% per year)

	2010	2021	2031
Petrol price at the pump (a)	$1.25	$2.89	$6.05
Petrol price: real 2010 prices	$1.25	$2.00	$3.00
Petrol: Real resource cost (b)	$0.76	$1.43	$2.35
Fuel efficiency gains	0	10%	30%
Fuel	6.89 cents/km	11.72 cents/km	15.04 cents/km
Tyres	0.91 cents/km	0.91 cents/km	0.91 cents/km
Servicing	5.45 cents/km	5.45 cents/km	5.45 cents/km
Total Running Cost	13.25 cents/km	18.08 cents/km	21.40 cents/km

Table 6: Future car running costs (2010 prices): resource cost

(a) Assuming continuation of recent rate of inflation (3.4% per year)

(b) Resource cost calculated as real price less indirect taxes (fuel excise and GST). See Glossary of Terms.

4.1.2 Public Transport Operating Costs

In respect of active transport initiatives in primary schools, the role of public transport is likely to be small, although there will be downstream effects in later life. Public transport is included in the evaluation framework for completeness but is unlikely to have a substantial impact on the evaluation outcomes.

These values are based on recent analysis of public transport operating costs for Perth, Western Australia. The train and bus technologies in Queensland are similar to those in Perth, but differences in unit (per passenger-km) costs may arise from differences in patronage or differences in operating conditions. However, such differences are unlikely to have a substantial impact on the benefit-cost outcomes.

Operating costs for public transport have recently been estimated for evaluation purposes as part of the development of the 20-Year Public Transport Plan (Transport WA, 2010). These values for bus and train services will be used in the evaluation.

Because fuel is a substantially smaller proportion of operating costs for buses than for cars and, in any case, many existing and all new buses run on compressed natural gas rather than oil-based fuels, no escalation over time for fuel prices has been applied. Similarly, all passenger rail in the metropolitan area is electric, with the electricity generated from non-oil sources, and no escalation over time has been applied.

All transport fuels and non-renewable energy sources may suffer increases in prices as a result of environmental policies, most particularly carbon pricing in one form or another. In this evaluation, this is already accounted through inclusion of an externality cost for 'greenhouse/climate change', which applies irrespective of whether or not these costs are recouped from users through some form of pricing. Therefore no further adjustment is necessary, nor is it necessary to make any assumptions about the form, level or timing of any carbon pricing.

4.1.3 Traffic Congestion

It is becoming increasingly difficult to provide road capacity for high levels of road traffic, whether it be local access or regional traffic. This is particularly true in larger urban areas. In these circumstances, traffic congestion will increasingly become a characteristic of the road system. However, even when the road system is not visibly congested there are interactions between vehicles that add to the travel time and other costs of all road users.

Congestion has a number of defining economic characteristics:

- The marginal cost always exceeds the average cost—that is, the additional congestion cost imposed by one additional car exceeds the congestion cost experienced by each car that is already on the road.
- The marginal (and average) cost increases with traffic volume—that is, each additional vehicle (for any given capacity) imposes successively higher costs.

Congestion is a cost each road user imposes on all other road users. It varies according to time and location and can exceed the direct running cost of a car (compare Figure 9 with (a) in Table 6 above).

According to Bureau of Transport and Regional Economics (2007), 6.7% of congestion cost is additional fuel consumption. As noted in Section 4.1.1 above, the real cost of motor vehicle fuel is expected to increase to $2/litre by 2021 and $3/litre by 2031, with 10% and 30% fuel efficiency improvement respectively. On this basis, unit congestion costs will be increased by 5% for 2021 and 8% for 2031.

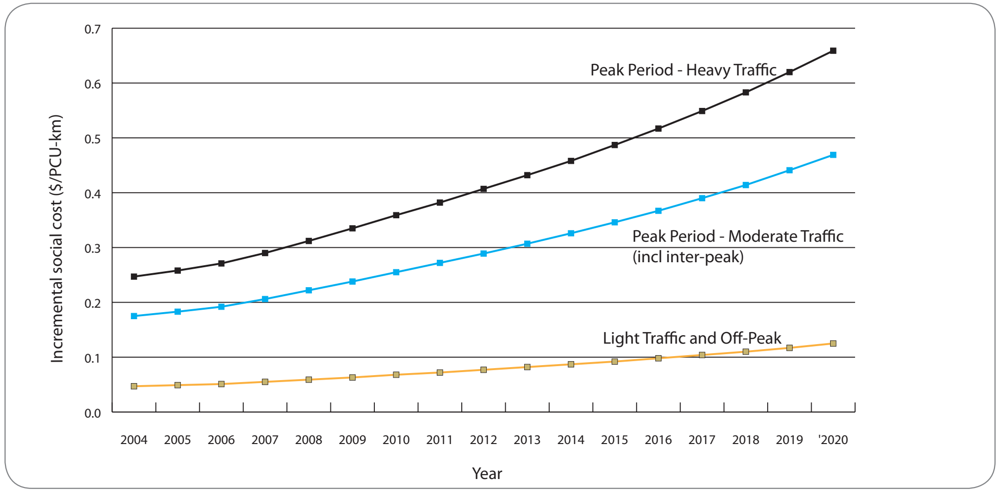


Figure 9: Marginal congestion costs for Brisbane/South East Queensland (2010 prices)
Source: Derived from data in Bureau of Transport and Regional Economics (2007) and Australian Transport Council (2006a)

4.1.4 Car Parking

Changes in the extent of car use will be reflected in the amount and type of car parking that has to be provided, and yet changes in car parking are rarely accounted for in benefit-cost evaluation. The land and other costs of car parking are potentially important but often ignored outcomes of changes in how we travel. In a practical sense, reduction in the space allocated to car parking is often constrained by physical circumstances (e.g. the extent to which car bays are suitably configured or located to allow other uses) or by statutory planning requirements in town planning scheme (Shoup, 2005; Shoup, 2010). In suburban situations, car parking at activity centres is provided as a requirement of town planning schemes and development approvals. The amount of parking required by the schemes is a minimum and is provided onsite. Whilst a growing number of municipalities are beginning to downsize their car parking requirements as a transport-demand management practice, this has not been generalised to the point of influencing our evaluation. In practice, therefore, the amount and cost of parking provision is not affected by the level of service provided by or the extent of use of other modes unless those requirements can be changed.

In the case of active transport in a school context, the extent to which land can be freed up for other uses will vary substantially. Where parent car parking for pick-up and drop-off is on-street, changes in the land use are unlikely, even in the long term, and the main impact is on congestion and traffic safety in the immediate vicinity of the school.

Where such parking is partly or wholly onsite, it may be congested at drop-off and pick-up times with the result that schools will choose to take the benefits of reduced demand in terms of less congestion and improved safety. Whether or not this is so, this space is only used for cars at the start and end of the school day and can be available for other uses during the school day.

New schools are the most likely to be able to effectively benefit by putting to alternative uses land freed up by lower levels of car usage, as this can be addressed during the planning stages.

Due to the range of differences between individual schools, it is not proposed to place a separate value on reduced demand for car parking in the evaluation of active transport for schools and this item is not detailed further in the appendices to this report. As a consequence, evaluation will be conservative (underestimating benefits) overall. Car parking impacts may be important at specific schools and the issue should always be assessed for individual school active transport projects.

4.1.5 Travel Time: Private and Commercial

Travel time has a value to travellers and this influences their decisions regarding when, where and how to travel.

Austroads (2008, Table 3.2) recommends a value of $11.49 per hour across all car use. Adjusting to 2010 in line with increases in average weekly earnings gives an estimated value of $12.06 in 2010 prices. Although the Australian Transport Council (2006a) suggested a differentiation between peak (8% higher) and off-peak (8% lower), based on the different mix of trip purposes at peak and off-peak times, the basis for this is not documented. However, to the extent that changes in travel time due to changes in mode of travel can be estimated, values can be differentiated between commuting travel and other trip purposes:

- $13.02/hour for commuting (employee travel)
- $11.10/hour for all other purposes

Changes in the circumstances of active transport (e.g. better facilities with a higher level of amenity and safety) can affect its perceived cost. Research in the UK suggests that travel time on off-road paths are valued at about 30% of on-road with no cycling provision (Wardman et al, 2007). Findings from the US suggests that off-road paths are valued at about 50–80% of on-road paths (Tilahun et al, 2007), whilst a Canadian study found off-road paths are valued at about 36% of no provision on roads (Hunt & Abraham, 2007).

Improvements to walking or cycling infrastructure associated with schools in active transport programs are likely to reduce the effective value of time (Litman, 2009a). However caution is needed in interpreting this, as this reduction will be, to an unknown extent, a function of other benefits (e.g. health and wellbeing). If the aim is to value those other benefits specifically, then a lower value of time would run the risk of double counting.

Changes to the way people access schools may have an impact on their travel time, but it is not clear that this would necessarily be either to increase or decrease it. For instance, the Walking School Bus program may increase the time commitment for some parents while reducing it for others. The situation is further complicated by the fact that if people are getting their 30 minutes of physical activity on their way to/from school, they do not need to set aside "exercise time" as a separate activity.

Travel time has not been widely monitored in the case of active transport initiatives. However, in an early evaluation of household travel-behaviour change it was observed that, if participants had actually valued time at the conventional rates used for evaluation, they would not have made the change as the other calculated personal benefits would have been insufficient to offset the travel time increases. In addition, these increases in travel time were purely temporary; repeated monitoring showed that the increase in travel time "disappeared", possibly as people became more familiar with their new modes of travel (Ker & James, 2000, p. 10).

It is not proposed to evaluate travel time unless there is specific reason to expect that substantial changes to the overall travel time will result from the active school travel program.

4.1.6 Road Trauma

Personal injury and fatality from road trauma is an important economic and social outcome of transport activity (Connelly & Supangan, 2006). There is also an economic cost arising from property damage in crashes, whether or not these involve injury or fatality.

Ker (2003) estimated an economic road trauma cost of 5.1 cents per kilometre (2003 prices) for metropolitan car travel, but made no estimate of the comparable cost for public transport. At 2010 prices, this would be 6.5 cents/car-km.

Ker (2003) also estimated an economic road trauma cost of 14.3 cents per kilometre (2003 prices) for metropolitan bicycle travel, taking account of evidence that, long-term, cycling crashes/injuries increase at only one-third the increase in cycling activity (see Appendix A3). At 2010 prices, this would be 18.2 cents/bicycle-km.

There is very limited comparative information on pedestrian crash/injury rates or costs. Harrison and Berry (2007) estimate serious injury rates of 40 per 100 000 people for cycling and 19 per 100 000 for walking. If we apply factors for trips per person and trip length to create a measure of relative exposure, the relative serious injury rate for cycling is 1.7 times that of walking (see appendices). This implies a road trauma cost for walking of 10.7 cents/km for walking (=18.2/1.7).

This calculated relativity of 1.7:1 between cycling and walking lies within the range of relative cycling/walking values for fatality (2:1—Sonkin et al, 2006) and crashes reported to police (0.9:1—Office of Road Safety, 2007; 2010), making it consistent with the limited available evidence.

It is often a concern that cycling and walking crash and injury rates are higher than for car travel. However this is, to an extent, a direct reflection of the amount of conflict between non-motorised and motorised road users, which will be reduced if people transfer from motorised to non-motorised modes. It is also worth noting, however, that active transport achieves health and fitness benefits that substantially exceed any net increase in road trauma costs (de Hartog et al, 2010). Even allowing five years for health and fitness benefits to accrue progressively, these benefits more than offset the net road trauma increase for cycling from the beginning of this period and, by the time the full level of health and fitness benefits is achieved after five years, they will offset the increase in net road trauma by a factor of more than four (Table 7). For walking, the net road trauma increase with a shift from car use is lower and the health and fitness benefits are higher. The health and fitness benefits immediately more than offset the net road trauma increase for walking (by a factor of five) and when the full level of health and fitness benefits is achieved after five years the trauma is offset by a factor of nearly 25 (Table 7).

The value for cycling is consistent with those derived by Lindsay et al (2011) which ranged from 3:1 for small amounts of substitution to over 40:1 for 30% substitution of short to medium length (<7 km) urban car driver trips. The higher relativity as the amount of substitution increases is a result of the 'safety in numbers' factor identified by Jacobsen, (2003).

	COMPONENT EFFECT	CYCLE	WALK
	First Year	**For each km of travel diverted from car to cycling**	**For each km of travel diverted from car to walking**
A	Car crash/injury costs	-6.5 cents	-6.5 cents
B	Cycle or walk crash/injury costs	+18.2 cents	+10.7 cents
C	Health and fitness costs	-13.0 cents	-20.8 cents
A+B+C	***Net health-related costs***	*-1.3 cents*	*-16.6 cents*
C/(A+B)	***Health & fitness/net road trauma***	*1.1**	*5.0**
	Ultimate		
D	Car crash/injury costs	-6.5 cents	-6.5 cents
E	Cycle or walk crash/injury costs	+18.2 cents	+10.7 cents
F	Health and fitness costs	-52.0 cents	-104.0 cents
D+E+F	***Net health-related costs***	*-40.3 cents*	*-96.8 cents*
F/(D+E)	***Health & fitness/net road trauma***	*4.4**	*24.8**

Table 7: Relative benefits: safety and health

* indicates the extent to which the reduction in health costs is greater than the net increase in road trauma

Public transport has a substantially lower injury/fatality rate than car driving. A shift from car use (whether driver or passenger) to public transport will, therefore, reduce the cost of road trauma. For walking and cycling the situation is more complex. Existing road trauma rates for walking and cycling are higher than for car, but will decline with increasing usage of these active modes of transport (Transport WA, 1996; Jacobsen, 2003).

These values are based on what is known as the human capital approach (i.e. the economic resource value), which is the commonly accepted basis in transport evaluation. However, there is a strong economic argument for using, instead, the amount an individual is willing to pay to avoid a risk (e.g. revealed by market behaviour), or the amount for which the individual would be willing to accept the risk. Willingness-to-pay values for fatality and injury are typically 1.85 times the human capital values and should be used as sensitivity test values for evaluation.

Consideration of road trauma in the evaluation framework is based on reduction in car use and increase in active modes. There is no specific consideration of:

- the extent to which active transport programs contain elements to enhance the safety of active modes through infrastructure improvements and traffic management or through education components to encourage safer walking and cycling
- the reduction in the car crash rate itself, through lower traffic volumes and hence fewer conflicts
- the tendency for non-motorised trips to be shorter than the motorised trips they replace. Although this is unlikely for school trips, for which destination is determined by other factors, diffusion of travel behaviour change into other areas of life could result in such substitution.

The effect of these factors is that the evaluation will tend to understate the reduction in car crash costs and overstate the walking and cycling costs. The overall evaluation of benefits will therefore be conservative.

4.1.7 Climate Change

Greenhouse gases (GHGs) are emitted by all motorised modes of transport, including electric rail, but vary substantially between modes. Non-motorised modes (walking and cycling) produce no GHG emissions. For practical purposes, car passenger travel also produces no GHG emissions unless the driver is travelling for all or part of his/her journey solely for the benefit of the passenger—as, for example, with parents driving children to school and then returning home, with no other activity associated with the trip.

The value of emissions for evaluation purposes depends critically on the economic value attributable to GHGs. There is no consensus on the appropriate value, but Austroads (2008, Table 5.1) recommends per-km values for cars based on $75/tonne CO_2e.

For consistency with road project evaluations using the Austroads Guide to Project Evaluation (Austroads, 2008), the BCA will use a value of 2.00 cents/km for cars and 11.79 cents/km for buses. With improved fuel efficiency (and use of alternative fuels), car emissions would reduce to 1.80 cents per car-km in 2021 and 1.40 cents in 2031, at the same unit value for CO2e emissions. Given the same level of fuel efficiency improvement in buses, the emission costs for buses will reduce from 11.79 cents/bus-km to 10.61 cents (2021) and 8.25 cents (2031).

For electric passenger rail the value of GHG emissions is estimated at 0.08 cents per passenger-km. There is no analytical basis for estimating future changes for electric rail, which depends on developments in the electricity generating industry.

4.1.8 Air Pollution

Austroads (2008, Table 5.1) recommends the air pollution costs for cars at 2.54 cents/km for cars and 28.61 cents/km (2007 prices) for buses. Adjusted to 2010 prices, these values become 2.81 cents/km for cars and 31.69 cents/km for buses.

These values should be reduced in line with engine fuel efficiency improvements used to estimate vehicle-operating costs. The resulting values are:

- car travel: 2.53 cents (2021) and 1.97 cents (2031)
- bus travel: 28.52 cents (2021) and 22.18 cents (2031).

Almost all air pollution costs are related to the health effects of pollution (Australian Transport Council, 2006b), in contrast to some developed countries in Europe and North America where acid rain damage to vegetation and property can be a substantial problem.

There are no air pollution costs for electric passenger rail, as emissions are remote from the point of use and, by and large, from population centres.

Walking and cycling do not create any air pollution.

4.1.9 Noise Pollution

At low speeds, most traffic noise is caused by vehicle engines, transmissions, exhausts and brakes. The stop-start braking and acceleration during peak-hour congestion also increases noise levels. On roads with more free-flowing traffic, most noise is caused by a combination of tyre contact with the road and aerodynamic drag over the vehicle (Australian Academy of Science, 2002). Trucks and motorcycles are largely responsible for the peak noises that stand out from the steady background rumble. It is these sharp and intermittent noises that are more likely to cause sleep disturbances and to contribute to other physical and psychological problems (Australian Academy of Science, 2002).

Austroads (2008, Table 5.1) recommends a value of 0.82 cents/km for cars and 2.00 cents/km for buses (at 2007 prices). Austroads does not suggest any differentiation between peak and off-peak traffic in an urban situation.

For practical purposes, in a strategic evaluation, noise should be regarded as an all-day phenomenon and the Austroads rates, updated to 2010 prices (0.91 cents per car-km, 2.22 cents per bus-km), should be applied to all trips:

Approximately 40% of noise costs are related to their impact on health (Australian Transport Council, 2006b).

No value for electric rail is proposed as all Brisbane suburban rail lines are electrified (with very low noise levels compared to diesel rail) and may have wide buffer zones from sensitive land uses. Elsewhere, passenger rail is unlikely to be significant part of daily travel to and from school.

Walking and cycling do not create any noise pollution.

Quieter engines and transmissions, including electric motors, will tend to reduce noise nuisance, but this will be offset by increases in traffic and congestion. Moreover, much of the noise caused by motorised traffic is related to tyre contact with the road surface and this is particularly the case with fast moving traffic. Increases in residential and activity density will also increase the numbers of people exposed to noise. Since these factors will counter each other, we do not propose to change the values for noise over time.

In practice, the value for noise is low and is unlikely to have a substantial influence on the results of a benefit-cost evaluation, except where special circumstances of noise sensitivity have been identified.

4.1.10 Water Pollution

Austroads (2008, Table 5.1) recommends values of 0.38 cents/km for cars and 4.29 cents/km for buses (at 2007 prices), but recommends that this be assessed on a project-by-project basis because of the site-specific nature of such impacts.

For strategic evaluation purposes, it is proposed to use the Austroads values, updated by CPI to 2010 prices: 0.42 cents per car-km and 4.75 cents per bus-km.

No value for electric rail is proposed as there are no substantial point-of-use emissions or waste products that might enter the water system.

Walking and cycling do not have any significant impact on water quality.

In practice, the value for water pollution is low and is unlikely to have a substantial influence on the results of a benefit-cost evaluation except where special circumstances of water sensitivity have been identified.

4.1.11 Health and Fitness

Where reduced car use leads to greater use of active transport modes, there will be health and fitness benefits. For public transport, benefits arise only from the activity of walking (or cycling) to and from the bus stop or train station; these are mainly short-duration, especially in the context of relatively short trips to and from school, and will provide limited aerobic fitness benefits and minimal muscular fitness benefits.[7]

Few sources provide any estimates of the health and fitness benefits of walking and cycling in monetary terms. The New Zealand Transport Agency (2010, Vol. 2) specifies values of NZ$2.60 per kilometre for walking and NZ$1.30 per kilometre for cycling (at 2010 prices)—equivalent to A$1.96 and A$0.98 respectively at current 2010 exchange rates. These values are based on both mortality and morbidity and make allowance for differential levels of benefit according to existing levels of physical activity (Genter et al, 2008).

A smaller proportion of Queensland school children currently gain sufficient physical activity than the population proportion in the New Zealand study. Adjusting for this, the appropriate values for Queensland become A$2.07 for walking and A$1.04 for cycling.

The New Zealand Transport Agency (2010) recommends that half the value attributed to health and fitness benefits of active transport should be regarded as internal to (and perceived by) consumers and that the appropriate resource cost is half the total value. However, the consumer 'half' will also include resource cost elements, so the following values have been adopted for this report:

- main evaluation: $1.04 for walking and A$0.52 for cycling
- sensitivity testing: A$2.07 for walking and A$1.04 for cycling.

The New Zealand values are based on data for people aged from 16 to 64, but Genter et al (2008, p. 54) argue that the values "apply to children as well as to adult users". This appears to be based more on the importance of reducing childhood obesity and increasing trends of sedentary lifestyles amongst children than on specific medical or health studies. In the absence of better information the values derived above will be used.

Many of the health benefits of active transport will take some time to positively impact on the health system (reduce its costs). Whilst some sources (e.g. ICLEI, 2003) suggest that benefits may take 10 years to be realised, the Department for Transport in the UK (2010e) suggests an accrual period of five years. This report adopts a five-year accrual period with linear accrual over that period.

[7]People who use public transport in Brisbane (206 000 people comprising 12.8% of the population) walk, on average, more than 2.3 kilometres and over 28 minutes to and from public transport, meeting the requirements for the Australian daily minimum physical activity. For primary schools, only 15% of walking trips involve another mode (most likely public transport). For secondary schools, 75% of walking trips are in conjunction with another mode and the walking distances are greater, with a mean of 0.76km from public transport to school. (Burke & Brown, 2007),

5 Public Sector Financial Evaluation

Active transport and other travel-behaviour change initiatives have predominantly been evaluated using social benefit-cost analysis. This views the initiatives and their effects from the point of the view of the community as a whole over the long term and is entirely appropriate for supporting decisions on resource allocation for community benefit.

At the same time, governments must consider the financial feasibility of the initiatives they wish to undertake, as their fiscal responsibilities (especially relating to taxation and borrowing) place limits on the cost of programs that can be implemented.

Initiatives may have both cost and revenue implications, which may arise upfront (i.e. the cost of implementation) or over a subsequent period. Where an initiative directly produces revenues or operating costs (e.g. public transport), these can be readily identified and quantified for use in a discounted cash-flow analysis.

In the case of active transport initiatives, there are indirect effects on costs and revenues that should, but rarely are, incorporated in such analysis. Some, but not all, of these indirect effects are as follows:

- A healthier population will place fewer demands on the health system, reducing health system costs (or allowing more to be done with existing levels of funding).
- Less car use will reduce air pollution from motor vehicle exhaust emissions, resulting in less population exposure to pollution, which will also reduce health system costs.
- Less car use will reduce consumption of motor vehicle fuel, which will in turn reduce the GST revenue from fuel, which is returned directly to the states. Whilst it is reasonable to expect that most of the money not spent on fuel is likely to be injected to other areas of the economy and thus result in no significant change in GST revenue, there is a difference in the extent to which the states have GST revenues returned to them. All GST on fuel is returned to the state in which it is raised, but Queensland receives less than 100% of other GST revenues raised in that state. For 2011-2014, the proportion of GST revenues returned to Queensland will average around 85% (Australian Government, 2010), so a shift in consumption from fuel to other items will reduce the Queensland GST revenue by 15% of the fuel-related reduction.

The household TravelSmart program in Western Australia has been estimated to produce a first-year financial rate of return of 49% to the state, with health system cost reduction accounting for nearly 20% of this, although this did not allow for an accrual period for health effects. However, since over 80% of the overall benefits are not affected by this, the first year rate of return would still be a very healthy 41.8%. Over the longer term, and even with a high interest/discount rate of 8%, the present value of the financial impacts was estimated to be 3.1 to 4.7 times the present value of the financial cost of implementing over a period of years (Ker, 2002).

Ker (2002) estimated a reduction in health system costs to the state of $90 000 for each $1 million invested in the household TravelSmart program—a first-year rate of return of 9% from health system costs alone, but without allowing for the accrual period for health benefits. With a five-year accrual period, the first-year rate of return is lower (1.8%), but the overall present value return would have been 0.79 (25 years at 8% with constant prices) or 0.45 (10 years at 8% with constant prices). If inflation (3% pa) and current lower public sector borrowing rates (5.5% pa) is allowed for, these values would increase to 1.44 and 0.62 respectively.

5.1 Lower Cost of Health Services

5.1.1 Who Funds Health Services?

Delivery and funding of health services in Australia is complex, with federal and state governments and the private sector all playing a part (Figure 10). In broad terms, according to the Australian Institute of Health and Welfare:

> Over two-thirds of total health expenditure in Australia is funded by government, with the Australian Government contributing two-thirds of this, and state, territory and local governments the other third. (2010, p. 9)

Over the decade to 2007/8, governments provided 67.8% of health system funding in Australia, consisting of 43.5% federal funding and 24.3% state funding (Australian Institute of Health and Welfare, 2010, Table 8.4). Towards the end of that period, from 2005/6, the federal proportion was below 43% and the state proportion rose to an average of 25.5%

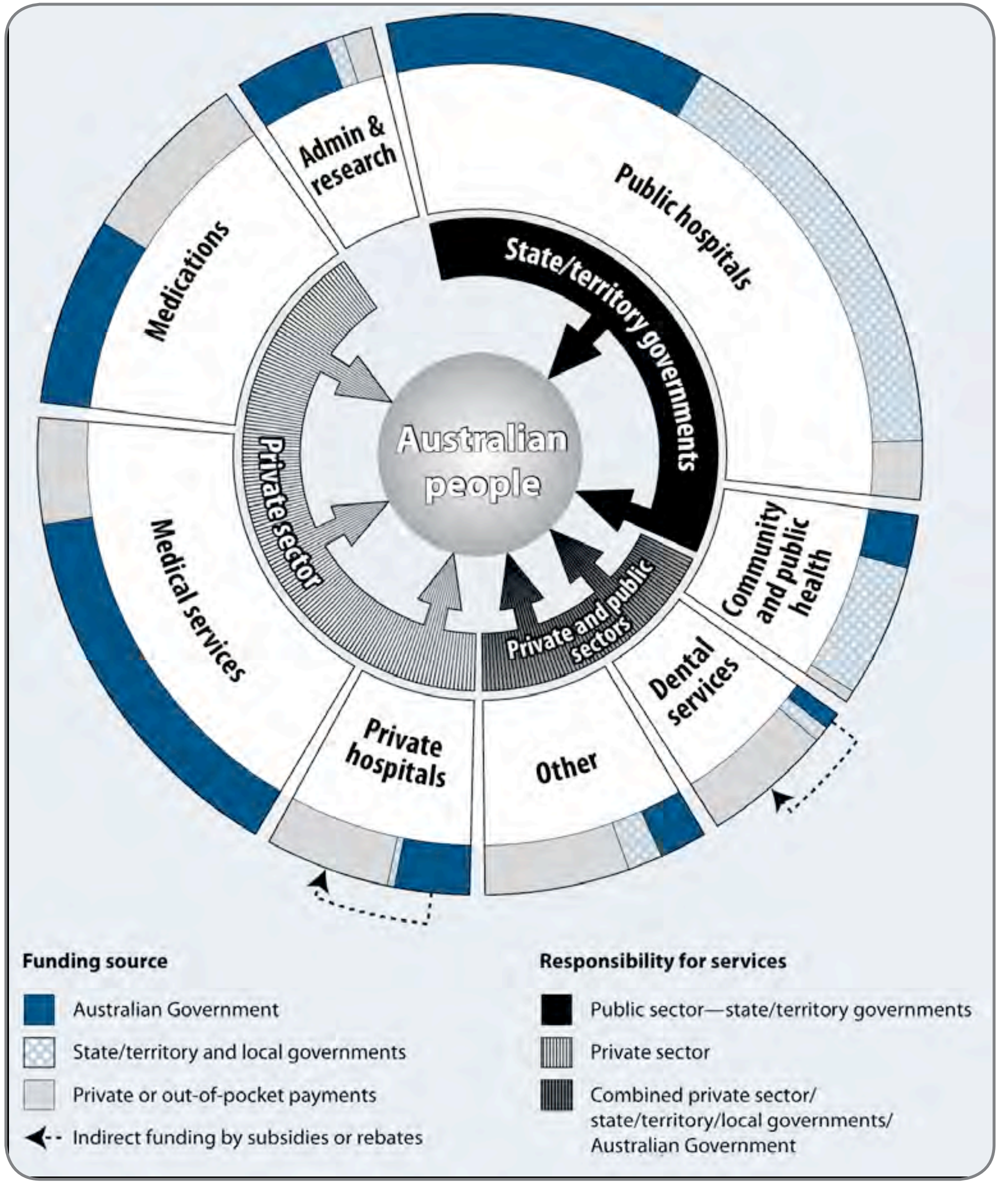


Figure 10: Health service funding and responsibility in Australia
Source: Australian Institute of Health and Welfare, 2010.

Health and Fitness

In the only comprehensive assessment of the benefits of both walking and cycling to the health system, Genter et al (2008, p. 49) estimate that the health sector financial benefits represent 26% of the overall benefits. However, they observe that, because of lags in the ill-health effects of insufficient physical activity, these values are likely to be under-estimates.

On this basis, the health system financial benefits would be 27.0 cents/km for walking and 13.5 cents/km for cycling.

With typical funding split of 43% federal, 25.5% state and 31.5% private sector, the benefit to each, assuming it was spread uniformly across the range of health services, would be:

- walking: 11.6 cents, federal; 6.9 cents, state; 8.5 cents, private
- cycling: 5.8 cents, federal; 3.4 cents, state; 4.2 cents, private.

Many of the health benefits of active transport will take some time to positively impact on the health system (reduce its costs). As with the broader socioeconomic benefits, this report adopts a five-year accrual period with linear accrual over that period.

Air Pollution

Ker (2002) calculated that each kilometre reduction in car use was worth 0.54 cents, in 2002 prices, in reduced health system costs resulting from air pollution. With average inflation of 3.4% per year, this is equivalent to 0.70 cents in 2010 prices. With typical funding split of 43% federal, 25.5% state and 31.5% private sector, the benefit to each, assuming it was spread uniformly across the range of health services, would be:

- 0.30 cents federal government
- 0.18 cents state government
- 0.22 cents private sector.

We will estimate the financial benefit of health system cost reduction through air pollution-related health improvements to Queensland as 0.18 cents for each kilometre of car travel reduction. Lower values may be appropriate outside the metropolitan region and South East Queensland.

5.2 Reduced GST from Motor Vehicle Fuel

Motor vehicle fuel is subject to two taxation components:

- the federal excise duty of 38.1 cents per litre
- Goods and Services Tax at a rate of 10%. This is a federal tax but revenue from fuel is returned directly to the states without the redistribution that characterises other GST revenues.

Any reduction in the use of cars will correspondingly reduce motor vehicle fuel consumption and therefore reduce federal revenue from the fuel excise and state revenue from the GST. However, if we assume that the money saved by less car use is spent on other goods and services that also attract the GST, the effect on the states would be limited to the extent to which general GST revenues are redistributed. Queensland receives less in GST revenues from the federal government than is collected in the state—there is a redistribution of 9.6% away from the state in 2010/11 (Australian Government, 2010), which is projected to increase to about 16% by 2013/14 and averaging around 15% over the period 2011-2014.

Consequently, we have estimated the net revenue loss to Queensland as 15% of the reduction in GST on fuel. This will need to take account of increases in the price of fuel and improvements in motor vehicle fuel efficiency over the years—$3/litre real price for fuel in 2031 (see Section 4.1.1) will mean around $6/litre at the pump. The current GST on a litre of fuel is around 11.4 cents/litre (for fuel price $1.25/litre). At $6/litre pump price, the GST will be 54.5 cents/litre.

Net revenue loss to Queensland from reduced car use will be 0.15 cents/km at 2010 prices and fuel efficiency, rising to 0.52 cents/km at 2031 prices and fuel efficiency.

5.3 Upfront Cost of Active Transport Programs

The upfront cost of active transport programs in schools is itself spread over a period of years and would be subject to discounting in a public sector financial analysis.

Whilst the present value of costs is reduced by spreading the program over a longer period, the benefits would be correspondingly deferred as well. Consequently, there is no effect on the financial returns relative to costs. The choice of time period for implementation is simply a matter of determining the feasible level of expenditure in terms of:

- the need to develop and prove an initial program
- the logistics of rolling out a broad-scale program
- the extent of competition for public sector funding.

6 Indicative Evaluation of Active Transport in Schools

This section outlines the results of applying the evaluation framework and values set out in preceding sections of this report to a potential program to encourage active transport in schools.

Taking a 10-year evaluation period and a 10% reduction in car driver/sole-passenger trips to and from school (all converted to active transport), the benefits of a school-based active transport program are estimated to have a value of between $110 000 and $135 000 for an inner urban school and between $80 000 and $100 000 for an outer suburban school.

These ranges depend upon the discount rate applied to future benefits. The higher values are reached by using a 2.5% per annum discount rate, derived as required by the Queensland Project Assurance Framework (Department of Infrastructure and Planning, 2010). The lower values are reached by using a 7% per annum discount rate, commonly used in other Australian jurisdictions (see Section 3.3 above).

The difference between the inner urban and outer suburban values is a consequence of the higher levels of traffic congestion in inner urban areas.

These results are based on the same level of car use reduction and active travel increase being maintained throughout primary and high school.

6.1 About the Evaluation of Active Transport

The key dimensions of the benefit estimation for active transport in Queensland are:

- the extent to which car trips are converted to walking or cycling
- the values to be attributed to the effects of changing from car driver (or, in the case of school students, sole car passenger) to walking or cycling
- the location of the trip, especially with respect to levels of road traffic congestion
- the time period for evaluation, which relates also to the durability of the change from car to active transport
- the rate of discounting of the future relative to the past.

With regard to the extent of change in walking and cycling participation, without a defined program of implementation, the evaluation is unable to be scaled to reflect the outcomes that are likely to be achieved. To overcome this, results are shown for each 1000 kilometre reduction in car use, with the assumption that two-thirds of these kilometres will be transferred to walking and one-third to cycling.[8]

The benefit values and their derivation are set out in this project report on evaluation framework and values. The values (with a small amendment to the road trauma value for walking, based on updated information) are set out in Appendix A. This evaluation uses the lower values for health and fitness benefits from walking and cycling.

With regard to location/congestion, in this report, we present evaluation results for the extremes of the congestion spectrum:

- high traffic congestion for the trip to school in the morning (which coincides with the work commuting peak)
- medium congestion for the trip home in the afternoon (which is slightly earlier than the work commuting peak)
- low traffic congestion in outer suburban locations for both travel to and from school, as these trips are likely to be less often on main roads (because of the way new residential developments are planned) and overall traffic levels are lower.

For the evaluation time period, we present results for 5, 10 and 25 years.

The longest period (25 years) is the usual period for transport infrastructure evaluation, however, due to uncertainty about the long-term durability of travel behaviour change, the New Zealand Land Transport Authority recommends using 10 years for evaluating active transport initiatives. For a program based on primary schools, 10 years is only a little longer than the period of school life after the program. Using the 10-year evaluation period, therefore, does not require any significant assumptions about the durability of the active transport change beyond school.

A five-year evaluation period is equivalent to assuming that the active transport effects would not extend beyond the first few years in high school.

Determining an appropriate discount rate has been discussed in the draft Stage Two report on the project. We present results for 2.5% (the rate implied by the Queensland Project Assurance Framework and the ATC National Guidelines for Transport System Management in Australia) and 7% (the rate required by most Australian jurisdictions other than Queensland).

[8] These proportions can be varied in the evaluation spreadsheet.

6.2 Evaluation Results: Inner Urban (High Congestion)

The evaluation results, for both 2.5% and 7% discount rates, are summarised in Figure 11. The principal effect of discount rate and evaluation period is on the level of benefits, with little impact on the relative importance of the component benefits.

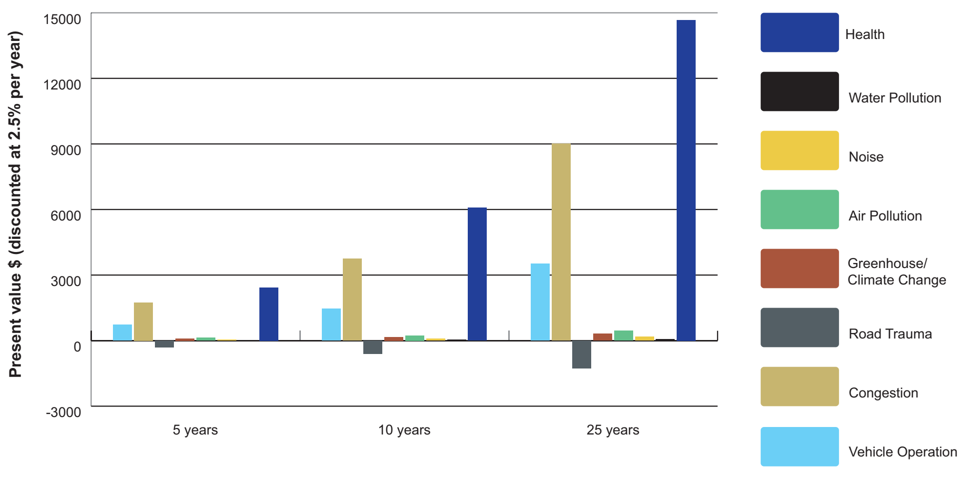


Figure 11(a): Benefits of active transport (inner urban, 1000 km annual car reduction) with 2.5% discount rate

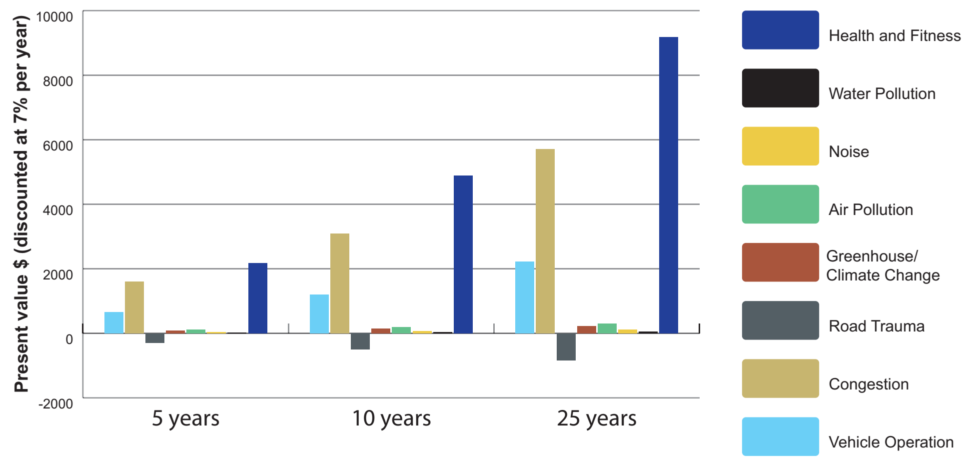


Figure 12(b): Benefits of active transport (inner urban, 1000 km annual car reduction) with 7% discount rate

The major components of the benefits of active transport are:

- health and fitness benefits (to the individual and to the community)
- reduced vehicle operating and congestion costs
- environmental benefits.

Each of the first two components accounts for around half the net benefits of active transport, whilst environmental benefits roughly offset any negative effect on road trauma.

6.3 Evaluation Results: Outer Suburban (Low Congestion)

The evaluation results, for both 2.5% and 7% discount rates, are summarised in Figure 13. The principal effect of discount rate and evaluation period is on the level of benefits, with little impact on the relative importance of the component benefits.

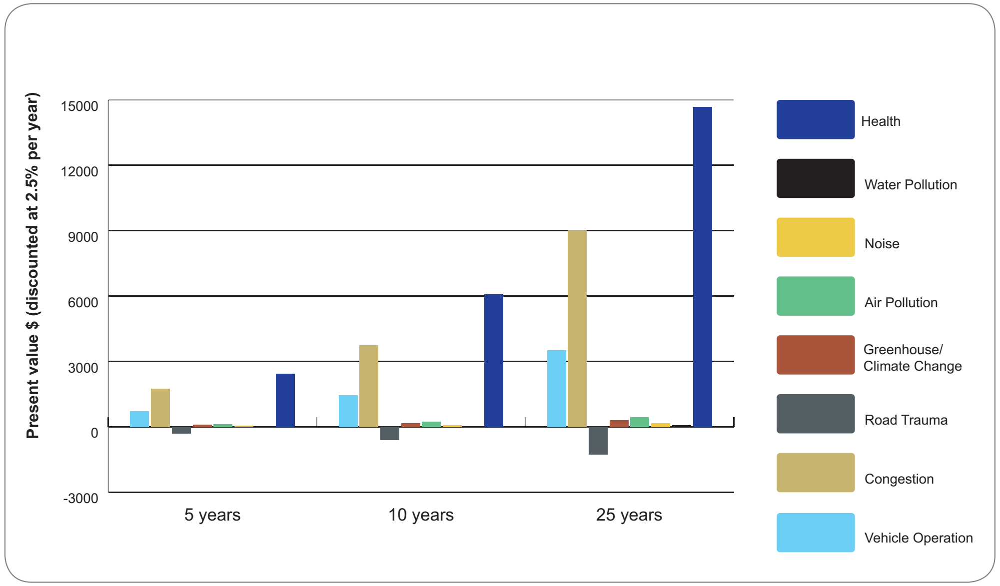


Figure 13(a): Benefits of active transport (outer suburban, per 1000 km annual car reduction) with 2.5% discount rate

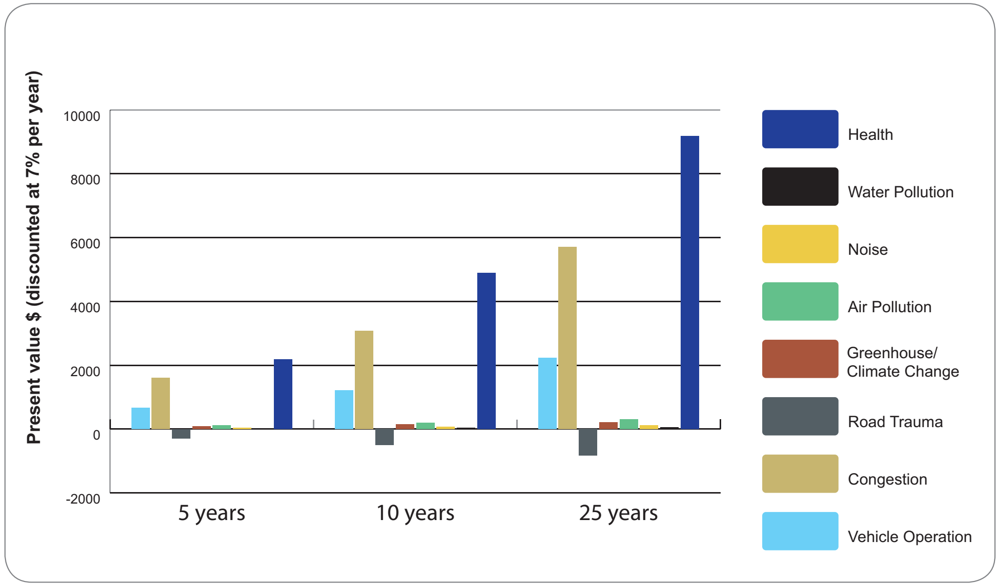


Figure 14(b): Benefits of active transport (outer suburban, per 1000 km annual car reduction) with 7% discount rate

In outer suburban areas (and other areas where road traffic congestion is low), health and fitness benefits are a more substantial part of a slightly lower total benefit as follows:

- health and fitness benefits (around 70% of net benefits)
- reduced vehicle operating and congestion costs (around 30% of net benefits)
- environmental benefits roughly offset any negative effect on road trauma.

6.4 Interpreting the Evaluation Results

All effects of a shift from car use to active transport are positive (beneficial) with the exception of the net effect on road trauma. Whilst the apparent increase in road trauma is a concern:

- It is based on system averages and the walking and cycling environment around schools can be effectively managed to improve safety for pedestrians and cyclists, especially as this is where the reduction in car traffic will be most concentrated. No road safety improvements around schools have been factored into this evaluation.
- The health and fitness benefits exceed the net increase in road trauma costs by a factor of more than seven–even in the short term.

The benefit evaluation has assumed the same level of active transport increase in all evaluation years. In practice, this will be subject to a number of potential influences that may make this assumption too low or too high:

- Travel distances tend to increase as students get older—high school catchments are larger than primary school ones.
- There may be a tendency for the active transport message to wear off over time.
- There may, on the other hand, be an amplifying effect as individuals become more aware of the benefits of active transport and make more travel decisions for themselves.

Results are presented below in the context of 5% and 10% reduction in car driver/sole-passenger trips to and from school. By comparison, the Brisbane City Council Active School Travel Program achieved a 16% reduction in car/sole-passenger trips in 2007/8. The Auckland Regional Council program achieved a 7% reduction in car use. In both these cases, a part of the change was to carpool or public transport, but the major change was to walking and cycling.

6.4.1 Inner Urban (high congestion)

The evaluation indicates that conversion of school-based car trips to active transport (walking and cycling) results in benefits with a present value of:

- $0.88 to $0.97 for each car-km reduction over a five-year period
- $0.91 to $1.12 for each car-km reduction if the effects last for 10 years
- $0.68 to $1.08 for each car-km reduction if the effects last for 25 years.

If we assume an average primary school trip distance of one kilometre each way and we assume that the number of school car trips that are home-school-home is equal to those that are on the way to another destination (most likely to work), then 1000 km of car travel represents the annual distance to and from school for five students.

If 75% of trips to school are currently by car (reported by Brisbane City Council as the ‘before’ figure in its Active School Travel Program evaluation), this represents 120 000 car-km per year (200 school days) in a 400-student school.

A reduction of 5% in car trips would reduce annual car travel by 6000 km, with a present value of benefits of:

- $26 400 to $29 000 over 5 years (30 000km);
- $54 600 to $67 200 over 10 years (60 000km);
- $102 000 to $162 000 over 25 years (150 000km).

A reduction of 10% in car trips would reduce annual car travel by 12 000km, with a present value of benefits of:

- $52 800 to $58 000 over 5 years (60 000km);
- $109 200 to $134 400 over 10 years (120 000km);
- $204 000 to $324 000 over 25 years (300 000km).

6.4.2 Outer suburban (low congestion)

The evaluation indicates that conversion of school-based car trips to active transport (walking and cycling) results in benefits with a present value of:

- $0.63 to $0.70 for each car-km reduction over a five-year period;
- $0.67 to $0.83 for each car-km reduction if the effects last for 10 years; and
- $0.50 to $0.80 for each car-km reduction if the effects last for 25 years.

If we assume an average primary school trip distance of one kilometre each way and that the number of school car trips that are home-school-home is equal to those that are on the way to another destination (most likely work), then 1000 km of car travel represents the annual distance to and from school for five students for a year.

If 75% of trips to school are currently by car (reported by Brisbane City Council as the 'before' figure in its Active School Travel Program evaluation), this represents 120,000 car-km per year (200 school days) in a 400-student school.

A reduction of 5% in car trips would reduce annual car travel by 6000 km, resulting in benefits with a present value of:

- $18 900 to $21 000 over 5 years (30 000 km)
- $40 200 to $49 800 over 10 years (60 000 km)
- $75 000 to $120 000 over 25 years (150 000 km).

A reduction of 10% in car trips would reduce annual car travel by 12 000 km, resulting in benefits with a present value of:

- $37 800 to $42 000 over 5 years (60 000 km)
- $80 400 to $99 600 over 10 years (120 000 km)
- $150 000 to $240 000 over 25 years (300 000 km).

6.5 The Appraisal Summary Table

The appraisal summary table is a means of acknowledging the extent of impacts that cannot be fully captured by benefit-cost analysis.

An important purpose of *the appraisal summary table* is to identify where negative or poor outcomes may arise and provide the opportunity for the project to be modified in such a way that these are wholly or partially avoided. Although these assessments should be regarded as indicative rather than precise, no negatives have been identified. Although walking and cycling currently have higher crash and injury rates than car use, this is more than outweighed by the health and fitness benefits. In addition, with more walkers and cyclists the crash/injury rates will fall as there is 'safety in numbers'.

The short-medium term assessment is more robust than the medium-long term assessment. Whilst some effects take time to accrue (especially health effects, which can take five to 10 years to accrue fully), the longer-term outcomes depend critically on the extent to which the use of active travel continues on into high school and adult life.

OBJECTIVE	CRITERION	DESCRIPTION/MEASUREMENT	ASSESSMENT			COMMENT/EXPLANATION
			Short-Medium Term	Medium-Long Term	Overall Rating	
Strategic Alignment	Towards Q2	Strong; green; smart; healthy; fair	+++++	+++++	+++++	Active transport supports all these directly and also creates opportunities for diffusion of principles and actions into other areas of individual and family activity and lifestyle.
	South East Queensland Regional Plan	Consolidation; reduce car use; fight congestion; strong, healthy communities	++	++++	++++	Potential for diffusion, as above. Children who are part of an active transport program are likely to use cars less when they become adults.
	Queensland Cycle Strategy	Safety/security of users; integrate policy and practice; effective encouragement	+++	++++	++++	More 'eyes on the street' in walking and cycling environments. Practical application of the importance of physical activity to health and fitness. Integrates physical activity with day-to-day living.
	The Health of Queenslanders	Individual and community health; active, healthy communities	+++	+++++	++++	Individual health benefits take time to accrue. Integrates physical activity with day-to-day living.
	Office of Sustainable Transport	Access; equity; affordability; choice; convenience; minimise adverse environmental, economic, and social impacts	+++++	+++++	+++++	No restrictions on choice, but helps people make choices. Walking and cycling are low-impact transport modes with minimal requirement for fossil fuels and other resources.
Economic and Financial	User cost of transport	Financial cost of transport for households	+++++	+++++	+++++	Walking and cycling are low-cost transport modes.
	Cost of transport infrastructure	Financial cost of roads and car parking	++	++	++	In some situations, space used for car parking on school sites may be converted to other uses.
	Transport energy use: fossil fuels	Extent of private car use; vehicle fuel efficiency	+++++	+++++	+++++	Demonstrated ability to reduce car use.
	Economic sustainability	Extent of reliance on fossil fuels for transport	+++++	+++++	+++++	Walking and cycling have minimal requirement for fossil fuels.
Environment	Climate change	Greenhouse gas emissions from transport	+++++	+++++	+++++	No greenhouse emissions from walking and cycling.
	Air pollution	Motor vehicle exhaust emissions	+++++	+++++	+++++	No air pollution emissions from walking and cycling.
	Water pollution	Any special issues/sensitivity	None identified			Location-specific but cycling/walking will have lower impact
	Noise pollution	Any special issues/sensitivity	None identified			Location-specific but cycling/walking will have lower impact
	Sensitive location	Any special issues/sensitivity	None identified			Location-specific but cycling/walking will have lower impact
Social: Amenity, People & Communities	Stakeholder impacts: school community	Extent of support in school community	++++	+++++	+++++	Early support depends upon effective engagement of school communities. Thereafter, demonstration effect.
	Stakeholder impacts: local community	Extent of support in local community	+++	+++++	++++	Local community will benefit from less school traffic on local streets and less pressure on kerbside parking at school pick-up and drop-off times.
	Community interaction	Extent of involvement of local community	++	++	++	Depends on how the program is developed. Past programs have focused on school without much involvement of local community.
	Health and fitness	Physical activity through walking and cycling; reduced exposure to motor vehicle exhaust pollutants	++++	+++++	+++++	Individual health benefits take time to accrue, but pollution-exposure benefits are immediate.
	Social equity	Accessibility for people without cars	+++	+++	+++	Less car traffic and congestion around schools. Improved safety.
Safety	Road safety: motorised modes	Impact on motor vehicle road safety—less car use; less conflict around schools	+++++	+++++	+++++	Fewer cars and more aware community.
	Pedestrian/cyclist safety	Improvement to pedestrian and cyclist safety—less conflict around schools	+++++	+++++	+++++	'Safety in numbers' combines with greater awareness, education components of program and, where appropriate, infrastructure improvements.
	Personal security	Perception of personal security, especially while walking or cycling	+++++	+++++	+++++	'Safety in numbers' combined with school community more aware of security issues and how to manage them.
Governance	Long-term certainty and assurance	Statutory or regulatory formalisation	++++	++	+++	Depends on forward government commitments. School community is given the skills to continue even if funding ceases.
	Extent of approvals needed	State and/or local government approvals required	++++	++	+++	Budget approvals.
	Stakeholder consultation	Extent of support from stakeholders	++++	++++	++++	The only issue is the time taken during the school week.

Table 8: Appraisal summary table for active transport in Queensland schools

6.6 Public Sector Financial Evaluation

As outlined in Section 5 above, a change from car driving to active travel will have financial consequences, in addition to the actual cost of the program, for the Queensland State Government, in addition to the federal government and to the individuals and families who change their travel behaviour. These impacts relate to:

- lower car operating costs
- public transport fares and operating costs (where public transport is a part of the change)
- lower cost of health services through improved health and fitness
- lower cost of health services through reduced exposure to air pollution
- changes in net GST revenue for federal and state governments, because of the different arrangements applying to the GST on fuel.

Using a similar indicative evaluation framework as for benefit-cost analysis, expressing the results in terms of each 1000 km/year reduction in car use, with the assumption that two-thirds of these kilometres will be transferred to walking and one-third to cycling, the estimated financial impacts of active transport are shown in Table 9.

DISCOUNT RATE	2.5%			7%		
	Federal	State	Private	Federal	State	Private
5 Years						
Health system cost saving: health & fitness	$272	$161	$199	$243	$144	$178
Health system cost saving: air pollution	$14	$9	$10	$13	$8	$10
Vehicle operating cost saving	-	-	$956	-	-	$879
Net GST revenue	$10	-$10	-	$10	-$10	-
TOTAL FINANCIAL EFFECT	$296	$160	$1165	$266	$142	$1067
10 Years						
Health system cost saving: health & fitness	$679	$402	$496	$545	$323	$399
Health system cost saving: air pollution	$27	$16	$20	$23	$14	$17
Vehicle operating cost saving	-	-	$1898	-	-	$1578
Net GST revenue	$23	-$23	-	$19	-$19	-
TOTAL FINANCIAL EFFECT	$729	$395	$2414	$587	$318	$1994
25 Years						
Health system cost saving: health & fitness	$1637	$971	$1197	$1024	$608	$749
Health system cost saving: air pollution	$57	$34	$42	$37	$22	$27
Vehicle operating cost saving	-	-	$4427	-	-	$2830
Net GST revenue	$69	-$69	-	$42	-$42	-
TOTAL FINANCIAL EFFECT	$1763	$936	$5566	$1103	$588	$3606

Table 9: Financial effects of active transport (1000 km annual car reduction): present value

7 Developing a Program

This section outlines a possible basis for developing a program of active transport in primary schools in Queensland. It identifies the necessary stages for effective program development, implementation and review. It also provides a means of estimating the costs of undertaking such a program.

7.1 Developing the Program

There are 1035 state and 248 non-government primary schools in Queensland (http://education.qld.gov.au/directory/schools). Of the state primary schools:

- 253 are in the Metropolitan Region
- 124 are in the South East Region
- 160 are in the Central Region
- 189 are in the Darling Downs South West Region
- the remainder are in the northern regions of the state.

The program planning phase must be conscious of the following factors when selecting the type and number of participating schools:

- School communities must have enthusiasm for active transport encouragement initiatives. It is not sufficient to mandate participation—for example, the UK program mandated and funded development of school travel plans, but only half of the schools with plans in London have led to even partial implementation (personal communication from Transport for London).
- Local government must support active transport programs. Local governments are responsible for the majority of the street network between residential areas and schools. Any comprehensive improvement in walking and cycling conditions within the school catchment area will therefore require the support of local government. As the tier of government closest to the community, local government can potentially play an important communications function to boost awareness within and between schools and the communities they serve.
- The methods of a new initiative must be tested before launching into a full-scale program. Whilst school-based active transport programs are well-proven, including in Brisbane, each program is different.
- Momentum needs to be generated quickly and sustained in order for the program to be effective.
- The duration of the program needs to be long enough and the funding assured in order to maintain the interest of those schools that cannot be accommodated in the first years.
- A substantial level of activity must be maintained over a period of years in order to achieve a visible and ongoing presence.
- The scale of the program must be compatible with the resources available and the ability of the school system to accommodate it.

In addition, the program must not be regarded as a once-only intervention. It is important that schools are given continuing support, albeit at a lower level than their initial involvement, to ensure continuing higher levels of active transport, including for new students entering the school.

A program must first engage and select schools to participate. Whilst the initial level of interest is an important factor in this process, this should not be the sole criterion. The socioeconomic status (SES) of schools may also be a consideration. Experience in Auckland shows that schools of lower SES are much less likely to be early adopters. However, for equity reasons, and also because the children at lower SES schools may be more at risk of developing health problems from insufficient physical activity (Figure 15), efforts should be made to engage schools across the socioeconomic spectrum.

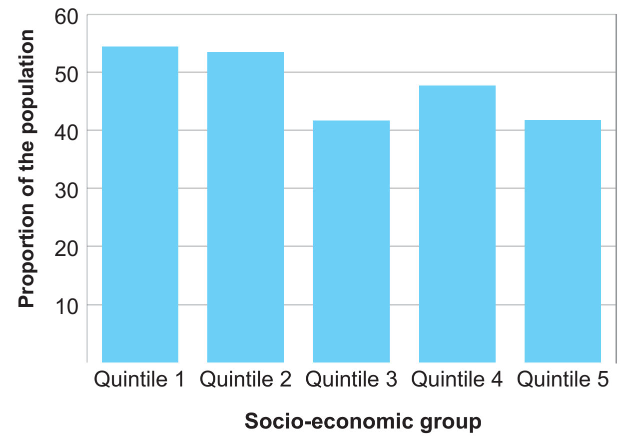


Figure 15: Insufficient activity by socioeconomic group (quintile 5 = most socioeconomically advantaged)
Source: Queensland Health, 2008

Developing a Program

The same applies to achieving participation from beyond major cities and inner regional Queensland as people in outer regional areas are less likely to get sufficient physical activity (Figure 16). However, in this case, the opportunities for walking or cycling to school may be lower than in areas with more and larger urban centres.

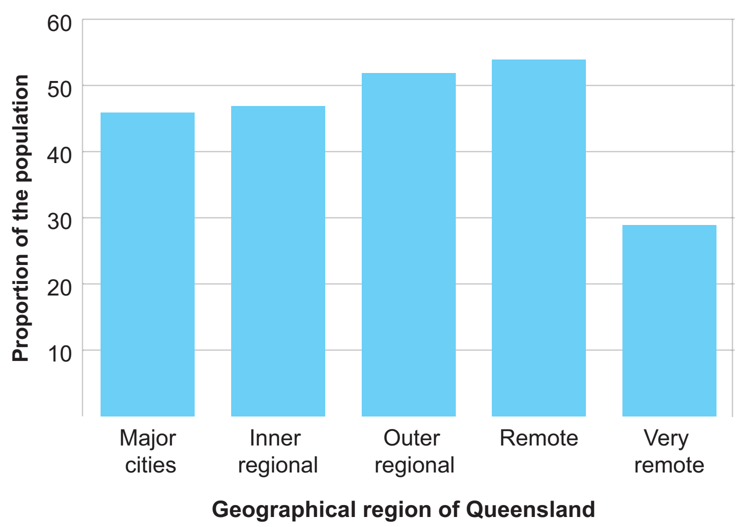


Figure 16 Insufficient activity by geographic area
Source: Queensland Health, 2008

7.2 An Indicative Program

An effective program should contain the following elements:

- engagement and selection of schools
- implementation (over a period of one school year)
- ongoing support to maintain the achievements of the first year, including new students.
- 'transition to high school' component to maximise the extent to which active travel is carried over from primary school to high school (see Appendix A).

YEAR	ENGAGE AND SELECT SCHOOLS	IMPLEMENT	SUPPORT	TRANSITION TO HIGH SCHOOL PROGRAM	PERCENTAGE OF PRIMARY SCHOOLS IN QLD	PERCENTAGE OF STATE PRIMARY SCHOOLS IN QLD
1	20	-	-	-	-	-
2	50	20	-	-	1.6%	1.9%
3	100	50	20	-	5.5%	6.8%
4	100	100	70	20	13.3%	16.4%
5	100	100	170	50	21%	26.1
6	100	100	270	100	28.8%	35.7%

Table 10: Indicative program for active travel in primary schools (number of schools)

This program would reach nearly 30% of Queensland primary schools over a five-year implementation period (six years including program development and engagement/selection of the first schools).

7.3 Program Costs

The cost of active school travel programs will vary between programs and from school to school, depending on their content and how much support is provided. The Brisbane City Council program cost an average of $22 000 per school, of which around one-quarter was for secure bicycle storage and slightly less than half was for staff costs (Ker, 2008).

Ongoing support costs were estimated to reduce to $3300 per school.

The Brisbane City Council program was small and in the early stage of development. It is likely that an ongoing program of a larger scale would be able to reduce costs. Indicative costs are shown in Table 11.

	ENGAGE AND SELECT SCHOOLS	IMPLEMENT(a)	SUPPORT	TRANSITION TO HIGH SCHOOL PROGRAM
First year	$1000	$25 000	$2500	$2500
After first intake		$20 000	$1 500	$1 000

Table 11: Indicative costs per school

(a) Includes some costs that may be incurred across the program as a whole rather than being specific to individual schools. Includes allowance for onsite secure bicycle storage but not for offsite walking or cycling infrastructure improvements or traffic management around schools, which are assumed to be funded by local, state or possibly federal government.

Applying these unit costs to the indicative program (Table 10), with allowance for development of program resources and materials, suggests a level of resourcing that ramps up to $2.25 million by year four, with a slower rate of increase thereafter to provide ongoing support for schools that have participated in the program (Table 12).

YEAR	DEVELOP PROGRAM	ENGAGE AND SELECT SCHOOLS	IMPLEMENT	SUPPORT	TRANSITION TO HIGH SCHOOL PROGRAM	REVIEW	TOTAL
1	$100 000	$20 000	-	-	-	-	$120 000
2		$25 000	$500 000	-	-	-	$525 000
3		$50 000	$1 000 000	$60 000	-	$25 000	$1 135 000
4		$50 000	$2 000 000	$140 000	$50 000	-	$2 240 000
5		$50 000	$2 000 000	$340 000	$50 000	-	$2 440 000
6		$50 000	$2 000 000	$540 000	$100 000	$50 000	$2 740 000
						TOTAL	$9 200 000

Table 12: Indicative program costs

7.4 Evaluating the Program

The benefit evaluation for an active transport program in schools has been set out in Section 6. This section compares the benefits with the costs of the program outlined above.

The following key assumptions have been made:

- 15% of schools in high congestion (inner/middle metropolitan) areas
- 85% of schools in low congestion (outer suburban/non-metropolitan) areas
- an equal mix of two-stream (two classes per year) and single-stream schools—average 300 students
- 10% reduction in car-km for school travel
- three-quarters of car-kilometres transfer to walking
- one quarter of kilometres transfer to cycling
- increase in active transport maintained for 10 years and 25 years respectively
- ongoing support maintained in each school for five years after initial implementation
- new students after implementation year achieve 50% of the level of benefits achieved by those exposed to the full program.

The results of a benefit-cost evaluation on this basis are shown in Table 13.

EVALUATION PERIOD	10 YEARS		25 YEARS	
Discount rate	2.5%	7.0%	2.5%	7.0%
Present value of costs	$10.6m	$8.8m	$10.6m	$8.8m
Present value of benefits	$37.0m	$24.9m	$89.1m	$46.4m
Benefit-cost ratio	3.5	2.8	8.4	5.2
Net Present value	$26.3m	$16.0	$78.5m	$37.5m

Table 13: Benefit-cost evaluation

Benefits exceed costs by a substantial margin in all scenarios (Table 13). Even the poorest result (BCR 2.8:1 for 10 years at 7% discount rate) is competitive with results from evaluation of most transport infrastructure projects.

In the event that the increase in active transport does not endure beyond the first couple of years of high school (a possibility that the transition to high school component aims to overcome), the benefits still exceed the costs (BCR 1.8:1 at 2.5% discount; 1.3:1 at 7%). This 'downside risk' strongly indicates that investment in active transport through a school-based program is a justifiable and robust way of using public funds.

8 Monitoring the Program

New developments in transport policy and programs are required to demonstrate their effectiveness, especially where these represent a significant departure from conventional programs. Credibility and performance is often established by repetition and consistent results, but the statistical requirements for such demonstration are often difficult for an individual project—particularly a small-scale or pilot project—to achieve.

Conventional benefit-cost evaluation for school-based programs requires measures of travel-behaviour change, usually a change from students being driven to and from school by their parents to the use of active modes and public transport, as well as carpooling. The primary measure is the reduction in car trips to school, but it is equally important to measure:

- the modes to which trips are changed, because the socioeconomic and environmental outcomes of those can vary substantially
- trip distances, because many of the outcomes are related to travel distance, although this may not be critical in primary schools, with defined local catchments.

In addition, the long-term effectiveness of school-based programs depends to a great extent on the continued participation of schools and parents in the program in subsequent years. The extent to which this happens depends as much on perceptions of the program and its activities as it does on the measurable achievements in terms of increases in active travel or reduced car use for travel to and from school.

Indicators of program performance must include, therefore, measures of participation and of teacher and parent responses to the program and its activities.

The primary means of monitoring actual achievement of school-based programs is a hands-up survey in classrooms undertaken early in the school year (before any active transport program activities) and late in the year (long enough after the last active transport program activity for immediate effects not to affect results). It is important that this should be in terms of actual travel on the days of the survey, rather than 'usual mode' of travel, which requires interpretation and will vary between children.

For the last day of the surveys, travel home will need to be on the basis of intention, rather than actual behaviour, to avoid extending surveys into an additional day (or week).

It is important to measure the number of students who sometimes use active travel, as this can be different from the change in active travel trips on a specific day. Multi-day surveys will help identify occasional as well as regular users of active transport.

Survey design and the recording of daily results should be as simple as possible and provide prompt feedback opportunities to the school community.

Simple and consistent end-of-year surveys of parents and teachers will provide information on perceptions of the active transport program. This will be important to identify aspects that might benefit from improvement, but also to help establish support for continuation into future years.

The monitoring and evaluation plan has been developed in the context of:

- Overall project goals: the strategic orientation to which the project will contribute.
- Project purpose: the intended near-term effects on the users of the project as a result of using the project's outputs.
- Component objectives: the specific effects that will support the overall objective of changing travel behaviour.

Data collection related to the above evaluation activities can be achieved through surveys (student hands-up surveys, parent and teacher surveys) and recording of student and parent participation in active transport initiatives.

Hands-up surveys should be on the basis of more than one day of the week, as single-day surveys are subject to a much larger range of influences (including weather and parental circumstances) than multi-day surveys. Surveys should ideally be over the full five days of the week, but if this is not possible Tuesday to Thursday are the days most likely to be reasonably representative of student travel overall.

The clearest and most effective way of presenting the results of the surveys is in graphical form.

For the student hands-up surveys, this can be done by means of a simple spreadsheet with embedded graphics, used for:

- entering the data for each class
- entering before and after survey
- automatically generating simple graphics for immediate feedback to the school community
- aggregating across classes and grades to give a whole-school picture.

A similar approach can be used for the parent and teacher surveys, but with a single end-of-year survey rather than measuring change during the year, and for measures of participation in active transport program activities.

It is also important to monitor the process of development and implementation of active transport program generally and in individual schools, to identify desirable process improvements and any factors that might affect outcomes in individual schools.

For more detail on monitoring the implementation and effectiveness of school-based active transport programs see Appendix B.

9 Summary and Conclusion

This report is the second in a project to develop a comprehensive, accurate and practical framework for evaluating the full benefits and costs of active transport. This includes monetised estimates of health benefits, as well as other economic, social and environmental outcomes, based on existing research, calibrated to the Queensland context. The first report reviewed and assessed experience with active transport programs and their evaluation. This second report sets out the specifics of an evaluation framework for active transport in Queensland, including information and tools to support public policy decisions that will enable active travel programs to become an effective part of the public policy mix and achieve effective outcomes in a broad range of areas, including health, transport and the environment.

The core of the framework is benefit-cost analysis, with values and their derivation set out in this report. These values relate either to the reduction in car use (including the negative externalities of car use) and to the increase in active transport.

Taking a 10-year evaluation period and a 10% reduction in car driver/sole-passenger trips to and from school (all converted to active transport), the benefits of a school-based active transport program are estimated to have a value of between $109 000 and $134 000 for an inner urban school and $80 000 and $100 000 for an outer suburban school.

The only apparent negative for increased active transport is that cycling and walking crash and injury rates are higher than for car travel. However, active transport achieves health benefits that substantially exceed any net increase in road trauma. Even allowing for the health benefits accruing progressively over five years, they more than offset the net road trauma increase for cycling from the start and by a factor of more than four when the full level of health benefits is achieved. For walking, the health and fitness benefits more than offset the net road trauma increase from the start (by a factor of eight) and by a factor of more than 40 when the full level of health benefits is achieved.

An indicative program for active transport in schools would need to develop over time, partly to learn from experience but equally to provide demonstrated performance that will assist in engaging schools in the program. Such a program would cost around $9.2 million and deliver benefits that exceed costs by a factor of 2.8-3.5 (i.e. benefit-cost ratio) even if the active travel increase for each individual endured only 10 years. Extension of the same rate of active travel into adult life increases the BCR to 5.2-8.4:1.

Other elements of the evaluation framework are:

- An *appraisal summary table*, which provides an assessment of performance against criteria that are not amenable to the quantification and monetisation required by benefit-cost analysis. The AST demonstrates a high level of consistency between community and government objectives and the outcomes of an active transport program.
- A stakeholder financial analysis, which quantifies the key financial effects of an active transport program on the Queensland State Government and on private individuals. The most substantial financial benefits accrue to those who change their travel behaviour, largely through savings in car operating costs, but the financial effects on both federal and state governments are also strongly beneficial, largely through reduction in health system costs.

In order to monitor the performance of school active travel programs, it is necessary to undertake consistent, reliable data collection. This should include students, staff and parents. For students, hands-up surveys, both before and after the intervention, are necessary. These should take place across a one-week period, to gain a representative sample of travel patterns. It is also important that the post intervention survey take place some months after the intervention period, to minimise the effect of short term, non-durable impacts.

References

Atkins WS, Polak J., 1997 *Bus Reliability – Stated Preference Research*. FOR Department of Transport: London, England.

Australian Academy of Science, 2002 *Quiet please! Fighting noise pollution in Australian cities*. Australian Academy of Science.
http://www.science.org.au/nova/072/072print.htm

Australian Greenhouse Office, 2008 *National Greenhouse Accounts (NGA) Factors*, January 2008.
Australian Greenhouse Office: Canberra, ACT.

Australian Institute of Health and Welfare, 2002 *Australia's Health 2002*, Australian Institute of Health and Welfare: Canberra, ACT.
http://www.aihw.gov.au/publications/aus/ah02/index.html

Australian Institute of Health and Welfare, 2010 *Australia's Health 2010*, Australian Institute of Health and Welfare: Canberra, ACT.
http://aihw.gov.au/publications/aus/ah10/ah10.pdf

Australian Institute of Petroleum, 2011 *Queensland Retail Petrol Prices*.
http://www.aip.com.au/pricing/retail/ulp/qld.htm

Australian Transport Council, 2006 *National Guidelines for Transport System Management in Australia: Part 3 – Appraisal of Initiatives*. Australian Transport Council of Ministers: Canberra, Australian Transport Council.
www.atcouncil.gov.au/documents/NGTSM.aspx#3

Australian Transport Council, 2006a *National Guidelines for Transport System Management in Australia: 4 – Urban Transport*, Australian Transport Council of Ministers: Canberra, Australia. h
ttp://www.atcouncil.gov.au/documents/NGTSM.aspx#4

Australian Transport Council 2006b *National Guidelines for Transport System Management in Australia: Part 5 – Background Material*, Australian Transport Council of Ministers: Canberra, ACT.
http://www.atcouncil.gov.au/documents/NGTSM.aspx

Australian Transport Safety Bureau, 2005 *Cross Modal Safety Comparisons*, Discussion Paper, Australian Transport Safety Bureau: Canberra, ACT.
http://www.atsb.gov.au/publications/2005/cross_modal_safety_comparisons.aspx

Australian Government, 2010 *2010-11 Budget Paper No 3: Part 3 – GST and General Revenue Assistance*, Australian Government: Canberra, ACT.
http://www.aph.gov.au/budget/2010-11/content/bp3/html/bp3_general_revenue.htm

Austroads, 2008 *Guide to Project Evaluation: Part 4 – Project Evaluation Data*. Austroads: Sydney, NSW.

Balcombe R, Mackett R, Paulley N, Preston J, Shires J, Titheridge H, Wardman M and White P., 2004 *The demand for public transport a practical guide*. Report TRL593. TRL Limited: Crowthorne, Berkshire, England.

Bauman A, Rissel C, Garrard J, Ker I, Speidel R, Fishman E., 2008 *Cycling: Getting Australia Moving: Barriers, facilitators and interventions to get more Australians physically active through cycling*, Cycling Promotion Fund FOR Australian Department of Health and Ageing: Canberra, ACT.
http://www.sensibletransport.org.au/sites/sensibletransport.org.au/files/CPF%20Cycling%20Getting%20Australia%20Moving%20Report%20Updated%202009.pdf

Birk M., Geller R., 2007 *On-Street Bikeways and Off-Street Trails: An Integrated Approach: Overview*, State of Oregon, United States.
http://www.ibpi.usp.pdx.edu/traildesign.php

Bureau of Transport and Regional Economics, 2007 *Estimating urban traffic and congestion cost trends for Australian cities*, Working Paper No 71, Bureau of Transport and Regional Economics: Canberra, ACT.
http://www.btre.gov.au/info.aspx?ResourceId=249&NodeId=59

Burke M, Brown AL., 2007 *Distances people walk for transport*, Road and Transport Research, Vol 16 No 3, September.

Cassell E, Clapperton A, Alavi H, Jones S., 2010 *Traffic-related pedestrian injury in Victoria (1): hospital-treated injury*, Hazard, 71. Victorian Injury Surveillance Unit, Monash University Accident Research Centre: Melbourne, Victoria.
www.monash.edu.au/muarc/VISU/hazard/Haz71.pdf

Cavill N, Kahlmeier S., 2007 *Economic analyses of transport infrastructure and policies including health effects related to cycling and walking: a systematic review*, European Centre for Environment and Health, World Health Organisation: Rome, Italy.

Cavill N, Kahlmeier S, Rutter H, Racioppi F, Oja P., 2008 *Methodological Guidance on the Economic Appraisal of Health Effects Related to Walking and Cycling*. European Centre for Environment and Health, World Health Organisation: Rome, Italy. http://www.euro.who.int/en/what-we-do/health-topics/environmental-health/Transport-and-health/activities/promotion-of-safe-walking-and-cycling-in-urban-areas/quantifying-the-positive-health-effects-of-cycling-and-walking/health-economic-assessment-tool-heat-for-cycling

Connelly LB, Supangan R., 2006 *The Economic Costs of Road Trauma: Australia, States and Territories*. Accident Analysis and Prevention, Vol.38 No.6, pp.1087-93. http://dx.doi.org/10.1016/j.aap.2006.04.015

De Hartog JJ, Boogaard H, Nijland H, Hoek G., 2010 *Do The Health Benefits Of Cycling Outweigh The Risks*, Environmental Health Perspectives.
http://ehp03.niehs.nih.gov/article/info%3Adoi%2F10.1289%2Fehp.0901747

Department of Infrastructure and Planning, 2010 *Project Assurance Framework*. Department of Infrastructure and Planning: Brisbane, Australia.
http://www.dip.qld.gov.au/guidelines/project-assurance-framework-guidelines.html

Department for Transport, 2009a *Transport Analysis Guidance: 3.3.5: The Greenhouse Gases Sub-Objective*, Department for Transport: London, England.
http://www.dft.gov.uk/webtag/documents/expert/unit3.3.5d.php

Department for Transport, 2009b *Transport Analysis Guidance: 3.11: Specification, Development and Use of Models for Major Public Transport Schemes*. Department for Transport: London, England.
http://www.dft.gov.uk/webtag/documents/expert/unit3.11.php

Department for Transport, 2010a, *Transport Analysis Guidance*. Department for Transport: London, England.
http://www.dft.gov.uk/webtag

Department for Transport, 2010b *Cost-Benefit Analysis* (Draft), TAG Unit 3.5.4, Transport Analysis Guidance, Department for Transport: London, England.
http://www.dft.gov.uk/webtag/documents/expert/pdf/unit3.5.4d.pdf

Department for Transport 2010c *Transport Appraisal and the Treasury Green Book* (Draft), TAG Unit 2.7.1, Transport Analysis Guidance, Department for Transport: London, England.
http://www.dft.gov.uk/webtag/documents/project-manager/pdf/unit2.7.1d.pdf

Department for Transport, 2010e *Appraisal of Walking and Cycling Schemes*, TAG Unit 3.14.1, Transport Analysis Guidance, Department for Transport: London, England.
http://www.dft.gov.uk/webtag/documents/expert/unit3.14.php

Department for Transport, 2010f *Appraisal* (Draft), TAG Unit 3.2, Transport Analysis Guidance. Department for Transport: London, England.
http://www.dft.gov.uk/webtag/documents/expert/pdf/unit3.2d.pdf

Department for Transport, 2010f *Transport Benefit Computation* (Draft), TAG Unit 3.5.3, Transport Analysis Guidance, Department for Transport: London, England.
http://www.dft.gov.uk/webtag/documents/expert/pdf/unit3.5.3d.pdf

Fishman E, Garrard J, Ker I, Litman T., 2011 *Undertake preliminary work for a proposed applied research project to assess the cost and health benefit of Active Transport in Queensland: Stage 1 Report, Research and Review*, CATALYST for Health Promotion Queensland, Queensland Health, Brisbane, Queensland.
http://www.sensibletransport.org.au/sites/sensibletransport.org.au/files/u5/QLD%20HEALTH_June%201.pdf

Genter JA, Donovan S, Petrenas B, Badland H., 2008 *Valuing the health benefits of active transport modes* Research Report 359, NZ Transport Agency: Wellington, New Zealand. http://www.nzta.govt.nz/resources/research/reports/359

Harrison JE, Berry JG., 2007 *Serious injury due to transport accidents*, Australia, 2003–04. Australian Transport Safety Board: Canberra, ACT. http://www.nisu.flinders.edu.au/pubs/reports/2007/injcat101.pdf

Hendrie D., 2006 *Road Injury Rates for Western Australia*, Injury Research Centre, University of Western Australia for the Office of Road Safety, Perth, Western Australia.

Hensher D, Prioni P., 2002 '*A service quality index for area-wide contract performance assessment*', Journal of Transport Economics and Policy, 36 (1) 93-113.

Hinckson E, Duncan S, Kearns R., Badland H., 2008 *School Travel Plan Evaluation: 2007 School Year*, Auckland Regional Transport Authority, New Zealand.

Hunt JD, Abraham JE., 2007 '*Influences on bicycle use*', Transportation (34), pp453-470.

ICLEI, 2003 *Active Transport Quantification Tool*, Cities for Climate Protection, International Council for Local Environmental Initiatives and The Victorian Health Promotion Foundation (VicHealth). http://att.ccp.iclei.org

Inchley J and Cuthbert L, 2007. *Active Travel Across the Primary-Secondary Transition Pilot Project: Final Evaluation Report*. Child and Adolescent Health Research Unit, The University of Edinburgh: Edinburgh, Scotland.
http://www.education.ed.ac.uk/cahru/publications/reports.php?menu=publications&id=2

International Association of Public Transport, 1998 *Switching to public transport*, Socialdata for International Association of Public Transport: Brussels, Belgium.

Jacobsen PL., 2003 '*Safety in numbers: more walkers and bicyclists, safer walking and bicycling*', Injury Prevention, 2003; 29: pp205-209.
http://www.20splentyforus.org.uk/UsefulReports/Walking cycling and transport safety an analysis of child.pdf

Ker IR., 1980 *Value and Value Judgements in Road Accident Evaluation*. Report No 245, Office of the Director General of Transport: Perth, Western Australia.

Ker IR., 2002 *Preliminary Evaluation of the Financial Impacts and Outcomes of the TravelSmart Individualised Marketing Program*, ARRB Consulting FOR Department for Planning and Infrastructure: Perth, Western Australia.

Ker IR., 2003 *External Costs of Transport*, ARRB Consulting FOR Department for Planning and Infrastructure: Perth WA.

Ker IR., 2008 *Active School Travel Program: Evaluation and Assessment*, CATALYST for Brisbane City Council: Brisbane, Queensland.

Ker I, Ginn S., 2003 '*Myths and realities in walkable catchments: The case of walking and transit*', Roads and Transport Research, 12(2). ARRB Group: Melbourne, Victoria.

Ker IR, James B., 2000 *The Benefits of Driving Less: Evaluation of the TravelSmart pilot program in South Perth*, Report 396, Transport WA: Perth, Australia.

Kokoski M., 2010 *Getting Real: Price Deflation of Nominal Values*, Journal of Benefit-Cost Analysis, 1 (1) Article 7.
http://www.bepress.com/jbca/vol1/iss1/7

Land Transport NZ, 2007 *School travel plan co-ordinator's guide*, Land Transport New Zealand, Wellington, New Zealand.
http://www.nzta.govt.nz/resources/school-travel-plan-coordinators-guide/2.html

Lindsay G, Macmillan A and Woodward A (2011). '*Moving urban trips from cars to bicycles: impact on health and emissions*'. Australian and New Zealand Journal of Public Health, 35 (1), 54-60.

Litman T., 2009 *Transportation Cost and Benefit Analysis: Techniques, Estimates and Implications*, Victoria Transport Policy Institute: Victoria, British Columbia, Canada.
http://www.vtpi.org/tca

Litman T., 2009a, *Travel Time Costs: Transportation Cost and Benefit Analysis*, Victoria Transport Policy Institute: Victoria, British Columbia, Canada.
www.vtpi.org/tca/tca0502.pdf.

Litman T., (2010), *Evaluating Non-Motorized Transport Benefits and Costs*, Victoria Transport Policy Institute: Victoria, British Columbia, Canada.
www.vtpi.org/nmt-tdm.pdf

Litman T., Fitzroy S., 2005 *Safe Travels: Evaluating Mobility Management Traffic Safety Impacts*, Victoria Transport Policy Institute, Victoria, Canada.

New Zealand Transport Agency, 2010 *Economic Evaluation Manual*. Two volumes. New Zealand Transport Agency: Wellington, New Zealand. www.nzta.govt.nz/resources/economic-evaluation-manual

Office of Road Safety, 2007 *Road Safety Fact Sheet: Cyclists*. Office of Road Safety: Perth, Western Australia. http://www.ors.wa.gov.au/_layouts/getAsset.aspx?URI=2467809&REV=1&RCN=D09#223086

Office of Road Safety, 2010 *Road Safety Fact Sheet: Pedestrians*. Office of Road Safety: Perth, Western Australia. http://www.ors.wa.gov.au/_layouts/getAsset.aspx?URI=2846757&REV=2&RCN=D10#173993

Pratt C., 2002 *Estimation and Valuation of Environmental and Social Externalities for the Transport Sector,* Proc. 25th Australasian Transport Research Forum: Canberra, ACT. http://www.patrec.org/atrf/index.php

Pucher J, Dijkstra L., 2003 *Promoting Safe Walking and Cycling to Improve Public Health: Lessons from the Netherlands and Germany*, American Journal of Public Health, Vol. 93, No. 9.

Public Transport Users Association, 2008 *Common Myths About Urban Transport*, Public Transport Users Association: Melbourne, Victoria. http://www.ptua.org.au/myths/greenhouse.shtml

Queensland Health, 2008 *The Health of Queenslanders 2008: Prevention of Chronic Disease, Second Report of the Chief Health Officer Queensland*. Queensland Health: Brisbane, Australia.

Quiggin J., 2006 *Stern and the critics on discounting*, University of Queensland, Brisbane, Queensland. http://johnquiggin.com/wp-content/uploads/2006/12/sternreviewed06121.pdf.

Shoup D., 2005 *The High Cost of Free Parking*, American Planning Association.

Shoup D., 2010 *Presentation on The High Cost of Free Parking*, Melbourne Town Hall, 4th November. http://www.sensibletransport.org.au/project/high-cost-free-parking-seminar-4th-november-2010

Socialdata, 1999 *Community Survey and Marketing Campaign for the South Perth TravelSmart Project: Report of the second evaluation*, Department of Transport: Perth, Western Australia. http://www.transport.wa.gov.au/tsmart_southperthpilot2.PDF

Sonkin B, Edwards P, Roberts I, Green J., 2006 *Walking, cycling and transport safety: an analysis of child road deaths*, Journal of the Royal Society of Medicine, 99:402-205. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1533510

Tilahun NY, Levison DM, Krizek KJ., 2007 *Trails, lanes or traffic: Valuing bicycle facilities with an adaptive stated preference experiment*, Transportation Research Part A (41).

Transport for London, 2008 *Mode of School Travel Data Validation Project – Final Report*, Smarter Travel Unit, Transport for London, England.

Transport WA, 1996 *Bike Ahead: Bicycle Strategy for the 21st Century*, Department of Transport: Perth, Western Australia.

Transport WA, 2010 *Public Transport for Perth in 2031*, Department of Transport: Perth, Western Australia. [not yet published].

United States Office of Management and Budget, 2009a 2010 *Discount Rates for OMB Circular No. A-94*. Office of Management and Budget: Washington DC, USA. http://www.whitehouse.gov/omb/asset.aspx?AssetId=2161

United States Office of Management and Budget, 2009b *Table of Past Years Discount Rates from Appendix C of OMB Circular No. A-94*. Office of Management and Budget: Washington DC, USA. http://www.whitehouse.gov/omb/asset.aspx?AssetId=2159

Wardman M, Tight M, Page M., 2007 *Factors influencing the propensity to cycle to work*, Transportation Research Part A (41).

Glossary of Terms

Accessibility
The ability to reach desired services and activities, such as work, school, shops and friends. Accessibility may be related to mobility but is also a function of proximity.

Active Transport (or Active Travel)
Human powered transport, including walking, cycling and their variants (wheelchair use, skating, scooters, etc.), either in their own right or in conjunction with public transport.

Adequately active (to obtain health benefits from physical activity)
For adults – recommendation is for 150 minutes per week of at least moderate-intensity physical activity, comprising ≥ 30 minutes per day (which can be accumulated in 3 x 10 minute sessions) on most days of the week (widely interpreted as five days a week). For children the recommendation is for at least 60 minutes of moderate-to-vigorous physical activity daily.

All-cause mortality
Death from all causes.

Benefit-Cost Analysis (BCA)
Measurement of the economic, environmental and social benefits of a proposed project in monetary terms and comparison with its costs. Sometimes called Cost-Benefit Analysis (CBA).

Benefits
In benefit-cost analysis, the stream of effects flowing from the creation of an asset. Usually includes operating and maintenance costs as a negative benefit.

Bottom Line
The consolidated effect of an action on a defined area of concern (eg, economic, environmental, social).

Capital Expenditure
Expenditures that create durable assets and generate benefits over an extended period of time. Usually limited to physical assets but can extend to social capital.

Car
The most common form of private motor vehicle. In this report, the term 'car' has been used to cover all private motor vehicle modes of transport, including utes, panel vans, SUVs and other light vehicles used for personal travel.

Community Cohesion
The quantity and quality of positive interactions among people in a community, particularly neighbours.

Congestion
A condition of road networks (and other transport systems) that occurs as use increases, and is characterised by slower speeds, longer trip times, and increased queuing.

Consumer Surplus
The difference between the price a consumer pays for an item and the maximum price they were willing to pay. For example, a telephone call that costs only 20 cents is often worth much more than that to the caller. This excess value, or consumer surplus, is a measure of the surplus benefits an individual derives from their environment.

Costs
In benefit-cost analysis, the expenditure necessary to create an asset – usually the 'capital cost'. Changes in operating or maintenance costs are usually counted as benefits (qv).

Cross-sectional studies
The study variables (eg physical activity and psychological health) are measured at one point in time in a sample (usually) taken from a 'naturally-occurring' population that is not participating in a specific intervention related to the study variables. This is in contrast to 'intervention' studies described below.

Discount Rate
A value applied to future benefits and costs that reflect a combination of community time-preference (for having something now rather than later – sometimes called the social time-preference rate) and opportunity cost (what else could be done with the resources).

Discounting
A means of making costs and benefits at different times comparable by reference to the community value of the future relative to the present by applying a discount rate to future values.

Durability
The extent to which effects are maintained beyond the initial impact.

Ecological study
An epidemiological study in which the unit of analysis is a population group rather than an individual. For instance, an ecological study may look at the association between active transport and obesity in different countries or cities. Ecological studies are susceptible to the 'ecological fallacy'; that is, assuming that what applies as the aggregate level is valid for individuals.

Economic analysis
The process of valuing a policy or project. Common economic analysis methods include benefit/cost analysis, lifecycle analysis, and net present value.

Evaluation
The systematic collection and analysis of data needed to make decisions.

Equity impacts
Impacts related to the distribution of costs and benefits.

External impact
Impacts that consumption of a good or use of a facility imposes on other people.

Generated traffic
Additional vehicle travel that results from highway expansion or other policies that reduce motor vehicle travel costs.

Inputs
The resources required to create specified outputs.

Internal impacts
Direct impacts on the consumer of a good or user of a facility.

Intervention studies
Usually involve conducting a program (ie intervention) and measuring the effects; for example, conducting an exercise program with a sample of adults and measuring their psychological health before and after the program.

Inverse or negative association
As one variable increases (eg physical activity) the other variable of interest decreases (eg obesity).

Median
The median is the numeric value separating the higher half of a sample or population from the lower half. For example, a median walking time to school of 10 minutes means that half the children in the sample spent less than 10 minutes walking to school and half spent more than 10 minutes.

Meta-analysis
A mathematical (statistical) synthesis of the results of two or more primary studies that addressed the same hypothesis in the same way.

Moderate-intensity physical activity
Defined as that between 3 - 6 Metabolic Equivalent of Task (MET) (ie 3 - 6 times the energy expenditure at rest), with walking at the lower end of the range and cycling at the top end of the range. The MET expresses the energy expenditure of physical activities as multiples of the resting metabolic rate; with 1 MET defined as the metabolic rate at rest.

Monetisation
Measuring non-market impacts using monetary units, such as dollars per death, or cents per kilo of pollution emissions.

Morbidity
Relating to the incidence of ill health in the population – the opposite of well-being, from a health perspective.

Mortality
Relating to the incidence of death in the population, including all causes (eg road trauma as well as disease).

Multi-Criteria Analysis (MCA)
Assessment against a range of criteria to assess the extent to which they are achieved by a project, often involves judgment as well as quantitative analysis.

Narrative review
An overview of research evidence from primary studies that are usually selected and synthesized using less rigorous methods than a systematic review (see below).

Outcomes
What the assets or activities deliver to the community.

Odds ratio (OR)
The odds ratio is the ratio of the odds of an event occurring in one group (eg being classified as 'fit' in the 'walking to school' group) to the odds of it occurring in another group (eg being classified as 'fit' in the 'travel to school by car' group). An odds ratio of 1 indicates that the condition or event under study (eg children classified as 'fit') is equally likely to occur in both groups. An odds ratio greater than 1 indicates that the condition or event is more likely to occur in the first group. An odds ratio less than 1 indicates that the condition or event is less likely to occur in the first group.

Odds ratio (adjusted)
Statistical methods (also called multivariate analyses) are used to adjust the OR for potentially confounding variables (also termed covariates). In the example above, the association between 'walking to school' and being 'fit' might be confounded by children's participation in leisure-time physical activity. If adjusting the OR for children's levels of leisure-time physical activity still leads to an OR that is significantly greater than one, then it is likely that walking to school is contributing to being 'fit', and not just due to already fit children being more likely to walk to school than 'unfit' children.

Peak Oil
The period in time when the maximum rate of global oil extraction is reached, after which the rate of production starts to decline. This concept is based on the observed production rates of individual oil wells, and the combined production rate of a field of related oil wells. Most observers agree that peak oil will be before 2020, with some arguing that it has already been reached.

Positive Association
As one variable increases (eg physical activity) the other variable of interest also increases (eg cardiovascular fitness).

Public Policy
The course of action (or inaction) taken by government (whether federal, state or local) with regard to a particular issue, including courses of action, regulatory measures, laws, and funding priorities.

Real Cost
The value of something in terms of the prices of today. For future costs and benefits, this excludes the effects of inflation. Where there is an expectation that a resource will become scarcer or otherwise increase in value faster than other resources, the future real cost may include increases to allow for this scarcity. For example, *Peak Oil* (qv) may result in increases in motor vehicle fuel prices beyond the general rate of inflation.

Recurrent Expenditure
Expenditure for the operation and maintenance (or consumption, where maintenance does not restore the asset to original condition) of capital assets.

Resource Cost
The real value of resources used in or by a project, including both costs and benefits. Distinguished from financial cost by:

- Using prices that exclude the effects of inflation over time;
- Excluding indirect tax (Excise on fuel; Goods and Services Tax) from financial costs.

Risk Ratios and Hazard Ratios
Similar to Odds Ratios but use different units as a basis for comparing 'exposed' (eg to walking to school) and 'unexposed' groups.

Social Capital
The ability of individuals to achieve desired outcomes (eg access to employment, education, recreation or better health) with fewer resources (eg cost of driving a car or use of medical services).

Smart growth
Compact, mixed, multi-modal land use development patterns.

Sprawl
Lower-density, single-use, automobile-dependent land use development patterns.

Systematic review
An overview of research evidence from all available primary studies using explicit and reproducible methods.

Sustainable Transport
A sustainable transport system is one that:

- Meets the basic access and equity needs of individuals and societies
- Societies can afford to construct, access and maintain
- Offers choice, convenience and supports economic activity
- Limits pollution and waste and consumption of resources to sustainable levels
- Is resilient and capable of being continued with minimal long-term effect on the environment.

Sustainability Assessment
A way of working through the social, environmental and economic issues in a transparent way to find integrated solutions where trade-offs are minimised or non-existent.

Travel Demand Management
Strategies to affect the level of demand and use of transport, especially where transport systems are congested and capacity increases are not feasible or desirable.

Travel Plan
A systematic way of identifying, with the relevant community, ways of reducing reliance on the private car – usually in a school or workplace context.

TravelSmart
A collective term for travel behaviour change initiatives in Australia. Originally applied to community/household programs, but now including schools and workplaces.

Walking School Bus
A group of children walking to school with one or more adults, usually on a formal basis, using a defined route with meeting points, a timetable and a regularly rotated schedule of trained volunteers.

Unit Cost
The cost per unit of travel. Depending on the context, it may be per person-km, per vehicle-km or other defined unit.

Utilitarian walking and cycling
Walking and cycling for transport (ie to get to places) rather than primarily for sport, recreation or fitness.

Triple Bottom Line
Consideration of economic, social and environmental impacts in planning and evaluation.

Randomised controlled trial
An experimental design in which participants are randomly assigned to receive or not receive a program (eg TravelSmart program in schools) and the post-program levels of the variable of interest (eg walking or cycling to school) are compared for the program group and the control group.

Appendix A: Detail on valuation of and values for benefits

Appendix A1 Vehicle operating costs

There are many different estimates of the costs of running a car. To a large extent these differences arise from the need to make assumptions about the type and age of car and the traffic conditions in which it is being operated.

For the purposes of evaluating the management of car parking, we can ignore the costs of ownership (interest/depreciation, registration, insurance), which can be as much as 75% of the total cost for a new car and 50-60% for a five-year-old car (according to RAC Queensland estimates).

Car operating costs are fuel, tyres and maintenance/servicing, which vary much less between older and newer cars, especially as average fuel consumption rates for the Australian car fleet have been almost constant since the early 1990s. The main differences are between the smallest cars, on the on hand, and others, although 4-wheel drives cost substantially more again. However, across the spectrum of small, medium and large cars the differences are quite small when considered from a strategic perspective (Figure 11). These figures, however, appear to underestimate fuel costs, probably because of their being based on new cars, with an average fuel consumption of 7-8 litres/100km – the current fleet average is around 11 litres/100km. The values in Table A1, below, have been adjusted for this difference.

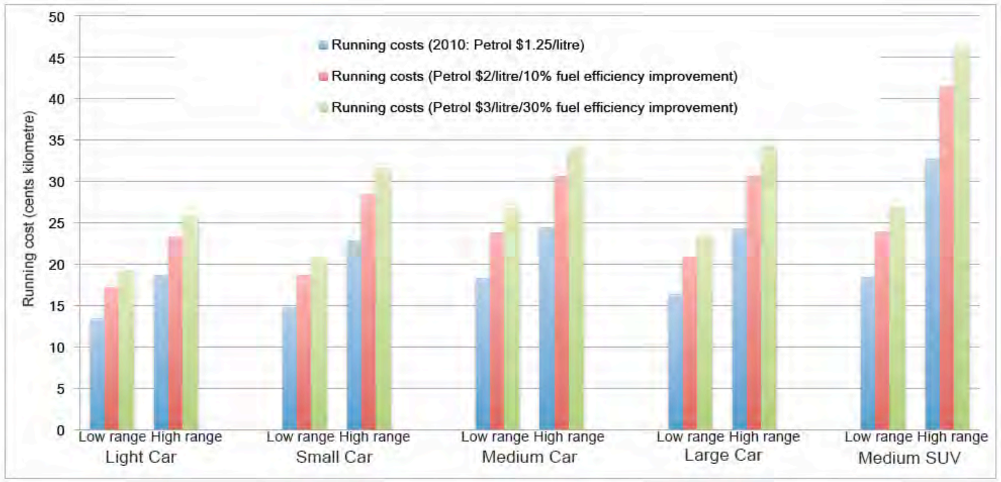


Figure 11: Car running costs (2010 prices)
Source: Derived from figures on RACQ website (January 2011)

For benefit-cost evaluation purposes, costs are expressed in constant value terms, usually interpreted as meaning in terms of the prices in the year of analysis. Unit costs, therefore, are constant over the evaluation period. However, there are some instances where the real value of resources is expected to increase (in practical terms, the price will increase more rapidly than the general rate of inflation because of increasing scarcity and/or increasing demand for a resource). This is most clearly the case for transport fuels as global oil production peaks and starts to decline.

For the base year of the evaluation, the 'resource cost' is the market price less indirect taxes (Department for Transport, 2010d). So for benefit-cost analysis, the values of all items subject to GST should be reduced by the rate of GST (10%). In the case of road vehicle fuel costs, the value should be reduced by the rate of GST and then the fuel excise (38.1 cents/litre) deducted.

We can estimate future operating costs by using some simple assumptions, consistent with those used in the recent evaluation of the WA 20 Year Public Transport Plan (Transport WA, 2010):

- Petrol price increase to $2/litre in 2010 prices by 2021 and $3/litre by 2031; and
- Improvement in effective fuel economy from around 11 litres/100km currently to 7.5 litres/100km in 2031.

On this basis, for 2031, car operating cost (in real values) is 26.2 cents/km (21.6 cents, resource cost) comprised as below:

	2010	2021	2031
Petrol price	$1.25	$2.00	$3.00
Fuel efficiency gains	0	10%	30%
Fuel	11.4 cents/km	16.4 cents/km	19.2 cents/km
Tyres	1.0 cents/km	1.0 cents/km	1.0 cents/km
Servicing	6.0 cents/km	6.0 cents/km	6.0 cents/km
TOTAL RUNNING COST	**18.4 cents/km**	**23.4 cents/km**	**26.2 cents/km**

Table A1: Future Car Running Costs (2010 real prices): Cost to the user

	2010	2021	2031
Petrol price	$1.25	$2.00	3.00
Fuel efficiency gains	0	10%	30%
Fuel	7.20 cents/km	12.06 cents/km	15.24 cents/km
Tyres	0.91 cents/km	0.91 cents/km	0.91 cents/km
Servicing	5.45 cents/km	5.45 cents/km	5.45 cents/km
TOTAL RUNNING COST	**13.56 cents/km**	**18.42 cents/km**	**21.60 cents/km**

Table A2: Future Car Running Costs (2010 real prices): Resource cost

Appendix A2 Traffic congestion

Congestion has a number of defining economic characteristics (Figure 12):

- The marginal cost always exceeds the average cost - that is, the additional congestion cost imposed by one additional car exceeds the congestion cost experienced by each car that was already on the road; and
- The marginal (and average) cost increases with traffic volume - that is, each additional vehicle (for any given capacity) imposes successively higher costs (Figure 13).

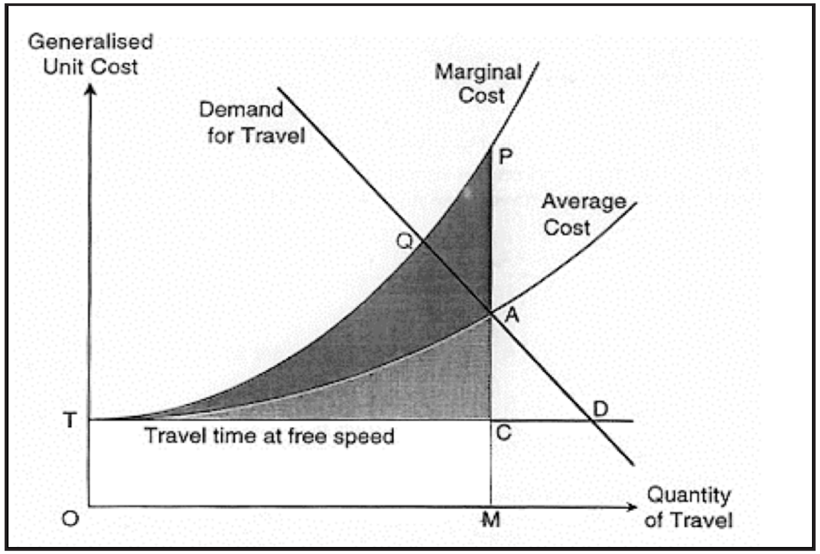


Figure 12: Characteristics of congestion

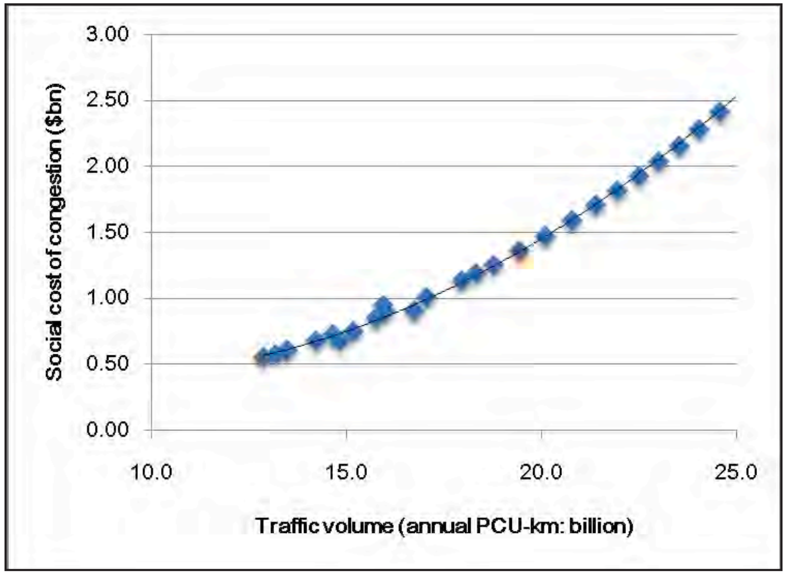


Figure 13: Congestion cost estimates for Brisbane (2005 prices)
Source: Derived from Bureau of Transport and Regional Economics, 2007

The major components of congestion cost are travel time, both private and commercial, and vehicle operating costs. Commercial travel time is generally accepted as having a definable value, at least in aggregate, because of the rigours of commercial enterprise. Private travel time has most often been valued by hedonic (indirect) techniques or by assuming that private time is substitutable, at the margin, for employment time (and hence income).

Congestion costs are most commonly expressed as a total cost, estimated by comparing the notional 'free-speed' travel times and vehicle operating costs with those that occur under real conditions (usually for a defined area, such as a city). This is not a useful basis for evaluation, as the free-speed case is not a realistic one. However, the marginal costs can be derived from successive estimates of such costs and can be related to both total and incremental traffic volumes. This incremental cost is itself an increasing function of traffic volumes (Figure 14).

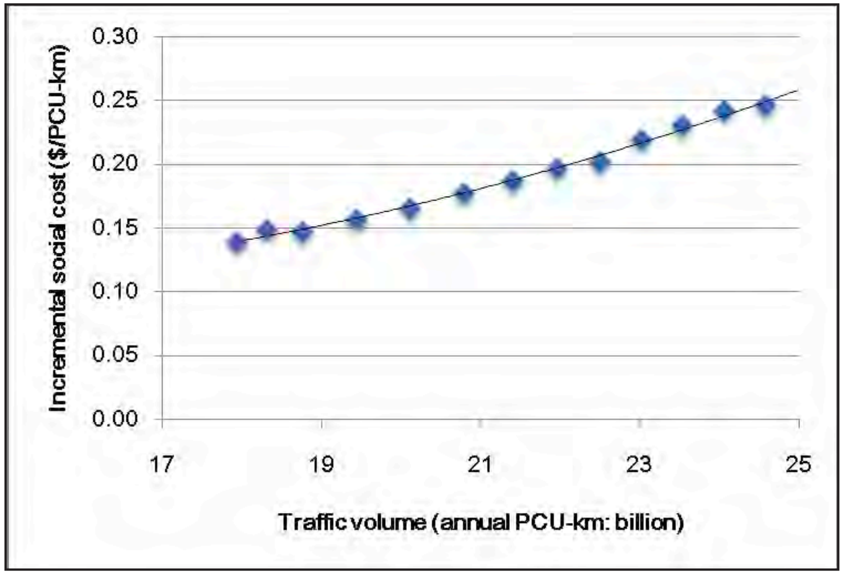


Figure 14: Incremental congestion costs for Brisbane: 2003 – 2020 (2005 prices)
Source: Derived from Bureau of Transport and Regional Economics, 2007

As there is high volatility in the *Bureau of Transport and Regional Economics* estimates from 1997 to 2003, inclusive, Figure 14 has been based only on BTRE estimates and forecast from 2004 onwards.

It is not surprising, given that all these congestion cost estimates are produced from the same model of traffic and the same basic road networks (with allowance for future enhancements) that the incremental cost change with traffic volume can be captured in a mathematical formula with a high degree of statistical accuracy (Figure 15).

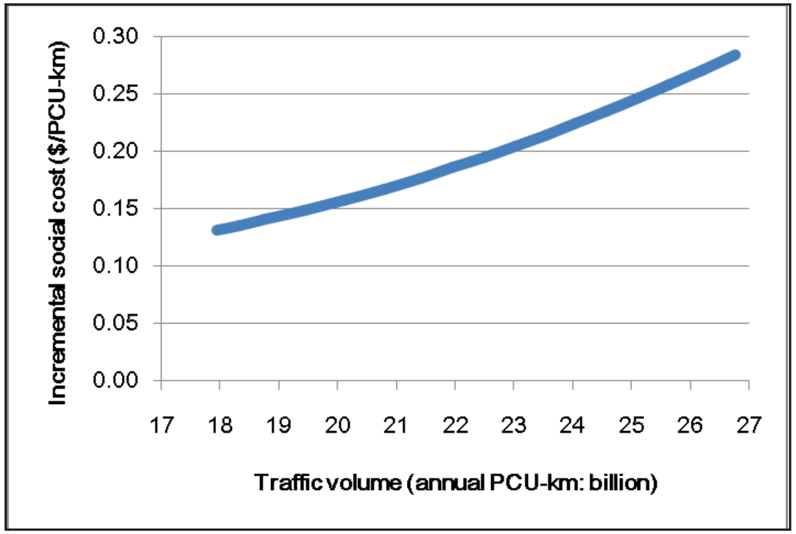


Figure 15: Incremental congestion costs for Brisbane: by traffic volume (2005 prices)
Source: Derived from Bureau of Transport and Regional Economics, 2007

The incremental congestion cost per PCU-km of travel doubles for a 50% increase in traffic volume and the rate of increase itself increases with the amount of traffic.

Austroads (2008) does not provide values for congestion costs, as both vehicle operating costs and user time costs for all users are outputs from road authority models used for evaluation.

Assuming that the Bureau of Transport and Regional Economics (2007) estimates of recent, present and future traffic volumes are reasonable, we can convert the function for incremental congestion costs into one that relates to time (Figure 16), rather than traffic volume per se. This is likely to be more useful for strategic evaluation of transport initiatives. On this basis, the incremental congestion cost for 2010 is 17.7 centres per PCU-kilometre in 2005 prices.

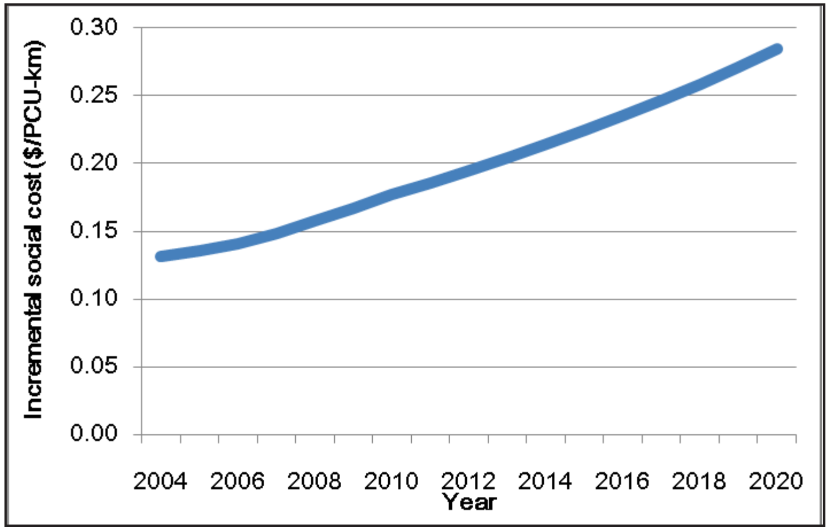


Figure 16: Incremental congestion costs for Brisbane: by traffic volume (2005 prices)
Source: Derived from Bureau of Transport and Regional Economics, 2007

Adjusting to current (2010) prices

The Bureau of Transport and Regional Economics estimates of congestion are presented in 2005 price terms. These need to be updated to current (2010) prices.

Between the March quarter 2005 and March quarter 2010 (the latest data available), the Consumer Price Index transportation group increased by 16.8%. This is an appropriate value to apply to congestion cost values derived from the BTRE estimates.

Application of this escalation factor to the incremental congestion cost in 2005 prices (17.7 cents per PCU-km) raises the value to 20.7 cents per PCU-km in 2010 prices.

Congestion cost by place and time of day

The very nature of congestion means that, within the overall levels discussed above, there are very substantial variations across the road network and throughout the day. Costs will be highest on arterial roads providing access to major activity centres (including, but not limited to, the Brisbane CBD) and during peak commuting periods.

These variations can only be captured in detail through applying a network-based traffic model for every scenario or project being evaluated, but in the absence of this, some approximations can be made.

The Australian Transport Council (2006a) quotes Victorian and New Zealand research into the variability of incremental congestion costing for benefit-cost analysis (Table A3). Of these, the Victorian relativities appear more appropriate, as the New Zealand figures require zero congestion out of peak periods – some roads will still experience some level of congestion even in off-peak times, particularly during the day.

TIME PERIOD	VICTORIA		NEW ZEALAND	
	Congestion Level	Benefit Rate (AU cents/vkt change) 2004 prices	City	Benefit Rate (NZ cents/vkt change) 2002 prices
Peak	Heavy	90	Auckland	63.5
	Moderate	64	Wellington	49.0
	Light	17	Christchurch	4.5
Off-Peak	All	17	All	0.0

Table A3: Congestion-reduction benefit rates by situation
Source: Australian Transport Council (2006a)

If we assume, for example, that the Brisbane congestion cost is derived on the basis of 30% heavy traffic (around 30% of urban travel is for commuting to/from work), 35% moderate traffic and 35% other, we can use the Victorian relativities to calculate comparable values for Brisbane, using the formula (where HV is the **Heavy** traffic benefit value; MV is **Medium** traffic; and LV is **Light/Off-Peak** traffic):

Average value		=	H%*HV + M%*64/90*HV + L%*17/90*HV		
		=	0.30*HV + 0.35*64/90*HV + 0.35*17/90*HV		
		=	HV*(0.30+0.35*64/90+0.35*17/90)		
		=	HV*55.35/90		
OR:	HV	=	20.7*90/55.35 cents		
		=	33.66 cents (2010 prices)		
THEN:	MV	=	64/90 * HV	=	23.93 cents (2010 prices)
AND:	LV	=	17/90 * HV	=	6.36 cents (2010 prices)

Rules of thumb would need to be specified for application of these values. This might be:

- Peak-period (to be defined) car travel to be 'Heavy Traffic';
- Inter-peak car travel to be 'Medium Traffic'; and
- All other journeys as Low/Off-Peak traffic

The New Zealand approach ignores the realities of delays to road traffic in the inter-peak periods in particular, but also in the evenings.

The above suggests incremental congestion cost values (2010 prices) of 33.66 cents per car-km for peak periods, 23.93 cents for the inter-peak and 6.36 cents at all other times for Brisbane.

Judgment will be needed in the application of these values in terms of both location and the fact that morning school travel coincides with the work-commuting peak whereas afternoon school travel precedes the main pm peak period.

Effect of Peak Oil

According to Bureau of Transport and Regional Economics (2007), around 6.7% of the cost of congestion is the cost of motor vehicle fuel. If the real price of fuel were to double, therefore, the unit value of incremental congestion cost should be increased by 6.7%.

However, increasing fuel prices will encourage improved engine efficiency and the adoption of alternative fuels, although the time frame for these responses to reach their full potential is likely to a long one – the *average* age of cars in Australia is around 13 years.

Bureau of Transport and Regional Economics estimates of congestion cost were based on a lower oil price (in US$ terms) than has eventuated (Figure 17). However, the higher January 2011 price (cUS$90 a barrel) has been largely offset by the higher value of the Australian dollar relative to the US dollar and the basic congestion cost estimates should be regarded as reasonable. However, beyond 2010, adjustments will be made to reflect the increasing real price of transport fuel, modified by fuel efficiency improvements.[9]

[9] Strictly, the congestion cost estimates themselves should be reinvestigated, as they depend on road traffic volumes, which are likely to be lower than BTRE estimate with oil prices US50-55 a barrel. However, this is beyond the scope of this current study. These proportions can be varied in the evaluation spreadsheet.

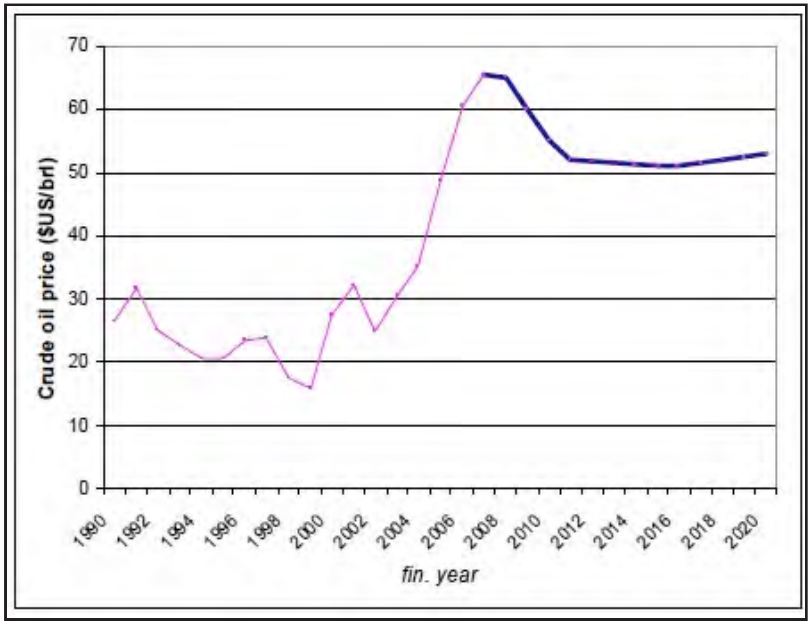


Figure 17: Bureau of Transport and Regional Economics assumptions of future oil price
Source: Bureau of Transport and Regional Economics, 2007

There are no formal forecasts of the extent to any of these factors will occur, but current work on strategic public transport planning in Perth is based on:

- $3/litre real fuel price by 2031 (currently around $1.20 – so a 150% increase). Note that this implies a pump price of $5.40/litre at current rates of inflation.
- 30% improvement in effective fuel consumption (including alternative fuels) by 2031.

The net effect of this is an effective real fuel price increase of 75% over 20 years, or 2.8% per year cumulative. If the real fuel price were to increase to $4/litre, the rate of increase would be 4.3% per year. To reflect this, the incremental congestion cost should be factored up accordingly, by 0.19% (=6.7%*2.8%) each year (0.29% for $4/litre real fuel price).

Travel Time

The Bureau of Transport and Regional Economics (2007) estimates that:

- 33% of congestion costs are for commercial time.
- 29% of congestion costs are for private time.
- 38% of congestion costs are other costs (vehicle operating costs and transport externalities).

If there is evidence of increasing real value of time, the 62% of congestion costs that are travel time should be increased for future years in line with the increase in real values.

Commercial travel time is generally accepted as having a definable value, at least in aggregate, because of the rigours of commercial enterprise. Private travel time, including commuting time, has most often been valued by hedonic (indirect) techniques or by assuming that private time is substitutable, at the margin, for employment time (and hence income).

Estimated values of non-work time are largely derived from observation of trade-offs between work and non-work time, but as real incomes increase people might be expected to change these trade-offs (Australian Transport Council, 2006c), Nevertheless, for the purposes of updating time values to current values, there is little evidence of any substantial overall reduction in average working hours (Figure 18).

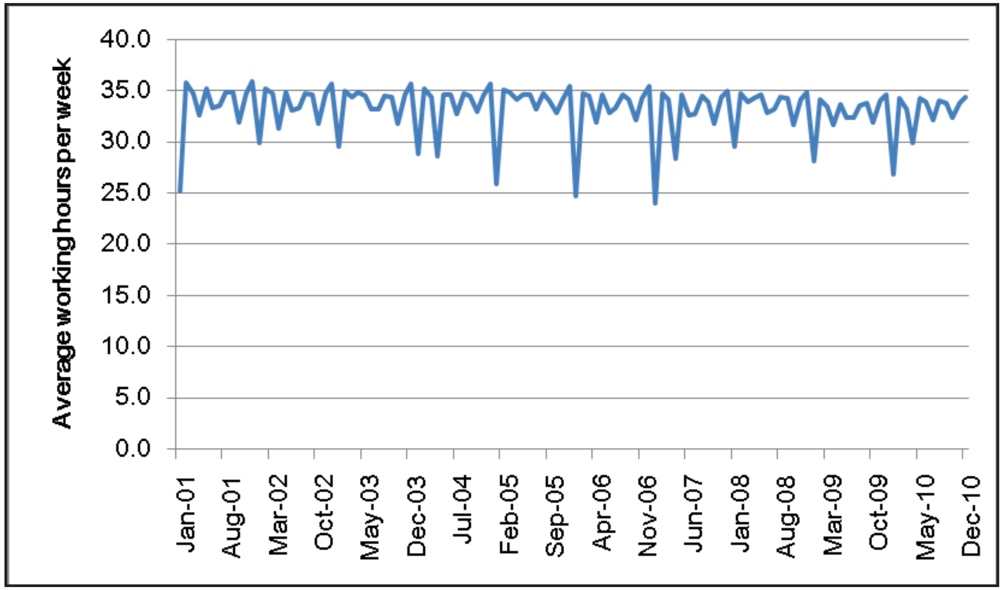


Figure 18: Average working hours – Australia (2006 – 2009)
Source: Australian Bureau of Statistics, 2009c

The Australian Transport Council (2006c) observes that the changing proportions of working and non-working population suggests that a measure of Gross Domestic Product per capita would be more appropriate than average weekly earnings to apply to the overall value of time. Over the past decade, GDP per capita in Australia has increased in real terms by 0.6% per year. To reflect this, the incremental congestions costs should be factored up accordingly, by 0.37% (=62% x 0.6%) each year.

Summary of Congestion Values

The Bureau of Transport and Regional Economics (2007) has developed estimates of avoidable congestion costs in each capital city of Australia. This paper has outlined a method of using this information to develop estimates of the incremental cost in Brisbane. Incremental (or marginal) cost of congestion always exceeds the average cost and is the appropriate value to use in evaluating initiatives that reduce (or increase) the volume of road traffic.

To the best of our knowledge, the Bureau of Transport and Regional Economics values have not been used in this way except for bicycle and public transport evaluations in Perth, Western Australia.

Benefit-cost evaluation requires that costs and benefits be expressed in real terms, which is usually interpreted as requiring constant prices. However, sometimes there is good reason to anticipate a change in the real value of a resource, which can interpreted as the actual price increasing substantially faster than the rate of general inflation. In terms of congestion:

- The real price of motor vehicle fuel is expected to increase, as global oil demand outstrips supply (although it will be partly offset by improvements in fuel efficiency).
- The real value of time is expected to increase, as GDP per capita has consistently increased over the past decade, even allowing for a slight downturn in 2009/10 with the global financial crisis.

Allowing for the expected real increases in fuel price and the value of time, the incremental value of congestion in Brisbane is expected to increase from 23.5 cents per car-km in 2010 to 40.5 cents in 2020 (Figure 19).

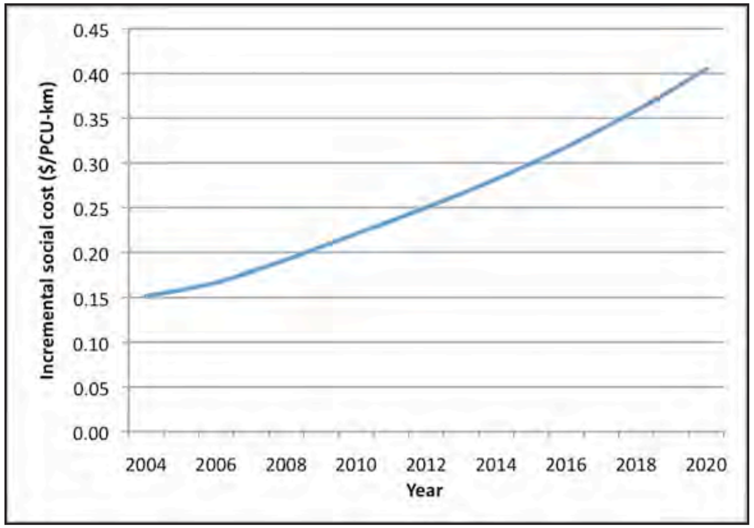


Figure 19: Incremental congestion costs for Brisbane (Real Values)

YEAR	PEAK PERIODS	INTER-PEAK	OFF-PEAK
2010	35.9	25.5	6.8
2011	38.2	27.2	7.2
2012	40.7	28.9	7.7
2013	43.2	30.7	8.2
2014	45.8	32.6	8.7
2015	48.7	34.6	9.2
2016	51.7	36.7	9.8
2017	54.9	39.0	10.4
2018	58.3	41.4	11.0
2019	62.0	44.1	11.7
2020	65.9	46.9	12.5

Table A4: Incremental Congestion Costs for Brisbane by year and time of day (cents/cm-km; 2010 real prices)

In practice, these values will need to be applied with appropriate recognition of context. For example, the peak period in outer suburban areas might resemble more the 'medium traffic' situation and assessed using the 'Inter-Peak' values.

There is also the question of what values should be used beyond 2020, which also begs the question of how well we are likely to be able to estimate the long-term effects of active transport initiatives. Given that the discounting procedure in benefit-cost analysis substantially reduces the present value beyond 20 years hence and the uncertainties about the longer term (including the availability of transport fuel for private motor vehicles), it is proposed to keep the value at the 2031 level for years beyond 2031.

Appendix A3 Road Trauma

The reduction in road trauma cost may be estimated by:

- Applying a 'per crash' cost to the estimated change in the number of crashes.
- Applying a component cost (for fatality, serious injury, injury and property damage) to estimates of the change in crash outcomes.
- Applying a per-kilometre cost for road trauma to the change in car-kilometres of travel.

At the strategic level, the first or third of these is favoured, as the second requires substantially more detail on the nature and location of changes, particularly where they involve changes to road infrastructure or reallocation of road space between users.

Ker (2003) estimated an economic road trauma cost of 5.1 cents per kilometre (2003 prices) for metropolitan car travel, but made no estimate of the comparable cost for public transport. At 2010 prices, this would be 6.5 cents/car-km.

There is limited comparable information on the road trauma performance of public transport. The Australian Transport Safety Bureau (2005) estimates the per-passenger-km fatality rate for bus and train to be 0.17 of that for cars. With the cost per car-km at 6.5 cents/car-km, this implies 5.0 cents/pass-km (at 1.3 persons/car). Bus/Train = 5.0*0.17 = 0.85 cents/passenger-km. This assumes that the relativities for injury and property damage are the same as for fatalities.

There is a common perception that cycling is a high-risk activity compared to driving or being a passenger in a car. Whilst this is objectively true at present, the data are affected by the extent to which cyclists have no option but to ride in unsafe conditions. This is clearly an outcome that can be directly addressed by better cycling infrastructure.

It does not follow that increases in cycling will result in a net increase in road trauma. To the extent that increased cycling is the result of better and safer infrastructure, the rate of cyclist road trauma will be lower. The Department for Transport (2010e), citing Jacobsen (2003), states that a doubling of cycling activity will result in a 32% increase in the number of cycling crashes. This is consistent with experience in Western Australia (Transport WA, 1996) where cyclist hospitalizations increased at approximately one-third the rate of cycling activity, as well as several US examples (Litman & Fitzroy, 2005; Birk & Geller, 2007; Pucher & Dijkstra, 2003).

There are two main reasons why cycle trauma rates will decrease with increased use, particularly in the context of supportive policy and infrastructure-provision paradigms:

- *Safety in numbers*. The more cyclists there are, the more visible they will be to other road users. It is also more likely that car drivers will, themselves, ride a bike at some time – car drivers who also ride a bike are more likely to be aware of and respect the rights of cyclists.
- *Safer with experience*. As individual cyclists become more experienced, their crash rate reduces. The rate of cyclist crashes is inversely related to the frequency of cycling – reducing by half with an increase from one day per week to 2 days per week and halving again (Transport WA, 1996).

Comparative crash, injury or fatality rates for walking and cycling are difficult to asertain, as so much walking activity (and to a lesser extent cycling activity) is unrecorded (Cassell et al, 2010) and crash or injury rates are most often expressed either as total numbers or as a rate relative to population.

Sonkin et al (2006) estimate that pedestrian fatality rates (relative to distance travelled) for child pedestrians are half those for child cyclists. This is likely to be, at least in part, a consequence of the locations of walking (mainly on paths) and cycling (more likely than walking to be on-road in-traffic, even if relatively lightly-trafficked roads).

The WA Office of Road Safety, however, has estimated that, in 2002/3 (relative to distance travelled):

- Pedestrians were 6.4 times more likely to be involved in crashes reported to the police than the average rate across all modes of travel (Office of Road Safety, 2010).
- Cyclists were 5.6 times more likely to be involved in police reported crashes than the average across all modes of transport (Hendrie, 2006).

These values imply a small differential between walking and cycling, on the basis of crashes reported to the police, with walking having a slightly higher injury rate. It is well-known, however, that reported accident numbers for cyclists are unreliable, especially in respect of single-user crashes, so the Office of Road Safety figures are likely to understate the rate for cyclists relative to pedestrians.

Australian Transport Safety Bureau (2007) reports serious injury rates of 40 per 100,000 age-specific population for cycling and 19 per 100,000 for walking. Although half the cyclists and 69% of the pedestrians were injured in non-traffic conditions, these figures reflect the overall safety of walking and cycling. If we apply factors for trips per person and trip length to create a measure of relative exposure, the relative serious injury rate for cycling is 1.7 times that of walking (Table A5). This implies a road trauma cost for walking of 10.7 cents/km for walking (=18.2/1.7).

This relativity of 1.7:1 between cycling and walking lies within the range of values for fatality (2:1 – Sonkin et al, 2006) and crashes reported to police (0.9:1 – Office of Road Safety, 2007; 2010).

	CYCLE	WALK	SOURCE
(A) Trips per person per day	2.2%	10.9%	PARTS (no date, Table 24)
(B) Average trip length (km)	3.7	0.6	PARTS (no date, Table 20)
(C) Relative exposure	8.14	6.54	(A) * (B)
(D) Serious Injury Rate per 100,000 persons	40	19	Australian Transport Safety Bureau (2007, p6)
Relative Serious Injury Rate per km of travel	4.9 1.7	2.9 1.0	(D)/(C)
Economic Road Trauma Cost/km	18.2 cents	10.7 cents	

Table A5: Estimation of relative serious injury rates for walking and cycling

Basis for Valuing 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, reflecting the costs incurred and production foregone through injury or fatality. This is entirely appropriate in the context of accounting-related (including national accounts such as Gross Domestic Product)) 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' (WTP) for the outcomes (Ker, 1980).

The value of a safety risk for socio-economic benefit-cost evaluation purposes should be the amount an individual is willing to pay to avoid a risk, (revealed by market behaviour, for example) or the amount for which the individual would be willing to accept the risk. This applies to injury as much as to fatality and, indeed, there are certain types of injury for which, before the event, at least, individuals would be willing to pay more to avoid than they would to avoid fatality (Ker, 1980).

Evaluations based on ex-post economic valuations of road trauma will understate the value the community gives to improvements in road safety and in transport safety generally. Ker (2003) reviewed the literature on road trauma valuation and estimated values for both economic cost and willingness to pay (Table A6).

IMPACT/CONSEQUENCE	ECONOMIC COST	WILLINGNESS TO PAY
Fatality	$1.7 million per fatality	$4.4 million per fatality
Severe Injury	$0.405 million per hospitalisation injury	$1.675 million per injury
Other Injury	$0.016 million per injury	$0.090 million per injury
Property Damage	$0.007 million per crash	Not separately estimated

Table A6: Economic cost and willingness to pay valuations for road trauma (2003 prices)
Source: Ker (2003, p. 38).

These costs are for each outcome, rather than for specific types of crash, which may involve more than one injury consequence. Using data for the five-year period 2002-2006 (the most recent year for which published data are available), we can calculate a weighted average factor to derive a per-km 'willingness to pay' value from the economic cost per kilometre. Even assuming no willingness to pay beyond the economic cost for property damage, the overall 'willingness to pay' value is 1.85 times the economic cost (Table A7).

Austroads (2008) provides the following values (in 2007 prices) for the four categories on an Australia-wide basis:

- Fatality: $1.635m per person (fatality)
- Serious injury: $0.393m per person
- Other injury: $0.0156m per person
- Property damage: $0.0075m per crash

These appear to be reasonably consistent with the values in Table A6 (adjusted to comparable price year). However, there are some substantial differences between the 'per crash' cost estimates in Austroads (2008) and those derived by the WA Road Safety Council (Road Safety Council, 2008), which suggest some differences of either data or methodology.

Transport investment evaluation is almost always undertaken using the economic cost for road and other transport trauma. This (6.5 cents/car-km) should, therefore, be the basic value for use in the evaluation. However, the arguments for 'willingness to pay' values (12.0 cents/car-km) are very strong and this should be used as a sensitivity test.

For public transport, the comparable 'willingness to pay' value is 1.78 cents per passenger-km.

For cycling and walking, estimate change in fatalities and serious injuries (having regard to the long-term reduction in fatality/injury rates with higher levels of use (ie marginal rate is about one-third the average rate).

IMPACT/ CONSEQUENCE	NUMBER (%) 2002-2006 AVERAGE (ORS, 2008)	ECONOMIC COST	WILLINGNESS TO PAY
Fatality	180	$1.7 million per fatality	$4.4 million per fatality
Severe Injury	2,957	$0.405 million per hospitalisation injury	$1.675 million per injury
Other Injury	11,804	$0.016 million per injury	$0.090 million per injury
Property Damage	60,694	$0.007 million per crash	Not separately estimated
Per car-kilometre	**2003 prices**	**5.1 cents**	**9.4 cents[(a)]**
	2009 prices[(b)]	**6.5 cents**	**12.0 cents**

Table A7: Deriving a willingness to pay value for road trauma

(a) Based on weighted average multiplier of 'willingness to pay' to economic cost, including property damage with multiplier of one (ie no difference between the two).

(b) Increased by Index of Average Weekly Earnings. According to Austroads (2008, Table 4.2) by far the largest components of the economic cost of road trauma are those most appropriately adjusted by the index of earnings or the 'health cost' index, which has moved very closely to the earnings index.

Appendix A4 Greenhouse/climate change

The estimates of greenhouse gas emission costs by the Australian Transport Council (2006b, Appendix C) assume a very low value for Greenhouse Gas emissions of $10/ tonne of CO_2e. Ker (2003) uses a value of $40/tonne, which is still towards the lower end of the range derived from Australian and international research and practice. Even the referenced source for the Australian Transport Council (2006b) gives a range from $10 to $90/tonne of CO_2e and notes that the Victorian Department of Infrastructure uses $40/ tonne (Pratt, 2002).

By comparison, the UK Department for Transport requires the use of a value of £Stg86.55 at 2002 prices (approximately A$145 per tonne of CO_2e at current (2010) exchange rates; $180/tonne at 2010 prices), increasing in real terms over time (Table A8). Even the 'lower bound' value for 2010 is equivalent to A$180 per tonne at 2009 prices.

YEAR	2000	2002	2006	2010	2020	2040	2060
Central estimate	71.00	73.87	79.96	86.55	105.50	156.77	232.95
Upper estimate	85.20	88.64	95.95	103.86	126.60	188.12	279.54
Lower estimate	63.90	66.48	71.96	77.89	94.95	141.09	209.66

Table A8: Social cost (£Stg) per tonne of carbon in 2002 prices
Source: Department of Transport (2009a)

Interestingly, the Department for Transport (2009a) specifies an increasing real value over time. However, there is no rationale presented and, in practice, any future value will depend very heavily on the extent to which measures are taken in all areas of the economy to reduce or limit greenhouse gas emissions. More important is the need to check the sensitivity of the evaluation to the value placed on carbon emissions. The Department for Transport suggests the use of ±10%, but given the uncertainty surrounding carbon trading and carbon prices it would be sensible to adopt wider bounds.

The Australian Greenhouse Office (AGO, 2008, Table 3) estimates the full fuel-cycle CO_2e emissions (ie including up-stream (production, refining, distribution) from petrol to be 2.47kg per litre. At an average 11 litre/100km for cars, this converts to 0.27kg per car-km. With improved fuel efficiency, this would reduce to 0.243kg/car-km in 2021 and 0.189kg in 2031.

Buses and trains also rely on fossil fuels – diesel or gas for buses and electricity for trains. Additional bus or train kilometres should be assessed for their greenhouse gas emissions. Australian Transport Council (2006a, Appendix C) provides a value of 0.83 cents per bus-km, but this is based on the very low value of $10/tonne for CO_2e emissions.

Austroads (2008, Table 5.1) recommends a value of 2.00 cents/km for cars and 11.79 cents/km for buses (at 2007 prices), but does not clearly state the basis for these values. The value for cars implies a greenhouse gas value of $75/tonne CO_2e, although the explanatory table in Austroads (2008) states *that recent research and the emerging national emissions trading scheme developments indicate a value of between $30 to $60 per tonne.*

For consistency with road project evaluations using the Austroads Guide to Project evaluation (Austroads, 2008), the BCA will use value of 2.00 cents/km for cars and 11.79 cents/km for buses. With improved fuel efficiency, this would reduce to 1.80 cents per car-km in 2021 and 1.40 cents in 2031.

Given the same level of fuel efficiency improvement in buses, the emission costs for buses will reduce from 11.79 cents/bus-km to 10.61 cents (2021) and 8.25 cents (2031).

Train emissions are best estimated from the electricity consumed and the emissions from electricity generation. In the absence of train electricity consumption estimates for Brisbane that can be related to passenger-km of train travel, alternative estimates of greenhouse emissions for electric passenger rail in Victoria (Public Transport Users Association, 2008 – 14g CO_2e per passenger-km) adjusted by the relative greenhouse emissions for electricity end users in Queensland and Victoria (Australian Greenhouse Office, 2008, Appendix 3 – Queensland emits 1.04kg CO_2e/kWh; Victoria 1.31). This results in a rate of 11.1g CO_2e per train passenger-km, with a value of 0.08 cents at $75/tonne CO_2e. For electric passenger rail the value of greenhouse emissions is estimated at 0.08 cents per passenger-km. There is no analytical basis for estimating future changes for electric rail, which depends on developments in the electricity generating industry, including the extent of use of renewable energy sources for electricity generation.

Appendix A5 Air pollution

Air pollution costs for the purposes of this report refer to damage caused by motor vehicle emissions. This includes human health, environmental damage and avoidance actions (such as restrictions on sports and other personal physical activities during air pollution events) resulting from various air emissions produced by motor vehicles. Valuation is usually on the basis of the predominant human health effects, although some European studies show non-health impacts (building, forest and crop damage) being 10-20% of the total cost.

Policies, programs and projects that aim to reduce car use and increase walking and cycling should be evaluated on the basis of two impacts:

- Reduced production of emissions through less car travel; and
- Reduced exposure to emissions for non-vehicle occupants by a factor of between 2 and 4, as a result of their no longer being exposed to the high concentrations of pollution in cars in the traffic stream. Train passengers are removed from the motor vehicle traffic stream and bus passengers are not exposed to such high concentrations as the air intakes are well above the exhausts of most vehicles.

Austroads (2008, Table 5.1) recommends values of 2.54 cents/km for cars and 28.61 cents/km (2007 prices) for buses. These are lower than the corresponding values derived by Ker (2003) although the relativity between them is similar:

- 3.5 cents/km for cars (4.2 cents at 2009 prices).
- 45.0 cents/km for buses (54.0 cents at 2009 prices).

However, Austroads has adjusted for population density (exposure) and its values are, therefore, preferred, as most of the resource documents are European.

For policies, program or projects aimed at getting people out of their cars, the air pollution impact measured solely relative to vehicle kilometres of travel or level of exhaust emissions will understate the full effect on exposure as those who transfer from car to public transport will be exposed to substantially less pollution.

For practical purposes, the reduction in car-km of travel should be used as the basis for valuation, acknowledging that it will be a conservative estimate.

Austroads values, adjusted to 2010 prices (2.81 cents/km for cars and 31.69 cents/km for buses), will be used for the main evaluation. These values should be reduced in line with engine fuel efficiency improvements used to estimate vehicle operating costs. The resulting values a:

- 2.53 cents (2021) and 1.97 cents (2031) for car travel.
- 28.52 cents (2021) and 22.18 cents (2031) for buses.

There are no air pollution costs for electric passenger rail, as emissions are remote from the point of use and, by and large, from population centres.

Appendix A6 Noise pollution

Whilst traffic noise is a fact of life in cities, it varies substantially depending on proximity to high traffic volumes. It is also a traffic impact where public transport, walking and cycling can make a noticeable contribution; Ker (2003) estimated that the per-vehicle-kilometre cost of noise for buses was 2.21 cents for a bus compared to 0,35 cents for cars. In practice this depends on the vehicle and engine technology of buses (for example, the fuel cell buses trialled in Perth produced much lower engine and transmission noise), but a conventional diesel and gas-powered bus will produce more noise than a car (but also carries many more people).

Noise is a very difficult to generalise, in terms of it impact, but is greatest at times and places of the highest traffic volume. Noise disturbance also depends upon the concentration of 'recipients' in the vicinity. At low speeds, most traffic noise is caused by vehicle engines, transmissions, exhausts and brakes. The stop-start braking and acceleration during peak-hour congestion also increases noise levels. On roads with freer-flowing traffic, most noise is caused by a combination of tyre contact with the road and aerodynamic drag over the vehicle (American Academy of Science, 2002).

Trucks and motorcycles are largely responsible for the peak noises that stand out from the steady background rumble. It is these sharp and intermittent noises that are more likely to cause sleep disturbances and to contribute to other physical and psychological problems (American Academy of Science, 2002).

Austroads (2008, Table 5.1) recommends a value of 0.82 cents/km for cars and 2.00 cents/km for buses (at 2007 prices), but does not clearly state the basis for these values. Austroads does not suggest any differentiation between peak and off-peak traffic, but recommends a zero value for all vehicles in a rural situation – presumably on the basis that noise levels are lower (with less need to accelerate or decelerate) but also that there are few people affected by the noise.

For practical purposes, in a strategic evaluation, we should regard noise as an all-day phenomenon and apply the Austroads rates, updated to 2010 prices using CPI, to all trips

- 0.91 cents per car-km.
- 2.22 cents per bus-km.

No value for electric rail is proposed as all Brisbane suburban rail lines are electrified (with very low noise levels compared to diesel rail) and may have wide buffer zones from sensitive land uses. Elsewhere, passenger rail is unlikely to be a significant part of daily travel to and from school.

Walking and cycling do not create any noise.

Quieter engines and transmissions, including electric motors, will reduce noise nuisance, but this will be offset by increases in traffic and congestion. Increases in residential and activity density will also increase the numbers of people exposed to noise. Since these factors will counter each other, we do not propose to change values for noise over time.

In practice, the value for noise is low and is unlikely to have a substantial influence on the results of a benefit-cost evaluation, except at the project level where special circumstances of noise sensitivity may be identified.

Appendix A7 Water pollution

Water pollution may occur through engine oil leakage and disposal, road surface and tyre degradation, air pollution deposition or seepage of weedkillers and other chemicals used on transport infrastructure. Paving of large areas for roads and other infrastructure may change rainfall run-off patterns. These impacts impose a number of costs including polluted surface and ground water, contaminated drinking water, increased flooding and flood control costs, wildlife habitat damage, reduced fish stocks, loss of unique natural features, and aesthetic losses.

Water pollution impacts vary depending on location (proximity to waterways and drainage systems), but for strategic evaluation, a single value is required.

Austroads (2008, Table 5.1) recommends a value of 0.38 cents/km for cars and 4.29 cents/km for buses (at 2007 prices). Austroads, following the Australian Transport Council (2006b) does, however, recommend that this be assessed on a project-by-project basis because of the site-specific nature of such impacts.

Ker (2003) found few useful estimates of water pollution costs, but on the basis of two Australian studies, recommended a value of 0.24 cents/car-km and 3.08 cents/bus-km (2003 prices) – equivalent to around 0.29 cents and 3.69 cents, respectively, at 2009/10 prices. These are somewhat lower than the Austroads values, but consistent in terms of the relativity between car and bus

For strategic evaluation purposes, it is proposed to use the Austroads values, updated by CPI to 2010 prices:

- 0.42 cents per car-km.
- 4.75 cents per bus-km.

No value for electric rail is proposed as there are no substantial point-of-use emissions or waste products that might enter the water system.

Walking and cycling do not have any significant impact on water quality.

In practice, the value for water pollution is low and is unlikely to have a substantial influence on the results of a benefit-cost evaluation except at the project level where special circumstances of noise sensitivity may be identified.

Appendix A8 Health

The Stage One report for this project includes a comprehensive assessment of the health impacts of active transport and should be referred to for more information on this topic.

Few sources provide any estimates of the health and fitness benefits of both walking and cycling, so it is difficult to obtain comparable values.

The New Zealand Transport Agency (2010, Vol 2, p. 3 - 16) specifies values of NZ$2.60 per km for cycling and NZ$1.30 for walking (at 2010 prices) – equivalent to A$1.96 and A$0.98, respectively, at current 2010 exchange rates. The derivation of these values is in Genter et al (2008), which makes it clear that the values for both walking and cycling:

- Are compatible, being derived from the same sources using the same methodology;
- Include both mortality and morbidity, with the latter based on the concept of Disability Adjusted Life Years;
- Adjust for the relatives speeds and energy-intensity of walking and cycling in deriving per-km values;
- Make allowance for differential levels of benefit according to existing levels of physical activity.

A key issue is the extent to which those taking up active transport are already undertaking physical activity. The New Zealand values are based on 50.5% of the population already being physically active but "*may receive benefits both in terms of continued health benefits and by a transportation project that encourages them to stay active*" (Genter et al, 2008, p. 5). Data for Queensland suggest that, in schools, in Year Five, the proportion of 'sufficiently active' children is 40% of boys and 53% of girls (approx. 46.5% overall), which is substantially lower.

Using the New Zealand methodology and overall values, but the lower Queensland 'sufficiently active' proportion increases the health benefits from additional walking or cycling by nearly 6%, equivalent to A$2.07 and A$1.04, respectively, at current 2010 exchange rates.

There are variations in current levels of physical activity between locations within Queensland (Figure 20), which suggest that the health benefits from active transport initiatives may be higher in Outer regional and Remote areas than in Major Cities or Inner Regional Areas.

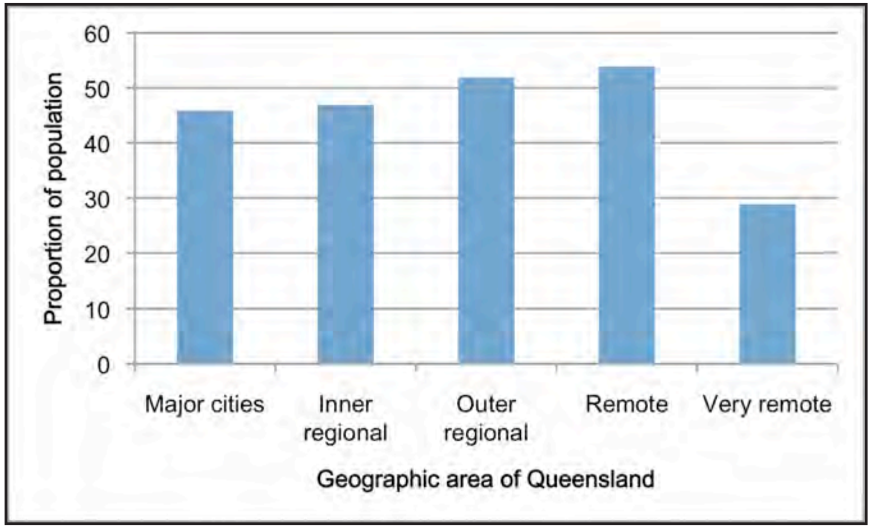


Figure 20: Insufficient activity by geographic area
Source: Queensland Health, 2008

The New Zealand Transport Agency (2010) recommends that half the value attributed to health and fitness benefits of active transport should be regarded as internal to (and perceived by) consumers and that the appropriate resource cost is half the total value. This is by assumption and the 'consumer' half will also include resource cost elements, and therefore the following values have been used:

- For the main evaluation: $1.04 for walking and A$0.52 for cycling.
- For sensitivity testing: A$2.07 for walking and A$1.04 for cycling.

The New Zealand values are based on data for people aged from 16-64, but Genter et al (2008, p. 54) argue that the values "*apply to children as well as to adult users*". This appears to be based more on the importance of reducing childhood obesity and increasing trends of sedentary lifestyles amongst children than on specific medical or health studies but in the absence of better information, the values derived above are used. This reinforces the importance of one of the 'Further Research' recommendations in the Stage 1 report for this study:

> Better information is needed on the effects of active transport on health for different age groups, especially for children, and the extent to which physical activity (including active transport) in childhood carries over into later life, either in terms of physical activity levels or residual health benefits.

There is also an issue of how long it takes for health and fitness benefits to eventuate. Whilst some sources (eg ICLEI, 2003) suggest that benefits may take 10 years to be realized. The Department for Transport in the UK suggests an accrual period of five years (Department for Transport, 2010e). A five-year accrual period with linear accrual over that period ha been adopted for this report.

Appendix B: Monitoring the Program

It is often difficult to measure the impacts of behaviour change programs. Although there has been prolonged debate in the context of household travel behaviour change programs (Brög & Ker, 2008), most commentators now acknowledge the effectiveness of such programs (Australian Greenhouse Office, 2005). Key elements in this demonstration have been:

- Consistent repetition of outcomes over a wide range of projects (including large sample sizes), with no instances of changes in the 'wrong' direction (ie increases in car use). The vast majority of examples show estimated car trip between 5% and 15%.
- Measurement against the travel behaviour of control (non-intervention) groups.
- Measurement of travel behaviour change across whole target populations, not just the direct participants.
- Some monitoring over a period of years that shows continuation of the reduction in car use.

Much of this demonstration has only been achieved with repetition and clear statistical design to measure changes in travel behaviour. Measurement of travel behaviour change for an individual project remains difficult unless the project is large enough to be able to support an adequate sample size for undertaking travel surveys with narrow statistical error bands for both intervention and control groups.

Many of the conditions for statistical robustness of travel behaviour change measurements cannot be met:

- In a pilot program.
- In small-scale projects.
- With substantial turnover of the population within the intervention period.

A school active transport project is unlikely, therefore, to be able to provide unambiguous evidence of travel behaviour change, meeting the requirements of statistical verification, in individual schools, especially in the initial stages of the program. However, experience from similar school-based programs elsewhere clearly demonstrates consistent effectiveness in reducing car driver trips.

Small-Scale and Pilot Programs

For small-scale and pilot programs, such as individual schools, it is best to use a range of measures, rather than just travel behaviour estimates (see *Indicators of Change*, below). It is useful to evaluate the extent to which school communities identify with and participate in the program. This will assist garnering support for active travel programs and encourage continued participation (see *Indicators of Performance* below).

A number of methods exist to monitor small-scale programs – each with respective advantages and disadvantages. It is often good practice to combine these methods and if they all point in the same direction and are consistent in terms of the magnitude of travel behaviour change, then it is most likely the evaluation results are a true indication of the impact of the program.

In a comprehensive review of voluntary travel behaviour change (VTBC) initiatives, Brög and Ker (2009), found there are three main measures that should be considered:

- *Marketing Indicators*, which relate to the level of interest shown by potential participants and their expressed responses to the program.

  In traditional direct marketing, this type of indicator is the *only* success factor used. They are reliable, precise and easy to measure, which should not be ignored.

  In household-based travel behaviour change programs, requests for information can be recorded. In school-based programs, levels of participation in activities can be recorded and responses to the activities and program will also be important.

- *External Indicators*, which measure the performance of parts of the transport system affected by the travel behaviour change initiative. Bus patronage on routes in the area and road traffic volumes is an example of an *external indicator*.

  Whilst such measures can be more robust than sample surveys (ITP, 2007), they rely on the intervention being large enough to have an observable effect. Primary schools, however are a often a small component of traffic and transport in their areas. This is particularly the case in the morning, as it coincides with the journey to work, and it can be difficult to separate the active school transport program effects from the general variability of traffic.

- *Behavioural Indicators* measure changes in the mobility characteristics of participants. By conducting extensive 'before' and 'after' travel surveys, a picture of the change in travel patterns can be gauged. The analysis is based on mode share, activities and travel time, and shows the mode shift from car-as-driver and passenger trips to environmentally friendly modes.

Changes in travel behaviour can be translated into other outcomes such as reduction in greenhouse gas emissions and improved participant health. For these outputs, reliable estimates of trip length (or duration), as well as trip numbers is required.

The most frequently reported behavioural indicator is the change in car driver trips, or, in the case of school-based programs, single-passenger car trips. This can be estimated more robustly than the change in any of the other modes, because such trips are the largest single component of personal travel. However, car travel *distance* is often the critical parameter for many of the objectives of travel behaviour change initiatives and this has not been consistently estimated across interventions.

Historically, attention has been focused on behavioural indicators only, to the exclusion of the marketing and external indicators.

For external and behavioural indicators, it is important to measure changes against a control group (ITP, 2007), to separate out the effects of changes that affect the whole population (such as changes in the price of petrol). However, it may be reasonable to assume no change in travel outside the program over a short period (less than 12 months) unless there are clear reasons to expect such change to take place (eg a rapid rise in petrol prices).

Marketing indicators pose some problems of comparative assessment as no common metric or scale has been developed for them.

Whatever methods are used, acceptance of the results will be highly dependent upon comprehensive and consistent documentation of processes and outcomes.

Indicators of Performance

Beyond a pilot, a key objective of an active transport program for schools should be to retain schools in the program. This requires a large part of the school community to view the program favourably, not only (or even necessarily) because of the travel behaviour outcomes, but because the program is something teachers, parents and students *want* to be involved with. This is as much about perceptions as reality. The school community's *perception* of the program can drive their willingness to continue to participate.

Participation

Individual activities provide direct measures of the extent of participation, which can be interpreted in terms of the potential for the mode(s) that are the focus of the activity. Equally important, participation can be used to demonstrate the extent to which the school community supports the overall program.

Prompted Responses

Student Journals

School-based programs, with related experiential and learning outcomes, lend themselves to students recording their (and their parents') responses to the program. For example, *Millennium Kids*, when it ran the WA TravelSmart to School program, posted extracts from student journals on the Travelsmart pages of its website. Such responses can indicate reactions to the program and activities, as well as student understanding of the objectives, outcomes and linkage to other areas of sustainability. *Millennium Kids* included the following:

> We are Sinead, Natasha and Harmony and we are the fit girls. Some grown-ups get fit by lifting weights and doing push-ups. Driving a car does not help you get fit. It's okay to drive somewhere if it takes half an hour or more, but it is easy for children to get fit by riding a bike or walking. It is great exercise and that is how we got fit. So remember what we say and stay fit!
>
> Yesterday, Zac & Brendon attended a Sustainability Showcase in Rockingham where we were able to tell people from local government, state government, industry and the community all the things we liked and didn't like about our community. We were also given the opportunity to talk about how we would like our community to be in 20 years! We discovered that we wanted almost the same things as what the adults wanted which was quite a surprise to both groups. The information that was presented is now going to help shape Sustainability Education in the area to help give other schools as much opportunity as possible to undertake projects. At Calista we already do Ribbons of Blue, Airwatch, TravelSmart to School, building Possum boxes and looking at how we can stop Cane Toads. We look forward to seeing what happens!

Reported Effectiveness

The willingness to continue in a school active transport program after the initial commitment will depend as much on the parental perceptions of the program as upon the actual achievements in terms of travel behaviour – perhaps more so. Brisbane City Council undertook surveys of parents and of teachers, which it described in the following terms (Brisbane City Council, 2007):

> *Teachers survey*
> In the middle of the year, teachers were surveyed to assess their understanding and participation in the program. Additionally, a teachers survey was distributed, in paper format, following completion of the AST program in November. This survey asked for anecdotal feedback on any changes in students travel habits, traffic volumes around the school, changes in students' road safety awareness and activities within the program that impacted positively on travel behaviour. Questions were also asked on improvements for future programs, specifically, teachers roles in promoting the program and communication methods with parents.

Parents survey

Parents were also surveyed to measure perceived changes they had seen in the school community following implementation of the AST program.

The parents survey was distributed in paper format, through the school newsletter, at the end of the AST program. The aim of the survey was to gain feedback on whether each families travel habits had changed as a result of the AST program, traffic volumes around the school, changes in road safety awareness of each family and to understand which activities were most effective in changing families travel habits. Additional questions were asked on the likelihood of parents assisting with AST activities in the future and how the AST program could be improved.

These surveys allow identification of how teachers and parents actually perceive the program and its component activities, including comparison between schools (Figure 21 & 22) and comparison between activities (Figure 23 and 24).

There is likely to be a fairly high level of correlation between teachers and parents, but the teacher survey relates to an overall perception of travel to school whereas the parental responses demonstrate the variability between families. It is important to note that the small incidence of increases in sole passenger trips is not necessarily a perverse outcome but could relate to some car pool participants starting to use individual active modes (walking or cycling) instead.

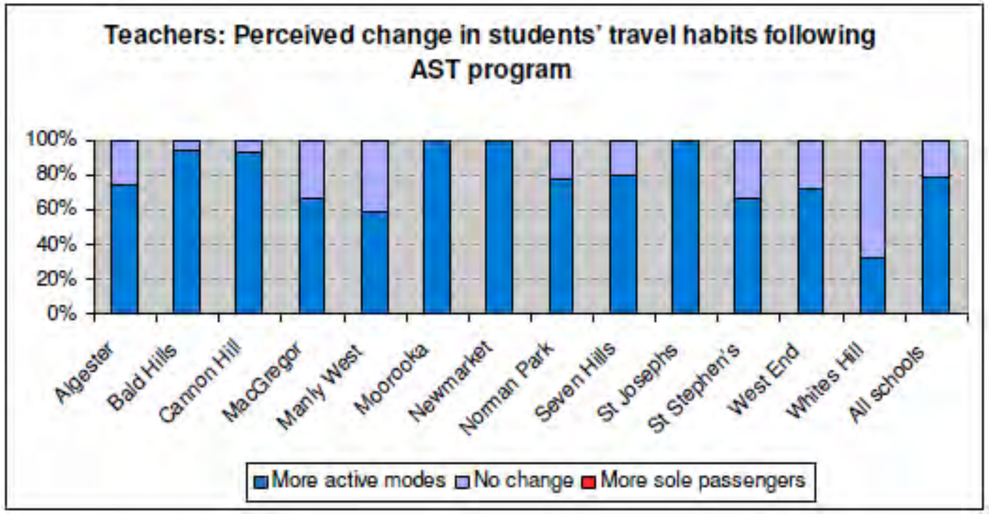


Figure 21: Perceptions of Brisbane City Council Active School Travel Program – by School Teachers
Source: Brisbane City Councl (2007)

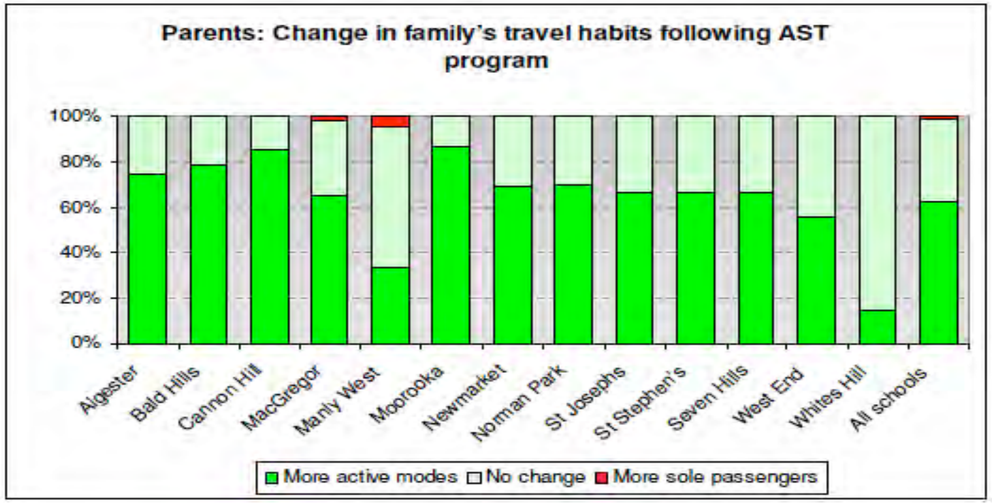


Figure 22: Change in family's travel habits following Brisbane City Council Active School Travel Program – by Parents
Source: Brisbane City Councl, 2007

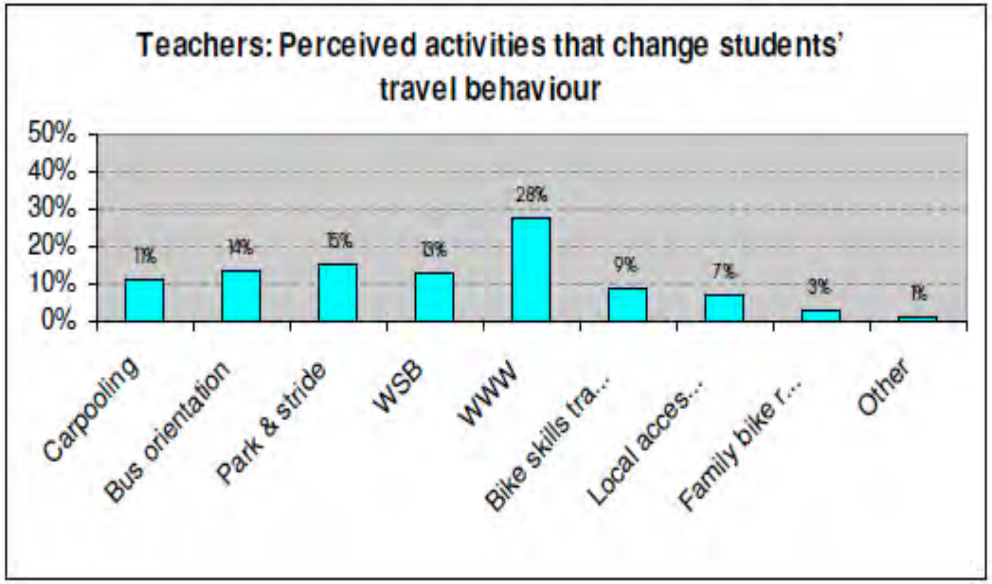


Figure 23: Perceived activities that change students' travel behaviour - Brisbane City Council Active School Travel Program – by Teachers
Source: Brisbane City Councl, 2007

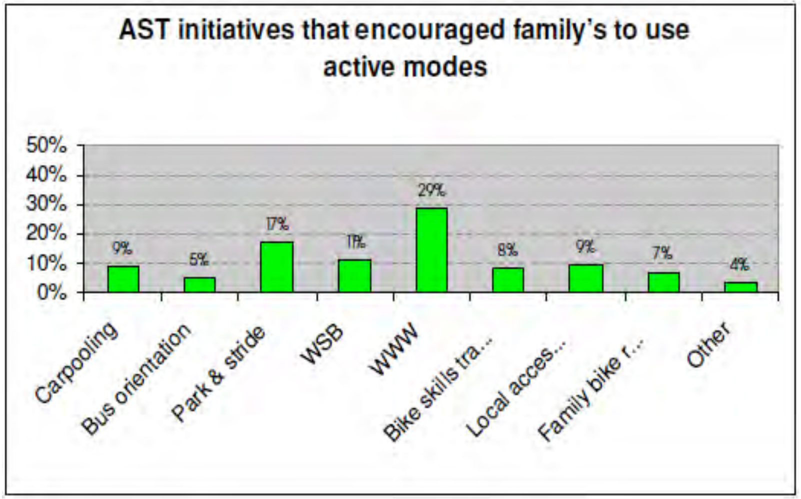


Figure 24: Perceived activities that change family's travel behaviour - Brisbane City Council Active School Travel Program – by Parents
Source: Brisbane City Councl, 2007

Comparison between schools can also be for individual component activities (Figure 25), which is valuable aid to identifying not only where an activity might be underperforming but also in identifying the reasons for this.

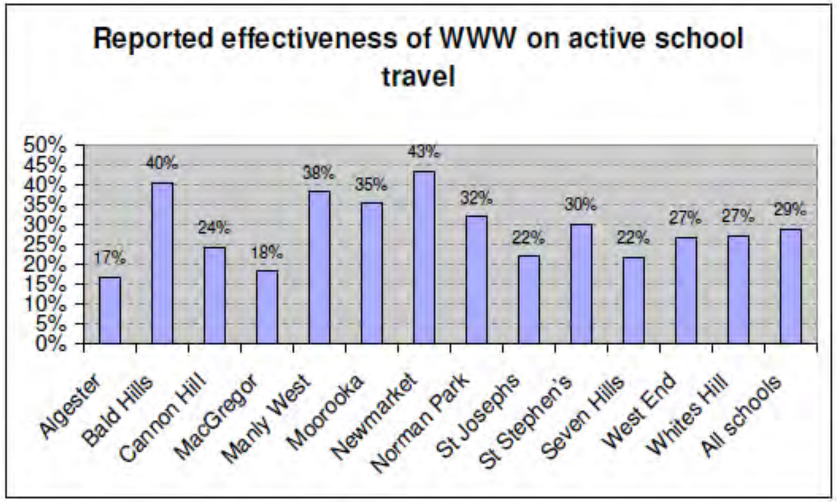


Figure 25: Comparision of parents' perceptions of effectiveness between schools
Source: Brisbane City Councl, 2007

The Auckland Regional Transport Authority (Hinckson et al, 2007) also undertakes surveys of parents and school staff. The only measurement of outcomes is an in-class hands-up survey.

Volunteered or Spontaneous Responses

Some of the most powerful demonstrations of the value of a travel behaviour change initiative come from the unsolicited responses of those who have been part of the project, especially as this is usually accompanied by an absence of complaints, either from those who were approached but declined to take part or from those who participated by felt they did not have a good experience.

By definition, volunteered or spontaneous response cannot be solicited. However, programs should be structured in ways that facilitate the capture of such comments – whether positive or negative. Such quotations can be very effectively used, for example in school newsletters, to promote the program and encourage participation in activities.

Indicators of Change

Indicators of change and travel behaviour outcomes are most commonly developed in terms of travel behaviour, using hands-up surveys (see *Monitoring and evaluation framework*, below).

Individual activities can also provide indicators of actual or potential change, particularly for a single-day activity where it is possible to ask those who participate how they would usually have travelled to school that day. For example, Brisbane City Council (2007) reports the results of *Walking Wheeling Wednesday* (in this case across all such days for the year) with comparisons with baseline travel surveys (Figure 26).

Such comparisons are not simple to interpret. The Brisbane City Council program, for example, uses the baseline survey for comparison. Some of the students are likely already to have changed to more active modes before the *Walk Wheeling Wednesday*, especially for those held later in the year. Asking 'usual mode' on the day acknowledges that change will already have been brought about by other parts of the program, but not that some of that change might be due to previous *Walk Wheeling Wednesdays* or similar activity.

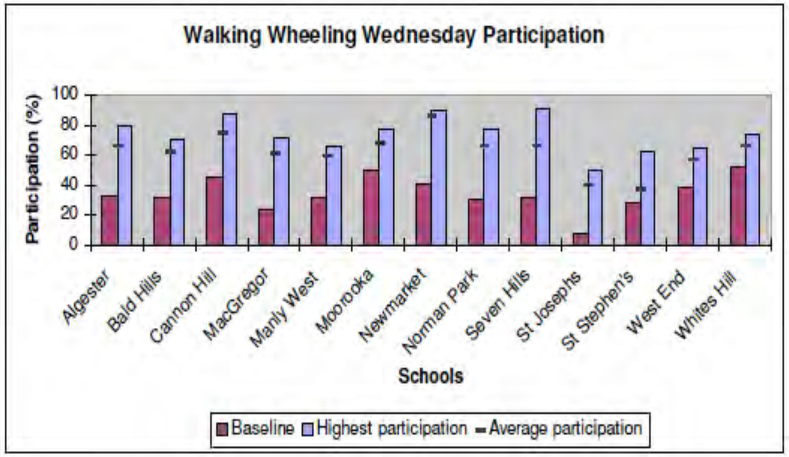


Figure 26: Walking Wheeling Wednesday indicator of effectiveness
Source: Brisbane City Councl, 2007

Beyond School Travel

It is important to acknowledge that whatever we monitor and measure as the impacts of school travel programs will have limitations. Recent commentaries have stressed the need to look beyond formal programs and initiatives to the impacts on capabilities and communities. David Engwicht, originator of the Walking School Bus (WSB) concept, poses the rhetorical question: *What was my original goal in proposing the Walking Bus? Was it to get kids walk- ing to school? Was it to reduce traffic levels? It was all of these things. But there was a deeper goal: to give kids independent mobility* (Engwicht, 2003, p. 1).

Collins and Kearns (2010, p. 7) go further into the area of community and concluded that:

> In light of such issues, the continued promotion of WSBs in Auckland should proceed with recognition that supervised walking is neither the sole answer to children's mobility needs, nor a panacea for the ills of auto-dominated environments. Rather, WSBs can and perhaps should be regarded as stepping stones towards two broader developments: increased independent mobility for children for a range of neighbourhood-level journeys; and significantly reduced car use, speeds and density in suburban neighbourhoods. If these twin goals were achieved, formalized WSBs might not be needed. Moreover, for as long as supervised walking is required, it may continue to reinforce some of the social identities associated with automobile-dominated space (i.e.,those around gender roles, and the public incompetence of children). This said, it is clear that routine walking in groups also helps to break down the social isolation often associated with automobilized family lifestyles, and alerts adult participants, in particular, to some of the costs and dangers associated with allowing motor vehicles to dominate the public spaces of everyday life.

The importance of this lies in recognising that we are only measuring the short-term and usually only the direct impacts of travel behaviour change initiatives. Whilst the magnitude of longer-term and indirect impacts is unable to be estimated at this time, there is no reason to expect them to be other than synergistic – adding to rather than detracting from the short-term and direct measurable impacts.

Monitoring and Evaluation Framework

Concepts and Practice

There is a number of important elements to any monitoring and evaluation framework, including:

- Measurement both before and after the intervention.
- Consistency of population and high response rates for any surveys.
- Assessment against a control group or, alternatively, acceptance that external circumstances have not changed significantly – this includes seasonal factors such as weather.
- Measurement of key elements of concern rather than spreading the net too broadly. This affects both the intrinsic reliability of responses and the response rates.
- Process monitoring – were actions undertaken efficiently and on-time to support delivery of program as a whole and the achievement of objectives.

The more formal the active travel 'planning' process, the more formal the monitoring and evaluation needs to be, to ensure that they link specifically to both the objectives and the strategies. Often this can be a formal requirement of the 'planning process'. In the UK, for example, it is requirement that school travel plans (which are mandatory and funded by the central government) show how progress is to be monitored (Figure 27).

Part 6 – How are you going to monitor progress?

Monitoring

Your STP must show how you intend to monitor your progress and the process for reviewing the plan. This must include details of:

- When the next survey(s) will be carried out (**an annual hands up survey** of pupil mode is a requirement and must be carried out)
- The month and year when the plan will be completely reviewed. You will be required to submit a progress report each year and to revise your whole plan every three years
- Who will be responsible for ensuring that the surveys and review will take place?
- A commitment that the review will consider pupil travel needs arising from new developments in education and transport provision

You should also consider:

- Including your STP in your school improvement plan
- Carrying out termly hands-up surveys, which will provide seasonal data and show indications of early successes of your plan
- An annual report to governors
- Keeping an evidence portfolio. This will provide a record of all the work you have undertaken on the plan. It could include minutes from meeting, photographs of events and engineering measures, survey results, examples of pupil work etc. The portfolio will make it easy for you to update your plan and will allow your School Travel Advisor to quickly see the progress you have been making

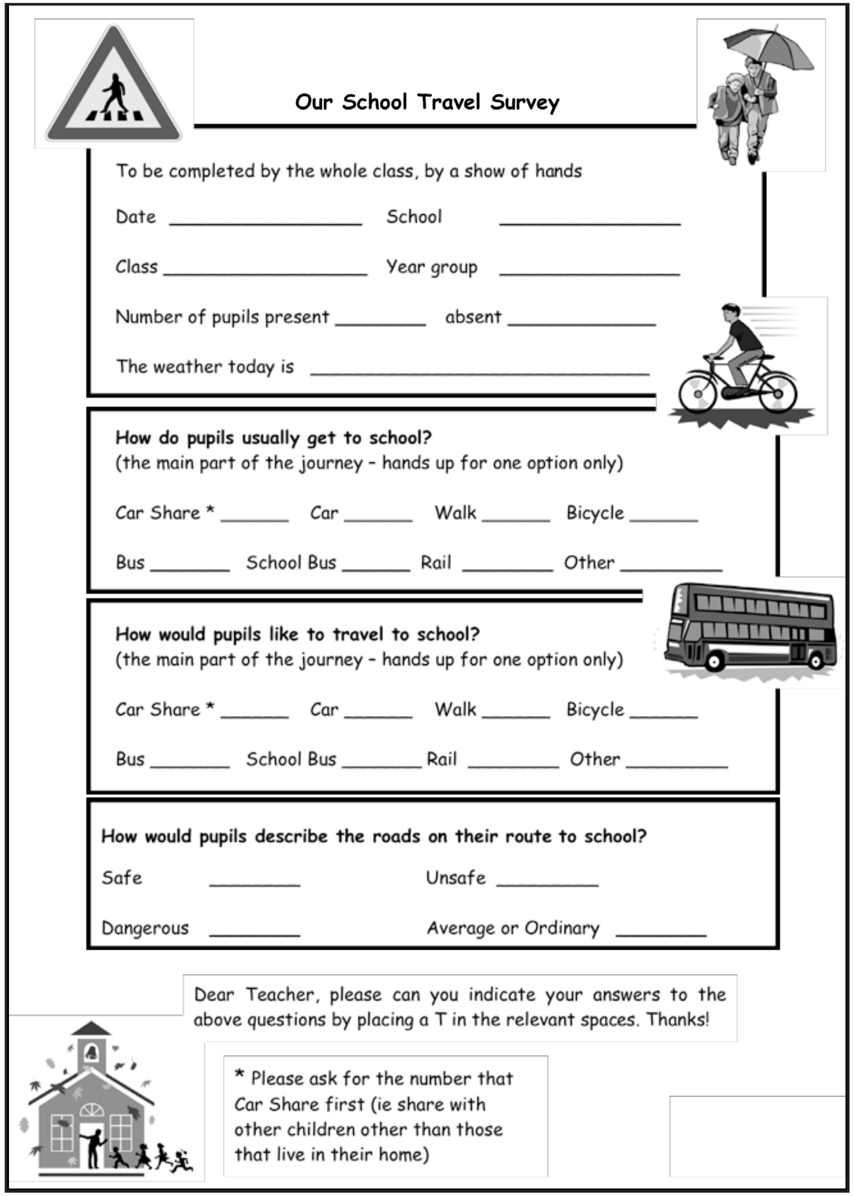
Figure 27: UK Monitoring of School Travel Plans
Source: Transport for London, 2008

Monitoring Achievement and Outcomes

Some UK local governments use lengthy and complex survey forms that might be difficult for some primary school children to respond to. There are also surveys for parents and staff. The student and parent surveys forms include questions relating to preference for travel to school or, in the case of parents, how they travelled to school at their children's age(s).

However, the primary means of monitoring *achievement* in UK schools is a 'hands-up' survey of students, but often on the basis of 'usual mode' rather than recording actual travel behaviour and for one day (and sometimes only the journey to school) rather than a full week. One-day surveys, even with recording of weather conditions (Figure 28), are very difficult to interpret and are subject to many influences that cannot be adequately assessed.

The Greenwich form asks for 'usual mode of travel' but the form could equally well ask for actual mode used on the day of the survey (see 'actual and usual mode', below).



Our School Travel Survey

To be completed by the whole class, by a show of hands

Date ____________ School ____________

Class ____________ Year group ____________

Number of pupils present ________ absent ____________

The weather today is ______________________

How do pupils usually get to school?
(the main part of the journey - hands up for one option only)

Car Share * ______ Car ______ Walk ______ Bicycle ______

Bus _______ School Bus ______ Rail ________ Other __________

How would pupils like to travel to school?
(the main part of the journey - hands up for one option only)

Car Share * ______ Car ______ Walk ______ Bicycle ______

Bus _______ School Bus _______ Rail ________ Other __________

How would pupils describe the roads on their route to school?

Safe ________ Unsafe _________

Dangerous ________ Average or Ordinary ________

Dear Teacher, please can you indicate your answers to the above questions by placing a T in the relevant spaces. Thanks!

* Please ask for the number that Car Share first (ie share with other children other than those that live in their home)

Figure 28: Hands-up survey form: London Borough of Greenwich

A recent review of travel survey methods for monitoring school travel behaviour in the context of school travel plans supported the use of hands up surveys as a practical, resource efficient, valid and reliable means of conducting school travel plan monitoring relating to the main type of transport used to travel to school (Transport for London, 2008).

Although there are some practical issues with hands-up surveys, such as the ability of students to identify a 'main mode' where multiple modes were used, most such issues are less likely to be of concern in respect of primary schools, where travel distances are usually short, than for high schools, where more complex travel patterns are more likely to be found.

The study found that, whilst travel surveys are commonly used for understanding community-wide travel behaviour, there were significant differences between such surveys and the simpler hands-up survey. On the other hand, there were no significant differences between hands up and individual pupil interview for any mode, prompting the authors to conclude that the simpler hands-up surveys was the most effective method of measurement (Transport for London, 2008).

In New Zealand, monitoring is seen at one level, solely in terms of travel behaviour and mode choice for travel to and from school (Land Transport NZ, 2007), but the overall process description provides a somewhat broader context of continuing improvement (Figure 29).

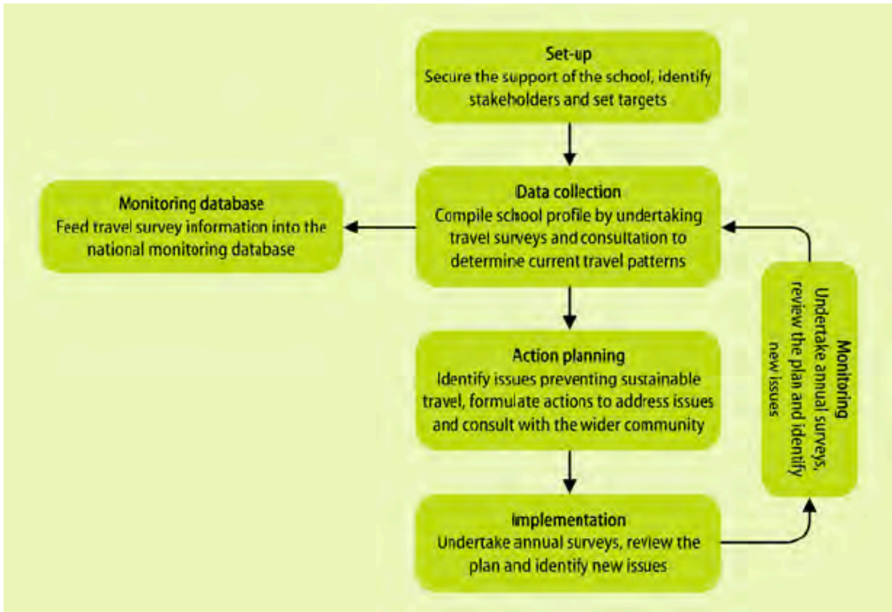


Figure 29: Phases of a School Travel Plan (New Zealand)
Source: Land Transport New Zealand, 2007

Actual or 'Usual' Mode of Travel

Surveys of school travel either ask for usual mode of travel or actual mode on specific days. Whilst it might be thought that 'actual travel' would be the more reliable measure, since it requires no judgment on the part of respondents (who are children), it appears that there is no statistically significant difference between the two measures (Transport for London, 2008). However, when dealing with travel behaviour *change*, 'usual' mode can hide or over-emphasise changes. For example, in the case of a child who at the start is driven to school every day and subsequently starts to walk two days a week, there would be no change in 'usual' mode. Conversely, a child who initially walks two days a week and changes to three days, would be recorded as changing mode for a relatively small change in behaviour. There is no reason to expect that these two effects will necessarily exactly offset each other and, in any case, it would be prudent not to rely on their doing so.

At the primary school level, in particular, 'actual' mode of travel should be recorded for two main reasons:

- There is no need for judgment on the part of the child.
- The response is unambiguous and provides the clearest indictor of *change*.

'Usual' mode is a simple means of getting an overall impression of travel to school (eg through an initial parent/family survey), but should not be relied on as the measure to indicate *change* in travel behaviour.

How Many 'Active Travellers'?

Hands-up surveys are a very good means measuring the number or proportion of school trips by various modes. As conventionally carried out, however, they do not help identify the number or proportion of students who use active travel. If, for example, 50% of students respond each day that they walk to and from school, then, unless it is exactly the same students every day, more than 50% will walk for one or more days during the week.

For many measures of benefit, such as congestion or safety, it does not matter who is undertaking the active travel (subject to factors such as time-of-day, travel distance, and location). However, in the case of health, lifestyle and social benefits, especially for the longer-term impacts, it might be very important. In the case of school active travel, for example, if 50% of students walk every day it could be:

- The same 50% walking every day.
- 75% walking three days a week and 5% walking every day.

In the latter case, 80% of students are getting at least some of the benefits of regular walking and exercise. To overcome this limitation, and accepting that ongoing benefits are likely to require regular (eg at least weekly) use of active modes for travel to school, a hands up survey should also ask at some stage (preferably the end of the week), 'how many walked/cycled at least one day in the past week?'

A Suitable Framework

Monitoring and evaluation of school active transport programs that include a developmental dimension, should include components that relate to stakeholder (primarily parents and teachers) perceptions of the program and activities as well as the actual travel outcomes.

Whereas objective measures of travel behaviour require before and after measurement to make an estimate of change, subjective and perception outcomes need only be measured after the event – unless the intention is to identify changes in attitudes towards the type of program.

Before and after student travel surveys

Student travel to and from school is the primary target of school active transport programs. This is however likely to be spillovers into other areas of activity for schools, students and their families. However, these spillovers are inherently very difficult to identify and estimate.

The simplest and most common means of measuring student travel behaviour is through 'hands-up surveys in class. These can also be used by teachers as an educational opportunity. It is important, however, that as much inherent variability is removed from the surveys by appropriate design:

- The 'before' survey inevitably has to be early in the school year and the 'after' survey towards the end of the year. The expected weather conditions should, as far as possible, be similar. The major weather factors affecting active travel are rain and temperature.
- Surveys should cover all days of the week to give an overall picture of school travel. If this is not possible, surveys should be mid-week, not Monday or Friday,and should try to avoid days on which there are scheduled school activities after school.

  There are many advantages to a full-week being used for comparative before and after surveys of actual behaviour. For anything less than a full week, the same days should be used for both surveys, but the fewer the number of days, the greater the likelihood that some unrelated event (including the weather) will affect the outcomes in ways that cannot be adequately assessed.
- Surveys should ask about both travel *to* school *and* the journey home. There can be differences between them (for example, due to the availability of a working parent in the morning but not the afternoon, or after-school activities), which, in turn, can affect the ability, as well as willingness, of parents to allow independent travel.

The journey home from school is best handled by asking intentions (see Figure 30), to avoid Friday afternoon's journey having to be recorded the following Monday.

- The design of surveys should be as simple as possible. This includes the design of the form. Some use a separate form for each day of the week (see, eg, BCC 2007); others use a single form to cover the whole week (Figure 30). A multi-day form has the advantage of providing a prompt to teachers as well as keeping information in one place.

There might be reasons why the full survey outlined above cannot be undertaken. However, the starting point should be the 'full survey', with any reductions being negotiated with teachers at the school and in line with the principles set out above.

For reasons set out in the *Monitoring and Evaluation Framework* section above, the survey form should be expanded to add, on the Friday, a question 'how many walked/cycled at least one day in the past week?'.

SAFE ROUTES TO SCHOOL
STUDENT ARRIVAL AND DEPARTURE TALLY SHEET

School Name: ____________ Grade: ______ # of students enrolled in class ______

Teacher: ____________ Monday's Date: ____________

School's Zip Code ________ (used to identify weather conditions)

Teachers, here are simple instructions for using this form:

- Please conduct these counts **each of the five days of the assigned week.**
- Before asking your students to raise their hands to indicate the *one answer* that is correct for them, read through all potential answers so they will know what the choices are.
- Ask your students as a group the question **"How did you arrive at school today?"**
- Read each answer and record the number of students that raised their hands for each.
- Follow the same procedure for the question **"How do you plan to leave for home after school?"**
- Please conduct this count regardless of weather conditions (i.e., ask these questions on rainy days, too).

Step 1. Fill in the weather conditions and number of students in class each day			**Step 2**. Ask students "**How did you arrive at school today?**" and "**How do you plan to leave for home after school?**" (*record number of hands for each answer*)							
	Weather S= sunny R= rainy C= cloudy Sn= snow	**Number of Students** (in class when count made)	**Walk**	**Bike**	**School Bus**	**Family Vehicle** (only with children from your family)	**Carpool** (riding with children from other families)	**Transit** (city bus, subway, etc.)	**Other** (skate-board, scooter, inline skates, etc.)	
Mon AM										
Mon PM										
Tues AM										
Tues PM										
Wed AM										
Wed PM										
Thur AM										
Thur PM										
Fri AM										
Fri PM										

Comments *(Please list any disruptions to these counts or any unusual travel conditions to/from the school on the days of the tally):*

____

____

Thank you for helping gather this information!

Figure 30: Typical multi-day hands-up survey form
Source: *UrbanTrans (2008)*

Parental Surveys

The importance of seeking parent feedback lies in enhancing awareness of the school travel program as well as creating support for continuation of the program into future years. Clearly, such a survey can only be carried out towards the end of the school year, when all activities have been implemented at the school.

A second role is the identification of activities that are not being well-received by parents, so that the program can be modified and improved for future years and other schools.

C. Parent Feedback Survey

Active School Travel - Parent Feedback

This year, in conjunction with Brisbane City Council, we launched the **Active School Travel program** at our school.

Activities included Walking Wheeling Wednesday, Bike Skills training, Bike Cage construction, Bus Orientation, Walking School Bus, RoadStar Road safety assembly presentations and more. We need to evaluate the effectiveness of our program so can plan for the future. **You can help us by answering this short questionnaire. Thank you.**

1. **Have your family's school travel habits changed since Active School Travel was introduced?**
   less driving (more carpooling, walking, cycling, public transport) not changed more driving

2. **Has the volume of traffic around the school changed since Active School Travel was introduced?**
   less traffic not changed more traffic

3. **Has your family's road safety awareness changed since Active School Travel began at our school?**
   improved not changed worsened

4. Which activities encouraged your family to leave the car at home?

- [ ] Carpooling
- [ ] Bus orientation
- [ ] Park & Stride (drive part of the way and walk the rest)
- [ ] Walking School Bus
- [ ] Walking Wheeling Wednesday
- [ ] Bicycle Skills Training
- [ ] General information about walking/cycling, including the Local Access Guide
- [ ] Family bike rides
- [ ] Other? ______________________________

5. What Active School Travel activities can you assist with in the future?

- [ ] Active School Travel Committee
- [ ] Walking School Bus walk leader
- [ ] Organising family bike rides
- [ ] Managing the 2 minute zone

6. In your opinion are there ways the Active School Travel program can be improved?

____

____

Your feedback is very important to our school. Every returned feedback questionnaire will be entered into a prize draw to win a **$40 A-Mart Sports Gift Voucher!** So don't delay, send in your form today!

Parent Name: ______________________________ Phone: ________________

Students Name: ______________________________ Class: ________________

Thank you for taking the time to complete our questionnaire!

Figure 30: Example of parent survey form for active school travel program
Source: Brisbane City Council, 2007

NB: A small incentive was provided by the Council for return of the survey form.
It is not recommended to use web surveys unless it can be verified that all potential respondents have internet access and are comfortable with responding in this way.

Teacher Surveys

Some programs collect information on teacher travel behaviour. However, this is not essential, although teachers should be encourage to demonstrate the behaviours students are being encouraged to adopt. It is more important to get feedback from teachers on what works and what doesn't, preferably in a way that is not seen as in any way judgmental in terms of the teachers' own travel choices. As with the parent survey, this is best undertaken towards the end of the year when all activities have been completed.

Subject to teachers agreement, web based surveys are the most efficient method of data collection.

E. Teacher Feedback Survey

Active School Travel – Teachers' Feedback

This year, in conjunction with Brisbane City Council, we launched the **Active School Travel program** at our school.

Activities included Walking Wheeling Wednesday, bike skills training, bike cage construction, bus orientation, Walking School Bus, RoadStar road safety assembly presentations and more. We need to evaluate the effectiveness of our program so we can plan for the future. **You can help us by answering this short questionnaire. Thank you.**

1. **Have your students' school travel habits changed since Active School Travel was introduced?**
   less driving (more carpooling, walking, cycling, public transport) not changed more driving

2. **Has the volume of traffic around the school changed since Active School Travel was introduced?**
   less traffic not changed more traffic

3. **Has your students' road safety awareness changed since Active School Travel began at our school?**
   improved not changed worsened

4. Which activities made a difference to students' knowledge and travel behaviour?

- [ ] Carpooling
- [ ] Bus orientation
- [ ] Park & Stride (drive part of the way and walk the rest)
- [ ] Walking School Bus
- [ ] Walking Wheeling Wednesday
- [ ] Bicycle Skills Training
- [ ] General information about walking/cycling, including the Local Access Guide
- [ ] Family bike rides
- [ ] Other? ____

5. How can teachers best promote Active School Travel?

____

____

____

6. What is the best way to communicate with parents?

____

____

7. How can the Active School Travel program can be improved?

____

____

8. Are you interested in participating in the Active School Travel Committee in 2008?

Yes No

Thank you for taking the time to complete our questionnaire!

Figure 31: Example of teacher survey form for active school travel program

Source: Brisbane City Council, 2007

Components and Timing

Four specific components are desirable in the monitoring and evaluation of a school active transport program. These are:

- *Hands-up surveys in class*, the first held a few weeks into Term 1 and the second around the middle of Term 4. These should be full-week surveys, but, if this is not possible, Tuesday, Wednesday and/or Thursday would be the preferred days. If anything less than a full week, it is essential that the same day(s) is (are) used for both before and after surveys, to remove differences in travel behaviour that are ' seasonal'.

  As noted earlier, however, the fewer the number of days the greater the likelihood that some unrelated event (including the weather) will affect the outcomes in ways that cannot be adequately assessed. Any reductions from the 'full' survey should be negotiated with teachers at the school and in line with the principles set out earlier in this Appendix.

  With a small amount of additional information (or estimates based on other sources of information) about trip lengths, changes in travel behaviour can be converted into changes in greenhouse gas emissions.

  Student 'hands-up' survey forms could be closely based on the forms used by Brisbane City Council in its Active School Travel Program, on the basis that these forms have been proven to be effective. They would need to be tailored to each school to reflect (eg show in **bold**) the agreed days for the hands-up surveys. As noted earlier in the Appendix, it would be best to cover the full week, but if this is not possible, then Monday and Friday are the best days to leave out. Single-day surveys are not recommended.

- *Participation counts at individual activities*, with, wherever possible, information collected on the method of travel of participating students if the activity were not being held.

- *Parent and teacher surveys* aimed at identifying what is seen to work well and what might be improved. These surveys need to be undertaken towards the end of the year, after all the individual activities have been completed.

  Interpretation of the responses to the parent and teacher surveys will be facilitated by the use of the same questions, albeit asked from a different perspective.

  Parent and teacher survey forms could be closely based on the forms used by Brisbane City Council in its Active School Travel Program, on the basis that these forms have been proven to be effective. However, there has been some simplification to focus on the most important information.

  Although shown in 'hard-copy' form, the teacher survey could include an option for completion electronically, However, for the pilot program this would add unnecessarily to the complexity of recording (through having more than one option) and it is not recommended at this stage. This option should be reconsidered when the program becomes a larger, mainstream one.

- *Process monitoring*, to ensure that program performance is not adversely affected by problems in delivery of activities or materials or, at the very least, that any problems can be identified early and remedial action taken where possible.

  The main requirement for this is a checklist of actions and identified timing, which may be in terms of the actual time of year, for precurser activities to the whole program in a school, or in terms of lead time relative to a specific activity that can undertaken at a number of different stages of the program.

Presenting and Understanding Results

The clearest and most effective way of presenting the results of the surveys is in graphical form.

Student hands-up surveys

A simple spreadsheet with embedded graphics should be used for:

- Entering the data for each class;
- Entering before and after survey;
- Automatically generating simple graphics for immediate feedback to the school community;
- Aggregating across classes and grades to give a 'whole-school' picture.

At this stage, a simple 'one-class' example has been developed. This is shown in Figure 32, with the data input area highlighted in green. The same format can be used for multi-class surveys, with aggregation to whole-of-school and for both before and after surveys, with changes being calculated automatically and converted into charts (Figure 33 and 34).

BEFORE Survey		Grade 1										
Number of Students												
Day of week	Morning/ afternoon	Weather					Walk	Cycle	Bus/ Train	Car	Carpool	Total
		Sunny	Cloudy	Hot	Rain or wet	Windy						
Monday	AM						11	2	0	15	1	29
	PM						13	2	0	14	0	29
Tuesday	AM						12	2	1	15	0	30
	PM						13	2	0	14	1	30
Wednesday	AM						13	1	0	16	0	30
	PM						13	1	0	16	0	30
Thursday	AM						12	2	1	15	0	30
	PM						13	2	0	14	1	30
Friday	AM						14	2	0	14	0	30
	PM						12	2	0	15	1	30
	Whole Week						**126**	**18**	**2**	**148**	**4**	**298**
All using active modes							15	2				
Percentages												
Day of week	Morning/ afternoon	Weather					Walk	Cycle	Bus/ Train	Car	Carpool	Total
		Sunny	Cloudy	Hot	Rain or wet	Windy						
Monday	AM						38%	7%	0%	52%	3%	100%
	PM						45%	7%	0%	48%	0%	100%
Tuesday	AM						40%	7%	3%	50%	0%	100%
	PM						43%	7%	0%	47%	3%	100%
Wednesday	AM						43%	3%	0%	53%	0%	100%
	PM						43%	3%	0%	53%	0%	100%
Thursday	AM						40%	7%	3%	50%	0%	100%
	PM						43%	7%	0%	47%	3%	100%
Friday	AM						47%	7%	0%	47%	0%	100%
	PM						40%	7%	0%	50%	3%	100%
	Whole Week						**42%**	**6%**	**1%**	**50%**	**1%**	**100%**
All using active modes							50%	7%				

Figure 32: Illustrative spreadsheet input for hands-up surveys

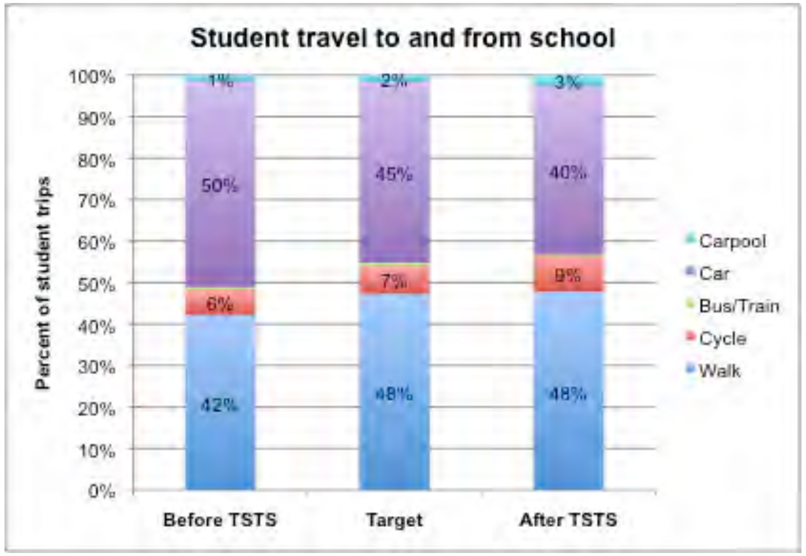


Figure 33: Illustrative graphic for presenting travel changes

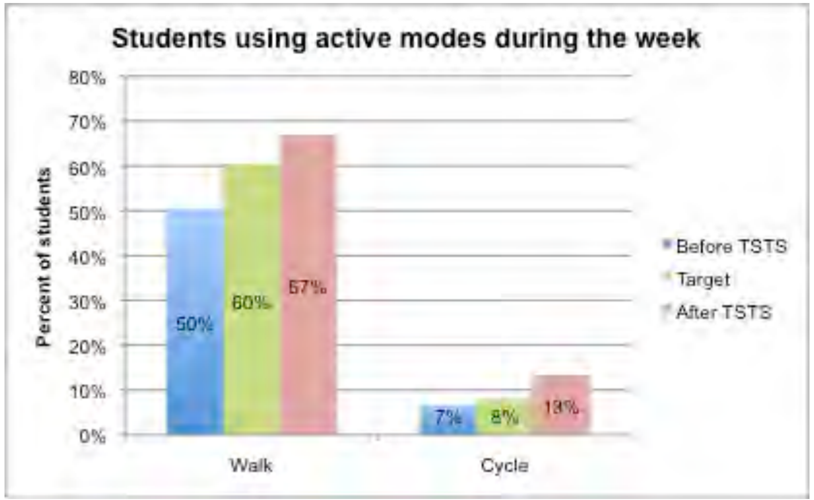


Figure 34: Illustrative graphic for presenting travel changes

Parent and Teacher Surveys

These are essentially qualitative rather than quantitative surveys. However, the results can still be presented graphically for clarity. It is proposed that these be constructed similarly to those used by the Brisbane City Council (2007) and outlined earlier in this Appendix.