

Introduction

The success of Queensland Transport in the management of road safety in Queensland has been well documented and Queensland's per capita road toll is one of the best in Australia. This success has been due to the integrated approach to road safety that has been fostered by Queensland Transport involving the cooperation and collaboration of all the agencies involved, the widespread use of effective programs and regular monitoring and evaluation.

Interest in and concern about the environment and ecological sustainability are increasing in Queensland as is recognition in government and the community of the importance of controlling greenhouse gas emissions. This paper explores the benefits to road safety and ecological sustainability of a number of existing and proposed initiatives.

This examination of the mutual benefits of road safety and environmental initiatives should lead to:

- Increased awareness amongst transport safety professionals that many road safety programs also have impacts on environment and congestion.
- Increased emphasis by transport safety professionals on programs which will maximise additional benefits on environment and congestion.
- Alliances developing between transport safety and environment professionals.

The expected outcomes include:

- Better safety, environment and congestion outcomes for the transport system as a result of the increased synergy.
- Funding for expansion of the synergistic programs in acknowledgement of their greater role in overall transport outcomes.

What is the situation?

Queensland has made significant gains in road safety outcomes in recent years. In per capita terms, road toll rates have fallen dramatically, from above 30 fatalities per 100,000 population in the 1970s to approximately 14 per 100,000 in the early 1990s. In 1999 and 2000, this figure has further dropped to 8.8 fatalities per 100,000 population.

These results have been achieved partly through a combination of steady improvements in road and vehicle engineering and emergency and medical treatment. Some of the significant road toll reductions however, have been associated with specific road safety initiatives. These include compulsory seatbelt legislation, blood alcohol limits for drivers, random breath testing and, in more recent years, random road watch, and the Speed Management Strategy.

There are still challenges ahead. The Queensland Road Safety Strategy 1993-2003, revised in 1999, sets a target of a 20 per cent reduction in the per capita road toll from 1998 to 2003, aiming for 6.4 fatalities per 100,000 population by 2003. The 2000 result of 8.9 per 100,000 indicates that much needs to be done in the next three years.

The National Road Safety Strategy sets a target of a 40 per cent reduction in the per capita road toll from 2001 to 2010. Abiding by this target would see Queensland achieving a rate of 5.3 fatalities per capita by 2010.

Our safety policies and initiatives have successfully reduced the consequences of most incidents and have removed many of the location specific problems which have led to increased incident risk. It may now be time to address the pervasive issue of overall risk exposure. The most fundamental measure of risk exposure is vehicle kilometres travelled (vkt). The reduction of overall vkt, or at least the expected growth in vkt, needs to become part of the safety strategy if we are to achieve the ambitious targets set to reduce road trauma.

The level of vkt is also the most fundamental measure of our level of greenhouse, air and noise pollution. Reducing vkt will also reduce other negative externalities associated with vehicle use such as congestion, land required for roads and social isolation (for those without access to a car).

There are thus large synergies to be gained by focusing more of our future strategy on vkt reduction to reduce risk exposure, environmental degradation and congestion.

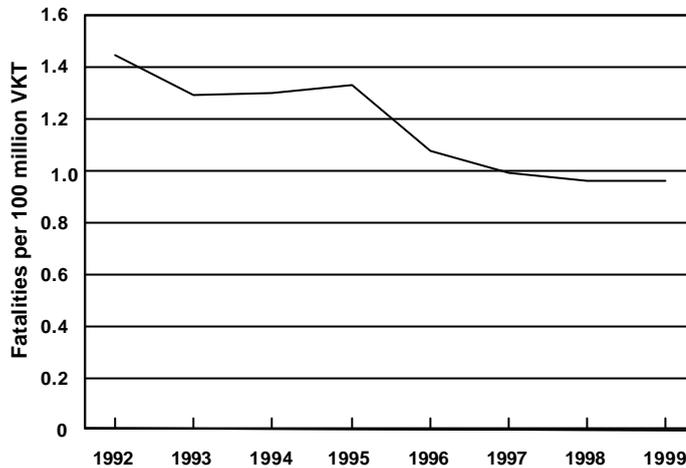
How does reducing vkt impact the environment?

Every litre of petrol burnt directly emits 2.25 kg of carbon dioxide equivalent (CO₂-e). Other emissions during fuel production and distribution raise this amount to about 3.4 kg CO₂-e/litre. The average car therefore emits roughly 37 kg CO₂-e for every 100 kms travelled. As each car travels roughly 16,000 km/annum, this adds to about 6 tonnes CO₂-e/car, which is more than an average house emits from all its energy use.

A 10% reduction in vkt would save about 600 kg CO₂-e/car. It would also save about 10% of air toxic emissions and noise pollution. If short trips were targeted, the air emissions from cold starts would be avoided and the saving would be greater than 10%. This may also impact the road trauma resulting from not wearing seat belts which is predominantly for short trips. Congestion and/or land take are also reduced by the 10%.

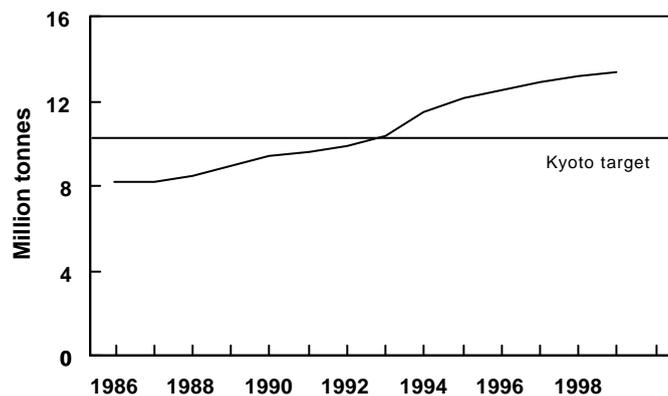
As shown in Figure 1, Road fatalities per 100 million vkt have dropped from 1.45 in 1992 to 0.96 in 1999, a 34 per cent reduction. Total vkt in Queensland stands at over 30,000 million kilometres each year and is increasing (ABS, 1999). This adds significantly to the challenge of meeting road toll targets. Clearly, a reduction in total vkt would help to achieve these road safety goals.

Figure 1: Fatalities per vehicle kilometre travelled
Queensland 1992-1998



There are increasing concerns regarding the ecological sustainability of the existing and planned transport system. Figure 2 shows that the trend in greenhouse gas emissions from transport in Queensland is climbing steadily, making it very difficult to achieve Kyoto targets. In 1999, emission of CO₂-e from road transport was approximately 13.4 million tonnes.

Figure 2: CO₂ equivalent emissions
Qld 1986-1999

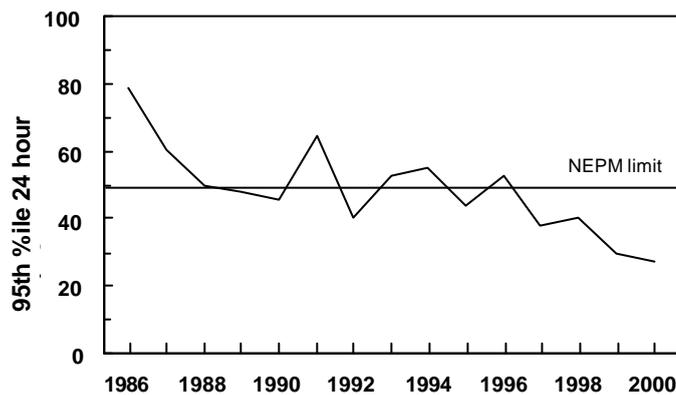


The Kyoto protocol allows Australia's greenhouse emissions to increase by 8 per cent between 1990 and 2010. Emissions from the transport sector in Queensland have already eclipsed that figure and are growing at two per cent per year. At the current rate, transport emissions will grow by over 80 per cent between 1990 and the Kyoto period, severely limiting Australia's ability to meet its obligations.

Air quality is another environmental issue to which the transport sector contributes. While current measures in south-east Queensland (SEQ) are under national limits, they are still contributing to over 200 premature deaths each year (EPA, 1999) (see Figure 3). Motor vehicles generate about 20 per cent of all fine particles emissions in SEQ. Fine particles exacerbate breathing difficulties, leading to increased respiratory failure, heart attacks and strokes, primarily in elderly people.

Motor vehicles also generate approximately 70 per cent of all oxide of nitrogen emissions, the major precursor to ozone formation and photochemical smog. These toxic emissions contribute to the premature deaths related to air quality and have health impacts including irritated airways, exacerbated asthma, increased wheezing, bronchial inflammation and coughing.

**Figure 3: PM10 particle emissions annual trend
Qld 1986-2000**



Successful road safety programs

There are a number of road safety programs currently operating in Queensland that contribute to the low road trauma numbers. These include speed management, random road watch, random breath testing, red light cameras, bicycle helmet legislation, compulsory seatbelts, fatigue management and public education and awareness raising programs. Additionally, road improvements, vehicle improvements and advances in emergency services and trauma management within the health system have helped to improve the record in road trauma management in Queensland.

Table 1 details the performance of five of Queensland's road safety programs. It shows that these programs are making significant contributions to Queensland's road toll reduction, saving a total of over 200 lives each year.

Random road watch (RRW).

RRW is a low intensity, widespread police enforcement program that randomly schedules traffic enforcement to different places at different times across the road network. It is designed to encourage the perception in the motorist that police enforcement can occur “anywhere, anytime” and to promote prudent driving behaviour.

Table 1. Road safety program outcomes - Queensland 1998-2000

Road safety program	Fatal crashes saved per year
Random road watch	80
Random breath testing	210* ¹
Speed cameras	82
50 km/h local street speed limit	19
Fatal 4 public education campaign	20* ²

*1 includes injury crashes

*2 1997/98 data

Random breath testing (RBT).

RBT operations involve assessing the alcohol content of drivers blood through a breath test. Currently over two million RBTs per annum are performed by the Queensland Police Service.

Speed cameras.

Queensland takes a coordinated approach to the management of excessive speed on Queensland’s roads through the speed management strategy. Some of the principle actions in this strategy include the introduction of speed cameras and the implementation of a 50 km/h local street speed limit.

Speed cameras are operated by the Queensland Police Service. Cameras are randomly scheduled to previously identified locations where there has been a record of speed related crashes. Cameras were introduced into Queensland in 1997 and have been successful in reducing excessive speeding behaviour on the road and, as a consequence, reducing the number and severity of speed related crashes.

50 km/h local street speed limit.

As part of the speed management strategy, a 50 km/h local street speed limit was introduced on residential streets in south east Queensland in 1999. This program reduced the speed limit

on these streets, usually from 60 km/h, and has resulted in fatal crash savings of over 15 per cent.

Fatal 4.

This public education campaign addresses four road user behaviours that contribute to significant proportions of the road toll: drink driving, speeding, not wearing seatbelts and driving while tired. A range of media messages encourage road users to obey the road rules and drive safely.

Programs to improve ecological sustainability

The major environmental impacts of transport operations include greenhouse emissions, toxic air emissions and noise pollution. The provision of transport infrastructure also creates other environmental problems such as water quality deterioration, hydrological changes, wildlife habitat and biodiversity loss and loss of productive agricultural land.

Some technological solutions are available to reduce principally toxic air emissions and noise pollution, with lesser benefits to greenhouse emissions and water quality. The principle means, however, to reduce environmental impacts is to use more energy and space efficient modes of transport and to reduce demand.

Most environmental strategies can be classified into one of the three following categories:

- Emission reductions
- Demand management
- Land use and urban planning

Emission reductions.

These strategies seek to reduce the negative impacts per unit of transport operations assuming a continuation of existing demand and mode choice. Where transport is dominated by one mode, as is the case in Queensland where approximately 78% of all personal travel is by car, even a small percentage improvement in fuel use or emission levels can have a large system wide impact in the short term. Improvements can be achieved by encouraging the purchase of more fuel efficient and lower emitting new cars to replace older models and by encouraging better maintenance, engine tuning and driving behaviour to optimise the performance of existing vehicles.

Queensland Transport (QT) has initiated 3 trial projects to achieve emissions reductions:

On-road Vehicle Emissions Random Testing Program (OVERT): Two mobile testing units are deployed on a random basis in SEQ to conduct roadside emission tests on petrol passenger vehicles. Each testing unit uses a portable gas analyser to conduct a simple idle test to measure emissions of hydrocarbons and carbon monoxide. Testing is limited to vehicles more than 5 years old, and test results categorised into pre 1986 and post 1986 vehicles. Results of the test are recorded on a slip and provided to the driver, showing whether

emissions performance is good, fair, or poor. For each test result the slip indicates “What you should do? Good: Keep your car serviced and tuned in accordance with the manufacturers recommendations. Fair: Emissions levels may be improved. Check with a qualified tradesperson who is familiar with your vehicle. Poor: It is likely that your car is causing unnecessary pollution. It is recommended that you have the vehicle serviced by a qualified tradesperson as soon as possible.

Smoky Vehicle Hotline: Members of the public phone in sightings of vehicles emitting smoke for more than 10 seconds to an automated hotline which prompts for specific information on each sighting. Details are checked against the Vehicle Register and assessed before generation of a letter to the owner advising of the report and requesting that the owner have the vehicle checked and or repaired. If the vehicle is reported a second time a stronger warning letter is sent; a Present Vehicle for Inspection Order is sent if reported a third time. Approximately 10,000 reports are received per annum, and approximately 5000 letters are sent to vehicle owners.

Aircare Public Education Program: This program comprises outdoor advertising, radio announcements and community newspaper advertisements to promote regular vehicle servicing and tuning, reporting of smoky vehicles, smooth driving, using public transport, and encouraging cycling and walking. Other promotions are also conducted with the Motor Trades Association (Qld), Channel 7, community groups and at major events such as the RNA Show.

Potential CO₂-e savings from emissions reductions: Studies have shown that engine tuning resulting from an emissions inspection program can achieve an average 1.5% reduction in fuel use over all cars tested. A program targeting the worst or oldest 50% of cars could expect to achieve a savings of 100 kt CO₂-e/annum in Queensland.

Demand management.

These strategies seek to reduce the total amount of vkt either by reducing the total demand for travel or by converting some of the demand to more environmentally friendly modes (walking, cycling, public transport and higher occupancy vehicles). As travel in Australia is dominated by cars, these strategies address the majority of achievable gains in environmental performance over the medium term.

The first necessary step is to improve the level of service of walking, cycling and public transport relative to car travel. This requires investment in facilities and infrastructure which improve the availability, reliability, timeliness and comfort of public transport and the perceived safety and amenity of walking and cycling. QT has invested considerably in the South East Busway to encourage greater mode share for buses along this major corridor by improving their relative level of service and by demonstrating this visibly to the congested freeway traffic. The Cycle South East Strategy is aiming to provide the necessary infrastructure and to improve safety and amenity to increase cycle travel. The Brisbane City Council is implementing

many Suburban Centre Improvement Projects (SCIPs) to improve the safety and amenity of walking around local village centres. This will increase the mode share of walking as well as reduce the need for longer trips to access services.

The other step is for people to have the necessary awareness and information so that they can be empowered to choose more environmentally friendly modes for a portion of their trips. This may seem self-evident, but research is showing that a significant portion of the population are unaware of their viable alternatives for many trips. Voluntary behaviour change projects in Europe, Perth and Adelaide have consistently achieved greater than 10% reduction in vkt merely by providing customised information and encouraging participants to consider and experiment with alternative modes. QT has participated in a National Travel Behaviour Change Proposal to the Australian Greenhouse Office in order to begin large scale implementation of this process.

Potential CO₂-e savings from demand management: A 10% reduction in vkt is achievable for the parts of the population who have viable alternatives to car use for a portion of their trips. This is realistically achievable over about 50% of Queensland's population who live in urban areas and have some local services or public transport. A savings of 700 kt CO₂-e/annum is therefore possible with an extensive program.

Land use and urban planning.

These strategies seek to modify urban form to reduce the need for long distance private vehicle trips. They can have a large impact on the transport system over the long term.

The urban structure of our towns and cities has developed since World War II around the need to accommodate increasing levels of car ownership and travel in an environment of cheap fuel, economic growth and seemingly boundless increases in personal mobility. The resulting suburbanisation and urban sprawl has left us dependent to a large extent on our private cars, unable to reach many services by walking or cycling and unable to afford the previous high levels of public transport provision.

A change in policy is required to promote consolidation of urban growth around public transport nodes and more mixed-use areas rather than low density residential estates and dispersed industrial areas. This process will gradually provide more viable walking, cycling and public transport options to a greater proportion of the population. QT has begun to address this issue through the development of a number of Integrated Regional Transport Plans (IRTPs) for the majority of Queensland's population. Other documents such as the 'Shaping Up Guidelines' and the 'QT Integrated Planning Act Guidelines' are also being implemented to raise the awareness and involvement of town planners in local government.

Potential CO₂-e savings from land use and urban planning: Studies to date have shown mixed results for changes in urban planning. Some have achieved significant vkt savings but

others have resulted in an increase in mobility for those who previously suffered social isolation due to living without a car or public transport access (ie a social dividend rather than an environmental dividend). In the long term, however, these changes will result in a society less dependent on cars. Significant reductions in vkt are achievable, dependent on the proportion of population growth which has viable alternatives provided. If Queensland's population grows 50% over the next 20 years and 50% of this is well planned in regard to public transport, a savings of 700 kt CO₂-e/annum can be expected.

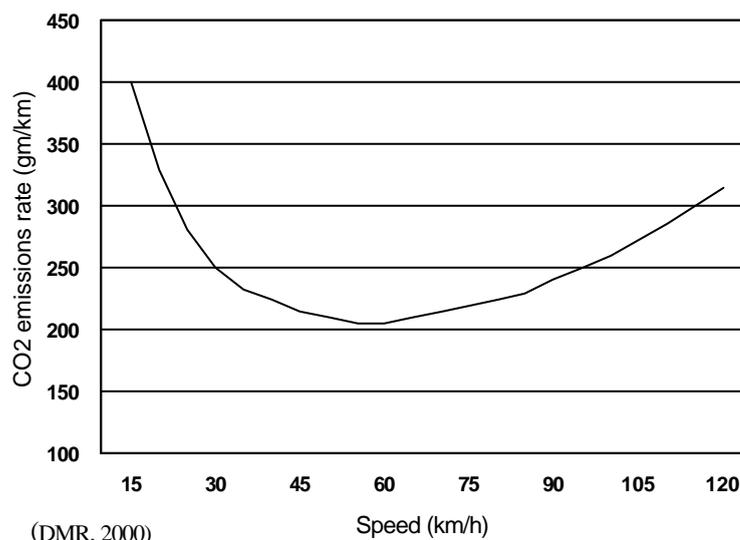
Road safety and ecological sustainability

Road safety programs

Enforcement and education: Road safety programs such as RRW, RBT, speed cameras, 50 km/h speed limits and the Fatal 4 campaign encourage more prudent driving behaviour and compliance with road rules. In particular, they tend to lead to lower vehicle speeds and less erratic driving behaviour.

Research has shown that lower average vehicle speeds and more consistent driving behaviour have exponential reductions in road crashes. They also have benefits for ecological sustainability. A reduction in speed from 110 km/h to 100 km/h reduces average fuel consumption by 9 per cent, a reduction from 70 km/h to 60 km/h reduces average consumption by five per cent (see Figure 4).

Figure 4: CO₂-e emission rate and cruising speed



More consistent driving behaviour also results in reduced fuel consumption. As shown in Figure 4, stop/start driving that involves travel speeds less than 40 km/h, markedly increases fuel use rates.

Table 2 summarises the road fatality and CO₂-e savings from five road safety programs. The fatality savings have been calculated from Queensland Transport’s regular evaluation of road safety initiatives; the CO₂-e savings from the reduced fuel consumption generated by the initiatives.

Table 2. Fatality and CO₂-e savings from road safety programs. Queensland 1998-2000

Road safety program	Fatal crashes saved per annum	CO₂-e reduction factor	CO₂-e saved per annum (k tonnes)
Random road watch	80	More consistent driving behaviour, lower speeds	40
Random breath testing	210 ¹	More consistent driving behaviour	40
Speed cameras	82	10% average speed reduction	400
50 km/h local street speed limit	19	10% average speed reduction on 50km/h routes	33
Fatal 4 public education campaign	20 ²	More consistent driving behaviour	67

1 includes injuries

2 1997/98 data

Speed cameras have been shown to reduce speeds at speed camera sites by approximately 10 per cent. Overall, speed reductions of around five per cent across the network have been achieved. Based on the data in Figure 4, this would equate to approximately a three per cent reduction in CO₂-e emissions. This calculates at 400,000 tonnes per annum using 1999 emission data.

As noted previously, RRW encourages more prudent driving behaviour and that more careful driving has resulted in an annual average saving of 83 fatal crashes. This prudence includes lower speeds, reduced drinking and driving and increased compliance with road rules generally.

In terms of CO₂-e reductions, the lower speeds from RRW are the primary driver of benefit. Based on crash distributions, RRW will have approximately 10 per cent of the effect of speed cameras on speeding, leading to 40,000 tonnes CO₂-e per annum saving.

The 50 km/h local street speed limit initiative was successful in reducing speeds on local streets in south east Queensland. Travel in south east Queensland makes up 50 per cent of the total annual vkt in Queensland and approximately 10 per cent of that travel is on local streets. A 10

km/h speed reduction equates to a 5 per cent reduction in CO₂-e (Figure 4) at around 60 km/h. Based on that data, a saving of 33,000 tonnes CO₂-e per annum has been generated by the 50 km/h initiative.

The Fatal 4 campaign supports enforcement programs such as RRW, speed cameras and 50 km/h. There has been a five percentage point reduction in the proportion of people who think that travelling 10-15 km/h over the speed limit is not speeding. If that reduction is translated into behaviour, five per cent of people are travelling 10-15 km/h slower. Across Queensland, a 10 km/h speed reduction for five per cent of vkt produces a CO₂-e saving of 67,000 tonnes per annum.

Random breath testing (RBT), while it is targeted at drink driving, encourages more prudent driving behaviour in a similar manner to RRW. Similar CO₂-e reductions would be expected from this program.

Better roads: Improved road design and construction, including more even vertical and horizontal curves, more appropriate speed limits and more dual carriageway and passing lanes has helped to reduce Queensland's road toll.

The following information provides approximate values for road safety improvements for various road engineering improvements:

- rural road duplication - crash reductions of 29 per cent;
- improving vertical curvature - crash reductions up to 52 per cent;
- improving horizontal curvature - crash reductions;
- passing lanes - crash reductions of 25 per cent.

(Ogden, 1996)

Similarly, better roads help drivers to maintain steadier speeds, avoid excessive overtaking and braking and generally encourage more consistent driving behaviour. Given appropriate speed limits, these factors also reduce overall fuel consumption and contribute to greenhouse gas savings.

Better vehicles: Better vehicles contribute to road safety outcomes in two main ways. Firstly, on average, newer vehicles contain more safety features than older vehicles and have been designed to offer better crash avoidance capability and more occupant protection in the event of a crash.

Secondly, newer or well maintained vehicles are less likely to have defects that could contribute to a crash. Currently, vehicle defects contribute to approximately five per cent of road fatalities in Queensland.

Better vehicles also contribute to greenhouse gas savings. Newer vehicles tend to have more fuel efficient engines resulting in improved fuel economy. Newer vehicles also contain more emission control systems to reduce the amount of noxious material released from the vehicle.

Similarly, well maintained vehicles, as well as being safer, tend to be better tuned so that engines work more efficiently, reducing excessive fuel consumption. Well maintained vehicles would be more likely to have correctly functioning emission control systems, minimising ecological impacts.

Programs for ecological sustainability

Reduce emissions: The QT programs detailed previously can deliver emission savings through encouraging regular maintenance and servicing of vehicles. The OVERT program, Smoky Vehicle Hotline and Aircare public education all encourage people to improve the roadworthiness of their vehicles.

Currently in Queensland, vehicle defects contribute to five per cent of fatal crashes, or 13 fatal crashes in 1999. Programs that encourage better vehicle maintenance should reduce the number of defective vehicles involved in road crashes. If it is assumed that 50 per cent of defective vehicle owners will respond to encouragement for more regular maintenance then a potential 6.5 fatal crashes per year would be prevented (see Table 3).

These programs also encourage owners of older vehicles, for which maintenance has become expensive, to either move to a newer vehicle or try other travel options. Newer vehicles, as well as being less polluting are also usually safer with more active and passive safety protection. Other travel options would tend to reduce vkt and both this and the newer vehicle option would have positive outcomes for road safety.

Demand management: Demand management encompasses programs that reduce vkt by reducing total travel demand or converting some demand from private vehicles to other modes. Reducing vkt means less vehicle travel which clearly reduces emissions but also reduces crash risk because of less exposure.

Demand management programs discussed previously are aiming for a conservative 10 per cent drop in vkt in urban areas. At our current level in Queensland of less than 1 fatality per 100 million vkt, this would result in a saving of 14 fatalities per year (see Table 3).

**Table 3. Potential fatal road crash savings from environmental programs
Queensland**

Environmental program	CO2-e	Potential fatal
-----------------------	-------	-----------------

	reduction (k tonnes p.a.)	road crash savings p.a.
Emission reduction	100	7
Demand management	700	14
Land Use/Urban planning	700	14

Land use/urban planning: Improvements in land use and urban planning can also reduce the need for people to travel as much as they currently do. Developments that increase housing density, particularly close to CBDs and developments aligned with public transport are typical examples. This type of planning means that trips may be shorter and more local, they may make more use of public transport and include more walking and cycling.

All this means there is less private vehicle use, less emissions and, for road safety, similar reduced crash risk as for demand management (see Table 3).

Are there any problems?

Increased walking and cycling would lead to a larger proportion of road users in two vulnerable groups. It will be important, from a road safety perspective, that increases in the proportion of these groups are carefully managed. Mode separation, appropriate speed limits and public education are possible actions to help manage any impacts

Lighter vehicles may increase the risk of life threatening injury to occupants in crashes but may reduce the risk to other road users. Airbags and collision avoidance technology should help to reduce injury rates.

Local traffic calming, to reduce crashes involving pedestrians and cyclists, can lead to increased emissions. Figure 4 shows markedly increased emissions for speeds under 40 km/h. It is important to design local traffic calming devices to encourage drivers to maintain consistent speeds rather than brake and accelerate repeatedly.

Where to from here?

This research is only in the early stages and requires further investigation. The development of models to value the comparative costs and benefits of road safety and ecological programs is a logical next step. The work of the Bureau of Transport Economics may be useful (BTE, 2000).

The impact of new vehicles on both safety and sustainability also needs further work. There are changes in the fleet in terms of vehicle size and type mix that confuse outcomes in both areas. New vehicles are usually safer but there is a trend to smaller/lighter cars and larger

recreational vehicles, both of which change the safety outcome. Similarly, newer vehicles tend to be more fuel efficient although they may also be more heavily optioned or larger (for recreational vehicles) which affects the fuel efficiency.

7. Conclusions

This paper has examined some road safety and ecological sustainability programs and found mutual benefits. While there is more work to be done in evaluating these benefits, it is clear that there are good arguments for closer cooperation between the two fields.

There should be more emphasis on programs that deliver benefits in both areas. There is potential for strategic partnerships between road safety and ecological sustainability to produce improved outcomes overall, making road travel safer and more sustainable.

References

ABS (1999) *Survey of Motor Vehicle Use*. Australian Bureau of Statistics, Melbourne, Australia

BTE (2000) *Road Crash Costs in Australia*. Bureau of Transport Economics, Canberra, Australia

DMR, 2000 Confidential in-house report

EPA, 1999 *A Strategy for Improving Air Quality in South East Queensland*, Environmental Protection Agency, Brisbane, Queensland

Ogden KW (1996) *Safer roads: a guide to road safety engineering*. Monash University, Melbourne, Australia