chapter 8

8. transport and the environment

8.1 Climate change

There is now little dissent from the view that climate change is happening, is highly likely to be caused by human activity and is accelerating. As the UK Stern Review noted:

> *"The scientific evidence is now overwhelming: climate change is a serious global threat and it demands an urgent global response."*[1]

This view has been endorsed by the interim report of the Garnaut Climate Change Review, which states that:

> *"The large majority of the relevant scientific opinion, and of the leadership of the learned academies of science in the countries of great scientific accomplishment, hold the view that human-induced climate change is with us, and that it is already affecting natural and human systems and will increasingly create risks to current patterns of human settlement and activity."*[2]

Similarly, the Intergovernmental Panel on Climate Change recently observed that global debate is now focusing on responses to climate change – on what must be done to slow its progress and ameliorate its effects.[3]

This view is accepted by the Victorian Government, which presented – and signed – a Declaration on Climate Change to the Council for the Australian Federation (CAF) in February 2007 that formally recognises "the scientific evidence demonstrating that human activities are already having an impact on the global climate and that to avoid dangerous climate change, deep cuts in global greenhouse gas emissions will be required by mid-century".[4]

The Study Team shares the view of the Victorian Government that climate change presents a real risk to the state's economy and the environment, and that action needs to be taken to reduce greenhouse gas (GHG) emissions. The Team notes that tackling transport's GHG emissions is part of a broader agenda that extends well beyond the scope of the EWLNA and that Victoria's new Office of Climate Change is investigating initiatives to reduce emissions from the state's transport sector.

While concurring with the view expressed by the Stern Review and others that "cost effective emission savings from transport are initially likely to come from improvements in the fuel efficiency of oil-based transport vehicles, behavioural change, and use of biofuels",[5] the Study Team recognises that transport cannot be immune from targeted action to reduce emissions and that it is essential to consider the impact of new transport projects on climate change and GHG emissions.

8.1.1 Transport's contribution to GHG emissions

Globally, transport is the third largest contributor to GHG emissions (after stationary energy – or power – and land use). Currently, transport contributes around 14 per cent of emissions worldwide and has been the fastest growing source of emissions worldwide, due to the continuing growth in car transport and the rapid expansion of air transport.[6]

As shown in Figure 88 the largest single source of direct GHG emissions in Australia is the stationary energy sector (electricity, gas and water), which accounts for 50 per cent of Australia's emissions. In 2005, 14 per cent of all GHG emissions in Australia were generated by the transport sector, with 87.9 per cent of these emissions coming from road transport. Between 1990 and 2005, these emissions grew by 29.9 per cent, increasing by around 1.8 per cent each year.[7]

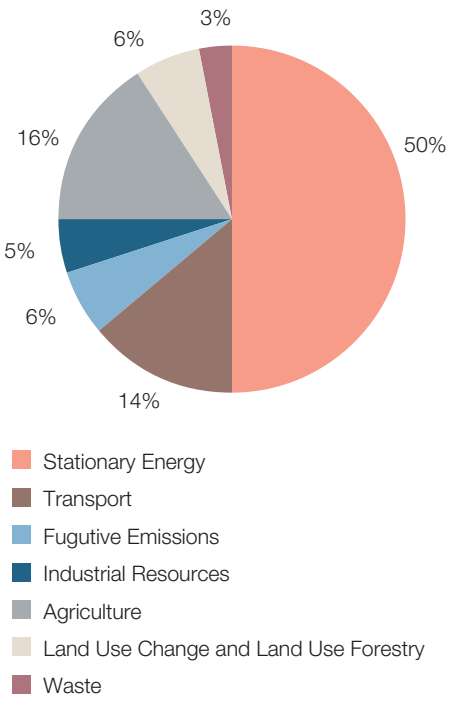
1. U.K. H.M. Treasury (2006), *Stern Review: The economics of climate change*, September 2006, United Kingdom, Department of Treasury, p.vi
2. Garnaut, Ross (2008) *Climate Change Review: Interim Report to the Commonwealth, State and Territory Governments of Australia*, Canberra, p.8
3. IPCC: Intergovernmental Panel on Climate Change (2007), *Climate Change 2007: The Physical Science Basis (Summary for Policymakers)*, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva, Switzerland
4. CAF: Council for the Australian Federation (February 2007), Declaration on Climate Change, available at the Department of Premier and Cabinet website: www.dpc.vic.gov.au
5. U.K. H.M. Treasury (2006), Annex 7.c
6. Ibid, p.356
7. All figures sourced from: Australian Greenhouse Office (2007), *National Greenhouse Gas Inventory 2005*, Department of the Environment and Water Resources, Commonwealth of Australia, Canberra

GHG emissions from transport are estimated to grow by more than 40 per cent between 1990 and 2010 and by more than 60 per cent between 1999 and 2020.[8] While these projections are for a relatively strong rate of growth in emissions (around 1.7 per cent a year between 2000 and 2020), the average projected growth rate is slightly below that of the 1990s (of about 1.9 per cent a year).[9]

The Bureau of Infrastructure, Transport and Regional Economics has noted that the scale of this forecast growth points to the fact that Australian transport demand is highly dependent on underlying economic and population growth.[10] The BITRE's projections of GHG emissions cover three scenarios (base case, high and low), with the BITRE noting that the high and low trends are not necessarily plausible scenarios for the future.[11]

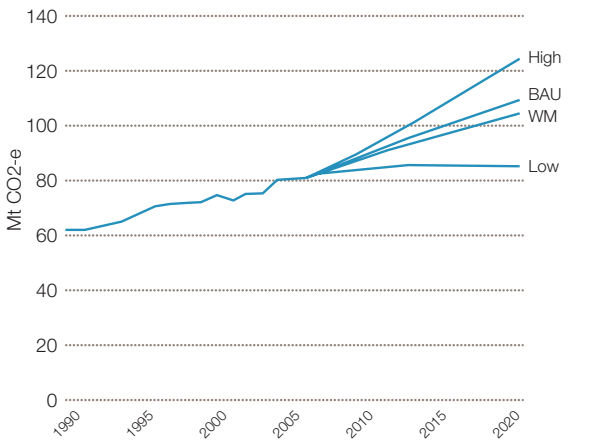
In Victoria, transport is also the second largest producer of GHG after stationary energy production. In 2005, energy production generated around 55 per cent of all GHG emissions attributable to Victoria, while transport across all modes generated 16.9 per cent of total Victorian emissions. Emissions from the transport sector grew by 26.5 per cent between 1990 and 2005.[12]

Figure 88 – Australia's GHG emissions by sector – 2005



Source: Australian Greenhouse Office (2007)

Figure 89 – GHG emissions from the transport sector, 1990 to 2020



Source: BITRE (2007), Department of Climate Change analysis
Note 1: WM = 'With Measures' best estimate; BAU = 'Business as usual'
Note 2: High and low scenarios are variations on the 'With Measures' scenario

8. Australian Greenhouse Office (2006), *Transport Sector Greenhouse Gas Projections 2006*, Department of the Environment and Heritage, Commonwealth of Australia, Canberra. See also: BITRE (2003), *Greenhouse Gas Emissions to 2020*, Information Sheet 21, Commonwealth of Australia, Canberra. In 2008, the programs and functions of the Australian Greenhouse Office were taken over by the Department of Climate Change. This report continues to refer to the Australian Greenhouse Office in relation to publications released prior to this change in administrative arrangements.
9. BITRE (2003b), *Greenhouse Gas Emissions to 2020*, Information Sheet 21
10. BITRE (2005), *Greenhouse Gas Emissions from Australian Transport – Base Case Projections to 2020*, Department of Transport and Regional Economics, Commonwealth of Australia, Canberra
11. Ibid
12. AGO: Australian Greenhouse Office (2007b), *Victorian Greenhouse Gas Inventory 2005,* Department of Environment and Heritage, Commonwealth of Australia, Canberra

8.1.2 Modes of transport and GHG emissions

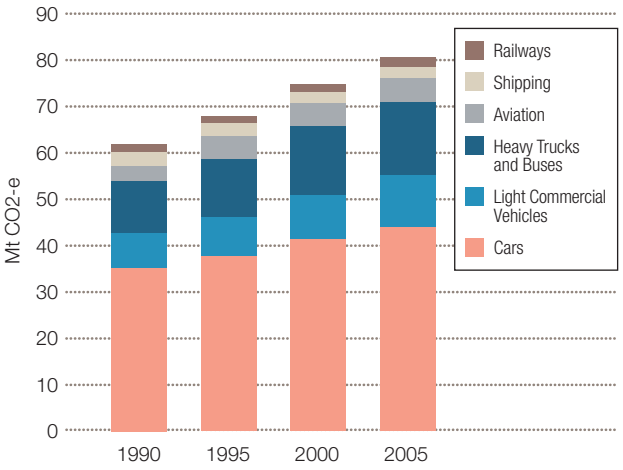
Currently in Australia, passenger cars account for more than half of the transport sector's GHG emissions. Emissions from cars increased by 25 per cent between 1990 and 2005;[13] however, car emissions grew at a slower rate than emissions from light commercial vehicles (LCVs), trucks and buses.

In Victoria, road transport was responsible for more than 90 per cent of emissions from the transport sector in 2005, although it should be noted that this calculation by the Australian Greenhouse Office does not include emissions associated with the use of electricity by Melbourne's metropolitan train and tram system.[14] Cars continue to contribute the majority of GHG emissions and are expected to contribute 56 per cent of emissions in 2008, with 25 per cent of emissions coming from trucks and other commercial vehicles.[15]

Victoria's Commissioner for Environmental Sustainability has noted that the current greenhouse intensity of car use in Melbourne is particularly high compared to many other cities – due largely to Melbourne's low urban density, which generates longer trip distances than comparable international cities. The Commissioner has observed that these relatively high levels of transport energy intensity mean that "attention must focus on ensuring that inefficient car use is minimised through better urban planning and design".[16]

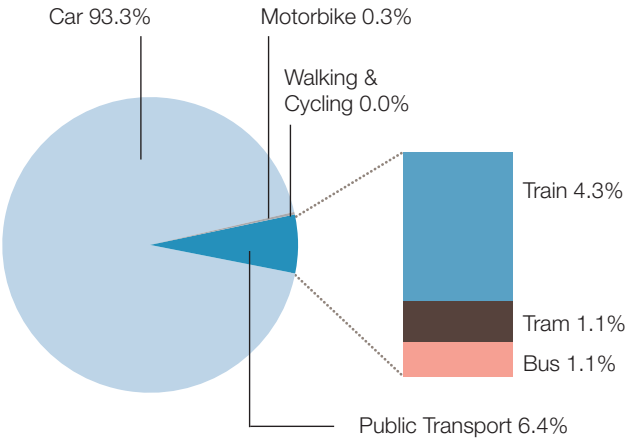
In Melbourne, recent research undertaken by Victoria's Department of Infrastructure shows that the overwhelming majority (more than 93 per cent) of GHG emissions from land passenger transport are being generated by motor vehicles (see Figure 91).[17]

Figure 90 – Total transport emissions by sub-sector in Australia, 1990 to 2005



Source: Australian Greenhouse Office (2007)

Figure 91 – Percentage of total passenger transport GHG emissions in Melbourne by mode



Source: Public Transport Division (DOI)

13. Australian Greenhouse Office (2007), *National Greenhouse Gas Inventory 2005*
14. This electricity use is accounted for within the energy industries sector: AGO (2007b)
15. BITRE (2002b), *Report 107; Urban Pollutant Emissions from Motor Vehicles: Australian trends to 2020*, Commonwealth of Australia, Canberra
16. Commissioner for Environmental Sustainability (2007), *Creating a city that works*, Position paper, May 2007, State of Victoria, Melbourne, p.8
17. Information provided by Public Transport Division (DOI)

8.1.3 Future trends

Australia-wide, by 2020, cars are expected to still be the largest single contributor to transport emissions, but the proportion of emissions they contribute will have decreased from around 57 per cent (in 2000) to around 50 per cent.[18] Emissions from cars will also grow at a slower rate (around 0.8 per cent a year) between 2005 and 2020 (see Figure 92).[19]

Aviation and LCVs are projected to have the strongest rates of growth (each averaging around 2.6 per cent per year).[20]

In Victoria, GHG emissions from transport are predicted to rise a further 16.4 per cent by 2020 (from 2005 levels). Of this, motor vehicles (cars and road freight vehicles) are expected to continue to contribute the greatest percentage of emissions.[21]

Over the next few decades, Melbourne's strong economic and population growth will fuel growing transport demand. The high value Melburnians place on personal mobility suggests that the demand for car travel will continue to rise, but at a slower rate as car ownership reaches a saturation point. These trends suggest that Melbourne faces some significant challenges in reducing GHG emissions from transport.

The EWLNA modelled future travel patterns in Melbourne in a 'carbon constrained world' in order to understand that changes that would occur in travel behaviour in such an environment. The Study Team examined a future scenario that looked ahead to 2031 to assess the impact of:

- an immediate overnight doubling in the cost of private vehicle travel, including a doubling in the price of petrol, parking and other vehicle costs relative to other household expenditure items (with no other change in disposable income;
- a 25 per cent decrease in the cost of public transport; and
- a large increase in city density (see Figure 93).

The modelling indicated that while the growth predicted for private vehicle trips will reduce by around 6 per cent compared to the EWLNA 2031 base case, the overall number of vehicle trips taking place each day in Melbourne will still be nearly 2 million more than today – due largely to population growth.

However, increasing city density does reduce the kilometres people travel, with a 19 per cent reduction projected in the model, compared to the EWLNA base case of 'business as usual'. This can be expected to reduce CO_2 emissions by a similar proportion.

While public transport's share of travel increases, also by around 6 per cent, it is a much smaller number per day in volume terms compared to the reduction in private vehicle trips. A number of conclusions can be drawn from the modelling of this scenario:

- As motor vehicle traffic volumes will always greatly exceed public transport trip volumes, any measures to reduce GHG emissions from motor vehicles will be the most effective.
- In the long term, increases in urban density can be very effective in reducing future GHG emissions, or at least limiting emissions growth.
- Modal switch to public transport reduces GHG emissions and should be pursued, but in aggregate volumes for the whole city, such a shift may be more limited in its effectiveness than other measures.

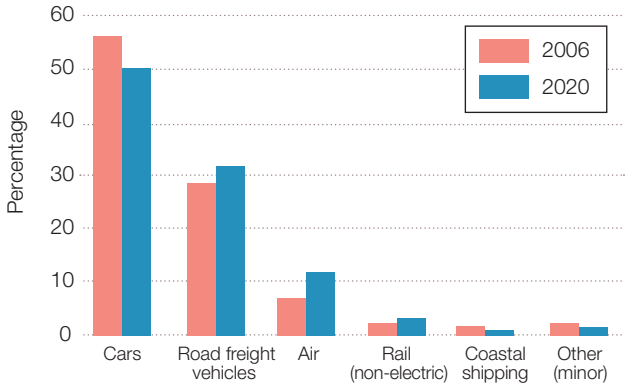
While recognising that Melbourne's transport sector must play its part in reducing GHG emissions, the Study Team believes that the timing and extent of GHG reductions demanded of the transport sector should be measured against the significant economic and social benefits delivered by the sector. As the Stern Review noted:

> *"Transport is one of the more expensive sectors to cut emissions from because the low carbon technologies tend to be expensive and the welfare costs of reducing demand for travel are high. Transport is also expected to be one of the fastest growing sectors in the future. For these two reasons, studies tend to find that transport will be among the last sectors to bring its emissions down below current levels".*[22]

This does not absolve Victoria's transport sector from the need to achieve substantial reductions in emissions; nor does it mean that transport should be 'left to last'. Substantial cuts in GHG emissions must be made by the transport sector and Victoria – and Australia – must move towards a situation where all transport users meet their external environmental costs. However, it does suggest that it may be in Victoria's long term interests to seek more immediate reductions from sectors where restrictions come at less economic and social cost (such as building efficiencies and stationary energy demand), while pursuing more aggressive measures to boost the numbers of efficient, 'clean' vehicles on the state's roads and increase public transport patronage.

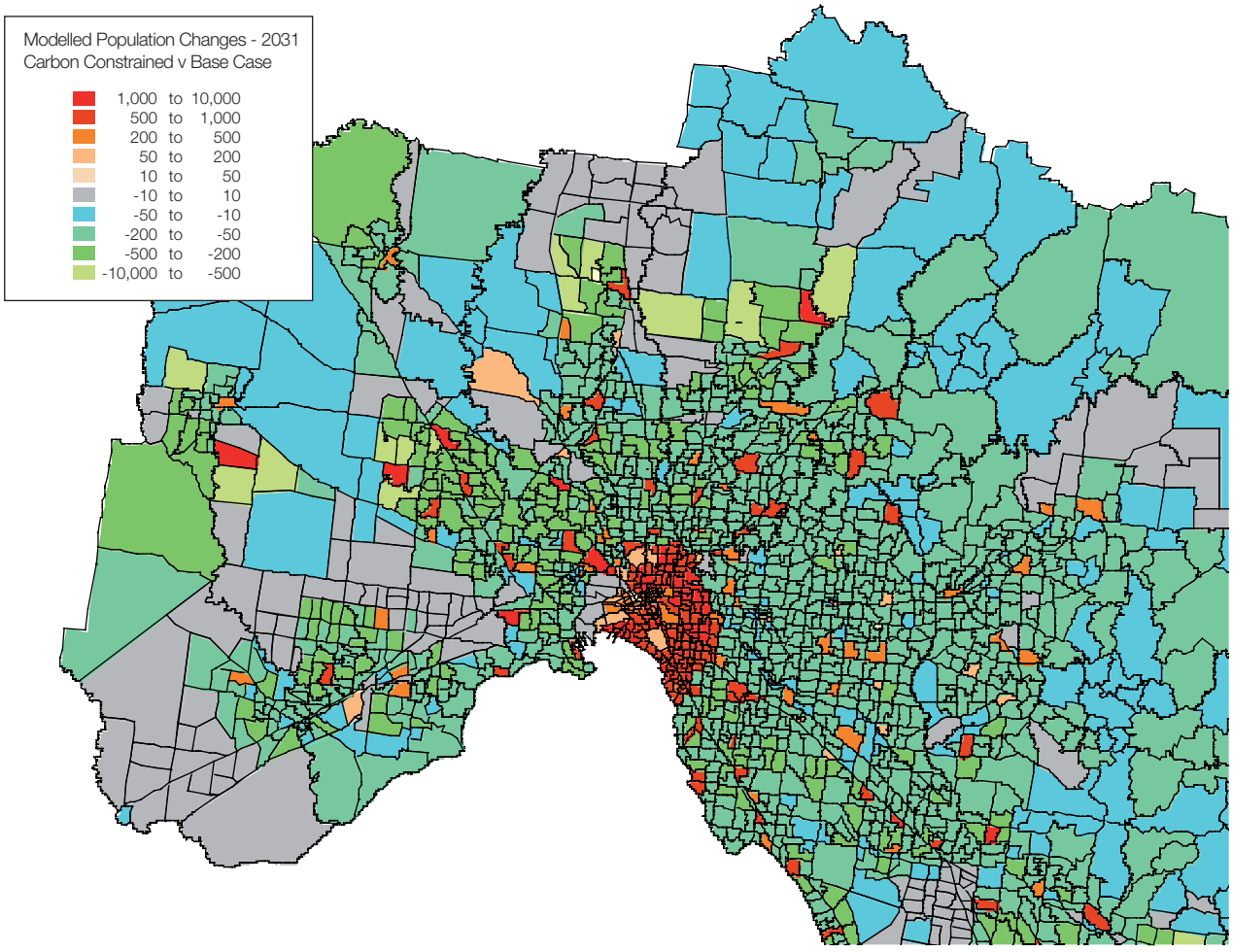
18. BITRE (2002a), *Report 105: Greenhouse Policy Options for Transport*, Commonwealth of Australia, Canberra
19. BITRE (2003), *Greenhouse Gas Emissions to 2020*, Information Sheet 21
20. BITRE (2005), p.ix
21. BITRE (2002b), *Report 107: Greenhouse Gas Emissions from Transport – Australian trends to 2020*
22. U.K. H.M. Treasury (2006), Annex 7.c

Figure 92 – Transport emissions by vehicle type (2000 to 2020)



Source: BITRE (2002)

Figure 93 – Demographics for EWLNA carbon constrained 2031 scenario



Source: EWLNA

8.1.4 Reducing GHG emissions from transport

In general, transport initiatives designed to reduce GHG emissions fall into three broad categories:

- Reducing travel demand
- Boosting public transport share
- Improving vehicle technologies

A sophisticated policy approach to reducing GHG emissions from transport combines all of these categories; however, it is important to understand the opportunities for large scale change and the relative effectiveness of each category in contributing to GHG reduction.

Reducing travel demand

Reducing or suppressing travel demand is a tough challenge, especially when confronted with a rapidly growing population, strong economic growth and an expanding city. Without adopting a draconian approach, the principal measures available to reduce travel demand involve regulating and/or encouraging different patterns of land use and persuading (gently or aggressively) people to change their personal travel behaviour.

Land use patterns

As noted earlier in this report – and confirmed by the EWLNA carbon constrained scenario – a growing body of evidence indicates that residents of high density areas tend to travel less. The Victorian Government has recognised the benefits of higher density development and taken action to promote a more compact Melbourne through its *Melbourne 2030* framework.

While a number of positive developments are occurring as a result of the framework, certain aspects – most notably the Urban Growth Boundary – are under pressure from developers, local councils and others. There also appears to have been little progress made towards more closely integrating transport and land use planning across Melbourne – although positive steps have been taken in the creation of the Growth Areas Authority, the appointment of a Coordinator General for Infrastructure and in giving planning referral powers to the Director of Public Transport.

Despite these issues, the Study Team believes that the aims of the *Melbourne 2030* framework are highly laudable from a transport perspective. In particular, overseas evidence suggests that the transit oriented development proposed for centres such as Footscray, Sydenham and Dandenong is likely to result in increases in public transport use and shorter, local trips replacing longer journeys. However, it is difficult to see these developments having a substantial impact on the overall demand for car travel within Melbourne over the next two decades.

The Victorian Competition and Efficiency Commission explored these issues in 2006 as part of its inquiry into congestion in Victoria and concluded that the overall impacts of land-use policies on road traffic and congestion are "likely to be limited in the short term, as urban development tends to occur incrementally".[23]

The Study Team's view is that, while initiatives such as *Melbourne 2030* must continue to be pursued, they will take time to make a major contribution to reducing GHG emissions from transport.

Changing people's behaviour

Historically, Melburnians' have not adjusted their travel patterns on the basis of environmental concerns. While the recent growth in public transport patronage may indicate some behavioural change as a result of growing awareness of climate change, most evidence suggests that increases in public transport patronage are due more to concerns about the increasing costs of travel, wanting to avoid inner city parking problems and perceptions of the greater convenience and accessibility of public transport.

There appears to be growing awareness about the adverse impacts of transport on the environment. A 2007 survey commissioned by the Australian Automobile Association (AAA) found that 8 in 10 Victorian motorists are concerned about the effect of motor vehicles on the environment – a significant change in attitude from previous years. However, this concern is taking time to translate into changes in travel behaviour: while significant numbers of respondents to the AAA survey believe that alternative technologies and fuels are the answer, only 14 per cent feel that driving less will help to reduce the effect of cars on the environment.[24]

23. VCEC (2006), p.312
24. Australian Automobile Association (2007)

Australians also show little inclination to purchase fewer cars. In 2007– for the first time – Australians purchased more than 1 million new motor vehicles in a single calendar year.[25] This indicates that, while many people say that they recognise the impact of cars on the environment, there is no corresponding behaviour change when it comes to their purchasing patterns (although it should be noted that new vehicles generally have a better emissions performance).

The type of cars being purchased also shows little evidence of being affected by environmental concerns In 2007, the number of new SUVs being purchased grew by more than 16 per cent.[26] As the Chief Executive of the Federal Chamber of Automotive Industries observed:

> *"The 2007 figures show it would be far too simplistic to conclude, as some have, that there is a general move by Australian consumers to smaller cars. While sales of smaller cars have been growing strongly, in 2007 sales of SUVs and 4x4 Pick-ups grew even faster."*[27]

The Study Team notes that there appears to be considerable scope for encouraging Melburnians to change their travel behaviour in relation to four particular areas:

- Shorter trips – While cars are the dominant mode of transport in Melbourne, more than 40 per cent of trips within the metropolitan area are less than 2 km long, and almost two-thirds are less than 5 km long.[28] There is clearly scope to encourage many more people to walk or cycle when undertaking short local trips.
- Trips to school – Between 17 and 21 per cent of all trips in Melbourne from 8.30am to 9am are children being driven to school.[29] There is clearly room to increase the number of these trips being made by walking, cycling or public transport.
- Single occupant trips – For around 90 per cent of commuter or peak period car trips in Melbourne, there is just one person travelling in the vehicle. Ride-sharing policies and schemes that encourage more people to travel together may help to remove some cars from Melbourne's roads, especially during peak periods.
- Peak period trips – Encouraging more people to travel outside peak periods or to use public transport during these periods would contribute to reducing GHG emissions from transport.

A range of measures can be used to encourage behaviour change in these areas, including community education and awareness programs (such as Victoria's *TravelSmart* program), specific initiatives (such as the 'Walking Bus' program or the Government's recently announced 'Flex in the City' initiative) and road pricing.[30]

In its examination of these and other measures, VCEC found that "international experience … suggests that although worthwhile, many of these measures will have a limited aggregate impact on congestion in Melbourne".[31]

The Study Team shares this view and believes that, as the general demand for car travel grows across the city, these measures can contribute to reducing GHG emissions when used in combination with other measures. However, it is highly unlikely that these measures alone will make a significant contribution to reducing overall GHG emissions from transport in Melbourne.

Boosting public transport mode share

Overall, public transport in Melbourne performs significantly better than cars when it comes to GHG emissions. However, when CO_2 emissions are analysed per passenger kilometre, the picture that emerges is a much more complex one – revealing that this performance is mainly due to the large number of people that are moved by public transport during peak periods, rather than to the inherent efficiency of Melbourne's trains and trams.

In fact, during off-peak periods, the GHG intensity of public transport increases to the point where it is higher than car travel (with average occupancy). As Victoria's Commissioner for Environmental Sustainability has noted:

> *"While GHG emissions from cars make up the greatest proportion of transport related emissions … Victorian modes that rely on electricity (trams and trains) have GHG full fuel cycle intensity levels on an average per-person kilometre basis that are comparable to motor vehicles".* [32]

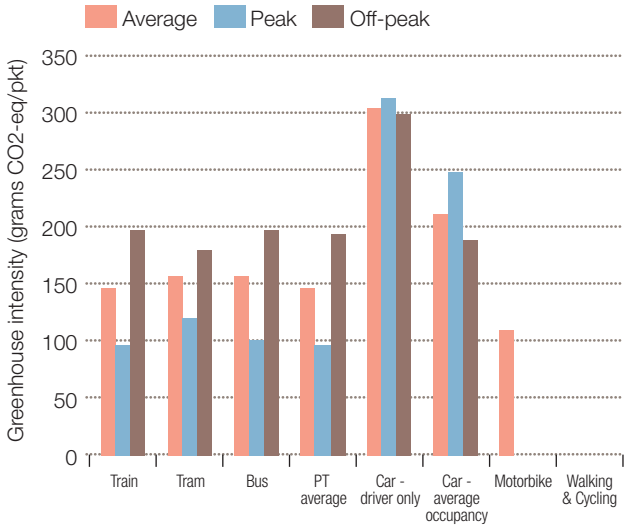
25. FCAI: Federal Chamber of Automotive Industries 2007, Vehicle Sales Reports, accessed at www.fcai.com.au
26. FCAI (2007)
27. See Federal Chamber of Automotive Industries, 'A milestone year for motor vehicle sales', Media Release, 7 January 2008, accessed at: www.fcai.com.au/medial
28. Patton, T. (October 2006), *Improving local access: a new program of demonstration projects*, Paper presented at Walk 21-VII, 'The Next Steps', The 7th International Conference on Walking and Liveable Communities, October 23-25 2006, Melbourne, Australia
29. Peddle, B. and Sommerville, C. (2005), Travel Behaviour Change through School Travel Planning: Mode Shift and Community Engagement – Results from 33 Schools in Victoria, 28th Australian Transport Research Forum, Sydney; VicHealth (2005), Walking School Bus Program. Funding Guidelines 2005-2006, Melbourne
30. See Chapter 4 for a more detailed discussion on road pricing.
31. VCEC (2006), p.302
32. Commissioner for Environmental Sustainability (2007)

This is due to Victoria being largely dependent upon brown coal for the State's electricity supply. This means that the operating GHG intensity of trams and trains is likely to be lower than motor vehicles during peak times (due to high occupancy rates and traffic congestion), but higher in non-peak times.

In the years ahead, efficiency gains in the stationary energy sector (such as clean coal technologies) will flow through to public transport and further improve its CO_2 performance, although these improvements will be relative to the improvements being made in road CO_2 performance.

Encouraging much greater use of public transport is a critically important element in reducing GHG emissions from transport. However, even under the most optimistic scenarios of modal shift to public transport, it will not be possible to achieve the magnitude of shift required to make a substantial impact on emissions over the next 25 to 30 years. Car travel will remain high – making emissions from motor vehicles a primary and urgent target for GHG reduction strategies.

Figure 94 – Average GHG intensities of public transport and cars in Melbourne



Source: Public Transport Division (DOI)

While every effort must be made to encourage public transport use, there are significant impediments to a large scale shift:

- Public transport is particularly effective when moving large numbers of people from a catchment area along a fixed route to a specific destination. While this makes public transport most effective for journeys to work and education in large centres, private motor vehicles remain the most flexible and convenient option for the millions of other journeys Melburnians make each day. Achieving a major mode shift in these other journeys is highly unlikely in the foreseeable future.
- Around 16 per cent of Melbourne's population lives within 10 km of the GPO.[33] Generally, these people have good public transport options and see public transport as a viable travel alternative for a range of trips. The vast majority of Melburnians live beyond that radius and do not have the same choices as inner city residents.
- In many parts of Melbourne – notably the outer suburbs – the car remains the most convenient and, in some places, the only travel option for some types of journeys: where trips are linked together (such as dropping the children off at school combined with grocery shopping and visiting a relative); where the trip takes place at a relatively quiet time of day; or where the trip involves a journey that would require several changes if undertaken by public transport (such as from car to train to bus).

  The most recent ABS Motor Vehicle Census shows that residents in Melbourne's outer suburbs purchase many more cars than people living in the inner city. Households with three or more cars have also increased rapidly in the outer suburbs, compared with inner Melbourne.[34]

  Even if Melbourne commenced a program of massive investment in rail extensions, it would take many years for projects to be completed – and these projects would still be unlikely to meet the diverse travel needs of people living in the outer suburbs.
- A significant section of the population simply does not have the option of shifting away from car travel. This includes tradespeople, delivery and salespeople, small businesses and others who need motor vehicles to conduct their businesses and earn a living.
- People's general preference for car travel means that there will be some people who will never shift from their cars, even where public transport is an available and attractive option.

33. DSE (2006)
34. The 2007 ABS Motor Vehicle Census shows that two thirds of the additional 350,000 cars on Melbourne's roads over the last 10 years were purchased by people living in outer suburban municipalities. Households with three or more cars also increased rapidly in the outer suburbs. ABS (March 2007), 9309.0 – Motor Vehicle Census, Commonwealth of Australia, Canberra

In short, for every trip made on public transport in Melbourne, seven or eight trips are made by car. Even where very large gains are made in public transport, the growth in the actual number of car trips will always be much higher. As the Victorian Government noted in its 2006 *Meeting Our Transport Challenges* statement:

> *"There are limits to the impact that public transport system improvements can have. This is because the current number of people travelling by car is several times higher than those using public transport (meaning that a small reduction in car usage requires a very large increase in public transport usage in relative terms)."*[35]

In 2006, VCEC examined the impact of major public transport improvements on congestion in Victoria and overseas. VCEC noted that most improvements resulted in small reductions in road traffic volumes (of around 5 per cent or less). Even where improvements had a significant impact on traffic volumes, the reductions achieved were between 10 to 15 per cent.[36]

VCEC concluded that the net impact of public transport extensions on road congestion in Melbourne is likely to be small.[37] However, VCEC did note that a combination of options (such as public transport improvements combined with road pricing) may lead to more substantial and sustained reductions in congestion levels.[38]

The Study Team strongly endorses the need for improvements to public transport in Melbourne and notes that the greatest impact on road congestion (and therefore GHG reduction) from modal shift will come from increasing the use of public transport during peak periods. As public transport performs much better than cars in terms of GHG intensities per person kilometre during peak periods, investments that lead to an increase in public transport during these periods will make the most effective contribution to reducing emissions via modal shift.

35. Government of Victoria(2006), *Meeting Our Transport Challenges*, p.28
36. VCEC (2006), p.211
37. Ibid, p.305
38. Ibid, p.306

Improving vehicle technologies

Over the last two decades, significant advances have been made in reducing emissions from motor vehicles that affect air quality – with some industry observers stating that for a range of standard vehicles, the emissions from one modern vehicle are around 1/70th of the emissions from the equivalent vehicle of 20 years ago.

More recently, the emphasis in vehicle emission technology has shifted towards reducing GHG emissions.[39] The latest international motor shows provide strong evidence of this shift, with global car manufacturers unveiling an increasing number of 'cleaner, greener' vehicles and demonstrating substantial investment in new technologies aimed at reducing GHG emissions from their vehicles.

These technologies include advances in petrol and diesel engines, petrol-electric hybrid vehicles (combining battery power and a combustion engine), plug-in hybrid vehicles (powered entirely by an electric motor and battery charged) and hydrogen fuel cell vehicles. Cars that run on alternative biofuels – such as ethanol and biodiesel – are also being developed (although these fuels come with potentially significant environmental and social costs that must be addressed before thay are acceptable on a broader scale).

Globally, a combination of high fuel prices, consumer concerns about climate change, increasing pressure from governments and the realisation that fossil fuels are finite is encouraging manufacturers to give greater priority to pursuing these technologies. As General Motors CEO Rick Wagoner recently noted: boosting the use of these technologies is both a "business necessity and an obligation for society".[40]

In Australia, the Study Team's consultations with local car manufacturers revealed a commitment to – and growing investment in – initiatives aimed at improving fuel efficiency (to reduce CO_2 emissions), making exhaust emissions cleaner (to reduce atmospheric pollution) and pursuing energy diversification. These initiatives range from improved vehicle aerodynamics and tyre technology to new types of engines, such as electric, hybrid and hydrogen.

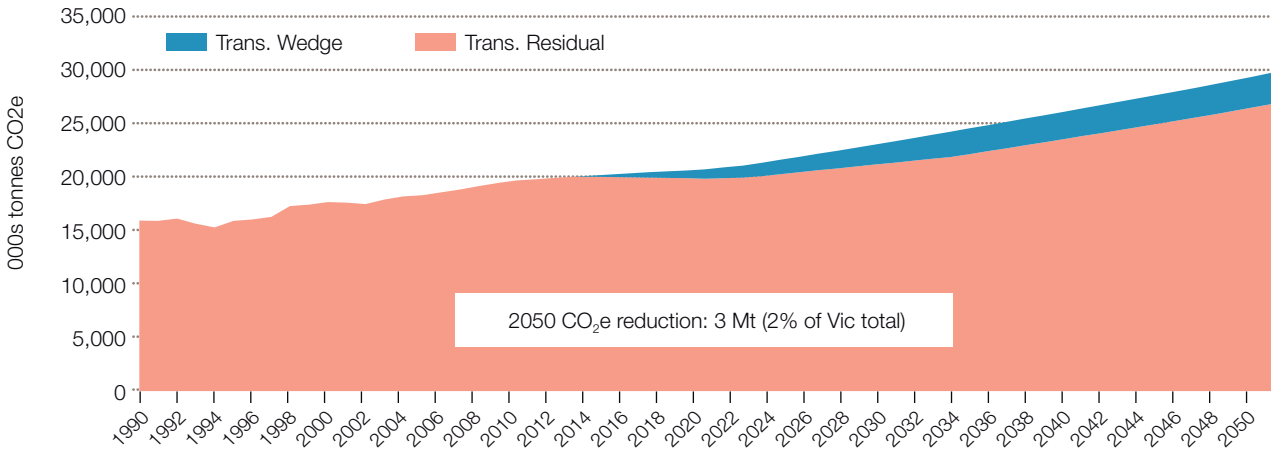
Evidence is emerging that these new vehicle technologies have the potential to deliver very substantial reductions in GHG emissions.

The US Environment Protection Agency has found that GHG reductions of up to 29 per cent could be achieved from hybrid electric cars; reductions of up to 80 per cent from optimised alternative fuel (ethanol) vehicles and reductions in excess of 90 per cent from fuel cell vehicles.[41]

39. The main GHG emitted by motor vehicles is carbon dioxide (CO_2). A vehicle's CO_2 emissions per kilometre are a product of its fuel efficiency (litres per kilometre) and its carbon emissions per litre.
40. 'Carmakers stress green at Detroit Motor Show', 14 January 2008, AFP, accessed at: http://afp.google.com/article/ALeqM5gEjnShnsRe11k1PfHukVH_fQXPAA
41. United States Environmental protection Agency (2007), *A Wedge Analysis of the US Transportation Sector*, Office of Transportation and Air Quality, US Government

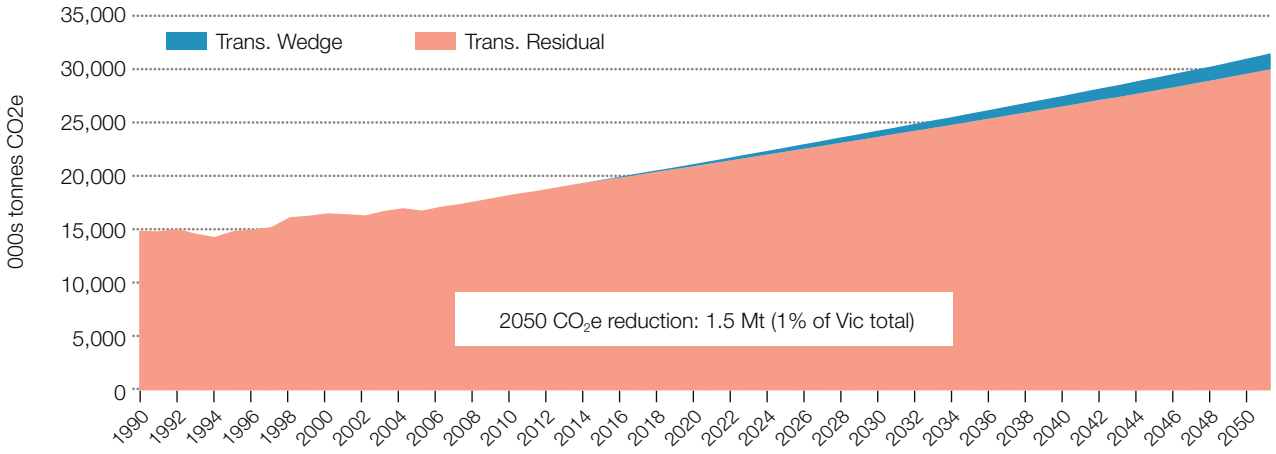
Impact on GHG reduction in Victoria

Figure 95a – Demand management



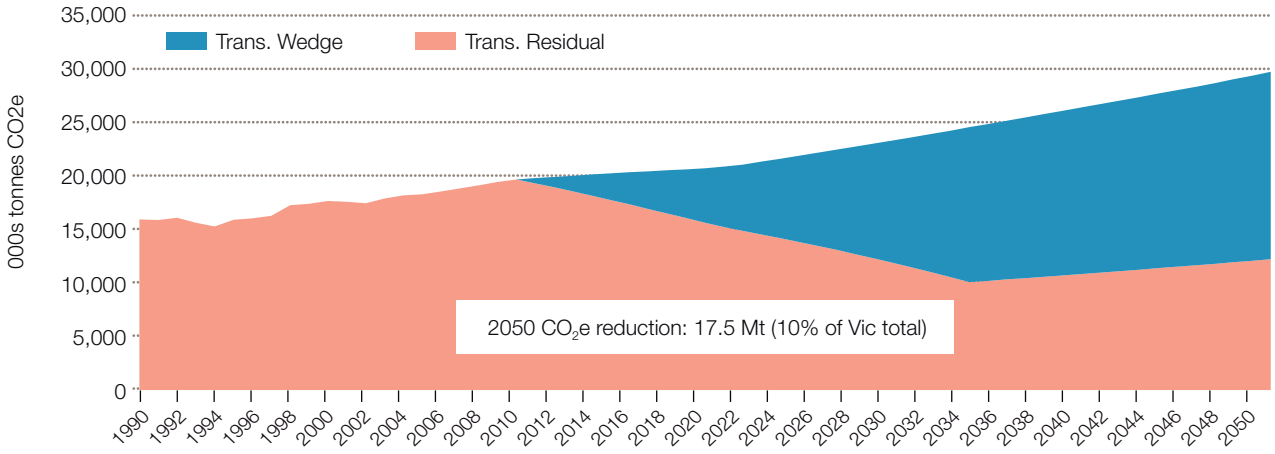
Source: Office of Climate Change (2008)

Figure 95b – Mode shift to public transport and rail freight.



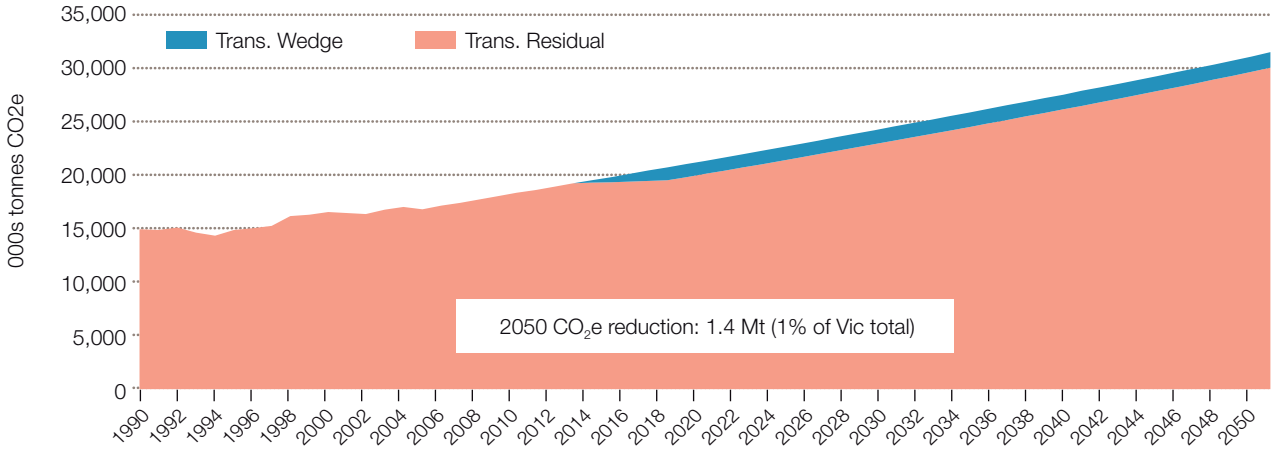
Source: Office of Climate Change (2008)

Figure 95c – Improved fuel and vehicle efficiency



Source: Office of Climate Change (2008)

Figure 95d – Increased vehicle occupancy



Source: Office of Climate Change (2008)

A 2007 analysis by the US Electric Power Institute found that if 'plug-in' hybrid vehicles could capture 60 per cent of market share in the United States, they could potentially help to reduce around 450 million metric tons in GHG emissions a year by 2050 (the equivalent of removing 82 million passenger cars from US highways).[42]

In Australia, the CSIRO has stated its belief that it is possible to reduce GHG emissions from the nation's transport sector by 37 per cent by 2020 and 80 per cent by 2040 and has stated that:

> *"To meet these targets, we see vehicles evolving from traditional internal combustion engine powered cars through to hybrid (combustion/electric) powered vehicles and, in the long term, possibly to hydrogen fuel cell powered vehicles."*[43]

Victoria's Commissioner for Environmental Sustainability has also observed that:

> *"The future is very optimistic for environmental vehicles. With the advent of hybrid and zero GHG fuel cells, GHG and air pollution will gradually decline (at least nationally)."*[44]

But there is still some way to go to achieve these sorts of results, with the current market share of conventional hybrid vehicles, such as the Toyota Prius, remaining very low. Some observers also believe that some of these technologies are untested and that their commercialisation and affordability are too far into the future to be of use in reducing GHG emissions. However, as shown by Figures 95a to 95d, recent analysis by Victoria's Office of Climate Change (OCC) found that improving fuel efficiency is easily the most effective way to reduce emissions from transport ahead of demand management measures, mode shift to public transport and increased vehicle occupancy. The OCC analysis also placed improved fuel technology in the top three measures that could be employed to reduce GHG emissions across the board by 2020.

Clearly, there are some uncertainties in these emerging technology trends. For example, considerable research and development still needs to be directed towards battery development before the benefits of plug-in hybrid vehicles can be fully realised. Similarly, the hydrogen fuel cell – which appears to offer very substantial benefits in reducing GHG emissions – is still at a relatively early stage of development.

However, there are already many vehicles in production that offer dramatically improved CO_2 emission levels compared to vehicles widely purchased in Australia. For example, Peugeot and Citroën achieved a combined fleet average of 140 grams of CO_2 per kilometre for all the cars they sold in France in 2006 – a considerable achievement.[45] Another French manufacturer, Renault, is already producing the Logan five-seater saloon, which has emissions of less than 100g CO_2/km – a good indicator of the small car performance that can be achieved in the near future.

Of course, a majority of vehicles within the broader vehicle fleet still have much higher CO_2 emissions, with larger 4WD vehicles averaging between 200g to 300g CO_2/km (and some well above 300g). However, Ford and GM have indicated their interest in exploring options for trucks, utes and 4WDs – recognising that these are the preferred vehicles for many American consumers.

42. Electric Power Research Institute (July 2007), *Environmental Assessment of Plug-In Hybrid Electric Vehicles – Volume 1: Nationwide Greenhouse Gas Emissions*, Palo Alto, California; See also: 'Hybrid cars can cut greenhouse emissions', Sydney Morning Herald, 20 July 2007, accessed via www.smh.com.au
43. CSIRO (2007), Overview: National Research Flagships – Flagship research into low emissions transport at: http://www.csiro.au/science/ps12m.html
44. Commissioner for Environmental Sustainability (2006), Review of procurement – Part 1 Government procurement of motor vehicles, A review of environmental, safety and cost considerations, State of Victoria, Melbourne
45. See for example: 'Peugeot/Citroen gets average CO_2 of 140g/km! Tops in France' accessed at http://www.autobloggreen.com/2007/05/16/peugeot-citroen-gets-average-CO_2-of-140g-km-tops-in-france/]

In Australia at present, most popular locally manufactured cars have GHG emissions in excess of 240g CO_2 per kilometre, with many models well over 300g CO_2/km.[46] This is significantly higher than Europe and Japan, where new cars average around 161g CO_2/km.[47]

However, a number of new cars are available in Australia with low GHG emissions. The Australian Government's *Green Vehicle Guide* lists several cars with emissions of less than 140g CO_2/km – including makes such as the Toyota Prius, Mitsubishi Colt, Honda Civic Hybrid, smart Cabrio and Coupe, Hyundai i30, Fiat Punto and Proton Savvy.[48] The range of smaller, more fuel efficient vehicles available in Australia is likely to expand significantly over the next five years.

Action and leadership by government

Despite these technological advances, there has been no significant change in the fuel efficiency of the Australian vehicle car fleet for four decades – because gains in technology have been traded off against 'extras' such as air conditioning and strong growth in sales of heavier, more powerful vehicles.[49]

For real improvements to occur across the fleet, stronger action will be required from governments to force the pace of change, including stricter regulation and changes to industry and procurement policies.

Currently, moves are underway in Europe and the United States to enforce mandatory emissions standards on car manufacturers. For example, in December 2007 the European Commission adopted a proposal for legislation to reduce the emissions level for new cars to 130g CO_2/km by 2012.[50] This will translate into a 19 per cent reduction in CO_2 emissions, placing the EU among the world leaders of fuel efficient cars.

The new world of 'clean cars'

The development of technologies to improve fuel efficiency and reduce CO_2 emissions is picking up pace rapidly. As car makers jostle for position in the growing 'green' marketplace, many different roads may lead to a more fuel-efficient future.

Toyota – the world leader in petrol-electric hybrid cars, Toyota aims to market a fleet of rechargeable hybrid vehicles to companies and governments by the end of 2010. Toyota also plans to sell a plug-in hybrid car by 2010 and is building a factory to produce the next-generation lithium-ion batteries needed for electric vehicles.

GM – plans to introduce eight new hybrid models in the US by the end of 2008 and a plug-in hybrid by 2010. GM has also unveiled two concept cars powered by bio-ethanol.

Ford – has introduced a new 'eco-friendly' technology called Ecoboost, which will deliver increased performance and lower emissions from Ford's current engine range. Ford aims to have a fuel cell or plug-in hybrid engine range on the market by 2013.

Honda – has developed a zero emissions, hydrogen powered fuel cell concept car, which it is marketing on a limited basis in the US and Japan in 2008.

Kia – has developed a petrol-electric hybrid sedan and a fuel-cell version wagon. Kia aims to include petrol-electric hybrids as part of its range from 2010.

Renault – around 40 per cent of cars produced by Renault meet the company's 'eco^2 concept', which requires vehicles to emit less than 140g CO_2/km, be 95 per cent end-of-life reusable and source at least 5 per cent of plastics used in production from recycling.

Further information can be found at the Australian Government's Green Vehicle Guide: **www.greenvehicleguide.gov.au**

46. See Australian Government's Green Vehicle Guide at www.greenvehicleguide.gov.au
47. European Federation of Transport and the Environment (2007), Regulating CO_2 emissions of new cars, Background Briefing, Brussels
48. More details are available from the Australian Government's Green Vehicle Guide at www.greenvehicleguide.gov.au
49. See BITRE (2002c), *Fuel consumption by new passenger vehicles in Australia*, Information sheet 18, Commonwealth of Australia, Canberra
50. See for example: European Commission (2007), *Reducing CO_2 emissions from light-duty vehicles*, accessed at: http://ec.europa.eu/environment/CO2/CO2_home.htm

In late 2007, the European Parliament adopted a plan that requires manufacturers to have average CO_2 emissions of 125 g/km across their model range by 2015 – with penalties and fines imposed on car makers who fail to meet these targets. According to the plan, average CO_2 emissions should not exceed 95g CO_2/km by 2020, with a possible further reduction to 70g CO_2/km or less by 2025.[51]

This plan reflects the European Parliament's recognition that mandatory standards are needed to compel motor vehicle manufacturers to produce vehicles with higher average fuel efficiency than new vehicle buyers would otherwise demand. It also suggests that a substantial improvement in emissions from cars is achievable within a relatively short time frame.

In Australia, emissions standards for new vehicles are set by the Australian Design Rules (ADRs), which reflect international standards developed by the UN Economic Commission for Europe – known as the *Euro* standards (these standards do not cover CO_2 emissions). Australia generally lags behind Europe in implementing the *Euro* standards: for example, the *Euro 2* standard was implemented in Europe in 1996, but only implemented in Australia in 2003. The *Euro 4* standard, which will apply in Australia from 2008, has been in force in Europe since 2005. However, the *Euro 4* standard will underpin the latest ADRs – bringing Australia into line with European GHG initiatives.

The Australian automotive industry and the Commonwealth Government have also entered into a voluntary agreement to reduce national average fuel consumption of new passenger cars by 18 per cent by 2010 (from 2001 levels).[52] The Department of Climate Change is converting this target to a CO_2 g/km target to align it with ADR requirements.

Around the world, countries and cities have adopted a range of other measures to encourage the take-up of more environmentally friendly vehicles, including differential registration pricing, differential congestion charging, exemptions from certain charges or taxes and changes to government procurement policies. In Victoria, the government has introduced several such initiatives, including a $50 registration discount for hybrid vehicles, a hybrid bus trial and a trial of 'green' taxi licences.

The Study Team believes that more can be done at local, state and federal government levels to improve the environmental performance of motor vehicles in Victoria. The Team's view is that a significant shift towards the types of vehicles that major manufacturers are now able to provide will require more than heightened awareness about climate change or concerns about petrol prices or minor incentives such as small registration discounts. The reality is that manufacturers will continue to meet market demands for larger, less efficient vehicles until there is a very substantial disincentive for people to buy, register and run vehicles with high CO_2 emission levels.

It is clear from the Study Team's consultations with car makers such as Toyota that manufacturers can – and will – respond accordingly if clear price signals are sent to consumers. A range of options are available for governments to deliver these signals, including:

- Tax incentives to encourage people to buy low emission vehicles (federal level)
- Tax disincentives to discourage the purchase of high emission vehicles (federal)
- Setting significantly lower registration fees for more environmentally friendly vehicles (state)
- Adopting much more stringent government procurement policies to ensure that publicly owned and operated fleets meet the highest emissions standards (local, state and federal).

The Team notes the recently announced review of Australia's automotive industry (to be undertaken by former Victorian Premier Steve Bracks for the Commonwealth Government) and believes that the review should examine the local industry's potential to contribute to reductions in GHG emissions.

Study Team Findings

While it is not within the scope of the EWLNA to recommend actions that government might take to reduce GHG emissions from Melbourne's transport sector, the Study Team notes the following:

Given the continuing high demand for car travel, improvements in vehicle technology are likely to be the most effective means of reducing GHG emissions from transport in Melbourne.

Using public transport in peak demand periods and car pooling are the most effective ways in which Melburnians can contribute to reducing GHG emissions from their personal travel.

There is considerable scope for government to take stronger action to improve the environmental performance of Victoria's vehicle fleet and encourage Melburnians to change their vehicle purchasing patterns and travel behaviour.

51. European Parliament (2007), 'MEPs back cuts in cars' CO_2 emissions', Media Release, 24 October 2007, accessed at: www.europarl.europa.eu/default.htm
52. Details of the NAFC target are set out on the Australian Greenhouse Office website at http://www.greenhouse.gov.au/transport/env_strategy.html

What other cities are doing

A number of cities around the world are adopting measures to reduce emissions from motor vehicles.

Stockholm (Sweden) – Stockholm has the highest percentage of clean vehicles in Europe, thanks to a program of city and federal incentives. The city is replacing all municipal vehicles with electric and electric-hybrid cars and is working with industry to set up biogas fuel stations (around 60 per cent of fuel stations in Stockholm sell alternate fuels). Stockholm also offers incentives for shifting to hybrid or alternatively fuelled cars, such as taxation discounts, free parking and congestion levy discounts.

San Francisco (USA) – San Francisco's Clean Air Vehicle effort has resulted in the city having one of the largest clean air municipal fleets in the world – with more than half of the city's buses and light rail services comprised of zero-emission vehicles; more than 700 cleaner air vehicles (compressed natural gas, hybrid and electric); more than 50 heavy duty vehicles on bio-fuel; 160 low-emission taxis; and 25 fire trucks and ambulances currently running on biodiesel. These efforts are expected to result in significant reductions in annual emissions

Berlin (Germany) – Berlin has established an inner city 'Environmental Zone' of around 88 km2 that is banned to vehicles with very high emissions. At present, the ban only affects 7 per cent of motor vehicles in Berlin, but from 2010 the zone will only be open to vehicles with low emissions. By creating the zone, Berlin aims to improve air quality in a very densely populated part of the city. The city has also implemented additional measures, including modernising its bus fleet and setting higher environmental standards for the purchase of municipal vehicles.

London (UK) – London is currently testing diesel hybrid electric buses with the aim of having 80 hybrid buses in operation by the end of 2008 and hybrids making up a quarter of the city's 8000-strong bus fleet by 2020. In February 2008, London also made changes to its cordon charging scheme, introducing higher charges for high emission vehicles and a 10 per cent discount for low emission vehicles.

New York (USA) – By the end of 2009, New York will have taken delivery of 850 new low-floor hybrid electric buses, giving the city the world's largest fleet of hybrid buses. In addition, the city has begun switching the rest of its bus fleet to a special ultra-low-sulfur diesel fuel. Not only is the switch having positive effects on air pollution in the city, it has also created a new market for cleaner vehicles and fuels. When New York's Metropolitan Transport Authority (MTA) first decided to use the fuel, it was not widely available in mass quantities in the USA. However, when fuel companies realised the MTA would eventually need to purchase more than 150 million litres of the ultra-low-sulfur diesel fuel, they started to produce it. In turn, this has made it easier for bus fleets in other cities to switch to the new fuel.

8.2 Changes and challenges in the study area

Issues of sustainable development at a local or neighbourhood level are becoming increasingly important to Melburnians. This is particularly the case in areas that are highly industrialised and urbanised. In these areas, local communities place a high value on protecting and enhancing natural and cultural heritage and on improving neighbourhood amenity.

A range of environmental and amenity concerns were raised with the Study Team through submissions and consultations. The Study Team recognises the significance of these concerns to communities within the Study Area, which includes some of Melbourne's most dense and industrialised suburbs. The Study Team has applied sustainability principles to its assessment of options and has identified environment values and issues within the Study Area, as well as future challenges and opportunities for improving the area's natural and cultural heritage, and neighbourhood amenity.

8.2.1 Flora and fauna

While inner Melbourne – including the Study Area – is largely urbanised, significant natural values remain. As the Victorian Biodiversity Strategy notes, Melbourne's urban areas have small remnants of habitat that are highly valued by local communities.[53] The biodiversity values remaining in these areas are particularly important in providing unique examples of pre-existing flora and fauna, protecting sites of biological significance and as seed sources for revegetation with indigenous species.

Prior to European settlement, the Study Area was covered by around 13 different native vegetation communities. Very few remnants of this native vegetation have survived. These remnants include the Derrimut Grasslands to the west of Melbourne, indigenous vegetation forming part of parks such as Pipemakers Park, Royal Park and Yarra Bend Park, and riparian vegetation alongside rivers and creeks in the area. Some of these remnants are of local and regional significance; other areas have been heavily modified and highly degraded.[54]

The loss of habitat has also had a dramatic impact on the number of animal species in Melbourne and in the Study Area. Work undertaken for the Study Team has identified the presence – or potential presence – of 46 rare, vulnerable or endangered fauna species within the Study Area and 23 rare, vulnerable or endangered flora species.[55]

Over the coming decades, flora and fauna within the Study Area is likely to continue to be threatened by development and growth. In particular, local councils face significant challenges in balancing the pressure for residential development with the protection of natural habitats and vulnerable species. However, growing community concern about these issues is delivering opportunities for including specific options for ecological improvement within development and infrastructure planning. These opportunities may include revegetation programs to protect waterways, plantings to reduce noise or improve amenity, and initiatives to offset the negative impact of development.

The Study Team notes that major transport projects within the area offer the opportunity for strategic programs to improve the current state of biodiversity characteristics, in addition to meeting the required offset options associated with the removal of any native vegetation.

8.2.2 Air quality

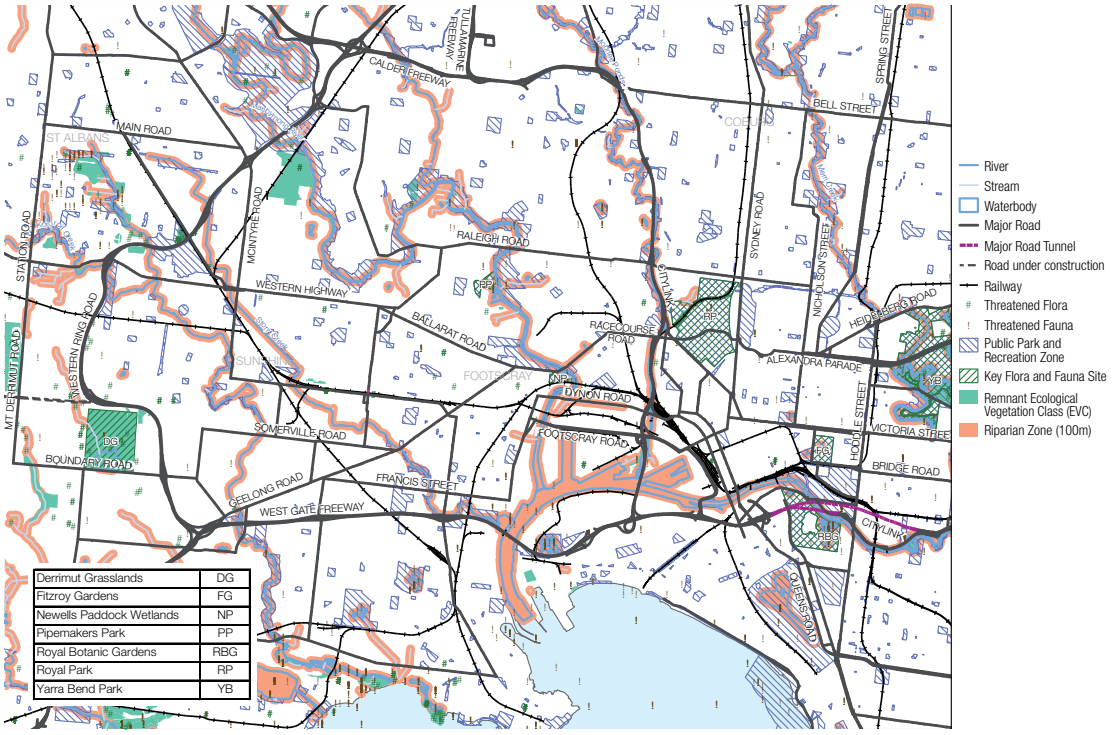
Air quality within Melbourne – and the Study Area – has improved over the last 25 years, due largely to emission controls on motor vehicles and greater industry compliance with environmental standards. Compared to similar cities around the world, Melbourne enjoys relatively good air quality.

The main pollutant in Melbourne is particulate matter, comprising minute particles emitted from some natural sources (such as bushfires and windblown dust) and from industrial processes, household wood heaters and open fireplaces, industrial incineration and motor vehicles. Particulate pollution is currently the major air quality issue requiring attention, with diesel-fuelled vehicles being a major contributor to such pollution.[56]

Motor vehicles are the major source of air pollution in Melbourne, contributing around 30 per cent of particulate matter to the city's overall air quality, 80 per cent of carbon monoxide (CO), 60 per cent of nitrogen oxides (NO_x) and 40 per cent of volatile organic compounds (VOCs).[57] However, while road vehicle use is increasing, levels of CO, NO_x and O_3 (ozone) have decreased since the mid-1980s.

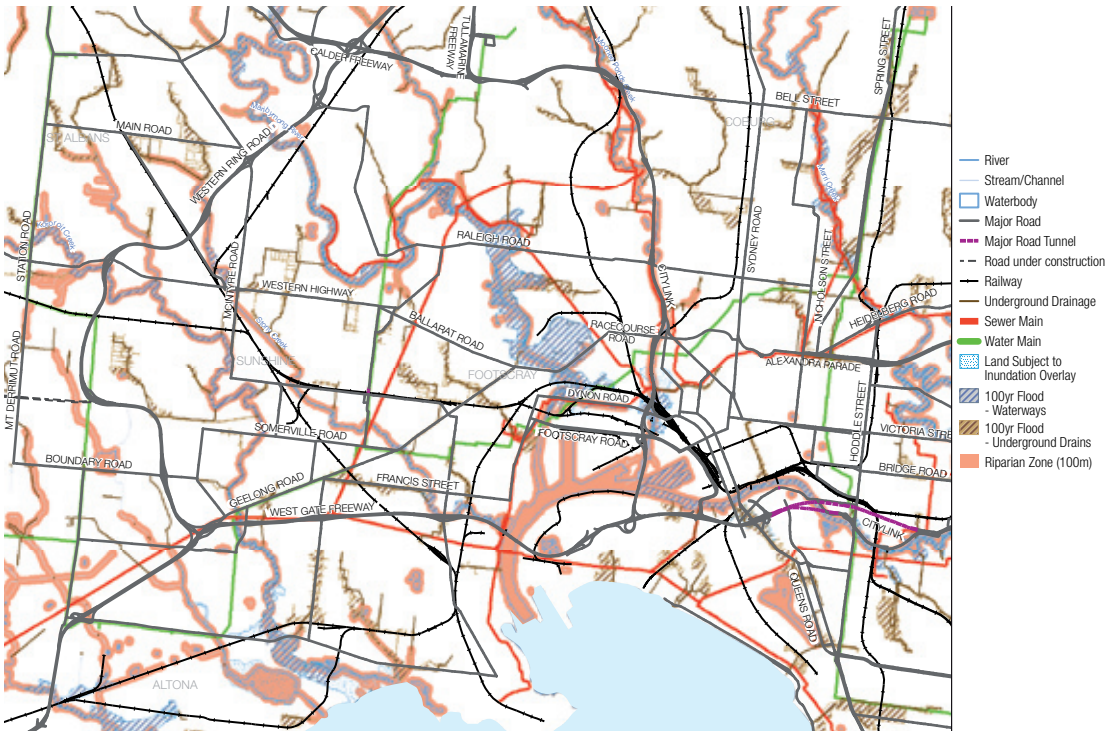
53. DSE: Department of Sustainability and Environment (1997), Victorian Biodiversity Strategy, accessed at www.dse.vic.gov.au
54. A list of key flora and fauna features is set out in SKM Maunsell (2008), *Environment and Heritage Issues Paper*, Report prepared for the EWLNA
55. Ibid
56. See EPA website: www.epa.vic.gov.au/air/aqa.aip
57. Environment Protection Authority Victoria (2006), *Victoria's Air Quality – 2005*, Publication 1044, State of Victoria, Melbourne

Figure 96 – Potential flora and fauna opportunities and constraints within the Study Area



Source: EWLNA (SKM Maunsell)

Figure 97 – Potential water resource opportunities and constraints within the Study Area



Source: EWLNA (SKM Maunsell)

The main future pressures on overall air quality in Melbourne will be population growth accompanied by an increase in the number of vehicles and a subsequent increase in the number of vehicle kilometres travelled. There may be a higher number of specific locations or 'hotspots' where air quality is affected by motor vehicle emissions. However, improvements in vehicle technology and controls on CO, NO_x and VOC mean that total vehicle emissions in 2020 are likely to be below those of 2006. This is not likely to be the case with particulate matter.[58]

Reducing particle pollution is likely to remain a significant problem in Melbourne, with ongoing efforts required to tackle the problem of diesel exhaust emissions.

For specific major transport initiatives, the challenges include identifying and managing any new air pollution 'hotspots' and providing walking, cycling and other options that will help to reduce the pressures on air quality.

8.2.3 Water quality

Rivers and creeks within the Study Area include the Yarra River, the Maribyrnong River, Merri Creek, Moonee Ponds Creek, Stony Creek and Kororoit Creek. Water quality in these waterways is of significant concern because they are highly important elements of urban biodiversity and are used for a range of water-based recreational activities. The quality of water flowing into Port Phillip Bay is also critical in determining the bay's ecological and economic future.

Water quality in the Study Area's rivers and streams varies considerably. Water quality in the Maribyrnong River is considered good, while water quality in the lower reaches of the Yarra River is moderate to poor. Water quality in Kororoit Creek is considered to be in fair condition while in the Merri Creek urban areas, water quality is very poor.[59]

Maintaining and improving water quality across the Study Area is likely to remain a significant ongoing challenge for local councils and communities, and for the Victorian Government. New housing and infrastructure construction will continue to threaten native riparian vegetation, the health of native fish and other fauna and the natural ecosystem connections between rivers, floodplains and wetlands.

However, there is increasing awareness of the importance of reducing the impact of new infrastructure on waterways, water quality and aquatic ecosystems. Communities now expect major transport and other infrastructure projects to include plans to manage water quality impacts, water sensitive construction processes and techniques to recycle or treat water runoff. Major projects also offer the opportunity to explore new ways of preserving and improving water quality in urban waterways.

8.2.4 Land contamination

Land contaminated by waste disposal and industrial activities is often discovered during changes to land use in Melbourne. The highly industrialised nature of the Study Area means that contamination is more likely to be a significant issue than in other parts of the city, with possible types of soil and groundwater contamination including heavy metals, polychlorinated biphenyl (PCB), asbestos, organochlorine, paint, oil and grease.

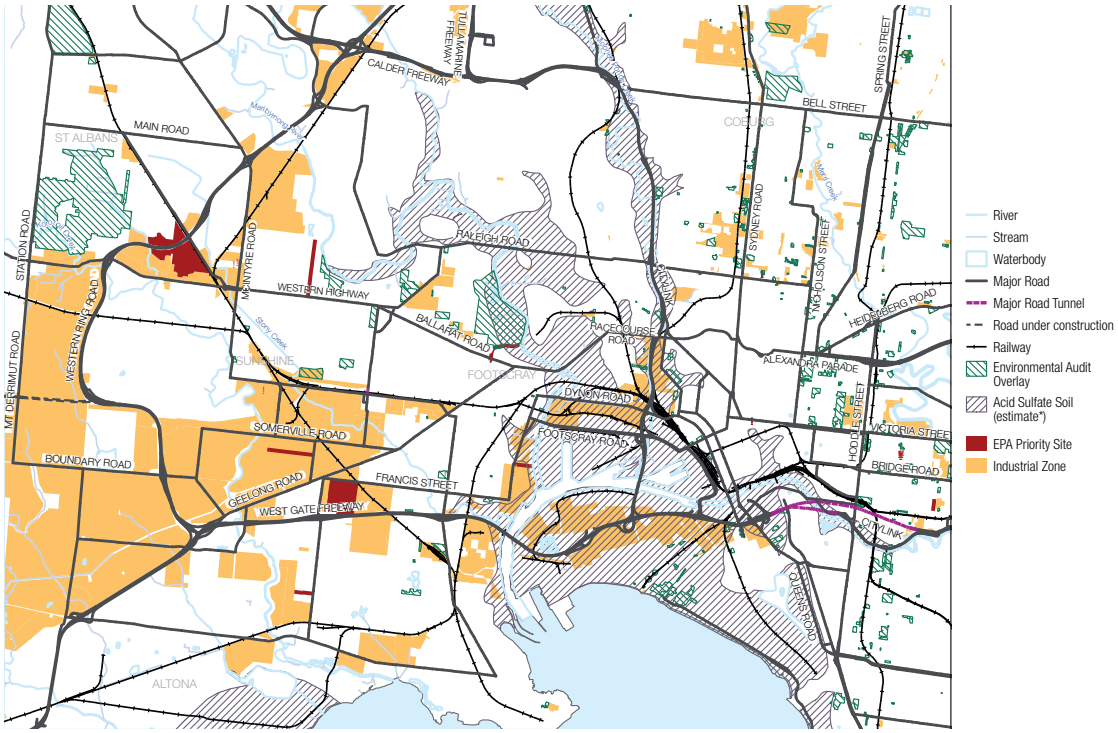
Twenty sites within the Study Area are listed as EPA Priority Sites (sites for which the EPA has issued a clean-up notice or a pollution abatement notice under the *Environment Protection Act* 1970). Typically, these are sites where pollution of land and/or groundwater presents an unacceptable risk to human health or to the environment. Sixteen of these sites are in Melbourne's west.[60]

In addition to sites listed on the EPA Priority Sites Register, there are likely to be numerous additional sites that have not been investigated or reported. In particular, naturally occuring acid sulphate soils (soils that contain significant amounts of iron sulfides) are probable in areas such as the Port of Melbourne, West Melbourne, Docklands, parts of Yarraville, Kensington and Flemington and alongside the Maribyrnong River, Yarra River and Moonee Ponds Creek.[61] These soils can have environmental, economic, engineering and health impacts, and can constrain development, construction and other activities, if not managed appropriately.

Contamination of soil and groundwater has the potential to increase costs and the time required to complete major developments. However, such developments also provide an opportunity to clean-up contamination, improve community amenity and explore new uses for contaminated and degraded land.

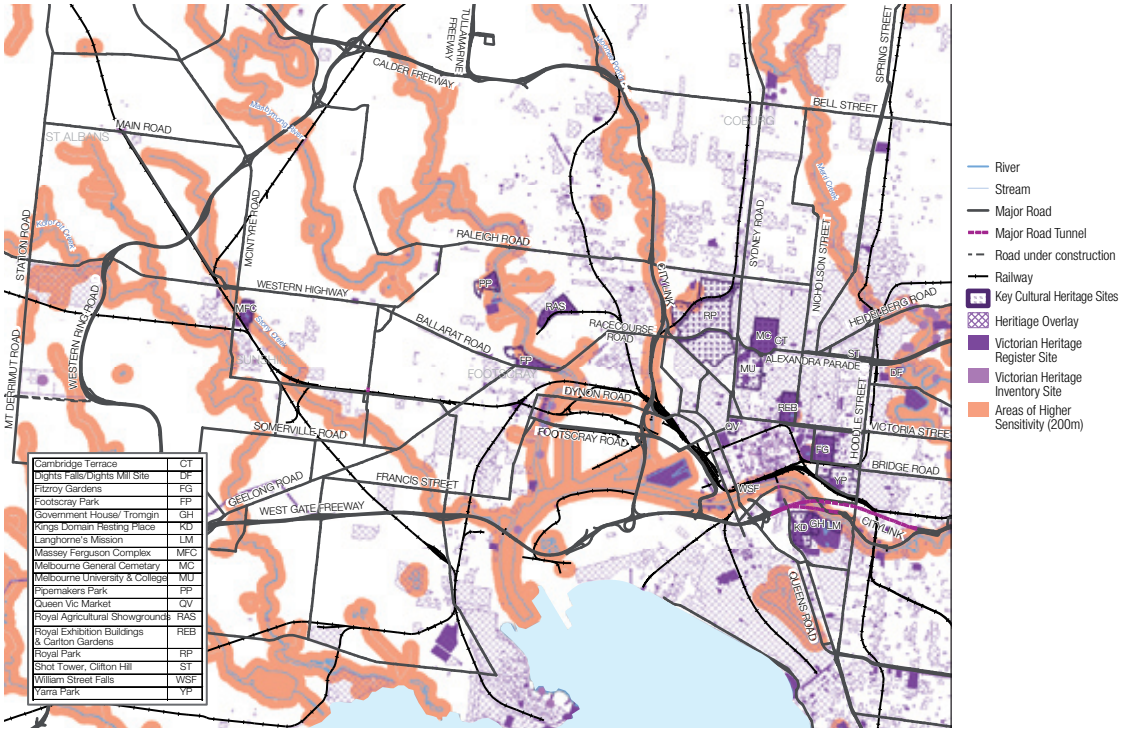
58. Beer, T., Borgas, M., Bouma, W., Fraser, P., Holper, P. and Torok, S. (2006), *Atmosphere Theme Commentary for State of the Environment Report 2006*, Department of the Environment and Water Resources, Australian Government, Canberra
59. Melbourne Water (2007), Melbourne Water Web Site, Our Rivers and Creeks, accessed at www.melbournewater.com.au. Details of water conditions within the Study Area are set out in SKM Maunsell (2008)
60. Environment Protection Authority Victoria (2007), Contaminated site information systems and Priority Sites Register, accessed at www.epa.vic.gov.au
61. SKM Maunsell (2008)

Figure 98 – Potential land contamination opportunities and constraints within the Study Area



Source: EWLNA (SKM Maunsell)

Figure 99 – Potential cultural heritage opportunities and constraints within the Study Area



Cambridge Terrace	CT
Dights Falls/Dights Mill Site	DF
Fitzroy Gardens	FG
Footscray Park	FP
Government House/ Tromgin	GH
Kings Domain Resting Place	KD
Langhorne's Mission	LM
Massey Ferguson Complex	MFC
Melbourne General Cemetary	MC
Melbourne University & College	MU
Pipemakers Park	PP
Queen Vic Market	QV
Royal Agricultural Showgrounds	RAS
Royal Exhibition Buildings & Carlton Gardens	REB
Royal Park	RP
Shot Tower, Clifton Hill	ST
William Street Falls	WSF
Yarra Park	YP

Source: EWLNA (SKM Maunsell)

8.2.5 Noise and amenity

As Melbourne continues to grow, transportation noise is becoming an increasing source of community concern, particularly in residential areas. The effects of exposure to high noise levels include physical and psychological health problems, sleep disruption and disturbance to activities such as personal communication and learning.

Road transport causes the greatest noise impact in terms of the number of Melburnians affected. However, the extent and effect of road traffic noise in Melbourne is difficult to ascertain, with only a small number of community noise impact surveys conducted since 1970.

Using data from a 1999 Austroads report, the EPA has indicated that around 12 per cent of homes in Melbourne are exposed to road traffic noise of Leq (24 hr) 65 dBA at least once during a 24-hour period, when measured outside the house (research shows that one in five people will be highly annoyed with these noise levels and higher).[62] The significant increase in road transport over the last decade suggests that the percentage of Melbourne's population exposed to these noise levels is likely to have increased since 1999; however, noise mitigation measures are now routinely applied to major transport projects (in line with VicRoad's noise attenuation policy).

In a recent community study commissioned in April 2007 by the Maribyrnong Truck Action Group (MTAG), 55 per cent of residents surveyed in Melbourne's inner west felt that sleep was "usually being affected" by truck noise. Reporting these results in its submission to the EWLNA, MTAG stated that:

> *"It is not just residents living right on truck routes that are affected; many complain that truck noise carries a long way…."*[63]

Railway noise also has a significant impact on communities in Melbourne. Railway noise is generated by a number of different factors, including the interaction of wheels and rails, engines in diesel locomotives, train speed, warning devices and shunting. Very few studies have been undertaken in Australia into community responses to railway noise (or to changes in noise when a new railway line is built or an existing line upgraded). However, studies indicate that noise from rail transport is considered to be less annoying than noise from motor vehicles or aircraft.

While little direct evidence is available about the effects of transportation noise within the Study Area, a number of community groups and local councils have expressed concern about the impact of road traffic and railway noise on local amenity.

Traffic noise is likely to continue to be a concern to communities across Melbourne as the city's population grows and the demand for travel increases. While meeting community expectations to manage and minimise any additional traffic noise, major transport projects also offer the opportunity to significantly reduce existing traffic noise by re-routing traffic (especially trucks), altering traffic flows, revising land use plans and erecting new noise barriers and screenings.

8.2.6 Cultural heritage

Melbourne's unique cultural heritage includes significant Aboriginal sites and a substantial number of 19th century buildings, streets and open spaces.

Within the Study Area are a range of Aboriginal cultural heritage sites that are protected under State and Commonwealth legislation. A review conducted for the EWLNA has identified key Aboriginal heritage places within the Study Area, including places protected under the Melbourne Planning Scheme (such as the Kings Domain Resting Place and scarred trees in Yarra Park and Fitzroy Gardens) and places identified in the City of Melbourne's Draft Indigenous Culture and Heritage Framework 2006-2009 (such as the Maribyrnong River Valley, Kororoit Creek and Dights Falls).[64]

62. See EPA (2002), Road Traffic Noise Strategy Background Paper, Information Bulletin – based on Austroads (1999), *National Performance Indicators*, Sydney
63. MTAG submission to the EWLNA (2007), p.17
64. A full list of key Aboriginal sites in the Study Area is set out in SKM Maunsell (2008)

The Study Area also includes many significant European heritage sites. More than 530 places are listed on the Victorian Heritage Register, which lists places and objects of statewide significance, and around 1200 sites within the Melbourne CBD are listed on the Heritage Inventory, which lists all known places and objects with archaeological value or potential. Key European heritage places within the Study Area include the Royal Exhibition Buildings and Carlton Gardens, Royal Park, the Royal Agricultural Showgrounds, Footscray Park, the Maribyrnong River and Fitzroy Gardens.[65]

Continuing pressures contributing to the loss of cultural heritage places in the Study Area include urban redevelopment, reduced public sector budgets for preservation and restoration, and a lack of information and awareness about particular places.

While addressing the effect of major transport projects on heritage sites can act as a constraint on development, opportunities also exist for transport infrastructure to incorporate and enhance cultural heritage values. These opportunities can include the restoration of buildings adjacent to transport developments, giving local communities the option to purchase or manage heritage sites, entering into heritage agreements with local communities, and improving sites with plantings, signs or screenings.

8.2.7 Opportunities from transport projects

Within the Study Area, local councils, businesses and communities are concerned about maintaining liveability, amenity and environment and heritage values in their local areas. In submissions and consultations, a number of groups expressed concerns about traffic noise, the importance of maintaining open space and parkland, the quality of inner urban waterways and the loss of neighbourhood amenity caused by high traffic volumes on suburban streets.

Several submissions noted particular concerns about declining amenity in local communities along major truck routes and adjacent to the Port of Melbourne.

The Study Team's view is that major transport projects potentially offer significant new opportunities to improve amenity and environmental values. These opportunities range from the removal of traffic from local streets and the creation of new bicycle lanes to initiatives that will increase native vegetation, improve urban waterways, clean up contaminated land sites and create new public spaces and artworks.

Melbourne's EastLink project provides a good example of how a major transport project can be used to improve local environments, with around four million native plants and trees being planted as part of the project and 70 wetlands filtering rainwater off the motorway, creating new habitats for native species.[66]

A number of submissions noted that improvements to the city's road connections that involved major new surface roads could have a detrimental impact on liveability and amenity in Melbourne's inner suburbs. As the City of Melbourne observed:

> *"There is very little space for building any additional surface roads in inner Melbourne without damaging the urban environment, local amenity and the City's liveability."*[67]

The Study Team notes that, unlike surface roads, tunnel projects offer much greater opportunities for improving neighbourhood amenity by reclaiming road space for other uses, such as walking and cycling, and new residential and commercial development. In its submission to the EWLNA, the Tourism and Transport Forum Australia argued that its proposal for a road and rail tunnel in Melbourne could be seen as reflecting:

> *"a more subtle, and typically 'Melbourne' approach to urban development – by opening up space in inner suburban environments and reducing the intrusion of vehicular traffic on inner-city life."*[68]

65. A full list of key European heritage sites in the Study Area is set out in SKM Maunsell (2008)

66. A detailed description of these improvements is set out at the EastLink website: www.eastlink.com.au
67. City of Melbourne submission to the EWLNA (2007) p.8
68. Tourism and Transport Forum submission to the EWLNA (2007), p.5

Royal Park

Royal Park has a long and significant history. Originally an important Aboriginal camping ground, the park is perhaps best known as the starting point for the ill-fated 1860 Burke and Wills expedition. In 1868 and again in 1878 the size of Royal Park was reduced for housing allotments. In the 1880s more park land was used to make way for trams, trains and roads.

The Park was used for the stationing of troops during the First World War. During the Depression, the park's status as a 'commons' allowed it to be used as an address for many country people on sustenance as they sought work in Melbourne. In the Second World War, the park was a major Australian and American army base. Camp Pell remained located in the park after the war and more than 100 army buildings were used as emergency housing until the park was 'cleaned up' for the Melbourne Olympics in 1956. In the intervening years, another 2.5 hectares of park land were transferred to the Royal Children's Hospital.

The Netball Association opened a major stadium in the park in 1969. This stadium was replaced in 2000 by the State Netball and Hockey Centre. In the 1970s, the City of Melbourne took over the Royal Park Golf Club for public use.

Royal Park is cut into several parcels of land by the Upfield rail line, the West Coburg tramline and a number of roads, including Elliot Avenue and Macarthur Road – a significant east-west arterial road link that carries approximately 40,000 vehicles per day (two way) and creates a significant barrier across the park. The Royal Park Master Plan[69] (which guides the development of the park) acknowledges that some traffic routes across the park cannot be closed, but should be designed to allow convenient and safe crossing for park users and to minimise visual disruption of the park. The plan specifically suggests negotiating with VicRoads and other stakeholders to put Macarthur Road into a tunnel and investigate the closure of Elliot Avenue once the tunnel is built.

One of the major recommendations of the EWLNA is the cross city road tunnel. This would pass under Royal Park, providing an east-west link from the Western suburbs, the Port of Melbourne and the Tullamarine Freeway to the Eastern Freeway. The tunnel has the potential to remove a significant amount of surface traffic from crossing Royal Park, consistent with the park's master plan. (However, the closure of Elliot Avenue was not considered by the EWLNA.)

While this is a desirable outcome, it comes with some short term cost. The construction of the cross city tunnel would require an area of the park to be used as a works site to access tunnelling works. After the construction period, the area would be fully rehabilitated with the potential to significantly enhance the park, including revegetation works and the creation of a bird and animal habitat.

69. City of Melbourne (1998), *Royal Park Master Plan*, Melbourne, available at City of Melbourne website: www.melbourne.vic.gov.au

8.3 The EWLNA options

The assessment process adopted by the EWLNA included a detailed review of the potential environment and heritage impacts of each option considered by the Study Team.

This review adopted a broad focus around the alignment of each option, recognising that further engineering development would result in changes to the final form taken by the option. The primary purpose of the review was to identify any significant environment or heritage issues that should be considered in any further development of each option.

All construction related to the new rail and road infrastructure proposed by the EWLNA would be within the fully developed Melbourne urban area. Following review of the initial feasibility design for each of the options, the Study Team concluded that there would be no 'fatal flaws' associated with potential environmental or heritage impacts. However, the review identified issues that will require careful consideration during any further development of the options.

8.3.1 Impact of EWLNA recommendations on GHG emissions

As noted earlier in this Chapter, GHG emissions from transport in Victoria are set to grow by 16.4 per cent by 2020. Looking longer term – and keeping in mind the Victorian Government's target to reduce overall GHG emissions by 60 per cent in 2050 – emissions from transport are likely to rise by between 60 to 80 per cent over the next 40 years.

Clearly, action needs to be taken to reduce these emissions; however, the scale and range of measures that can be taken to achieve this outcome are beyond the scope of the EWLNA.

Some submissions to the EWLNA put the view that the 'worst thing' to do in terms of GHG emissions is to 'build more roads'. This view states that building more roads (or major new road extensions) increases Melbourne's reliance on cars, induces more car travel and undermines the attractiveness of public transport as an alternative to car travel. In the Study Team's view, many arguments about 'induced travel' fail to take into account the complex factors associated with travel demand and travel behaviour that come into play in response to increased road capacity.[70]

It should be acknowledged that travel is a 'derived demand' – in that people rarely travel for the sake of travelling, but for some specific purpose: work, education, social or recreational. This means that a new east-west road link is likely to facilitate greater efficiency in journeys that people were already making (although there may be a small increase in discretionary travel). Modelling undertaken for the EWLNA shows that this efficiency generates a very small reduction in future GHG emissions in Melbourne through reduced stop-start congestion and by removing traffic from adjacent roads that would become more congested as Melbourne's population grows.

In addition, the EWLNA recommendations do not extend the road network beyond the city boundaries or provide direct city access by road. The provision of an inner metropolitan road link should stimulate further development within the inner and middle suburbs (with careful planning controls), increasing urban density in line with *Melbourne 2030* and contributing to reducing or limiting growth in GHG emissions (as indicated by the EWLNA's carbon constrained future scenario).

The Study Team's view is that major road investments continue to have their place. However, investment in public transport is absolutely critical to ensure that modal share in transport optimises efficiency, minimises GHG emissions arising from growing travel demand and addresses transport disadvantage. This balance is reflected in the EWLNA recommendations.

8.3.2 Environmental review

The main environmental impacts of the recommended options are briefly discussed below.[71]

New east-west rail infrastructure

A significant portion of the proposed new east-west rail infrastructure would be constructed in tunnel, probably as two separate bores of seven to eight meters in diameter, placed approximately one diameter apart. The tunnel depth would vary from directly below the natural surface to a possible 50 metres below the surface under the CBD. Surface works would be required where stations are located and where the new rail infrastructure connects to the existing network, causing disruption during the construction period.

70. A discussion on induced travel is set out in Appendix E.

71. Further discussion is set out in SKM Maunsell (2008)

Construction

Whilst the wider range of potential risks has been assessed by the review, the most significant environmental and heritage risks associated with this type of construction are considered to be hydrogeological impacts and the occurrence within the Study Area of naturally occurring and man-made soil 'contamination'.

With today's advanced and improving tunnelling technology, hydrogeological impacts can be effectively managed during construction and 'tanking' or 'water-proofing' of tunnels is now considered an effective design and construction technique to ensure that the long-term influences of an underground structure do not impact on groundwater levels. As standard practice for different methods of tunnelling, underground grouting and compressed air support are used successfully to control water inflows in tunnels during construction. In addition, the use of Tunnel Boring Machines (where they are best suited as the tunnelling method), combined with fine tolerances and sealed pre-cast concrete segment linings, has provided further improvement in the control of hydrogeologic issues associated with tunnels.

Acid sulphate soils are a naturally occurring material located in Melbourne's central region. Excavation and exposure of this soil creates the potential for soil contamination. In addition, man-made contamination is likely to be encountered in any urban area with a long history of development. Again, currently available construction and soil treatment techniques enable these risks to be managed adequately, although this could have a bearing on the cost of construction. Any contaminated soils would be removed and located at approved locations or treated to the requirements of a relevant authority.

Operation

The most significant environmental and heritage risks associated with the operation of a new east-west rail tunnel are considered to be regenerated noise or vibration and longer-term hydrogeological impacts.

Surface noise associated with the operation of the new infrastructure would be restricted to those areas near west Footscray and east of Caulfield, where existing rail lines currently operate. The impact associated with additional trains running in these areas is not considered to be significant. Overall, the provision of extra services in tunnel would result in a net positive impact in relation to surface noise across the rail network.

Regenerated noise and vibration can be mitigated by vibration damping of the rails and rail beds, a well established technique. Costs associated with the use of these construction methodologies and design techniques to control hydrogeologic risk, soil contamination and noise have been incorporated within the project cost estimates.

New east-west road infrastructure

A significant portion of the proposed new east-west road infrastructure would be constructed in tunnels of varying sizes and construction methodologies, including cut and cover techniques directly below the surface and driven tunnelling to create tubes well below the surface. Driven tunnel tube diameter would vary between 12 and 15 metres, dependent on lane configuration. The tunnel depth would vary from immediately below the surface to a possible 30 metres below the surface.

Where the new link connects to existing roads (such as the Port of Melbourne area, the Tullamarine Freeway and the Eastern Freeway), interchanges would need to be constructed from the surface, causing disruption during the construction period. West of Footscray, the options being proposed would be constructed on the surface, incorporating elevated and surface roadways.

Construction

The construction issues associated with tunnelling are similar to those for the proposed rail infrastructure, with the primary difference being that larger tunnels create a larger exposure to hydrogeological risks and contamination due to the larger volumes of material being excavated.

As for the rail tunnel, these risks can be adequately managed using appropriate tunnelling technology and material handling techniques.

Other risks associated with surface works can be managed satisfactorily with currently available construction methods and environmental management measures.

Operation

The most significant environmental and heritage issues associated with the operation of a new east-west road are considered to be GHG emissions, tunnel ventilation, noise and hydrogeological impacts.

GHG emissions associated with the new road infrastructure have been analysed using the outputs modelled for the EWLNA. These modelling outputs indicate that the inclusion of additional road infrastructure results in decreases in GHG emissions as trips that would otherwise be made on congested local and arterial roads are reallocated to a new free-flowing road. However, these decreases are so small as to be statistically insignificant in the wider Melbourne area.

Ventilation of the tunnels would require a number of ventilation stations along the route – probably between four to six (two for each tunnel 'stretch', depending upon the final option adopted). The location of these stations would be subject to extensive design analysis. For other Melbourne tunnel projects, EPA approval processes have ensured community involvement in this analysis. In the case of CityLink, no negative impacts on local air quality have been found to be associated with ventilation stations. In some circumstances, local air quality may be enhanced by reducing local surface traffic and the resulting emissions.

Noise is always a risk associated with the operation of major new roads and noise amelioration guidelines would need to be implemented. New traffic noise would be limited to locations where traffic enters and exits the tunnel. Other parts of the road network would benefit from an overall reduction in traffic noise by taking thousands of vehicles beneath the ground.

Longer-term hydrogeological impacts would be controlled during the design and construction phase by the use of water-proofing design and construction techniques.

Costs associated with the use of these construction methodologies and design techniques to control hydrogeologic risk, soil contamination and noise have been incorporated within estimates of the project costs.

8.3.3 Legislative requirements

If the Victorian Government proceeds with the EWLNA recommended projects, further consideration will need to be given to the requirements of the *Environmental Effects Act 1978*.

The process for meeting these requirements is set out in the *2006 Ministerial Guidelines for the assessment of environmental effects under the Environmental Effects Act 1978*. In summary, where a project could have a significant effect on the environment, a proponent (in this instance the relevant part of government given the task of implementing the project) must ask the Minister for Planning whether an Environmental Effects Statement (EES) is required. This process is known as a 'referral'. In general terms, the threshold question considered by the Minister is whether the project, considered in its entirety, could have *significant adverse impacts* on the environment in a regional or state context. The Ministerial Guidelines outline the type of matters to be considered by the Minister as to whether an EES is required.

From the environmental matters considered as part of the Study, and having regard to the likely mitigation measures that would be adopted (including tunnelling techniques to minimise adverse groundwater impacts), it is possible that an EES would not be required for a rail tunnel project. Clearly, the matters identified in the Study Team's environment and heritage review would need to be carefully studied and understood before any final conclusion could be drawn in this regard.

A road tunnel is likely to be a different matter. Having regard to the matters to be considered by the Minister, it is highly likely that an EES would be required.

In either case, sufficient technical work needs to be undertaken to support the referral and to inform a decision by the Minister for Planning under the Act. That work could commence immediately and should include opportunities to consult with communities likely to be affected by the projects.

Study Team Finding

A number of environmental issues within the Study Area will need to be further considered if the projects recommended by the EWLNA are to proceed. However, there are no 'fatal flaws' or significant problems in relation to potential environment or heritage impacts that cannot be appropriately and effectively managed.

As with other major transport infrastructure projects, the EWLNA recommended options offer significant opportunities to redress previous environmental damage, improve future environmental outcomes and enhance neighbourhood amenity.

The large scale, broad solutions to reduce GHG emissions are beyond the scope of the EWLNA; however, the Study Team has assessed all options considered as part of the EWLNA in relation to their impact on GHG emissions. The final package of recommendations proposed by the team has a minimal – but beneficial – impact on overall GHG emissions in Victoria.

Peak oil

A number of submissions to the Study Team expressed concern about the impact of the future availability of oil supplies on Victoria's transport system. The Study Team recognises that governments and others making decisions about future transport options need to carefully consider the impact of diminishing global supplies of oil and the workings of a post-carbon global economy.

It is well-accepted that the world's oil reserves are finite and that world oil production will eventually reach a peak, before starting an irreversible decline – a concept known as 'peak oil'. However, there are differing views about the timeframe in which this will occur.

The 'depletionists' – such as the Association for the Study of Peak Oil (ASPO) – argue that half the world's oil supplies have been used already, that oil production has peaked or is about to peak and that a sudden downturn in oil production will occur in the very near future, with a major disruptive impact on national economies and the global economy.

The 'antidepletionists' – such as the USA Geological Survey and Cambridge Energy Research Associates (CERA) – have forecast longer timeframes. These groups argue that – due to technological advances, changing economies, improved knowledge about oil reserves and growth in non-traditional and unconventional liquid fuels – the world's remaining oil resources are sufficient to meet projected cumulative world demand for at least another 30 to 50 years, giving economies time to adjust. CERA has expressed the strong view that "not only will world oil production not peak before 2030, but that the idea of a peak is itself a dramatic and highly questionable image". CERA argues that global production will follow an 'undulating plateau' for one or more decades before declining slowly, possibly over several decades.[72]

The International Energy Agency (IEA) has stated that "world oil resources are judged to be sufficient to meet the projected growth in demand to 2030", although it does not rule out "a supply-side crunch in the period to 2015."[73] However, the IEA has noted that it regards current trends in energy consumption as "neither secure nor sustainable – economically, environmentally or socially".[74]

The 'peak oil' timing debate is made more confusing by the absence of reliable data, with both schools of thought agreeing that the amount of oil in the world is unknown. There is considerable disagreement about the total quantity of oil resources that will ever be produced and the amount of oil that can be recovered commercially from known resources. However, it is clear that the global demand for oil is continuing to increase, that the balance between supply and demand is much tighter and that supply disruptions will have a much larger influence on oil prices.

Since 2005, world oil prices have risen sharply, from US$30 a barrel in 2005 to the current level of US$110 a barrel. This increase has flowed through to retail petrol prices, increasing the cost of petrol in Melbourne from around AUD$1.15 a litre in 2005 to around AUD$1.45 a litre in 2008 – although the rising Australian dollar has softened this impact to some extent.

In Australia, demand for petroleum is projected to increase from more than 750,000 barrels per day to over 1.2 million barrels per day by 2029-30 – an increase of almost 2 per cent per year over the period.[75] Australia's self-sufficiency in oil is expected to decline significantly, with future discoveries not likely to make up for growth in demand and the decline in reserves.[76]

Irrespective of the uncertainty surrounding the timing of 'peak oil', it is clear that the demand for oil is unsustainable and must be reduced – and that market forces and technological progress must be encouraged to bring alternative fuels on stream in a timely way and in sufficient quantity to serve the 'post oil age'. Around the world, most countries have increased fuel prices above the market price and are directing increasing effort and investment into reducing the dependence of their transport systems on oil. As noted earlier in this chapter, leading automotive manufacturers are also investing heavily in R&D to develop more 'environmentally friendly' motor vehicles.

72. Cambridge Energy Research Associates, 'Peak Oil Theory – 'World Running Out of Oil Soon' – Is Faulty; Could Distort Policy & Energy Debate', Media Release, 14 November 2006, accessed at www.cera.com
73. IEA: International Energy Agency (2007), *World Energy Outlook 2007 – Executive Summary*, OECD/IEA, Paris, p.4
74. IEA: International Energy Agency (2006), *World Energy Outlook 2006*, OECD/IEA, Paris, p.49
75. ABARE: Australian Bureau of Agricultural and Resource Economics (2005), *Australian Energy – National and State Projections to 2029-30*, Commonwealth of Australia, Canberra, p. 63
76. See discussion in Senate Standing Committee on Rural and Regional Affairs and Transport (February 2007), *Australia's future oil supply and alternative transport fuels*, Final Report, Commonwealth of Australia, Canberra, p.17

Some commentators predict that a significant increase in petrol prices over the next 25 years will lead to a much greater demand for public transport and a significant shift from road to rail freight. Others believe that it will stimulate the development and take-up of alternative fuel technologies and lead to people shifting not to public transport, but to more fuel efficient motor vehicles and to alternatives such as electric, hybrid, hydrogen and bio-diesel cars.

It is difficult to predict accurately the impact on Melbourne's transport network of the various peak oil scenarios; it is certainly not as straightforward as suggested by some submissions to the EWLNA. In some ways, the peak oil debate misses the point when it comes to travel behaviour. Irrespective of the timing of peak oil, the demand for mobility – people's need to move around – will still exist. Should the 'depletionists' be proved correct, the price of petrol will escalate dramatically in the very near future and the race for the alternative-fuelled vehicles will be even more competitive than it is today. Under such a scenario, as the EWLNA 'carbon constrained' modelling shows, more and more people will use public transport, and action needs to be taken to ensure that public transport options exist with sufficient capacity to meet this increased demand. But motor vehicles will still exist – and in greater numbers as the population grows: they just may not be running on petrol.