

Cutting Transport Fuel Use: the priorities for climate change and uncertain future oil supplies

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1 Introduction

The purpose of this paper is to show that a paradigm shift in transport planning and provision is needed to cope with peak oil and future oil shortages and to reduce Australia's contribution to global warming. Of particular concern is that in 2006 and 2007 sound research became available showing that uncertainty about future crude oil supply makes it important to develop a strategy to address the oil peak, the increased cost of oil imports and inevitable oil shortages.

New transport policies and innovations are proposed to reduce carbon emissions and to fulfill Commonwealth international obligations. The first task is to use market instruments to encourage carbon neutral trading and energy conservation (Stern N. 2006). It would be prudent for the Commonwealth and state governments to develop a risk management strategy to deal with the uncertainty of future oil supplies. An early start in implementing the Senate's February 2007 Oil Report recommendations and to introduce energy conservation initiatives and transport innovations is urgently needed. (US GAO 2007)(Heinburgh 2006).

2 Risk management measures to cope with uncertain oil supplies

The growth of oil dependence, over the last fifty years in the US and Australia has created a chronic addiction to cheap oil. In Australia the transport sector is responsible for 76% of oil consumption. Oil dependence has to be reduced. In a few years it will become very costly and scarce which will pose a very serious threat to the well being of Australians, particularly those with outer suburban lifestyles which are hinged on two or three car families and constant car trips to work, school and supermarkets. Outer suburban car trips to work are much longer than inner suburban trips with four times the weekly kilometres travelled. (Parker 2004) (Dodson and Sipe 2005).

Government intervention is necessary at least ten years before world oil production peaks to mitigate the potentially disastrous consequences and oil is no longer affordable (Hirsch, Bezdeck and Wendling 2005). Researching and developing practical measures to reduce oil dependence is urgently needed. For Australia that means the rapid implementation of all the recommendations in the 2007 Senate Committee Report "Australia's future oil supply and alternative transport fuels" (Senate 2007).

Since 1980 the gap between world oil demand and potential oil supply, once considerable, has steadily narrowed and today is almost negligible. When oil consumption begins to exceed production, by even a small amount, the price of oil could soar to well over US\$100 a barrel, greatly increasing the cost of transport fuels and the petrochemicals used to make thousand of plastics products, fertilisers and pesticides for food production. Within a year or so this would create a global recession. The affordable

oil upon which the world economy depends would become costly with reducing energy returns on energy invested (EROEI) in extracting oil, particularly in deep water, the most likely source of any new Australian discoveries.

The Commonwealth and state governments have no serious risk management measures in place nor energy security plans to cope with peak oil by implementing demand and supply side measures. There is no understanding that an international oil depletion protocol to reduce oil consumption in the developed world by 2.2 % per year is necessary and would have the benign side effect of greatly reducing carbon dioxide emissions. (Heinberg 2006) CSIRO modelling of the energy costs of conventional and non-conventional oil in the long term in Australia found that:

“The critical importance of energy use to the maintenance and growth of our economic system is not properly acknowledged in most national analysis (that have a short term focus). Long run analysis suggests that energy use is responsible for 50% of production in a modern economy but represents only 5-10% of the cost. This tension between physical and economic realities effectively blocks the transition to a physical economy with low carbon energy sources”. (Foran and Poldy 2002).

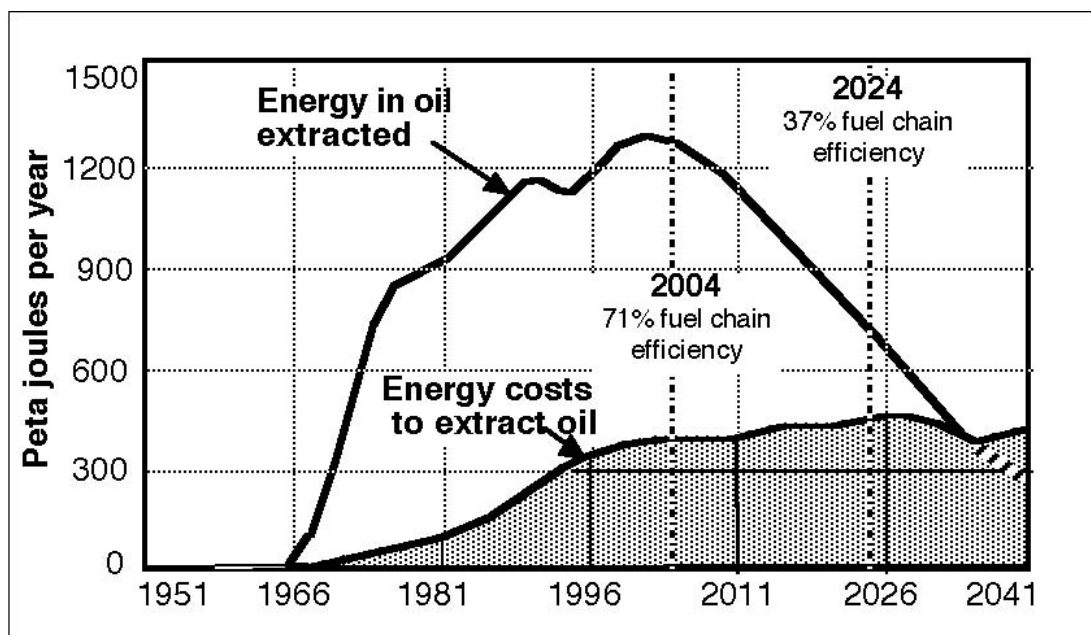


Figure 1 Energy costs and benefits of oil extraction 1951 to 2041

Source: Foran and Poldy (2002)

The increasing energy costs of discovering and extracting conventional oil (shown on Figure 1 for Australia) apply generally to other new sources of conventional oil.

2.1 Balancing out the decrease of world oil production by reducing consumption

Figure 2 shows world conventional oil production increasing by around 2.2% per year from 1985 to 2006 and then peaking between 2008 to 2012, followed by a 2.2% per annum decline in production to 2045. That means that oil demand should be reduced to balance it with reduced oil production of 2.2% per year.

Figure 2 shows the increasing proportion of heavy oil and natural gas liquids (NGL) that is extractable from 2005 to 2040. The increasing energy costs of discovering and extracting conventional oil (shown on Figure 1 for Australia) apply generally to other new sources of conventional oil.

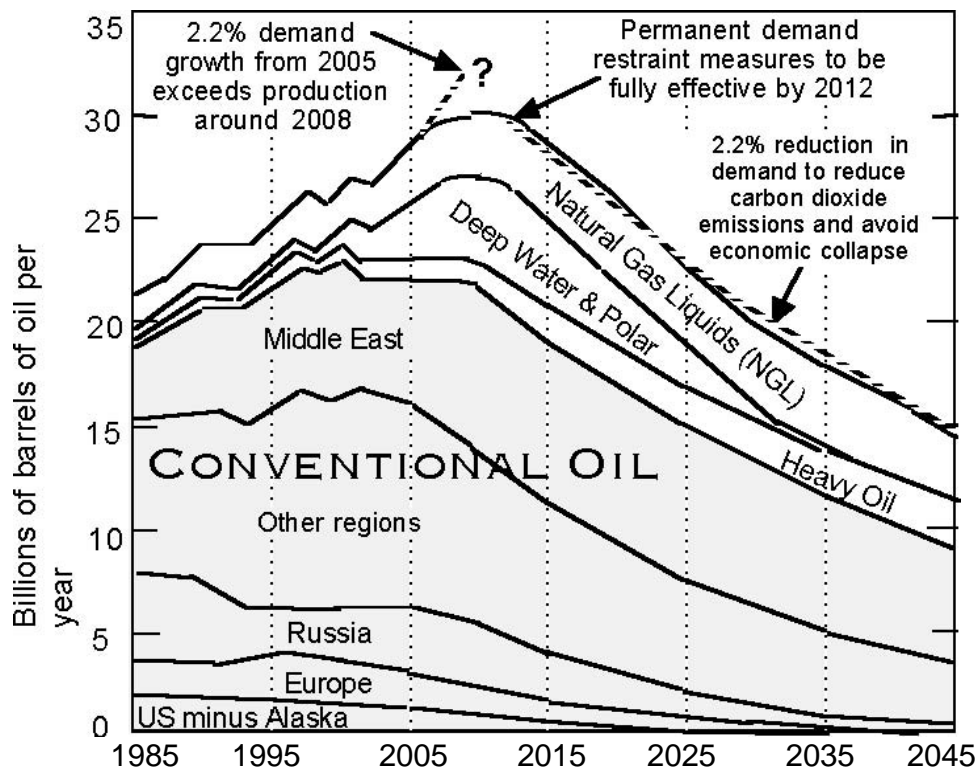


Figure 2 World oil and gas liquid production from 1985 to 2045: 2.2% demand restraint to cope with declining production [SOURCE?]

Figure 2 does not show any non-conventional oil from tar sands, shale or oil substitutes synthesised from brown and black coal because these will greatly increase CO₂ emissions without carbon sequestration and will lower the EROEI with carbon sequestration.

The latest annual World Energy Outlook report from the IEA states that global greenhouse gas emissions will rise by 52% by 2030, unless the world takes action to reduce energy consumption. It says that, under current consumption trends, energy demand will also rise by more than 50% over the next 25 years and that oil prices will "substantially" rise unless there is extra investment in oil facilities because the world has seen "years of under-investment" in both oil production and the refinery sector. (IEA Nov 2006).

2.2 The production of non-conventional oil will increase CO₂ emissions

The IEA Executive Director Claude Mandel has stated that “non-conventional oil resources can solve all our problems if there is a major investment in geo sequestration and other new technologies of US\$6,500 billion in the next decade or so”.(Mandel, 2007). The problem is that once all the light, sweet, conventional oil has gone and non-conventional oil production increases it will produce far more CO₂ emissions.

High oil prices are also removing lingering doubts about the long-term profitability of extracting molasses-like oil from sand. At the same time, prices of natural gas --which oil-sands producers have relied on to produce the steam and electricity needed to push the viscous oil out of the ground -- have risen 45% in the past year.

Producing oil from shale requires hydrogen and vast quantities of heat. According to the World Energy Council the term "oil shale" is a misnomer:

“It does not contain oil nor is it commonly shale. The organic material is chiefly kerogen, which can be converted into a substance somewhat similar to petroleum. However, it has not gone through the "oil window" of heat (nature's way of producing oil) and therefore, to be changed into an oil-like substance, it must be heated to a high temperature. By this process the organic material is converted into a liquid, which must be further processed to produce an oil.” (World Energy Council 2005)

2.3 Non-conventional oil cannot make up for the decline in conventional oil

No one doubts the unrealised potential to make oil products from shale, tar sands, very heavy oils or to make oil from coal, however it is unsound to assume that unproven greenhouse friendly technology can and will be developed to cope with the peaking and then decline of conventional oil production and hence reduce CO₂ emissions in the next ten to fifteen years. Even if this kind of new technology is proven to work its widespread application is at least 25 years away. According to the Oxford Institute of Energy Studies:-

“...unconventional oil is unlikely to exceed 10% of the world supply before 2020” (Skinner 2005)

Another researcher points out:

“While non-conventional oil is emerging as a new major source of oil, even an aggressive world-wide development scenario can only capture some 10 -15% of the required new oil supply in the next 20 years. In addition, non-conventional oil by itself cannot make up for the decline in world conventional oil production” (Isaacs 2005).

World oil production will peak before 2020 with the risk of creating a world depression and starvation and misery for millions. IEA chief economist Fatih Birol says "We must change these outcomes and get the planet onto a sustainable energy path." The IEA has also warned oil-consuming countries that they can no longer rely on the major oil-

producing countries to invest enough to meet long-term oil demand. (IEA 2006)

2.4 The unsound forecasts of the International Energy Agency (IEA) and ABARE

Given that ABARE and other Australian agencies get their information wrong about future oil prices for a mere two years ahead it is not surprising likely that their predictions for 2010 and 2020 are will prove inaccurate. Their information comes from several overseas government agencies that reflect one another's' estimates and the IEA all of which are grossly over optimistic. (See Table 1) The latest 'World Energy Outlook' oil price estimates for the year 2030 is US\$55 a barrel or 55% more than their previous 2004 estimate. (IEA 2006)

Some economists have made serious errors of judgement because they have put their faith in oil reserve estimates that ultimately are derived from the nationalised oil industries of dictatorial regimes. (Economist 2006). These countries do not publish details about how much oil is extracted from each reservoir and what methods are used to extract that oil; nor do they permit external audits. See figure 3. However in 2007 the IEA have published a graph, which shows that new oil supplies peak at about 3 Mb/d in 2008, and fall to 1 Mb/d by 2011. (IEA 2007).

Table 1 Oil price forecasts for the period 2010, 2020 and 2030 (US \$ per barrel)

Government or intergovernmental source	2010	2020	2030
International Energy Agency (IEA).	22	26	29
Energy Information Agency (EIA); US Department of Energy.	23	25	
European Commission (EC)	28	33	40
Organisation of Petroleum Exporting Countries (OPEC)	19	19	
Institute of Energy Economics Japan (IEEAJ)	24	27	
Centre for Global Energy Studies (GGES)	20	15	

Source: (BTRE 2005 working paper 61. p. 24)

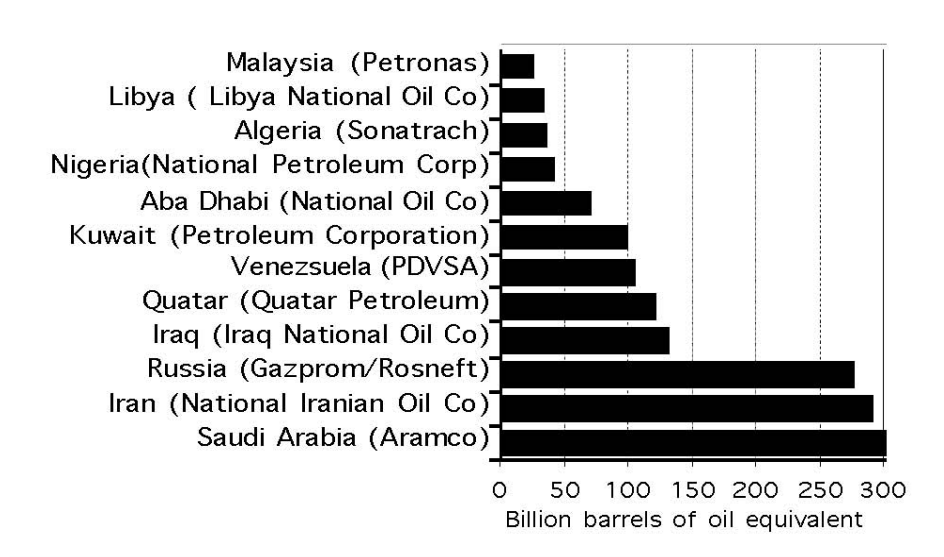


Figure 3 Largest national oil companies by proven level of oil and gas reserves

Source: Economist 12 August 2006 p 56

Table 2 shows the range of predicted timing of peak oil by many expert observers in 2006. A more comprehensive survey was published in April 2007 of peak oil forecasts by 31 experts and organisations. There were 13 forecasts of peak oil before 2012 and 25 forecasts of peak oil before 2021. (Hirsch 2007). The continuing uncertainty about the timing of peak oil was also analysed by the US Government Accountability Office (GAO) report, released in February 2007 which stated that: -

“The timing of the peak depends on multiple, uncertain factors that will help determine how quickly the oil remaining in the ground is used, including the amount of oil still in the ground; how much of that oil can ultimately be produced given technological, cost, and environmental challenges as well as potentially unfavourable political and investment conditions in some countries where oil is located; and future global demand for oil. Demand for oil will, in turn, be influenced by global economic growth and may be affected by government policies on the environment and climate change and consumer choices about conservation.” (US GAO 2007)

Table 2. Peak oil forecasts for the period 2006 to around 2020

Peak Oil Forecast	Sources and books.
2006 - 2007	Bakhtari (Iran)"A Middle East View of the Global Oil Situation"
2007 - 2009	Simmons (US) <i>"Twilight in the desert"</i> 2005 John Wiley
After 2007	Skrebowski (UK) <i>"Emerging signs of oil depletion – where reality meets theory"</i> 2005 Editor Petroleum Review,
2008	Campbell (Ireland) "Oil Crisis" 2005 London, Multiscience.
Around 2009	Deffries (US) <i>"Hubberts Peak"</i> 2003 & <i>"Beyond oil"</i> 2005 Heinberg 2006 <i>"The Oil Depletion Protocol : a plan to avert oil wars , terrorism and economic collapse"</i> 2006
Before 2010	Goodstein (US) <i>"Out of gas: the end of the age of oil"</i> 2004
After 2010	World Energy Council
2012	Weng (China) and Hirsch R.L (US) see references
2016	Doug-Westwood (UK) "The world oil supply report 2003-2050" www.dw-1.com, Email: admin@dw-1.com
After 2020	CERA (US)
Around 2020	Sweden commits to weaning itself off oil by 2020

The GOA report states what needs to be done by governments: "Crude oil: uncertainty about future oil supply makes it important to develop a strategy addressing a peak and decline in oil production". The GOA report also assessed the potential for transportation technologies to mitigate the consequences of peak oil. The key recommendation is as follows and may be implemented fully after the 2008 US Federal election. This recommendation for inter agency cooperation is very much needed in Australia.

To better prepare for a peak in oil production, GAO recommends that the Secretary of Energy work with other agencies to establish a strategy to co-ordinate and prioritise federal agency efforts to reduce uncertainty about the likely timing of a peak and to advise Congress on how best to mitigate consequences. In commenting on a draft of the report, the Departments of Energy and the Interior generally agreed with the report and recommendations. (US GAO 2007).

Claude Mandil in his presentation during International Petroleum Week (Mandil 2007) set the alarm bells ringing in one of his key messages.

"Growing dependence on oil from a shrinking number of producers will pose threats to energy users by: exposing importers to market power; reducing the level of flexibility in the system (Mandil 2007).

The prospects for reducing carbon emissions and conserving oil resources thereby avoiding disastrous changes in the climate and a world economic depression are not good. In 2007 there are there are some very serious geopolitical problems that stand in the way of moving from the age of oil to the sustainable use of renewable resources in a peaceful way.

The major constraint to reducing carbon emissions worldwide has been the U S government which has not accepted the reality of global warming, would not commit to reducing emissions and was the largest oil importer in the world, with 60 percent of its oil demand met. What happens in the global energy market -whether in terms of price or disruptions of supply -can have disastrous economic consequences for the world and the US. (Yergin 1991)

2.5 The UN Security Council

The recent decision of the United Nations Security Council to discuss, for the first time, the impact of climate change on peace and security; the meeting held on April 17 2007 represented a major milestone, with representatives of 55 nations in attendance. According to the Worldwatch Institute the discussion came at the initiative of the British government, which circulated a concept paper that called attention to a range of climate change security issues including energy:-

Security implications of climate change, include border disputes, migration, societal stress, humanitarian crises, and shortages of energy, water, arable land, and fish stocks. U.K. Foreign Minister Margaret Beckett, who had previously helped negotiate the UN Framework Convention on Climate Change, spoke about the potential risks of an unprecedented rise in refugees from flooding, disease, and famine; increased competition for food, water, and energy as a result of widespread drought and crop failures; and the possibility of climate related economic disruptions on a scale not seen since World War II. The Security Council discussion is only the latest in a series of recent meetings and reports intended to highlight the intersection of environment and security (Renner 2007).

Table 3 Key mineral resources time to exhaustion Source: (Cohen 2007)

Minerals	Years	Used for in the manufacture of
Antimony	15-20	Prescription drug,
Hafnium	10	Computer chips power stations .
Indium	5-10	LCDs
Platinum	15	Catalysts and fuel cells in vehicles
Silver	15-20	Catalytic converters and many other uses
Tantalum	20-30	Cellphones and camera lenses
Uranium	30 - 40	Weapons and power stations
Zinc	20 - 30	Galvanising and in alloys.

2.6 Other resources

There are other well-known resource depletion problems for many countries in the same time frame as peak oil: natural, gas low sulphur, coals, fertiliser and fresh water supplies. The way to deal with them is by the adoption of more sustainable life styles and

international “depletion protocols” to conserve, recycle and make more efficient use of them or find alternatives. Not so obvious, is that we are using up the following minerals at an alarming rate and if the predicted demand for them continues to grow they will also be depleted

The rare earth metals and mineral resources in Table 3 are all in need of a co-operative international effort to conserve recycle and find replacements. An oil depletion protocol would pioneer the means of taking an important first step in combating climate change and provide a model for other “depletion protocols” so as to avoid conflict over access to other vital resources.

3.0 AN OIL DEPLETION PROTOCOL: THE FIRST STEP [lower case capitalised]

To raise the awareness of the serious consequences to mankind of oil depletion the Association for the Study of Peak Oil (ASPO) has proposed the voluntary adoption of an Oil Depletion Protocol to reduce oil consumption each year. If wars over oil are to be avoided the largest oil consumers, the US, China, Japan, India, and Russia, must lay the foundations of peaceful and equitable use of the remaining low cost oil. A global oil conservation and energy efficiency program coupled with the accelerated development of renewable energy resources is needed before it is too late.

The purpose of the oil depletion protocol is defined by Heinberg as follows: -

'The Oil Depletion Protocol is a unique accord whereby nations would voluntarily reduce their oil production and imports by according to a consistent, sensible formulae. This would enable the task of energy transition to be planned and supported over the long term, providing a context of stable energy prices and peaceful co-operation. The protocol will be presented at international gatherings initiating the process of country by country negotiation and adoption, and mobilising public support'.

The simplicity of the protocol is defined as follows:

'The protocol is so simple that its essence can be stated in a single sentence: signatory nations would agree to reduce their oil consumption gradually and uniformly to a simple formulae that works out at a little less than 3 % per year..... For both individuals and nations, transportation is the area of greatest dependence and vulnerability with regard to petroleum. It is also the area in which it is easiest to make measurable reductions in oil usage' (Heinberg 2006).

So far the Oil Depletion Protocol (ODP) has been explicitly endorsed by several cities, including San Francisco, California and Bloomington, Indiana. More significantly, perhaps, it has been implicitly adopted in the targets of the Portland, Oregon peak oil task force. The Peak Oil task force of Oakland, California will likely make similar recommendations (Heinberg 2007). It is recommended that this be adopted in all Australian states and by the commonwealth.

3.1 Australian Senate report on the future oil supply and alternative transport fuels

The Senate's Rural and Regional Affairs Committee warns in its report of future oil supply problems and alternative transport fuels. It states that by far the quickest and most cost-effective means of responding to the long-term issues of peak oil and climate change is to make gains on the demand side. The Committee made several important recommendations: increase fuel efficiency of all new vehicles for major cities, adopt congestion charging, support use of rail for long distance freight and review fringe benefits taxation to reduce perverse incentives for car use (Senate 2007).

The report's biggest failure was not to make stronger recommendations to encourage walking, cycling and public transport in cities. The best they managed was to recommend the Commonwealth's continuing funding of Travelsmart projects. The report did note that:-

"Australia's demand for petroleum is more than 750,000 b/d and projected to rise to more than 800,000 b/d by the end of the decade and to more than 1.2 million b/d by 2029-30." "Australia's net self-sufficiency in oil is expected to decline significantly as future discoveries are not expected to make up for the growth in demand and the decline in reserves as oil is produced."

The committee argued that upstream development is needed to offset depletion of existing oil fields and to supply the growth in demand would require significant investment and would increase greenhouse gas emissions because:-

"All scenarios for future oil production assume increased exploitation of non-conventional oil (heavy oil, tar sands, shale oil) to offset declining conventional oil."

The report stated that *"the essence of the peak oil problem is risk management"*. Australian governments need better information from which to decide a prudent response to the risk. Its first recommendation reflects the continuing uncertainty underlying current policy.

"The committee recommends that Geoscience Australia, ABARE and Treasury reassess both the official estimates of future oil supply and the 'early peak' arguments and report to the Government on the probabilities and risks involved, comparing early mitigation scenarios with business as usual."

The continuing uncertainty underlying current Australian policy was reinforced by a US Government Accountability Office Report also released in February 2007 entitled "Crude oil: uncertainty about future oil supply makes it important to develop a strategy addressing a peak and decline in oil production", It also states that alternative transportation technologies face challenges that could impede their ability to mitigate the consequences of a peak and decline in oil production, unless sufficient time and effort are brought to bear. For example, the report states:-

• Ethanol from corn is more costly to produce than gasoline, in part because of the high cost of the corn feedstock. Even if ethanol were to become more cost-competitive with gasoline, it could not become widely available without costly investments in infrastructure, including pipelines, storage tanks, and filling stations.

. • *Advanced vehicle technologies that could increase mileage or use different fuels are generally more costly than conventional technologies and have not been widely adopted. and currently constitute about 1 percent of new vehicle registrations in the United States.*

. • *Hydrogen fuel cell vehicles are significantly more costly than conventional vehicles to produce. Specifically, the hydrogen fuel cell stack needed to power a vehicle currently costs about \$35,000 to produce, in comparison with a conventional gas engine, which costs \$2,000 to \$3,000.*

Key alternative technologies currently supply the equivalent of only about 1 percent of U.S. consumption of petroleum products, and DOE projects that even under optimistic scenarios, by 2015 these technologies could displace only the equivalent of 4 percent of projected U.S. annual consumption. Under these circumstances, an imminent peak and sharp decline in oil production could have severe consequences, including a world-wide recession.

4. TRANSPORT INNOVATIONS TO REDUCE OIL CONSUMPTION

In Australia adapting vehicles to use Australia's abundant supplies of natural gas as transitional fuel and for the Australian car industry make gas powered vehicles is a sensible alternative transport option. This is not case in the US. The limitations of ethanol and hydrogen fuel cells are set out in the box and they apply to both the US and Australia. However the use of ethanol to power energy efficient and clean two stroke engines for mopeds, light scooters and power assisted bicycles using the clean fuel injection system developed by the Orbital Engine Company in Perth deserves serious consideration.

The most practical option for cars and light commercial vehicles in both countries is petrol and diesel fuel efficiency standards and tax incentives to encourage the use of smaller vehicles. The technologies investigated in the USA face challenges that could impede their ability to mitigate the consequences of a peak and decline in oil production, unless sufficient time and effort are brought to bear (US GAO 2007). This most relevant to Australia as the Senate report (2006) argues that

“Prudent risk management requires the planning and implementation of mitigation well before peaking. Early mitigation will almost certainly be less expensive than delayed mitigation.”

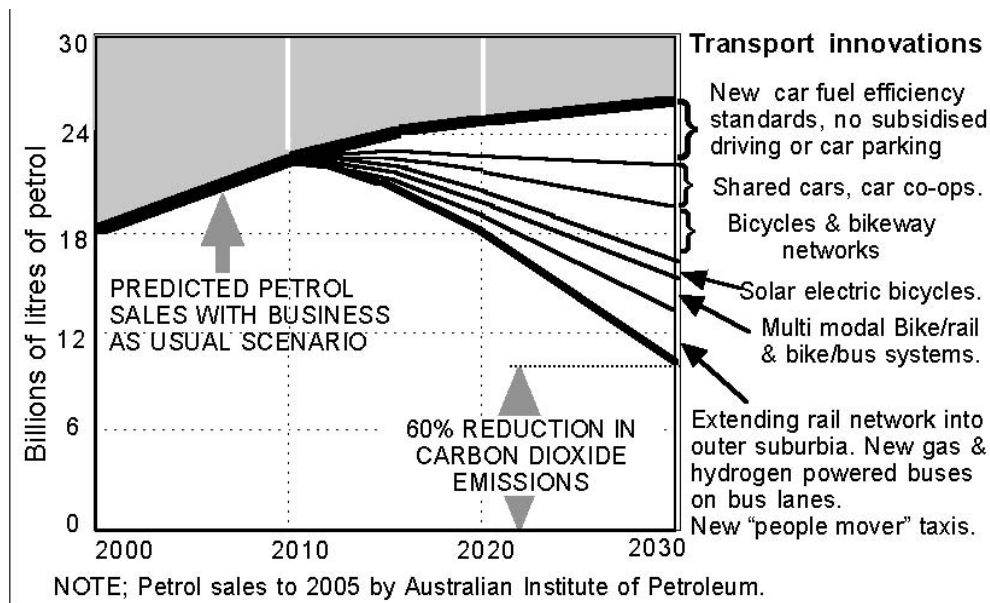


Figure 4 Adaptation measures to reduce Australian oil consumption by 2.2% per year and reduce greenhouse gas emissions

Until this additional research has been done we will not know the cost of delayed mitigation. It would be prudent to prepare now to introduce fuel efficiency standards and congestion pricing in Sydney, Melbourne, Brisbane Perth and Adelaide so that no time is lost and to ensure the adaptation measures shown on Figure 4. These are fail-safe options and include the limited use of hydrogen on buses.

The adaptation measures on Figure 4 focus on new transport innovations, transport mode shift and lifestyle changes which can best be made at local government level by the promotion of Travel Smart programs supplemented by the provision of safe bicycle route networks that provide safe and secure access to public transport. These need to be applied in the outer suburbs of the capital cities where most long, single occupant car commutes originate.

Extending the rail system into outer suburbia, new car fuel efficiency standards, abolishing subsidised driving and parking provision are all required. The use of solar electric charged power assisted bicycles is the way to increase walking, cycling, car sharing and the use of public transport. The Australian government needs to intervene now to ensure that the car industry co-operatively produces petrol electric hybrid vehicles. Taxation and other incentives should be applied to the ten imported cars that are recommended by the Department of Transport and Regional Services as the top environmental performers with the best greenhouse and air pollution ratings.

There is an important role for carbon taxes for transportation. Dutch experience shows that greening the tax system can provide incentives to use cars less or to encourage the use of more energy efficient vehicles and can greatly encourage bicycle use. Limiting the amount of car parking has also been successful in encouraging bicycle use in Dutch cities (Wellemen 1999).

Getting rid of incentives to overuse cars such as the salary packaging schemes and replacing them with salary packaging for public transport would help. Tax incentives for smaller and more energy efficient cars and commercial vehicles would reinforce the following proposals for fuel efficiency standards.

In the medium term the salary packaging of electric bicycles and electric scooters powered by batteries charged from household solar cell arrays could create three new industries: making the electric bikes, the electric scooters, and solar electric installations that could feed into the electric grid or charge the batteries of domestic electric appliances. Carbon saving spin offs would hybrid solar /main electric air conditioners charged by solar cells and backed up by main electricity which would greatly reduce summer peak loading of power stations.

4.1 Fuel efficiency standards for cars, vans and commercial vehicles

The average car in the Australian car fleet is bigger and consumes more fuel in 2005 than a decade ago, despite the fact that engine efficiency has improved. Sound and effective fuel efficiency standards have been mandated in the past in the US and this could be done again. Australian vehicle fuel efficiency standards are needed that will ensure that by 2015 the average fuel consumption of the car fleet including 4WDs will be 5 litres/100 km and for the SUV and light truck fleet to be 6.5 litres/100 km. giving an overall 50% increase in fuel efficiency. If hybrid petrol/electric and gas electric cars and LCVs are built in Australia then fuel economy improvements of 40% or more are possible (Hirsch, Bezdek and Wendling 2005).

Figure 5 shows how hybrid petrol electric cars when fully loaded can greatly reduce fuel consumption. In outer suburbia the bicycle could also be used to access shared cars for commuting and the use of bike racks would enable bicycles to be used at both ends of a commuting trip.

4. 2 Bicycles and electric bicycles on urban bikeway networks

From a strategic transport planning perspective investing in bikeway networks would be cost effective in Australian cities if they enabled bicycles and electric bicycles (E-Bikes) to be more safely used instead of cars (Parker and Worth 2006). Figure 6 shows that E-Bikes are very energy efficient using between one twentieth and one sixtieth of the energy used by cars per km. E-Bikes have great potential as access modes to public transport in the low-density areas of cities because they are designed to reduce the physical effort of pedalling by around 50%, so that elderly people will be able to cycle as easily as they did in their youth.

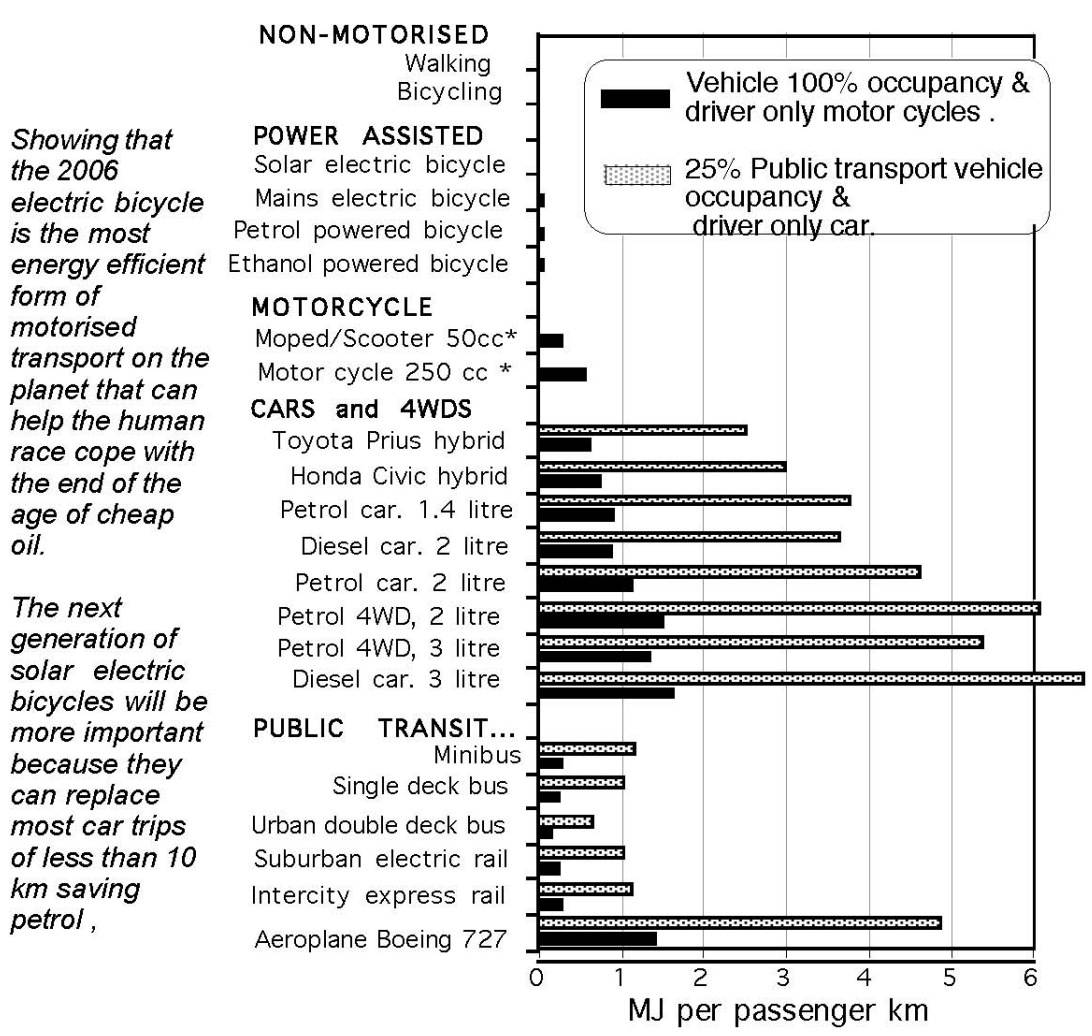


Figure 5 The electric bicycle efficiently uses electricity to replace urban car trips

The best E-Bikes are designed and made in Japan and weigh only a few kilograms more than bicycles. They have electronically controlled power assistance via sensors in the cranks linked to a computer chip. There is no clutch to worry about after switching on with a key. The power assistance operates automatically on starting, going uphill and combating headwinds. Power cuts out at 24 km per hour so they can be safely used on shared footways (Parker and Worth 2006). In 2005 the production of E-Bikes in Japan was 210,000.

In China, the production of electric bikes, mostly with throttle controlled power assistance and higher power outputs of 250 to 400 watts, reached 19.6 million in 2006. Chinese consumers have a wide choice of electric bicycles to pick from now that petrol powered bicycles, mopeds, and light motorcycles with polluting two stroke engines are being banned in their major cities. Electric bicycles are now mass-produced and could be safely used in Australian cities to reduce traffic congestion if continuous bikeway

networks were created in all cities. Bikeways could be created more easily on existing main roads if cars were used less, and if residential street routes and off-road bicycle paths and shared footways were linked up in way to make it possible to have more direct routes from A to B for cycling than driving.

The Australian Road Rules need to be revised to allow E-Bikes of 300 watts power output to be classed as bicycles as they are in NZ. Nearly all of the safest Japanese E-Bikes cannot be purchased in Australia as they would be classified as motorcycles. In NZ disabled people are allowed to use fully powered 600 watt E-bikes (Parker and Worth 2006). In Canada and the USA there are electric scooters being marketed with power out puts of 500 watts which are legally classified as bicycles and can cruise at 40 km per hour. When the price of petrol becomes unaffordable it is important that such vehicles are legally available as bicycles to those in outer urban areas with poor public transportation.

4.3 Making the Fabric of Outer Suburbia More Permeable for Walking and Cycling

Studies to identify the existing and future constraints to walking and cycling in the urban fabric of the capital cities are needed. The fabric of the outer urban areas is not permeable because there are long waterway barriers of rivers and creeks, intermingled with large man made barriers of railways and freeways, many of which are more than one km long and divide communities. Many main roads do not have enough signalled crossings for pedestrians and cyclists to cross in safety. This also applies to many middle suburbs

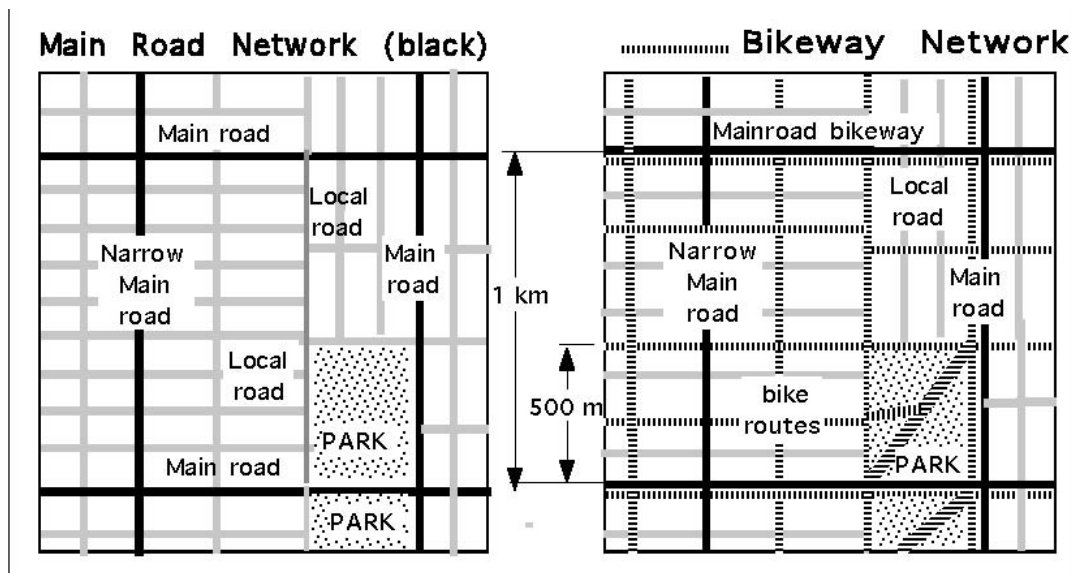


Figure 6 A bicycle arterial network should be a recognised part of the “hierarchy of roads” with a finer mesh than the main road network

The residential street and access road network is very important because it connects

with off-road 'shared footways' used by walkers, the disabled and by cyclists of all ages. More mid block crossings and refuges are needed to link up residential streets and create walking and cycling routes across main roads.

The provision of a safe bicycle route network will require hundreds of safer main road crossings to link footpaths, residential streets, shared footways and back street bypass routes in a co-coordinated route network; this is illustrated on Figure 6. Arterial road networks typically have a coarse mesh as shown on the left of Figure 6. The arterial bikeway network has to be a much finer mesh so that for most short car trips it is more direct and quicker to get from A to B by bicycle (see right map Figure 6).

The proposed "principal bicycle network" in Melbourne and other capital cities is far too coarse, with too many breaks in the network and too few shortcuts to encourage bicycle use. It is also only 35% complete and not keeping up with urban growth. What is needed is a complete arterial bicycle network to provide short cuts for cyclists and pedestrians over and under freeways, railway lines, rivers and other barriers to motor vehicle travel. Main road bikeways on or alongside the roads, linked with traffic calmed local streets and off-road shared footways, are required. The mesh of the bikeway network would be 500m x 500m in the inner areas and 750m x 750m in the outer areas, or the rectangular equivalent of these sizes. In Melbourne a bicycle arterial network would be around 7,500 km long (Parker 2001).

Most one-way streets for cars should be two way for bicycles and roads with bike lanes and should have a maximum speed limit of 50 kph. The introduction of a 50 kph limit on local roads in January 2002 in Victoria and the reduction of the legal leeway given to violators to 3 kph have made these roads safer for cycling and walking. It makes sense to use them to bypass sections of dangerous main roads. In the longer term a 40 km per limit on all residential streets is required as has been implemented in Unley in South Australia. On outer urban residential streets without a footpath for child cyclists to use there should a 30 km per hour speed limit as there is in many European cities.

4.4 Put in Public Transport with Safe Bicycle Access in New Housing Developments

The absence of public transport is a problem in outer suburbia but it can be dealt with relatively easily. Developer contributions for roads and footpaths and for major infrastructure works, such as water reticulation, are fairly common in Australia. State governments should ensure that this development charge is extended to public transport infrastructure and services. Melbourne data are used below as a typical example of bicycle access in Australian capital cities.

Table 4 Station catchment area data for walking & cycling with the same physical effort of 75 watts for 7.6 minutes, within a rectangular street grid

	Walking	Mountain bike	Racing bike
Effort advantage	1	3.1	3.8
Speed km/hour	6.1	20	23
Distance km.	0.8	2.5	3
Catchment area sq km	1.3	12.4	19

Table 4 shows that within a rectangular street network, bicycle access uses the ergonomic advantage of pedalling over walking to go 3.5 times as far and to access an area ten times as large as the pedestrian catchment. Cycling 2 to 3 kms will increase the rail corridor catchment area 4 to 10 times compared to walking, four times for closely spaced stations and 10 times for widely spaced stations. Only 12 % of the population of Metropolitan Melbourne is within easy walking distance of a station but around 70% are within easy cycling distance (Parker 2002). The bicycle for the able bodies and the power assisted electric bicycle for the elderly or lame can be used to access stations. Note that electric bicycles are designed in Japan to reduce the effort required to cycle by 50%.

In most low density outer suburbs stations and express bus stops are too far away to walk to, too time consuming to access by local bus, or not accessible at all by public transport. It is important to provide safer bike routes, more public transport and to provide secure thief and vandal proof storage for bicycles at rail stations and at express bus stops.

If there were secure bicycle parking and if the rail system was extended into outer urban areas the potential of the existing rail system in Melbourne would be extended by 50,000 bike rail commuters or more. With new express bus services running around the extended radiating rail routes the potential for bike/rail travel would be well over 100,000 commutes per day.

In Brisbane a good start has been made with 2,000 bicycles lockers in use at stations in 2006 and several hundred more lockers were installed in 2004 and 2005. Several hundred bicycle lockers were provided in 2004 and 2005 on rail systems in Perth, Adelaide, Sydney and Melbourne (Department of Environment and Heritage 2006). If a bicycle is used at both ends of a rail trip, as happens with 25% of the bike/rail commutes in the Netherlands, the rail system not only provides convenient access to the CBD but to most of the inner suburbs within 10 km of the CBD and to suburbs within to two to three km of the radiating rail lines (ECMT 2001).

Japan has the most developed and sophisticated rail system in the world with around 5,500,000 cyclists parking their bicycles at rail and bus stations on their journey to work school or university (Replogle 1992). Since the 1973/4 oil crisis Japan has had an energy security policy in place that encourages bicycling and bicycle access to public transport (Hook 1994). In the Australian capital cities there is a planning opportunity to greatly increase the volume of multi-modal bike travel by having a bicycle arterial network that connects with all rail stations and express bus stops (Austroads 2002).

State and local governments need to work together to plan new trunk and express bus routes on outer urban main roads and give priority to buses using these roads so that they can replace a large proportion of long urban car journeys. The ergonomic advantage of cycling over walking can be used to increase the catchment area of these new bus routes. Bicycle theft can be minimised by providing vandal proof bicycle parking at heavily used bus stops.

4.5. Planning for Bicycles to Substitute for Short Car Trips

The Dutch have been successful in achieving the trip substitution objective by the integration of demand management strategies, spatial planning strategies, the restriction of car parking and an innovative range of bicycle programs (Welleman 1999). If, at some future date, oil were to be rationed, as it was in the 1940s, bicycle transportation would have obvious advantages. Most of the population in outer urban areas, who could no longer use their cars, could use bicycles for journeys up to 10 km, on relatively safe roads used by very few motor vehicles legally travelling at lower speeds to conserve fuel. For longer urban journeys, bicycles could be used to access rail stations and bus stations and if electric bicycles were available it would be a lot easier to cope with longer access trips.

Metropolitan Melbourne has a disjointed network of bike lanes mostly on roads with speed limits of 60 kph or more, but lacks the Dutch close-knit bikeway networks on which it is safe to ride. Around one in four Dutch women choose to cycle to work on local roads with 30 kph speed limits, on bike lanes on roads with a maximum 50 kph limit and on separate bike paths alongside high speed main roads and freeways because it is safe to do so (Welleman 1999, Parker 2001). In the outer suburbs of Melbourne around 5 Australian women in a 1,000 choose to ride a bicycle to work. 50 times as many women choose to cycle to work in Dutch cities than in Australian outer suburbia. Similar safe riding conditions and high levels of female and male bicycle use exist in many Danish, Swedish and German cities.

Even so, the scope for trip substitution is good in Melbourne. The data in Table 5 are from the Victorian Activity Travel Survey and show that there are 11.8 million trips made everyday in Melbourne and that 7.9 million of these trips are made by car. When we consider the current estimates of how far cyclists ride bicycles for all purposes in Melbourne there is a huge potential for bicycles to be used for many of the 5 million car trips of less than 5 km.

Table 5 Car trips: Melbourne all days, all purposes Source (VATS 1994 to 1999).

Distance.....	Drivers	Passengers	Total cars	% of trips.
0 to 1 km	624,246	373,658	997,904	12.6%
0 to 2km	1,471,807	895,650	2,367,457	30%
0 to 5 km			4,977,000	63%

4.6 Encouraging the Use of Bicycles and Electric Bicycles in the capital cities

When we consider the current estimates of how far cyclists ride bicycle for all purposes in Melbourne (see Table 6 below) there is huge potential for bicycles being used by the able bodied instead of cars for trips of 8 km or less and electric bicycles for 16 km or less.

Table 6 How far do cyclists ride in Melbourne in mostly flat areas.

<u>Distance.....</u>	<u>% of trips</u>
0 to 1 km	33%
1 to 2 km	22%
2 to 4 km	19%
4 to 8 km	13%
8 to 16 km	11%
More than 16 km	1%

Most cyclists who cycle 2 km or less (55%) do so in relatively flat areas. Most cyclists riding more than 8 kms have journeys that take them through hilly areas which requires more physical effort. Hills are a deterrent to cycling which can be overcome by the use of E-Bikes; they are a practical substitute for many urban car trips of 8 km or less in the hilly areas. The use of E-bikes with a 300-watt power output would greatly encourage fuel saving the hill suburbs especially in Brisbane and Sydney. For partially disabled or elderly people many trips are less than 5 km and the use of bicycle, shopping tricycles and electric bicycles would be a great asset. E-Bikes could significantly increase bike lane usage on main roads and make them safer as a consequence.

4.7 Institutional Constraints to bicycle use: the lack of funding and clear vision

The main constraints to increased bicycle use are institutional and changes need to be made to Commonwealth, state and road agency policies and practice. Melbourne is used as a typical capital city example of token measures taken for cyclists.

A review of the proposed VicRoads bike lane network on main roads, revealed that if it was completed it would create a network of 1.5 km x 1.5 km or rectangular equivalent) with huge gaps where the certain freeways, sections of truck routes, the Westgate Bridge and the Bolte Bridges provide short cuts for motorists with no alternative routes for cyclist and pedestrians. Dutch and Danish experience shows that such a coarse

mesh bike lane network will not make it quicker to make a short trip by bicycle than by car, because it will not provide the shortcuts to the arterial road system for cyclists. High speed limits on roads with bike lanes are another serious deterrent to cyclists (Wellemen 1999).

Another serious problem is that there is no recognition in the strategy 'Melbourne 2030' that bicycle and pedestrian planning is very labour intensive and requires proper staffing. Bikeway networks are not capital intensive like freeway networks which cost \$ billions. The cost of construction is very low in comparison but there is a lot of complex detail to plan, design and construct as well as tiny property acquisitions and endless consultations with interested parties.

It does not cost much to provide bicycle facilities on new roads but to retrofit existing roads is sometimes impossible and, if feasible, often a time consuming exercise that involves a number of organisations. If not feasible on main roads alternative and reasonably convenient and safe routes a need to be mapped and signed on other roads or off the road (Parker 2001).

VicRoads has never been a properly constituted and or required by the Transport Act to have a staffed pedestrian/bicycle planning unit with a budget of around \$36 million a year for ten years to create a fine mesh bicycle arterial route network in Metropolitan Melbourne (Parker 2001). Neither does VicRoads provide adequately for pedestrians and public transport users. The same applies to most other road agencies particularly the Road Traffic Authority of NSW.

The competent provision of bicycle facilities and programmes needs a bicycle/pedestrian planner in every LGA and the state and Commonwealth governments needs to recognise the labour intensity and importance of this task. Until that happens new graduates will avoid this kind of work; and will not take bicycle planning seriously as a career option. Government persists in providing token measures particularly in integrating bicycle access to public transport in the new outer urban areas which are so spread out that walking is not a convenient means of access.

Eighteen years ago VicRoads added the states' bicycle advisory committee to its organisation and took over the job of making main roads safe for cyclists. The bicycle movement is still waiting. They produced the Victorian Bicycle Strategy 16 years ago in 1991, a 10 year strategy that included the creation of a metropolitan wide network of bicycle lanes on main roads with an off-road network of shared footways for cyclists and pedestrians that was linked with the main road bike lanes. These two linked networks of on-road and off-road cycle routes were to be 3420 km long and are only 35% complete 16 years later. It is now 26 years since "shared footways" started to be constructed in Melbourne under the direction of the then State Bicycle Committee which had an independent chairman reporting directly to the Minister for Transport.

VicRoads role in this strategy was providing 2000 km of bike lanes but has only lane marked 26% of them at an average of 40 kilometres of bike lanes each year and will take 40 years to finish off at that rate. A more serious problem is that over 1,000 km of the existing main roads do not have enough width to provide bike lanes.

It is only in the City of Melbourne and some inner suburbs where the councils have done a lot for cyclists to link up main road bike lanes with bike routes on traffic managed

local roads that cycling has increased to around 4% of commuter trips to work. In the outer suburbs only 0.5% of bicycle trips to work are by bicycle and that is where a 500,000 population increase will take place. The problem is that VicRoads like the RTA in NSW is serving the interests of the roads and trucking lobby not providing a comparable level of service for walkers, cyclists and the disabled.

5. INSTITUTIONAL CHANGES TO REDUCE CO2 AND OIL USE

Carbon trading will have an important role to play in world trade and in reducing the competitive advantage of fossil fuels which will encourage the growth of renewable energy infrastructure.

There is also a need for institutional changes to be implemented as soon as possible:

- green the tax system to embody the costs of oil depletion into the price of diesel, petrol and aviation fuel and use the funds raised to decouple the growth in oil consumption from the growth of GDP provide tax incentives and constraints reduce size of cars in the Australian car fleet.
- introduce a Commonwealth government target to reduce Australian Greenhouse gas emissions to 30% below 1990 levels by 2020. Ratify the Kyoto protocol and negotiate a post-2012 global emission reduction treaty which commits Australia to serious, legally binding reduction targets. See Greens policy "Re energising Australia" (Milne 2007).
- use the green taxes raised to build bikeway networks in all Australian cities, enhance rail infrastructure and extend rail services and express bus services into all outer urban areas and provide secure bicycle parking at all modal interchanges and railway stations. Fund Travel Smart programs in all urban areas directed to reducing the number of multi car households.
- change current planning legislation to enable land use planners to eliminate urban sprawl and provide public transport services in new residential and industrial areas and make urban areas more permeable for walkers and cyclists.
- change the constitution of road planning agencies to make it their responsibility to reduce the; demand for road space, unsustainable travel, road congestion and the creation of a continuous arterial bike network within the overall hierarchy of roads. When there is room for bike lanes on main roads speed limits would be reduced to 50 kph. When there is not room for a bike lane or bike path in the road reserve a safe alternative route would be provided on residential streets. There would be more short cuts for cyclists, more bridges over barriers, safe mid block main road crossings linking and better route signage.
- upgrade the Commonwealth Greenhouse Office and state environmental agencies to further encourage the take up of renewable energy resources and encourage the widespread use of rooftop solar electric cells and solar hot water heating. Focus on providing solar electricity on providing peak air conditioning, refrigerators and the use of electric bicycles and electric scooters with overnight battery charging. There many synergetic benefits from an integrated approach to the use of domestic solar

electricity.

- change commonwealth and state laws and taxes to make better use of the car fleet by increasing fuel efficiency by 50% by 2015; introducing car "fuel efficiency standards so that the average fuel consumption of the car fleet including most 4WDs be 5 litres/100 km and for the SUV and light truck fleet to be 6.5 litres/100 km. Promote and fund telecommuting, eco-driving, car sharing and car co-ops.

- establish a 6 month strategic reserve of an appropriate mix of crude oil and refined oil products based on need and necessity.

- promote the use of national gas as a transitional fuel and ban the import of large petrol and diesel fuelled cars whose engine not designed to be converted to efficiently burn natural gas

- remove Australia from involvement with US plans to solve their oil problem by military force and to work within the Asian region for an equitable regional rationing of oil and mineral resources.

6. CONCLUSION

There is a significant risk of world crude oil peaking around 2010. This is the worst-case scenario, which would induce a worldwide depression, wreck the Australian economy and produce mass unemployment. It is almost certain to occur by 2018. Whatever the timing of peak oil, outer suburbanites and the poor in rural areas would initially be the most disadvantaged. Within a year or so the well being of most Australians would be under threat. It would be prudent for the Commonwealth and state governments to develop a risk management strategy by January 2009 to mitigate oil dependence well before conventional oil production peaks and to maintain essential public services.

The following are suggested as minimum requirements:

1. Produce a national Energy Security Policy to mitigate oil dependency with both demand and supply side measures that focus on the synergistically beneficial actions and transport innovations that reduce both greenhouse gas emissions and reduce oil use.

2. Establish a 6 month strategic reserve of a mix of crude oil and refined oil products.

3. Unilaterally implement the Oil Depletion Protocol by reducing oil consumption by 2.2% per year and launch an all out diplomatic effort to persuade nations in this region to do likewise.

4. Make a commitment to freeing Australia from oil dependence by 2020 similar to Sweden and Norway and to oppose the use of military force to gain control of foreign oil reserves.

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