Submission to the Productivity Commission Inquiry into economic and environmental potential offered by energy efficiency

Contents

FIGURES

TABLES

INTRODUCTION

This submission focuses on Australia's energy wasteful passenger transport system and why an ' energy efficiency gap' exists between the most efficient means of passenger transport and those that are actually in use. This has generated a high degree of oil/car dependency and puts the nation at risk of economic collapse some time between 2008 and 2024. There is also a need for a 'cradle to the grave' assessment of the energy efficiency of passenger vehicle fleets today and in 2024 when the energy efficiency of the "fuel chain" will be greatly reduced. Cheap oil (conventional oil) will no longer be available from around 2008. The energy return on energy invested in extracting oil from dificult locations in deepwater or from energy intensive, low quality resources, such as tar sands will increase. By 2024 the physical energy costs of exploring, extracting, transporting, refining and distributing oil and gas based fuels, which will make them far less competitive with sources of renewable energy such as wind turbines, solar cells and electricity production from brown and black coal. (Foran and Poldy 2002 A)

It is argued, that, in isolation, the depletion of the world's stocks of cheap oil is a risk management problem of global proportions. The risk would be manageable given an international agreement by all the developed nations to conserve much of the remaining cheap oil for essential purposes, but there is no such agreement, nor any intent to create one. Evidence is presented to show that the synergetic interaction of oil depletion with other environmental "time bombs" that have been ticking away for many years will result in world food production peaking and then declining at a rapid rate. The peaking of world oil production is analysed. Cheap oil production is declining in the same 30 year time frame as increased drought , storm damage and rising sea levels due to global warming; a decline in fresh water availability and quality; increasing salinity and soil loss. All of these environmental problems are beginning to reduce food production. (Abernethy 2004) (Pimental & Wilson 2004) (New Scientist Supplement 2001)

World wide there is a need to create energy efficient transport systems within cities and between cities. These must be created as world oil production peaks and cheap oil resources are drained and replaced by much more expensive and greenhouse intensive sources of oil. Energy efficiency is an integral part of the package of measures to cope with the peaking of world oil production shown on the front cover graph. In Australia a crash program to introduce energy efficient gas powered vehicles is a realistic option well before 2008 but the other measures are also needed as an integrated package. If gas is used as a transitional fuel the energy used to extract and deliver gas will exceed the energy contained within that gas by around 2050 so there is no easy way out. An Australian energy security policy like they have in Japan is needed which over writes narrow economic concerns in order to produce more energy efficient passenger trains and intermodal networks, hybrid petrol electric vehicles of all kinds, electric bicycles and modal substitution (including 5 million bike/train commutes).

It is argued that world's population is increasing by around 70 million people a year but without cheap oil the current patterns of trade, travel and farm productivity cannot be maintained and as a consequence health and welfare services will also decline, creating a world economic depression. A billion or more people may starve in the densely populated or oil poor countries. From a global perspective, the most energy efficient and equitable use of the remaining reserves of oil, is to 'power assist' labour intensive agriculture in the developing world. This will ensure that the complex hydrocarbons in oil are used to manufacture the essential petrochemical

products required by hospitals and essential services and to provide the infrastructure for the development of renewable energy resources.

Australia is not immune to this gathering global storm but has the capacity and resources to survive with a more frugal lifestyle and use of more energy efficient renewable energy technologies which become more efficient as the energy return on energy invested in producing oil declines. However it will not be able to produce surplus food for export, when oil becomes expensive, shortages of fresh water begin and climatic change take effect.(Flannery 2004)

The current wasteful combustion of oil in single occupant motor cars is not best way to use this complex chemical. It is as wasteful as using mains electricity to heat water or cool air instead of providing quality power for energy efficient lighting, precision machines, computer and electronic devices of all kinds.

Without far higher levels of energy efficiency Australia cannot survive and hence the need to define what the role of energy efficiency is for its ecologically sustainable development. The Dutch concept of energy efficiency is recommended . The objective of which is too slowly:-

"decouple economic growth from the growth in oil consumption and the use of non renewable resources". (NEPP 3 1998)

TOTAL ENERGY EFFICIENCY OF OIL AS A FUEL DROPS FROM 2004 TO 2024

The first need is to establish base data for **total energy efficiency** to accurately assess the of both vehicles and vehicle fleets and the passenger transport system as a whole. (Fuel chain efficiency x vehicle efficiency = total energy efficiency) The physical energy costs of discovering, extracting, refining and transporting oil during the lifetime of today's passenger vehicle and freight vehicle fleets are currently ignored in calculations of total vehicle fleet energy efficiency.

The total energy efficiency of today's internal combustion engines and fuel cells using fossil fuel in 2004 is shown on Figure 1. No account is taken of the decreasing energy efficiency in the production of oil based fuels over the lifetime of vehicle fleets. This is 12 years for cars, 4 WDs and LCVs; 15 years for trucks B-Doubles and road trains; 20 years for buses and aircraft; and 25 years for diesel trains and many special purpose vehicles.

The definition of energy efficiency in the Commission's Issues Paper is fundamentally flawed because it fails to take into account the large increase in real fuel costs within the life of existing vehicle fleets. Nor does it take into account the oil needed to manufacture motor vehicles and to maintain them , the space used for roads and parking or the costs of road deaths, injuries and the shortening of peoples lives due to air pollution.(Parker 1995)

.**Figure 1 US Fuel Chain Efficiency, Vehicle Efficiency and Total Efficiency 2004**

Source: Wald, M.L. (2004) Scientific American May 2004 p 42 to 47

The failure to consider the **"energy return on the energy invested"** (EROI) 20 years from now for vehicles using more expensive fuels, which will hopefully be discovered in deep waters beyond the continental shelf, is a very serious methodological error. The biggest change is for petrol and diesel IC engines whose **total energy efficiency** drops by 50% due to the predicted increase in the energy costs to extract, refine and transport crude oil in 2024.(See Figure 2) A CSIRO study "Dilemmas Distilled" states the following:-

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 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".
p 28. (Foran and Poldy 2002 B)

Figure 2 Energy costs and benefits of oil extraction 1951 to 2041

Source: Foran and Poldy (2002) Chapter 5 "The future of Energy" from "Future dilemmas: options to 2050 for Australia's population, technology, resources and the environment", by CSIRO Sustainable Ecosystems, Working paper series 02/01
Note: fuel chain efficiency notes added by Alan Parker

The term EROI (Cleveland et al ,2000) and 'energy profit ratio'(Fleay, 1995) were used by CSIRO's scientists, who recommend that physical energy profit accounting procedures should complement monetary accounting procedures for all important energy companies and national accounts. (Foran and Poldy 2002 B) That applies to this PC Inquiry.

Using the "ecological footprint" of Australia as an energy efficiency indicator

Another way of looking at the concept of energy efficiency is to measure the 'ecological foot print' of different transport modes. It would be useful for such an analysis to be made as a means of measuring the environmental impact of wasting energy.

The "ecological footprint" methodology is a tool for measuring and analysing natural resource consumption and waste output within the context of nature's renewable and regenerative capacity. According to the authors (Venetoulis, Chazan.and Gaudet 2004) It is a quantative assessment of the biological area required to produce the resources (food, energy and materials) and absorb the wastes put out by the population of a country, state or city over the period of one year. From the ecological perspective, if we remove more from nature that can be provided indefinitely we are on a unsustainable track. Therefore energy efficiency must be defined in a way that in time will result in a reduced the ercological footprint for Australia.

Humanities' total footprint is at an unsustainable level .The carrying capacity of the planet was exceeded in the late 1970s. It continued to increase till 1997 and started to level out. This supports the prediction of a failure of food supplies as the worlds population expands.

The general relationship between the high national ecological foot prints in hectares per capita

and high per capita GDP, oil consumption, carbon dioxide emissions and motor vehicle ownership is shown on Table 1

.

Table 1 The ecological footprint and other indicators of 32 selected countries: major oil producers & consumers, the most populous and the poorest

.

Country Ecological Footprint: hectares per capita Year 2000		GDP per capita in 2001 US$1000's per year	Oil consumed, per capita barrels per year	Carbon Dioxide tonnes per capita year 2000	Motor vehicles per 1000 population 1997	Tonnes of CO2 per US $ of GDP Year 2000
Bangladesh	0.5	1.7	0.2	0.21	2	0.36
India	0.76	2.5	0.7	0.96	12	1.39
Indonesia	0.98	3	1.6	1.21	21	1.11
Nigeria	1.1	0.8	0.7	0.35	1	2.12
China	1.36	4.6	1.4	2.69	10	2.03
Cuba	1.53	2.7	-	2.78	-	1.54
Algeria	1.67	3.6	-	2.26	87	2.02
Iraq	-	2.3	6.8	3.18	50	3.23
Iran	1.85	6.7	0.53	-	23	2.36
Azerbaijan	1.91	3.6	6.3	3.76	51	5.94
World average	**2.18**	**7.8**	**4.42**	**6.12**	**111**	**1.73**
Turkey	2.2	7.2	3.6	3.3	67	1.31
Brazil	2.39	7.6	4.4	-	81`	0.71
Venezuela	2.42	5.3	6.71	5.54	110	3.04
Mexico	2.59	8.8	6.71	3.67	138	1.33
Libya	3.21	6.1	12.1	7.68	234	2.78
Italy	3.26	25.1	11.76	7.7	566	0.91
Netherlands	3.81	27.1		10.82	417	1.23
Japan	3.91	28.7	15.5	9.62	543	1
Saudi Arabia	4.05	11	20.43	-	336	3.6
Germany	4.26	26.2	12	10.16	488	1.19
Russia	4.28	9.7	6.01	10.65	124	3.84
United Kingdom	4.72	25.4	10.32	9.28	426	1.17
Denmark	5.32	28.8	13.6	9.53	408	1.08
France	5.74	25.9	11.9	6.03	438	0.78
Australia	**7.09**	**26.6**	**16.13**	**16.84**	**619**	**2.07**
Sweden	7.95	26	10#	5.2#	411	0.7
Kuwait	8.01	16.9	-	28.8	330	2.92
New Zealand	8.13	19.8	14#	14.4#	560	1.19
Norway	8.17	32.8	16.05	7.76	494	0.74
Canada	8.56	29	22.6	16.2	563	1.69
U. A. Emirates	8.97	21.7	51.83	29.1	193	4.92
U.S.A.	9.57	36	24.76	19.84	782	1.77

Data Source: www.Nationmaster.com unless otherwise stated.
Ecological Footprint 2000 www.RedefiningProgress.org
# indicates that this data is an estimate from other sources

Table 1`indicates that the economic growth for the developed nations ceased to be sustainable many years ago. It is far above the world average being from 7 to 20 times higher than the poorest nation, Bangladesh. The footprints of India, China and Indonesia indicate that over a billion people now live in dire poverty in these countries despite increasing economic growth.

On closer examination some developed countries have a much more energy wasteful footprint

than others. In year 2000 the US became the became the nation with the largest per capita footprint. By 2004 US motor vehicle ownership per capita had increased but the energy efficiency of the vehicle fleet decreased due to the growth in the proportion of SUVs in the vehicle fleet. The US has also invaded two nations in this period and used enormous amounts of fuel in the process, so the ecological footprint of the US is likely to increase further despite its investment in the use of gas instead of coal for the generation of electricity. In marked contrast some wealthy European countries and Japan have reduced their foot print from 1999 to 2000 because they have a serious committment to reducing greenhouse gases.

According to "Our Ecological Footprint", a bicycle is the most efficient form of personal transportation for short trips.(Mathis, et al 1996) According to their research, someone travelling 3 miles twice a day by bicycle requires the productive capacity of 1,300 square feet of Planet Earth, a number that includes the extra food it requires to fuel a bicyclist. Taking the bus requires 3,240 square feet and driving a car requires 15,500 square feet. An interesting indicator that is supported by some research iin Australia. (Parker 1995).

The best indicator of energy efficiency for the developed nations is reducing the amount of CO2 per US$ of GDP. (Table 1) The data for Japan, the Netherlands and Denmark are far more favourable than those for Australia and the USA. Furthermore, the growth in the number of 4 WDs and SUVs in the Australian and US car fleets, used as single occupant commuting and shopping vehicles, is a most energy wasteful (and dangerous) trend that will further contribute to an increase in the amount of CO2 per US$ of GDP. Therefore, reducing the ecological footprint by targeted reduction of CO2 per US$ of GDP would be very good both as an economic and environmental indicator of energy efficiency.

Decoupling the growth in oil consumption from the growth of GDP

The national peer review of the Netherlands transport system by the OECD (European Conference of Transport Ministers) identified the Netherlands as being the best passenger transport practice for the EU (ECMT 2001). Indeed the Dutch have been moving slowly towards ecologically sustainable development with their National Environment and Policy Plan by *"decoupling economic growth from the growth in fuel consumption and finite resources.* (N.E.P.P. 3. 1998)

As these plans evolved the Dutch improved the performance of their transport system. NEPP 3 makes it very clear why non-motorised travel is considered to be so important and why the car, which in the 1960s and 1970s was regarded as a sacred cow and still is in Australia, is now subject to many regulatory constraints. The transport objectives of the NEPP are:-

Vehicles must be as clean, quiet, safe and economical as possible.
The choice of mode for passenger transport must result in the lowest possible energy consumption and least possible pollution.
The locations where people live shop, work and spend their leisure time will be coordinated in such a way that the need to travel is minimised.

Without the NEPP it was expected that car kms would increase by 72% over the period 1986 to 2010. With the NEPP this increase will be lowered to 48%, a positive step towards ESD. Dutch experience with implementing the NEPP suggests that there is the potential for a shift of at least 10% of all "drive alone" commuter trips to multiple occupant trips.(Parker 2001) This is in addition to using bicycles to substitute for short, highly polluting car trips. (Wellemen 1999) When considering economic efficiency in the passenger transport sector the overall energy efficiency strategy should be focussed on the transport objectives of the NEPP as stated above. Reducing the growth rate of car kms and light commercial vehicle kms every two years in Australia would be a useful way of measuring any reduction in energy wasteful activity.

For example, the Japanese, the Dutch and Dane's have put in place energy efficiency policies over the last 15 years that have resulted in many short single occupant car trips in urban areas being replaced by bicycle trips and many long single occupant car trips in urban areas being replaced by bicycle/train trips, or bicycle/train/bicycle trips. The end result is a per capita reduction in oil use and more efficient use of fuel by their respective car fleets and the more efficient use of railway rolling stock and public transport generally. The Dutch in particular been very successful in using bicycles to replace car trips, short peak hour bus trips and moving much of the car and LCV fleets over to the use of natural gas. (Parker 2001).

When dealing with finite resources such as Australian oil, which will require far more energy to deliver it to the point of end use by 2024, oil conservation can be considered to be energy efficient because it conserves the oil for more essential uses. Clearly using high performance large cars or SUVs designed to carry four of five people for short single occupant car trips for the journey to work or purchasing small items locally is not an example of energy efficiency.

The definition of energy efficiency in Box 2 of the Productivity Commissions Issues Paper is confused in this regard because it fails to state that there are "horses for courses" and that needs to be specifically stated as it is in the the Dutch NEPP.

The potential for modal substitution and more energy efficient vehicles 2004 to 2014.

The ABS Census data for commuting and other transport data reveal that the energy wasteful use of the Australian car fleet is likely to continue to 2011, unless the potential for modal substitution to conserve energy and more energy efficient vehicles are introduced between 2004 to 2014. (Parker 2004 B)

Figure 3 shows vehicle energy efficiency (not total energy efficiency) to illustrate the potential for mode shift and choosing 'horses for courses'. The vehicle energy efficiency of public transport vehicles is shown when they are fully loaded and 25% loaded. The vehicle energy efficiency of single occupant cars is very low compared to fully loaded cars.
Power assisted bicycles (petrol and electric battery powered) are available on in Japan the EU, the USA and Canada. Unfortunately, the safest electric bicycles cannot be purchased in Australia because of road rules that result in restriction of free trade by preventing Australians from buying the safest electric power assisted bicycles (Parker 2004 A). Even so there is scope for using power assisted bicycles to substitute for many short single occupant car trips of less

than 10 km and they would use between one twentieth and one sixtieth of the fuel used by cars per km. In 2004 the combined production of electric power assisted bicycles in China, Japan and Taiwan is expected to reach four million and many of these will be sold in Japan the EU, the USA and Canada. Power assisted bicycles both have great potential as access modes to public transport in low density areas (See page 32).(Parker 2002)

Figure 3 Petrol, diesel, ethanol & electricity energy use of vehicles and aircraft

The latest electric power assisted bicycles weigh only a few kilograms more than bicycles which give power assistance only from on-board rechargeable batteries. They have electronically controlled power assistance via sensors in the cranks linked to a computer chip. There is no no clutch to worry about after switching the power assist system on with a key like that of a car which then operates automatically on starting, going uphill and combatting headwinds. Power cuts out at 24 km per hour so can be safely used on shared footways. For the able bodied in the hilly suburbs of cities they are a practical substitute for many urban car trips of less than 10 km. and extend the range of bicycles. On main road bike lanes they would significantly increase bikelane usage and make them safer as a consequence.(Parker 2004 A)

The use of electric power assisted bicycles, coupled with roof mounted solar electric panels for recharging, has been proven to be practical in Japan. The electric power assisted bicycles coupled with roof mounted solar electric panels for recharging, is the most energy efficient motorises road vehicle ever made. This applies to able bodied people making urban trips of 10 km or for lame or partially disabled people or elderly people make trips of less than 5 km.

As a sustainable product design initiative it is suggested that there is an opportunity to provide imported or assembled power assisted bicycles in new housing schemes using using batteries recharged from Australian made roof mounted solar cells.(Parker 2004 A) (Rose 2004). Ethanol can also used to fuel power assisted bicycles that would use less than one litre per 100 km. and in some rural areas for cars and LCVs. Ethanol is not a solution for urban fuel supplies except for blending with petrol as a pollution reduction measure.

The mass production of petrol electric hybrid cars by Toyota and Honda has started with 70,000 petrol electric hybrids predicted to be sold in the USA in 2004. Not only that, but a more efficient version of the small petrol engine in the hybrid vehicle is being developed. Most car producers are still years away from doing that in Australia and most of the cars produced this year will not be energy efficient and will still be on the roads ten years from now or scrapped prematurely because they will become too costly to run on petrol. There is a need to do what governor Arnold Schwartzenager has done in California. That is to persuade the Toyota and Honda to make these vehicles in Australia. The government needs to introduce incentives to encourage people to buy them. Petrol/electric hybrid trucks are now being produced in Japan and they need to be produced in Australia.

Australia is also dependent on aircraft for long distance passenger travel and tourism; on light commercial vehicles and trucks for freight; and on shipping for international trade. Highly efficient engines powered by natural gas are commercially available for long distance trucks, B-doubles and road trains. The best hope for Australia is to use the large reserves of natural gas as the transition fuel for Australian vehicles. To do that effectively will require that LPG, CNG and LNG be used by government car fleets, providing financial incentives for vehicle conversions

or the purchase of dedicated gas vehicles and financial support for the provision of fuel storage or distribution infrastructure. (STC 2004).

Passenger rail could become one of the few energy efficient uses of electricity if it is generated from gas. The provision of high speed diesel/electric inter city passenger and freight trains could greatly assist in reducing liquid fuel use by substituting for road freight and air passenger travel. There is a need to build up the rail infrastructure, which is in a shocking state.

The short term goal should be to stop that freighting which is in the category of 'taking coals to Newcastle', which has been done overseas, and to steadily increase the price of diesel so as to deter unnecessary freight movement. There is a the need to conserve diesel use and build up a strategic reserve of diesel to keep the truckie's going for at least one year. (Parker 2004 C)

At present most of the Australian LCV fleet is not fuel efficient. In Japan most Australian LCVs would not be allowed on the roads because they are not fuel efficient and produce more pollution as a consequence. In the long term all the new LCVs should be petrol electric hybrids or powered by gas. The Commonweath Government should encourage the manufacturers to build vehicles which efficiently use natural gas. In the short term dual-fuel conversions would work for many older vehicles

Before the process of vehicle fleet energy efficiency improvements can take place at the rate required to be effective, energy efficiency incentives or subsidies need to be put in place. It can take many years for national fleets of cars, trucks, buses, tractors and aircraft to become more energy efficient in freemarket economies with privatised industries. Greening the Australian tax system with Dutch style tax and other incentives to encourage the use of gas as a vehicle fuel, while reducing car use at the same time, will also be required. (See page 30)

Given a reduced growth in transport demand and a growing proportion of fuel efficient vehicles in the car and LCV fleets over ten years, the demand for oil could be greatly reduced. During this period short-term dual-fuel conversions would work for many older vehicles but this is not a long-term solution. Australia will, hopefully, muddle through till 2014 but that will only be because of its oil, gas, coal, solar and wind energy resource wealth. Australian oil wealth has not been conserved, used efficiently or used wisely and it is an accident that, as the world's gas supplies are dwindling, Australia has an abundance of natural gas that is needed as a transitional fuel.

The potential to use hydrogen produced from renewables as a fuel: 2014 to 2024

Australia has sufficient wind resources to produce clean hydrogen by electrolysis for a large number of fuel cell vehicles between 2014 and 2024. (MacGill and Outhred,2004) Japan, the Netherlands and many other nations that have not wasted their energy resources as Australia has, are not so fortunate.

Figure 4 demonstrates that by 2024 that 'fuel cell' powered vehicles **using hydrogen made from fossil fuels** are not energy efficient due to the decrease in fuel chain efficiency of oil. This

is why the so-called US 'hydrogen economy' will not happen. However, this does not mean that clean hydrogen produced by electrolysis using surplus wind power from wind farms or large wind turbines cannot be used in Australia as part of a package measures to reduce Australian oil dependence. The use of hydrogen produced by wind farms in rural areas can serve both the local needs of farmers and some mining ventures. Hydrogen can be efficiently use to fuel trucks passing through rural areas and bush and long distance inter city trains for transport of freight and passengers.

Figure 4 IC Engine and fuel cell total efficiency for the years 2004 and 2024.

Source: Extrapolated by the author from charts in the Scientific American. (Wald M 2004)

The total fuel chain emissions and vehicle emissions are not so different for internal combustion engines and fuel cells. Unless the hydrogen is made from a renewable energy resource. The ethanol fuel cell 'fuel chain emission' data looks good but, as Wald the author notes many people argue that fuel used at all stages in growing corn to make ethanol needs to be taken into account. (Wald 2004) However, the Australian Commonwealth is no longer supporting significant research and development of ethanol production that policy needs to be changed as niche markers for which ethonal is a highly efficient fuel.

There is a need to get the infrastructure to produce clean hydrogen in place before 2014 because by then synergetic interaction of oil depletion and other environmental problems will perhaps have reduced a billion or more people to unemployment and poverty. By 2024 there could be a Malthusian die-off from starvation in populous countries in the developing world and more invasions of nations with cheap oil reserves may be an inevitable outcome. The economic sectors that will most likely collapse first in the developed world will be: -

1. Aviation and agriculture due to high prices of jet fuel and nitrogen fertilisers made from gas and oil. (Cochet 2004).

2. A little later road and rail passenger and freight transport, tourism, the petrochemical industry and the car industry will be working part time and will finally go under in a depression as severe as that of the 1930's (Cochet 2004).

We know what could happen to Australian ports through which exports and imports come and go because, for a short period during the oil crisis in 1973, the Dutch Port of Rotterdam had no oil. There was no bunker oil for the ships; no diesel for the trucks and trains that distributed the cargo; and no petrol for people to get to work.

Between 2014 and 2024, it will perhaps get much worse because rising oil prices will not only have collapsed the developed industrial economies but those of the developing world as well. Die-off from starvation and a mass unemployment will reduce greenhouse gas emissions in the most inequitable and barbaric way unless the nations of the world mobilise their people and industries to create energy efficient green products and processes to conserve oil and produce food without massive inputs of gas and oil.

This submission has so far assumed that to achieve major improvements in energy efficiency that, a “landing place exists”, and that we may be able to land on it softly. Even if the landing place exists (some experts in CSIRO doubt it), getting there won't be easy. A "soft landing" means something like a smooth transition to an economy whose infrastructure provides as much as possible of what we have today, but using different technologies and energy sources. This is not very realistic because the existing urban and rural economies depend on huge stocks of infrastructure which were built up over many decades. Replacing that will take a comparable time and during the transition, while cheap oil becomes less available, the “existing show has to kept on the road” whilst diverting resources to the construction of the new infrastructure.

One expert believes that a soft landing is possible (Fleay 2002) and he has been thinking about the transition period. The need has been demonstrated to reserve the limited buffer provided by natural gas for agriculture, essential transport and the construction of the new infrastructure. The problem is, that this is not current policy. Another difficulty is being locked into our current structures when they are not operationally compatible with the new ones - as they often will not be. The transition to the new structures could take several decades and the rate at which we can divert resources depends on having enough cheap oil resources available.

However, one thing is absolutely certain there is no time to waste. It takes a long time to introduce such new technology; which involves a lot more than installing a few hundred large 1 to 3 megawatt wind turbines. Those multi-nationals with the research and development skills currently receive very little support to increase the total energy efficiency of machines and vehicles in this way. World energy trends reveal that the use of renewable energy to produce electricity has declined from 11% in 1971 to 7% in 2001. Worse still, the 26 developed nations of the world have no collective plans to replace oil with renewable sources of energy. The ‘energy invested. to produce oil are steadily; the ‘total energy efficiency’ of most machine and vehicles is decreasing (see Figure 2). (Hogan and Cohen 2004)

THE END OF THE AGE OF CHEAP OIL: 2008 TO 2024

Figure 5 shows world oil production and population growing rapidly. Cheap oil enabled the human population to increase from 2.2 billion in 1938 to 6.3 billion in 2003; the greatest increase in world history. This was only made possible by the increased production of cheap oil from 2.5 billion barrels in 1938 to 26 billion barrels in 2003. Cheap oil made possible the green revolution which introduced new strains of higher yielding crops that could be planted more than once a year but needed more and cheaper fertiliser made from oil and gas. Cheap oil enabled poor people to transport and trade their produce and eat better. (Vital Signs 2003)

Figure 5 World population growth made possible by cheap oil 1938 to 2004

Soon we shall be forced to adapt to a world without cheap oil, also known as conventional oil. Before that day arrives we will have to learn to live with the world oil supply not satisfying world demand , estimated to be 82 million barrels per day (bpd) in 2004. (Douglas Westwood Ltd 2004) (Wood Mackenzie RADAR 2004) (Skrebowski 2004) This is an increase of around 4.3 million bpd or 5.5 %per annum in the past two years and it is predicted to continue to grow at this` rate in 2005 by the Reserve bank of Australia (Dickson & Holloway 2004) That growth

cannot go on for much longer because the oil discovered in the last ten years is not sufficient to keep pace with demand. Around 2008 Australia will be vulnerable to increasing costs of imported oil, even with new oil discoveries in deep water around Australia; the oil will cost more. (Geoscience Australia 2004)

Since the mid-1990s the average value of oil discoveries has fallen and discoveries from new fields have replaced only 40% of production. In Saudi Arabia, which has the largest oil reserves, they have been drilling for oil since 1938 but now discover much less.
Of the first 60 productive wells drilled from 1938 to 1969 Aramco found 300 billion barrels within 24 fields. Of the last 60 productive wells drilled from 1978 to 2003 Saudi Aramco found only 13 billion barrels within 50 fields.

Another serious problem is that, after oil peaks, proportionally more of the oil will be sour oil, which gets more costly to extract and refine as oil field outputs drop. The world's four largest oil fields are Ghawrer and Burgon in the Middle East, Cantarrall in Mexico and DaQuing in China. Together, they produce one tenth of the world oil production, and the three largest of these are past their peak, producing lower quality sour oil. This reduction in quantity of oil discovered, in as larger number of much smaller oil fields now, was inevitable. It is a finite resource: the more oil that is found the less oil that remains to be found.

Perhaps the best example of what is occurring is in China which exported oil as late as 1992, but has become a net importer, due to a steady decline in indigenous oil reserves. By 2003 oil consumption was growing by over 10% a year and had reached 5.4 million barrels per day. China is now the world's second largest oil consumer after the US, which is consuming 20 million barrels per day. China will import more oil to fuel its runaway economic boom which will generate a demand for oil of 14 million barrels a day by 2010. This will be required for oil-fired electricity generation, all kinds of motor vehicles and a car fleet predicted to increase, by official sources, to 140 million by 2020.

The EU has predicted an increase in road traffic of 50% and an increase in air traffic of 90%. in Europe by 2010 Similar increases are expected in the USA. It is also likely that by 2006, many countries in anticipation of oil production peaking, will build up strategic stocks of oil and that will also drive up the price of crude. Around 2008, when the worldwide demand for oil outstrips global oil production, "the big rollover" will have begun. This is the point at which world oil production goes over the top of a bell shaped curve, known as the Hubbert curve, which is shown on Figures 5, 6 and 12. This curve is named after King Hubbert, a Geologist who pioneered the science of predicting the peaking of oil fields in the 1960s and the peaking of mainland US oil production in 1976. .

By 2003 Hubbert curves had been plotted by researchers for all the 95 countries that have or can produce significant volumes of oil. 52 of these countries, including the US, are already well past their peak (greater than 5 years) while another 16, including the UK, Norway, Australia, and China, are at peak or will reach it soon. The remainder will peak within the next 25 years. By 2020 the production of conventional oil is expected to roll over the top of the Hubbert curves for the world. (Douglas Westwood Ltd. 2004) (Deffries 2003)

World oil production by product is shown on Figure 6 which is taken from the paper by a senior expert in the corporate planning division of the National Iranian Oil Company (Samsam-Bakhtiari 2004). The problems created by the slow decline in world oil production could be survived given a modicum of oil conservation and demand management but oil demand is surging upwards with no recognition of the need for oil conservation as a sensible means of risk management. The resulting shortages will be permanent and not due supply constraints, as with previous oil crises.

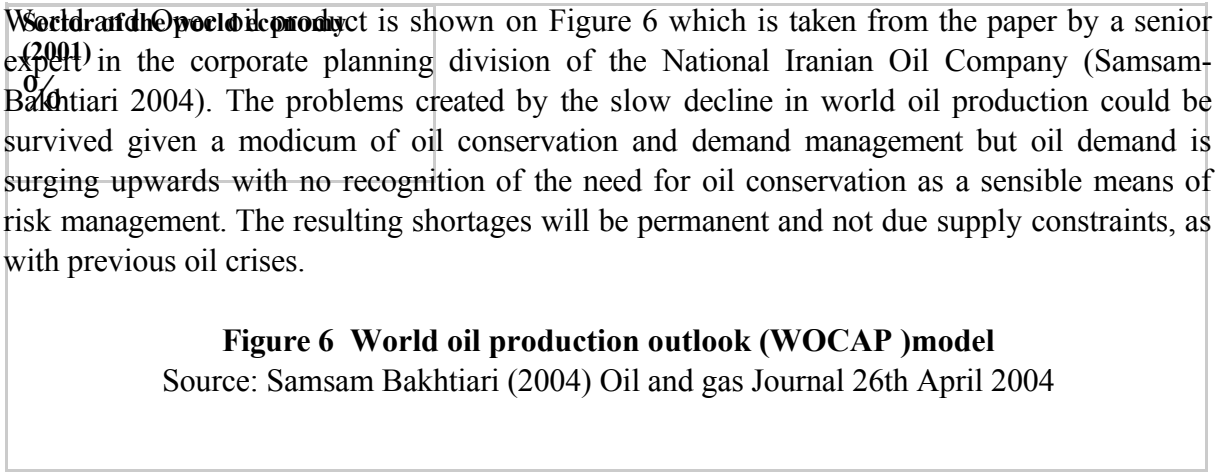

Figure 6 World oil production outlook (WOCAP)model
Source: Samsam Bakhtiari (2004) Oil and gas Journal 26th April 2004

The demand for oil is surging upwards, the resulting shortages will be permanent and not the result of deliberate supply constraint, as with previous oil crises. *"The problem is not with the tank but with the tap,"* said a retired geophysicist who spent 37 years with Total Oil. (Laherrere 2004) If the developed nations could decouple the per capita growth in oil consumption from increases in GDP it would reduce the flow from the tap on the world oil tank and the remaining oil would last a lot longer.

The May 2003 Association for the Study of Peak Oil (ASPO) Conference held in Paris evidenced a growing consensus on a scenario of world oil depletion of 5-10% per year; a recognition that oil reserves had been deliberately overestimated by the oil industry; and that there are unlikely to be more major significant reserves to be found. Most delegates agreed that nearly all of the private multi-national and national oil and gas companies have over estimated their gas and oil reserves to maximise either private company share values or to attract overseas investment into their national economies. The ASPO Conference held in Berlin in 2004 confirmed the previous over estimates of oil reserves and ASPO provided its own estimates that are revised regularly and can be accessed at: http:/www.asponews.org

Table 2 shows crude oil consumption by sector of the world economy and some of the major national consumers of oil for the year 2001. Assuming the current rate of increase in oil demand world oil production would need to double in the next 10 years. This is not possible without extracting oil from shale and tar sands, from beneath the poles or from deep water which will greatly increase greenhouse gas emissions. If the developed nations could reduce their oil dependency by decoupling the per capita growth in oil consumption from increases in per capita GDP the world's reserves of cheap oil would last a lot longer. That is not likely to happen and makes it imperative for Australia to have a more fuel efficient motor vehicle fleet, increase the energy efficiency of all machines that use oil or use other fuels and to keep a large strategic reserve of cheap oil in the ground.

Table 2 Crude oil consumption by sector of the world economy and country.
Source: Weekend Australian p 36 7-8-04. (Financial Times: Bloomburg) and www.cia.gov

Sector of the world economy (2001) % **By Country 2001**				**Barrels per day**
Road transport.	39		USA	19.65 Million
Chemical & petro chemical (incudes fertilizer)	9.7		China	4.97 Million
Power and heat	7.8		Japan	5.29 Million
Industry	6.8		Germany	3.81 Million
Home use	6.4		France	2.03 Million
Air transport	5.9		Saudi Arabia	1.45 Million
Own use	5.8		Australia	0.8 Million
Other (mainly refineries)	1.87		New Zealand	0.2 Million

World Bank consultant Mamdouh Salameh stated that "*there are 300 billion fewer barrels of oil in the world than asserted by OPEC which has 519 billion barrels, not 819 billion..... Deducting 300 billion barrels from OPEC reserves is equivalent to removing a major oil producer like Saudi Arabia,"* .(New Scientist 2004)

To put it another way, that is enough oil to keep the US, the world largest consumer, supplied for four years or China supplied at current 10% GDP growth rates for the next ten years. This would mean that OPEC will not be able satisfy even a modest increase in the world demand for oil and supports Bakhtiari's prediction.

Congestion and energy wastefull single occupant cars

Congestion in Australian cities was generated many years before it was studied. In the early 1980s, it was caused by the growth in the population, which spread into sprawling outer suburbs, where the employed have to commute long distances and have no alternative to the car. As a consequence, the car population doubled between 1976 and 2001, an increase of 5 million cars that parallels the 5.4 million increase in the resident population. Figure 3 uses the Census Data to show the almost parallel growth of human and car populations since 1976.

The costs of congestion in Australian cities, particularly Sydney, Brisbane and Melbourne, are increasing. The projected growth rate of congestion costs from 1995 to 2011 is higher than the actual and projected growth in the car and human population and is even higher than the number of commutes by all modes. The increase in commutes by all modes would be far less costly if the number of single occupant car commutes could be cut back.

Figure 3 includes CSIRO's estimates of car fleet fuel efficiency which is projected to get worse from 2001 to 2011 due to the growing proportion of large cars and four wheel drives (Foran & Poldy 2002). In 2003 85,500 4WDs were sold, 13.8% more than in 2002, and existing policies will continue this trend. (Parker 2004 B)

Figure 7 Unsustainable Australian commutes 1976 to 2011

The benefits of improved fuel consumption in new small and medium sized cars will be lost making the car fleet less fuel efficient per passenger km. As the average car has a life of 9.5 years half the fuel wasteful cars on the roads will still be on the roads in 2014 and there are no tax incentives to buy small fuel efficient cars.

Figure 7 shows that the cost of congestion in Australian capital cities is primarily caused by commuters who use a vehicle designed to carry three, four or five people to drive alone to work. Single occupant car use has been encouraged by the introduction of the GST in 2000 which reduced the cost of cars. The absence of import duty on 4WDs is another concession for buying and driving these larger vehicles. The introduction of reduced tariffs in January 2005 will reduce the price of imported small cars by around $800 and the cost of large luxury cars by around $3,000, thereby encouraging more fuel wasteful driving.

The practice of subsidising car use as part of salary packaging has grown to such an extent that it significantly discourages public transport use and encourages the purchase of vehicles that are larger than they would be if not part of a salary package. New cars in 2003 will have fuel efficiency labels for buyers but there are no fiscal incentives to buy fuel efficient cars and around 25% of all cars sold will be 4WDs in 2004. More roads are being built to encourage more driving. Freeway construction which is underway will only reduce congestion in the short term, but after a few years will generate more road congestion and further discourage the use of public transport, walking and cycling. Existing Commonwealth policies will ensure that car fleet oil consumption will increase by around 2.7% per year and high levels of petroleum product use (shown in Table 3. will increase.

Table 3 Sectoral use of Australian petroleum products in 2002

Sector of the economy	% Share of use	Main products used	Type of use
Agriculture	3.7 %	Petrol & diesel	Farm equipment & electricity generators
Mining	4 %	Diesel & fuel oil	Mining Equipment & power for mining towns
Chemicals	3.1 %	Industrial diesel	Boilers and chemical products
Metal products	2.7 %	Industrial diesel	Boilers and process equipment
Other manufacturing	3.7 %	Industrial diesel	Heavy industrial machines & boilers
ALL TRANSPORT	76 %		
Road transport - cars	32.5 %	Petrol	Mostly cars and 4WDs: some LCVs
Road transport - trucks	23. %	Diesel	Mostly Trucks, B-doubles &buses
Road transport - LPG	3.5 %	LPG	Mostly taxis and fleet cars
Rail transport	1.6 %	Diesel	Intercity passenger and freight trains
Air transport	12.4 %	Aviation fuel	Domestic and international flights
Sea transport	2.8 %	Diesel & fuel oil	Fishing, coastal & international shipping
Commerce & services	1 %	Heating oil & LPG	Hospital boilers, resturaunts etc
Residential	0.9 %	Heating oil & LPG	Cooking and heating
Lubricants	3.1 %	Lubricants	Heavy equipment
Electricity generation	1.8 %	Diesel & fuel oil	Regional generator & coal fired stations

Source ABARE

COMMUTING TO WORK IN A TYPICAL AUSTRALIAN CAPITAL CITY

The Census data for the journey to work and car ownership are very reliable data for making intercity comparisons right down to local government level, being based on a 97% population sample. Melbourne is a good example of growing Australian oil dependence; the robust trends (shown on Figure 8) also apply generally to other capital cities. All the capital cities have an overall modal split that is similar to that of Melbourne, with the growth of female car commutes from 1976 to 2001 being the most dominant trend. (Parker 2004). Other sources show that car commutes have also become longer than most other weekday journeys; in 2001 they accounted for 32% of the total distance travelled by car. Car commutes are concentrated in the congested rush hours, and are subject to stop-start driving conditions and 'cold starts'. Commutes are responsible for around 40% of peak hour emissions, fuel consumption and road congestion, Similar trends for all the other capital cities predict increased congestion costs and vehicle fuel consumption to the year 2011. (VicRoads 2003)

Unsustainable commutes are graphed from 1976 to 2001 on Figure 8. In metropolitan Melbourne 80% commutes were made by car. Walking and cycling combined only accounted for 3.9% of all journeys to work in 2001. Cycling has stayed around 1% in the last 25 years. Most commuter destinations are now beyond walking distance so walking declined from 6.3% in 1976 to 2.9% in 2001. The only sustainable trend is the five percent of those who worked at home on Census day. This was similar in all five Australian cities and has increased since 1986 which suggests that a further increase will occur by 2006. (Parker 2004 B).

Figure 8. Melbourne journey to work ABS Census 1976 to 2001

With current government policies the growth of the oil dependent transport system will inevitably retard the urban economic growth not only in the outer suburbs of the capital cities but also in provincial cities which have the same level of car dependence. Data for 8 Victorian provincial cities in a recent paper show this to be the case.(Parker 2004)

Most long single occupant car commutes originate in the outer suburbs

Commutes and house hold density are plotted for the 16 statistical regions in Melbourne in 2001 on Figure 9 and show the dominance of single occupant car commutes in outer suburbia. The percentage of commutes: walking, cycling, public transport, single occupant cars, female car drivers, incidental exercise and household car ownership levels are plotted against household density per square kilometre. There is a significant difference between the the Inner Melbourne Region, and the six outermost regions. (Parker 2004 B)

The Inner Melbourne Region, has a density of 1,300 households per square km, commuting is far less car dependent and 43% of commuters benefit from "incidental exercise" incurred during walking, riding a bike, or walking to and from public transport. When petrol becomes expensive, most households in this region will be able to dispense with their cars and survive without petrol, as people did from the beginning of World War 2 to around 1950, when Melbourne was a more compact city.

Figure 9. Melbourne Commutes: 16 urban regions & household density 2001

Most of the unsustainable commutes are located in the sprawling outer suburbs with between 20 and 800 households per square kilometre where 75% of the population now reside. In these areas, 80% of households own 2 or more cars; around 85% of those who are employed commute by car and are responsible for 85% of the distance travelled by all commuters and for 70% of the drive alone commutes in the metropolis. (VicRoads 2003).
Furthermore, 78% of the car fleet resides in households with 2 or more cars. Walking, cycling and public transport account for only 13% of all commutes. Many city dweller are likely to suffer considerable hardship because 90% of their journeys to work are by car, truck or motorcycle and there is no easy way of continuing to do that without cheap oil.

OIL SHORTAGES COULD REDUCE THE WORLD POPULATION BY 2028

The synergetic interaction of oil depletion and other environmental problems is likely to be a great threat to world food production. A lot is known about environmental problems in isolation but there is great uncertainty about how they will interact with one another and how increasing costs of oil will constrain efforts to deal with these problems. We know that cheap oil powers farm machinery such as tractors, refrigerated food storage systems, trucks to take the food to market and ships to export it. Most fertiliser and pesticides are petroleum (oil) based. The world's fleet of tractors, cars, trucks and buses has increased from around 15 million in 1938 to 800 million today.(Vital Signs 2003).

Assuming adequate food production, the population of the world has been predicted by the U.N. to grow by 1.2% per year from 6.3 billion in 2003 to 8 billion by 2028; ie 1.7 billion more people to feed in 25 years. The problem is that world cereal crop production has been shrinking on a per capita basis since 1984 and world tonnage of grain production and grain reserves have been dropping from 1999 to 2004. By 2008 most grain will be consumed almost as quick as it is produced. The poor nations of the world will suffer because there is not enough grain and what is available is not equitably distributed. (Vital Signs 2003) World food production is likely to decline from around 2008 and a billion people or more could starve to death a few years later because to the interaction of the following :

1) Oil to power-assist labour intensive farming in poor countries is not affordable

Wealthy OECD countries will buy all the high cost oil to keep their car dependent transport systems going and for their oil intensive agricultural practices. For example U.S. food

production consumes ten times more fossil fuel energy than it produces in food energy. Four litres of oil are expended each day to feed each American and, because power "comes out of the end of a gun", they and other rich allies will get priority in accessing oil supplies. In 2003 there were 224 million motor vehicles and 4.8 million tractors in the USA for a population of 290 million people, but for 2,571 million living in China, India and Indonesia there were only 31 million motor vehicles and 2.5 million tractors.

The continued growth of oil/car dependent lifestyles in the wealthy developed world will deprive China, India and Indonesia and other poor countries of the oil needed to power assist their labour intensive food production, with small tractors and light agricultural machinery, and to transport their food to regional markets. (Simms 2004)(www.nationmaster.com) There is no international agreement to ensure oil at an affordable price is available when the cheap oil is no longer available, nor is there any such agreement being considered by the UN or WHO.

2) Oil for the mitigation of the worldwide depletion of soil is not affordable

Cheap oil is needed to power the machines and desalination plants needed to combat enhanced desertification and salinization of the fresh water supply along the coastal areas due to sea level rise and enhanced erosion of arable land. India has the worst salination problem of any country. The countries of the Middle East, most African, South American countries, Australia and China all have a serious salination problem. Salination is a minor problem in Pakistan, Canada and Indonesia and the US but is not a problem in Russia. (www.nationmaster.com)

Due to desertification, 8,800 square kilometres of formerly productive land and 25 billion tons of topsoil will be lost globally each year. Due to misuse or overuse of the land arable and permanent farmland has been shrinking by over 1% every year, as an ever-larger proportion of the world's population live in cities built on what was formerly productive farmland. Soils,long term value as renewable resource that will hold water and produce food, fuel and fibre has been ignored by free market ideologues. As with cheap oil, the soil is being depleted at a much faster rate than it is being rejuvenated. (CFAN 1999).

The countries at most risk from soil depletion are the poorest or most populous developing nations. For example, the four land rich developed countries of the U.S. Russia, Australia and Canada have 400 million hectares of arable and permanent farmland with a combined population of 487 million or 0.82 hectares per person. The most populous developing nations of China, India, Indonesia, Pakistan, Bangladesh and Nigeria in total also have 400 million hectares of arable and permanent farmland to feed 3 billion people or 0.13 hectares per person. China has been using twice the amount of fertiliser per hectare than the US, and when the cheap oil to make affordable fertiliser has gone, crop yields will greatly reduce. (www.nationmaster.com)

3) Water for agriculture in most parts of the world is being used up

According to the UN, in 2001 30 nations faces water shortages; by 2020 that will increase to 50 nations with empty wells, polluted lakes and rivers that will run dry. Cutbacks in grain harvests will occur in many countries due to world's largest aquifers being depleted in China, India, and the U.S. These countries collectively account more than half of the world's grain harvest.

(www.nationmaster.com)

Because it takes a thousand tons of water to produce a ton of grain, fresh water, its acquisition and delivery will become critical for many more countries in the next decade. Water scarcity, once a local issue, is creating conflict as major rivers are being damned in one country and depriving water to countries down stream.

In 20 years, southern Australia will experience severe drought and permanent water shortages. Australia has perhaps the most nutrient deficient soils in the world, especially in the south-west corner of W A. Present crop production practices have only succeeded through extensive use of fertilisers and diesel fuel but in the future water shortages will decimate grain production. (Pearce 2004) (Brown 2003) (Flannery 2004) (Fleay 2003)

4) Climate change depletes or destroys land, spreads tropical diseases over more habited areas and produces a tidal wave of refugees

The oceans are warming and warmer sea water is slowly spreading towards the poles. The Arctic ocean is melting, glaciers all over the world are in retreat. On the Indian subcontinent 500 million people depend on the Indus and Ganges Rivers which are fed from the melting ice and snow from the great mountain ranges. These massive snowfields are getting smaller. More violent cyclones, floods, drought, tornadoes will occur and violent storm surges will increase in frequency and intensity. This will destroy homes, gardens, villages, crops, plantations, terrace agriculture and other irrigation systems that have taken decades to be productive. In low lying coastal areas sea level rises will flood farmland. In the longer term, sea levels will rise by 1 metre and water will permeate through the ground and waterways further inland, destroying even more productive farmland. The interaction of hunger and sea-level rises in vulnerable low lying areas in the developing world could produce up to 800 million refugees fleeing from starvation. (Brown 2003) It is predicted that the diffusion of respiratory disease will occur as the world warms and that around 600 million more people will die. For example, in Australia airborne vectors carrying malaria and Japanese encephalitis will head south into productive farming areas ans some cities. Note that the above is not the worst case scenario for climate change that was described in a US Pentagon study. (Schwartz and Randall 2003)

OIL DEPENDENCE IS A SERIOUS THREAT TO NATIONAL SECURITY

Australia is its own worst enemy because over the last forty years Australia has become addicted to cheap oil, especially for transport which uses almost 80% of Australia's petroleum; 55% of road transport fuel is petrol, 39% diesel and 6% is LPG. Transport predictions to the year 2010 for single occupant car commuting, car travel generally, air passenger travel, inter city road freight and intra-city commercial vehicle traffic all show unsustainable growth of oil dependency.The oil dependent transport sector is responsible for 76% of oil consumption and that cannot be seriously reduced unless the car industry is restructured, the light commercial vehicle import business is regulated and fuel prices are increased. The provision of more fuel wasteful vehicles has to be stopped as they pose a very serious threat to Australia’s future economy. Worse still, Australia’s Liquid Fuel Emergency Act 1984 is virtually useless, as it stands, and needs to completely rewritten to provide the Commonwealth with the powers to introduce oil conservation measures that will reduce the national consumption of oil each year

and allow a planned additional decline in the production of indigenous sources of oil.(Parker 2004 C)

High levels of car and oil dependence are potentially very serious threats to Australian national security and the Commonwealth's current policies are based on science that has been corrupted by ideological considerations. (Flannery 2004 B) Even the US took energy security planning seriously in the 1970s and produced a sound definition of national security:-

> *National security requires a stable economy with assured supplies of materials for industry. In this sense frugality and conservation of materials are essential to our national security. Security means more than safety from a hostile attack; it includes the preservation of a system of civilisation. (Huddle 1976)*

Figure 10 Australian crude & condensate: imports, production, consumption and self sufficiency from 1960 to 2020

DATA SOURCE. Fifth report of the Royal Commission on Petroleum 1976.
"Oil and Gas Resources of Australia 2002" Geoscience Australia, March 2002.

The Commonwealth does not recognise this growing threat to national security. The assumption is that there is enough cheap oil in the world barrel for another 30 years. The decline of Australia's oil production has been documented (Geoscience 2004) and is shown in Figure 10. The disparity between, the growth in oil consumption and oil imports and the decline in indigenous oil production predicts a serious loss of self sufficiency between 2006 and 2020.

Six reasons why Australia is its own worst enemy

The Federal governments assumptions about global and indigenous oil supply has no basis in fact and ignores the complicated environment problems that will turn a potential threat to national security into a very real threat. The following seven issues need to be addressed:-

1. According to the Australian Petroleum Production & Exploration Association, by 2010 Australian oil production (shown on Figure 6) will cover only half of the country's needs and will cost between $3 billion and $12 billion at today's prices. It is more likely to be at or near the $12 billion mark if significantly more oil is not found in deep water. (Trounson 2004)

2. In the unlikely event that major oil fields are found in deep water, providing enough oil (at higher cost) for self sufficiency for the next 30 years, with some left over to export, there would still be a serious threat to Australian national security. The risk of the world economy and global food production imploding as a consequence of world oil/environment interaction is very high and that would bring the Australian economy down with it. For Australia, there is little time left to take effective action and oil shortages are likely to initially collapse aviation and agriculture due to high prices of jet fuel and nitrogen fertilisers. The petrochemical industry will collapse and many manufacturing plants and service industries will close because the plastic raw materials for finished products they need will be unavailable.

Even though Australia, unlike the U.S. the E.U.China and Japan, is well endowed with natural gas which could be used as a transitional fuel, the political intent to do that or to produce smaller gas powered vehicles does not exist. This will result in most petrol powered cars not being used, so the car industry will be working part time and then collapse. The road freight industry

and tourism will die. The resulting depression will be as severe as that of the 1930's and last a lot longer. (Fleay 1998)

3. The White Paper, Saving Australia's Energy Future released on the 15th June 2004 assumes that centuries-old dirty fossil fuels, such as oil and coal, should not and will not give way anytime soon to solar, wind or tidal power. The White Paper assumes that there will be no problems with global or indigenous oil supplies for the next 30 years and totally ignores the evidence that there will be major problems within a decade. (SESSWG 2004).

4. There is no practical alternative to oil in the next few years and we have to adjust to a growing oil scarcity. The timetable laid out by the Bush Administration in its $1.2 billion "hydrogen economy" policy statements is not credible. The hydrogen economy is not the quick fix to oil depletion. On the contrary, a 2004 report from the US National Academies of Science concluded that, "under the best case scenario the hydrogen transition will do little to cut oil imports or greenhouse gas emissions during the next 25 years." That conclusion is supported by other experts who state that the propaganda about hydrogen fuel cells producing water as their only emission is nonsense, because vehicle manufacturers propose to use commercially available hydrogen made from fossil fuels. This is shown on figure 11.

Figure 11 Total Greenhouse emissions of vehicles with IC engines and fuel cells 2004
Source: US Department of Energy and Wald 2004

Indeed, there is no commitment by the oil and gas industry who sell hydrogen to produce it from renewable sources of energy. Why should they ? That is not what they do and they would lose business. (Bossel & Eliasson 2003).(Wald 2004)

5. Figure 12 shows that hydrogen (made with fossil fuels) in fuel cell powered vehicles will not significantly reduce greenhouse gas emissions. However, the efficient production of clean hydrogen by electrolysis from the surplus power capacity of wind farms is unlikely to happen. Australia has the wind resources (Magil and Outred 2004) and the capacity to develop the technology to make enough clean hydrogen but the political will and the vision to do this, does not exist.

NATIONAL ADAPTATION MEASURES REQUIRED TO REDUCE OIL DEMAND

There is a need for a crash program to conserve oil reserves and increase the energy efficient use of Australia's remaining oil within the context of a national energy security plan. The general form of such a crash program has been illustrated at at international conference on oil depletion and adaptation measures to combat global oil depletion have been proposed. One set of adaption measures is shown on Figure 12 which would almost reduce the demand for oil to match the depleting supply.

Figure 12 World trends in the demand for oil and motor vehicles with adaption measures to conserve oil .

Swenson realised in1998 that deprivation and crop failure had to be shown as an adaptation measure because there was not enough time to do what was needed.(Swenson 1998) Six years later there is less time so there will be even more pain..
Energy efficiency, transport mode shifts to make the passenger transport system more energy efficient and the use of natural gas are also recognised as being important. Lifestyle changes are also important. A significant contribution can be made at local government level to lifestyle changes by the promotion of Travel Smart programs. (Socialdata 2004) (Robinson 2004) However, the Commonwealth will need to introduce the pricing and green taxes (see page 30) to encourage and promote greater fuel efficiency and the use of natural gas as a transitional fuel. (Fleay 1998).

Australia is one of the world's leaders in the application of behavioural change programs that persuade people to drive less and make more efficient use of household vehicles. These programs are called 'Travel Smart' or 'Individualised Marketing' and have made very significant reductions in car travel rates. Programmes have been completed, or are underway, in several states. (see page 34) WA has the most successful programmes. The average reduction in car-kms travelled in the completed WA projects is 13% at a benefit: cost ratio of 30:1, far higher than that of most transport projects. Similar results have been obtained in Europe and the US. (Socialdata 2004) (Robinson 2004).

National energy security plan needed to implement the adaptation measures

It would be prudent for the Commonwealth to have an energy security policy as they have had in Japan since the since the 1974 oil crisis, which closed down industries vital to the national economy and demonstrated the vulnerability of the Japanese economy to reduced oil supplies. (Hook 1994)

The Japanese ruling bureaucracy realised in 1974 that national security is about enabling Japan to survive oil shortages; that oil conservation is just as important as having a military capacity and that oil dependence was a serious threat to their way of life. Japan's energy security policy has reduced oil dependence in the transport sector by creating the finest rail system in the world, for urban commuting and intercity transportation, which is sustainable because it is reliant mainly on hydro electric sources (Hook, W. 1994). Intermodal passenger transport is highly developed with 6 million bicycles being used to access rail stations; very efficient modal interchanges linking buses and trains and providing secure bicycle parking.

Japan has introduced legislation requiring the sale of new cars, after four years of use to other countries so that new energy efficient cars, particularly small petrol electric hybrids, will, in a few years, renew their car fleet and make it the most fuel efficient in the world. Petrol is A$1.75 per litre, a price high enough to encourage the sale of smaller cars. Electricity generation is heavily dependent on oil and is the reason for Japan planning to generate 40% of its electricity from nuclear power. This electricity can be also used for more high-speed trains and to power electric bicycles which are becoming popular in Japan (Parker 2004 A). Japan has almost zero population growth, has no indigenous oil resources and has been sensibly planning to survive since the 1970s when Japan's elite bureacracy MITI made important decisions. Since the middle

1990's energy security planning has no longer been as dominant in decision making, so Japan may have problems in adapting to coming oil shortages.

Around 1980 the US developed a national plan for the more energy efficient use of oil and gas which was designed to buy time to develop more energy efficient uses of renewable energy resources. As a result of the unwarranted influence of the military/industrial complex instead it made massive investments in long range ballistic missiles and a nuclear arsenal, which is now obsolete. Since 1990 the a group of neo-conservative republicans has formulated a clandestine energy security policy based on invading other countries to access their oil resources. This policy option not open to Australia or other nations. Indeed, the EU accepts that conserving oil resources and investing in the energy efficient use of oil and renewable energy is the only sensible option. The US invaded Afghanistan to guarantee access to oil and as a consequence the leaders of the terrorist forces, they had financed and armed for many years, took out the world trade center in retaliation. (Bamford, J. 2004)

The US is not a model of world best practice but there is a lot to learn about energy security planning from Sweden whose first plan goes back to the 1949.(Link 1977). By the late 1970's Swedish view of the national security had matured a great deal it even dealt with the problem of combating terrorism. The Journal 'Sweden Now", stated what their basic assumptions were:-

> *"Our war arsenals are like gigantic dinosaurs fostered and fed on an environment that no longer exists. Instead infiltration, sabotage and terrorism are better adapted to today. So watch guarding, stockpiling and preparedness by means of economic rather than military defence is becoming ever more realistic.....Sweden is one jump ahead in what they call 'economic defence' Designed as a plan to cope in case of war...it proved during the 1973 oil crisis to serve an important purpose in this type of emergency, which is expected to happen again" .(Link 1977)*

Sweden's approach to energy security planning has a great deal to commend it. Promoting energy efficiency, energy conservation and the use of renewable energy are more important means of ensuring national security than military might. Two thirds of Sweden's primary energy is hydro-electric power, and should all else fail it can survive without oil. Neutral Sweden has not been in a war for 160 years because its national security policy has always been sophisticated. Since 1949 the need for land use planning around rail lines and the support of industries which make energy efficient trains, buses and light rail vehicles was recognised. These were developed because they could use the plentiful supply of hydro-electric power. The high level of bicycle, moped and public transport use, coupled with, successful road safety measures and the provision of bicycle infrastructure, is part of a transport and land use planning process. Since 1949 this has been a component part of a national security policy designed to enable Sweden to survive and preserve the integrity of their way of life.

There are long lead times in making significant energy efficiency changes, Sweden took 40 years and Japan took 30 years. The Dutch took 14 years to increase public transport use, increase bicycle use to 25% of all trips and make the Dutch car fleet more fuel efficient with 40% less fuel consumption per vehicle than in Australia (Parker 2001). The Dutch Bicycle Master Plan and the Greening of their tax system were very successful

The "greening" of the commonwealth tax system is needed

The Dutch experience shows that Greening the tax system could provide incentives and constraints so that tax reform results in the conservation of oil reserves and a reduction in greenhouse gas emissions by all levels of government. It would be based on the principle that the polluter must pay and that the overuse of petrol and diesel fuels is harmful to the environment and the economy. It would be applied within the context a "National Energy Security Plan" in the following ways:-

The internalisation of environmental costs.The future costs of oil depletion need to be built into the price of diesel, petrol and aviation fuel so as to encourage fuel conservation, the purchase of more fuel-efficient cars, LCVs, trucks and aircraft.

Reduce the long lead times in adapting to oil depletion by increasing fuel taxes every year to pay for the introduction of alternative fuels, particularly gas, and to build the infrastructure needed to encourage walking cycling and public transport.

For those who cannot do without cars for essential purpose in business, or are disabled, provide tax incentives for the ownership of more energy efficient cars and disincentives to the ownership of large cars and 4WDs in urban areas.

Provide incentives for tele-commuting; informal and formal sharing of cars; and innovative forms of car leasing such as the Dutch "Call-a-Car" scheme. Eliminate subsidised car parking and provide incentives for commuting by bicycle.

Establish the general principle that car travel to and from work is a personal expense. Salary packaging for commuting, or for vehicles owned by other family members, will not be subsidised. Season tickets on public transport and the provision of bicycles for commuting and/or work business should be salary packaged instead.

The achievement of the 'big picture' planning and transport outcomes induced by the Commonwealth "Greening" of the tax system, would be dependent on state funding and investment being radically changed so that they reinforce and complement these tax reforms.

Prevent new housing developments that lock people into car dependence

Encouraging low density housing and gated communities is not the way to enable people to walk, cycle, use public transport or share cars. Some outer areas have so many unoccupied investment properties that it effectively reduces the population density which is already low and creates the perception of being isolated for many elderly pedestrians and young women. Local and state governments have a role in removing the barriers to non-motorised travel which they have created by approving this kind of development. Children aged 7 to 11 years are legally allowed to ride bicycles on footpaths alongside pedestrians of all ages. The problem is that many outer suburban streets have no footpaths.

It is necessary to make the urban fabric of the capital and provincial cities more permeable for walkers and cyclists so as to provide safer and more convenient access to an enhanced public transport system. Studies to identify all the existing and future constraints to walking and cycling in the urban fabric are needed in all local government areas (DOI 2002).

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 signalised crossings for pedestrians and cyclists to cross in safety.

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 coordinated route network. The introduction of a 50 kph limit on local roads in January 2002 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. (Parker 2001)

As an adaptation measure to reduce oil consumption a close knit bicycle arterial network is needed for all capital and provincial cities. The mesh of the bike way network would be around 500m x 500m in the inner areas and 750m x 750m in the outer areas, or the rectangular equivalent of these sizes. In Melbourne such a bicycle arterial network would have around 7,500 km of bicycle routes, with proportionally more or less in other cities based on population and urban density.

Put in public transport with safe bicycle access when providing new housing

The absence of public transport is a problem 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. Indeed a recent report prepared for the Melbourne Transportation forum states that:-

> *"Public transport services are expensive to operate to an adequate standard in newly developed areas. It is reasonable to expect that some of the funding could be provided by beneficiaries of the development in these areas. In this respect, development levies are a legitimate funding mechanism to consider. If the intention is to increase public transport usage (as it is in Melbourne) it may be appropriate to extend the pre-set schedule of "off the shelf" levies to public transport. In outer Greenfield areas, the greatest need is likely to be for public transport services, whereas in inner areas the need is likely to be infrastructure improvements to improve capacity and priority for buses and trams".(Richardson 2004)*

Such schemes, with a variable charge per square metre for small and large, residential and commercial lots, would encourage urban designers and architects to make more efficient use of available land. As a lesser charge would apply to the more sustainable smaller lots, it would also provide a more equitable outcome.

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 and the power assisted electric bicycle will be most important for the elderly to conveniently access stations as they 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 more safe bike routes, more public transport and to provide secure thief and vandal proof storage for bicycles at rail stations and at express bus stops (Gardiner 1993).

If there was secure bicycle parking and if the rail system was extended into outer urban areas the potential of the the existing rail system would be around 50,000 bike rail commuters. 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 1,800 bicycles lockers in use at stations in 2003 and several hundred more lockers being installed in 2004 and 2005. Several hundred bicycle lockers are being provided in 2004 and 2005 on rail systems in Perth, Adelaide, Sydney and Melbourne.(Parker 2002)

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). In Australia there is a planning opportunity to greatly increase the volume of intermodal travel by having a bicycle arterial network that ultimately connects with all rail stations (Austroads 2002).

Planning for bicycles to substitute for short car trips

The Australian National Bicycle Strategy has the objectives of substituting bicycle trips for short car trips especially when made on a cold engines; such trips are very polluting, contribute to increasing greenhouse gas emissions, have negative public health effects and greatly increase

congestion costs. The Dutch have been successful in achieving the trip substitution objective by the integration of demand management strategies, spatial planning strategies (C.R.O.W. 10 1993), the restriction of car parking (C.R.O.W. 11 1994) and an innovative range of bicycle programs (Wellemen 1999).

If, at some future date, oil were to be rationed, as it was in 1940s and as it might be in the not too distant future, 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 7 km, on relatively safe roads used by very few motor vehicles. For longer urban journeys, bicycles could be used to access rail stations and bus stations and if electric biycles were available it would be a lot easier to cope with longer trips.

Unfortunately Australian cities lack 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 bikelanes on roads with a maximum 50 kph limit and on separate bikepaths 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 1000 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.

The scope for trip substitution is very high 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 for all purposes 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 cars trips of less than 5 km. In the previous section on ‘The potential for modal substitution and more energy efficient vehicles 2004 to 2014 the use of electric bikes to substitute for many single occupant car trips was described and they could share that bicycle infrastructure.To make this happen in every Australian capital city will take a decade or so. It will require a lot of patient planning and engineering work by at least ten times as many professionals as work in this area today.

Table 5 Car trips: Melbourne all days, all purposes. Source (VATS 1994 to 1998)

Distance.....Drivers	Passengers	Total cars	% of trips.
0 to 1 km 624,.246	373,658	997,904	12.6%
1 to 2 km 847,561	521,992	1,369,553	17.3%
0 to 2 km 1,471,807	895,650	2,367,457	30%
0 to 5 km From VATS 1996		4,977,000	63%

Bikeway networks are not capital intensive like freeway networks which cost $ billions. The cost of construction may be low 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. Bicycle planning is very labour intensive. It does not cost much to provide bicycle facilities on new roads but to retrofit existing roads is sometimes impossible and often a time consuming exercise that involves a number of organisations.

The competent provision of bicycle facilities and programs needs a bicycle/pedestrian planner in every LGA and the Commonwealth and the States need to recognise the labour intensity and importance of this task. Until that happens new graduates will avoid this kind of work; nobody is going to take bicycle planning seriously as a career option if it is obvious that governments are only interested in token measures.

Behavioural change programs that reduce the use of car

Australia is one of the world's leaders in the application of behavioural change programs that persuade people to choose to drive less without any provision of new existing infrastructure. These behavioural change programs aim to raise awareness and to provide information and encouragement for people to make more informed and conscious choices when choosing a travel mode.These programs are called 'Travel Smart' or 'Individualised Marketing' and have made very significant reductions in car travel rates. Programmes have been completed, or are underway, in several states.

"The TravelSmart Individualised Marketing programmes in WA have covered suburbs with some 158,000 people to date, and have resulted in the annual saving of some 115 million car-kms, or 11 million litres of petrol. Extrapolated to Australia's urban population, this would equate to about a thousand mega-litres of oil saved each year".(Robinson, 2004)

What was really needed is to use the pioneering work on Travel Smart, which had been proven to be effective, and to go national with it. Towards that end, in 2003 the Commonwealth provided $6.5 million over five years; that was matched 1 to 1 with state funds. This funding was calculated to target 186,000 of Australian households with Travel Smart Behavioural Change programs. This funding is welcome but will reaches only 4 % of Australian households in five years and at that rate it will take 96 years to get to every occupied household in Australia with "Travelsmart". Text and Figures 8 and 9 on page 20 and 21 show that the following specific commuter behaviours need be targeted with Travel Smart Programs and then measured and evaluated by local government every five years using the Census data :

1. Reduction in drive alone car commutes by women,
2. Reduction in drive alone car commutes by men,
3. Increased use of public transport,
4. Increase in walk and bicycle commutes all the way to work,
5. Increased intermodal access to the public transport system,
6. Reduced household car ownership via car-pooling, informal car sharing or the development of car clubs.

CONCLUSIONS AND RECOMMENDATIONS

There is a need to introduce a crash program to counter energy wastefull trends in transport, in order to reduce oil/car dependence, reduce greenhouse gas emissions and conserve oil reserves. The world will change in a way that threatens national security by 2014 so there is a need to provide the Commonwealth with the powers to introduce this crash program that will the reduce oil consumption each year and allow of indigenous sources of oil to be conserved as a strategic reserve. To survive the end of the age of cheap oil Australia has to start adapting now .The report of the Productivity Commission on energy efficiency, should state clearly and unambiguously that national security is about enabling Australia to survive oil shortages and that oil conservation and greater energy efficiency in all sectors of the economy are more important than our military capacity. It should be premised on the understanding that the uncontrolled growth of oil dependence is the most serious threat to the Australian way of life; particulary family values, mateship, multi-culturalism and the egalitarian tradition. It should recognise, recommend or advocate the following:-

1. It should recognise that the energy used to extract and deliver oil to its end use will exceed the energy contained within that oil by around 2036 and that oil will cease to be competitive with other fuels well before then. It should recommend the systematic de-coupling of oil consumption from economic growth.

2. It should recommend that natural gas be used as a transition fuel and that an energy efficient hybrid electric cars, LCVs and a truck should be made in Australia. That electric bicycles complying with EU regulations be promoted in Australia and that there needs to be a strategic reserve of one years supply of petrol and diesel oil.

3. That Australia can and should adapt fast enough to build the infrastructure and develop the technology that will exploit energy from our abundant clean and renewable resources. In particular the use of abundant wind power to produce hydrogen by electrolysis needs a major study and significant investment.

4. An energy security policy is needed that will reduce oil dependence in the transport sector. It should state that a major shift is needed for urban commuting and intercity transportation, and for private air and road travel to rail travel, which is reliant on coal based electric power. It should ensure the growth of intermodal passenger transport, with bicycles being used to access rail stations and trunk bus routes; and modal interchanges linking buses and trains with secure parking for bicycles and electric bicycles.

5. It should advocate that the financial barriers to changing travel behaviour can be removed by "Greening" the Commonwealth tax system to provide incentives for more sustainable transport behaviour; constrain unsustainable car use and make the use of energy efficient cars a mandatory requirement for all government car fleets; and encourage the car industry to manufacture petrol electric hybrids. and cars specifically designed to efficiently use natural gas.

6. Petrol prices need to go up to A$1.75 per litre, a price high enough to encourage the sale of

smaller cars and provide the funding for the needed bicycle and public transport infrastructure. The sale of large fuel wasteful cars should be discouraged via taxation.

7. It should advocate that State Governments change their Transport Acts to redefine main road departments roles in reducing the demand for more roads; encouraging walking, cycling and public transport; and enabling bicycles to substitute for short drive alone car trips. State governments must work with local government to make the urban fabric more permeable for walkers and cyclists, so as to provide safer and more convenient access to nearby destinations and an enhanced public transport system.

8. A legal mechanism is needed for the Commonwealth and state governments to have a 'National Energy Security Plan' to implement necessary counter measures and give them a level of priority that reflects the serious risk to national security and the economic viability of the outer urban areas, particularly in the capital cities which are most at risk.

9. Current Commonwealth energy policy has no rational basis and is founded on a taboo that has been described by George Monbiot (The Guardian, 2003) who states that:-
"Every generation has its taboo, and ours is this: that the resource upon which our lives have been built is running out. We don't talk about it because we cannot imagine it. This is a civilisation in denial."

Those who write the Productivity Commission's Report on Energy Efficiency should remember that Australia survived with minimum oil supplies for several years, when the Japanese imperial navy with battleships, and swarms of carrier based torpedo bombers cut off oil supplies. Will the Report on Energy Efficiency reflect taboo or will it "tell the truth to power" and acknowledge that Australia's current level of oil dependence is the greatest threat to national security since Federation.?

REFERENCES

Austroads (2002) "Improving the integration of public transport services report" AP-R197/02
Bossel, U. and Eliasson, B. (2003): Energy and the hydrogen economy: Switzerland, http:// www.methanol.org/pdfFrame.cfm?pdf=HydrogenEconomyReport2003.pdf

Bamford, J. (2004) "A pretext for war: 9/11, Iraq, and the abuse of America's intelligence Agencies", June 2004 first edition, Doubleday New York and Sydney.

Brown, L. R.(2003) World creating food bubble economy based on the unsustainable use of water http://www.earthpolicy.org/update22.htm

Campbell, C.J. (2004) Email from Campbell forwarded to the author

Clark, A. (2004) "Charge has helped break love affair with the car: one year on, statistics reveal success of congestion fee"Transport correspondent The Guardian (p 8) 14 -2-04.

Cleveland C.J. Kaufman R. K. and Stern D.I. (2000) "Aggregation and the role of energy in the economy", Ecological Economics 32,301-317.

Cockel, C. (2003) Oil may come between us and China,China Post Washington DC

Cochet, Y. (2004) Towards the Petro-Apocalypse: speech by the former French Minister for the Environment, Paris, Le Monde 31-3-04.

Coglan, A. (2003) Too little oil for global warming, Page 18 New Scientist 4th October 2003

CFAN (1999) Deforestation: tropical Forests in decline
http://www.rcfa-cfan.org/english/issues.12-6.html

C.R.O.W. 10 (1993). "Record 10. Sign up for the Bike: Design manual for a cycle-friendly infrastructure." Centre for Research and Contract Standardisation, Ede, The Netherlands.

C.R.O.W. 11 (1994), "Record 11-Guidelines for a coordinated parking policy", Centre for Research and Contract Standardisation, Ede, The Netherlands.

Deffeyes, K. S. (2003) "Hubbert's Peak: the impending world oil shortages" revised edition, Princeton University Press, Princeton and Oxford.

DOI (2002) Reducing car dependence by making the urban fabric more permeable for walkers and cyclists in the Inner West Region.prepared by DOI on behalf of the Steering Committee for the Inner West Integrated Transport Strategy.

Douglas-Westwood Ltd (2004) The world oil supply report 2003-2050 Douglas-Westwood Limited www.dw-1.com, Email: admin@dw-1.comice Paris

Dickson ,A and Holloway,J. (2004) "Oil market developments and macroeconomic implications" Economic analysis department Reserve Bank of Australia, Bulletin October 2004, (www.rba.gov.au)

ECMT (2001) National Peer Review:The Netherlands. Implementing sustainable urban travel policies, European Conference of Ministers of Transport, OECD Publications Service, Paris.

Flannery, T. (2004) Warnings about the effect of climate change in Southern Australia, given by Dr Tim Flannery speaking at the Sydney Futures Forum 18-5- 04

Fleay, B, J. (1995) The decline of the Age of Oil: petrol politics and Australia's road ahead. Pluto Press, Annadale, NSW.

Fleay, B, J. (1998) Climaxing oil: how will transport adapt? Chartered Institute of Transport in Australia, National Symposium, Launceston Tasmania 6-10-98.Published as Occasional Paper No1/99 by the Institute for Science and Technology Policy, Murdoch Uni, WA.

Fleay, B (2004) pdf file recieved from the author in June 2004.

Foran, B. and Poldy, F. (2002 A) Future Dilemmas:Options to 2050 for Australia's population, technology, resources and environment, Chapter 5 The future of energy CSIRO Sustainable ecosystems, Canberra.

Foran, B and Poldy, F. (2002 B) Dilemmas distilled: options to 2050 for Australia's population, technology, resources and environment. A summary and guide to CSIRO technical report p 28, CSIRO Sustainable ecosystems, Canberra.

Forest, J. (2003) Keeping hydrogen in perspective, EV World Friday August 1 2003

Gardiner, C (1993) "Report on the bicycle security trial" prepared by Chris Gardiner, Engineer (Intermodal Facilities) Metropolitan Region Queensland Railways.4th June 1993.

Geoscience Australia (2004) Oil and gas resources of Australia 2002 Department of Industry Tourism and Resources

Huddle, P.F (1976). "The evolving national policy for materials". Science, February 20 1976.
Hogan, J. and Cohen, P. (2004) Is the green dream doomed to fail? New Scientist pp 6-7, 17 July.
Hook, W. (1994) The evolution of Japanese urban transportation and non-motorised transport. Paper No 940954. Transport Research Board 73rd Annual meeting January , Washington DC

Laherrere, J. (2004) email from Jeanne Laherrere forwarded to the author, May 2004

Link ,R. (1977) "The best defence is a good defense", Sweden Now No 2 Vol ii 1977

MacGill, I and Outhred, H (2004) What are the acceptable limits to wind penetration in power systems? 3rd Australian Wind Energy Conference, Adelaide Februaary 2004, School of Electrical Engineering and Telecommunications The University of New South Wales
Email: I.macgill@unsw.edu.au; h.outhred@unsw.edu.au www.sergo.ee.unsw.edu.au

Manning, I (1984) Beyond walking distance: the gains from speed in Australian urban travel."Urban Research Unit, Australian National University

Mathis, Wackernagel and Rees, W (1996) New Society Publishers,

NEPP 3 (1998) National Environment Policy Plan 3 English Language version (264 pages, Ministry of Housing, Spatial Planning and the Environment, The Netherlands.

New Scientist Supplement (2001) Global Environment Supplement: A compelling tale of your future, your disaster...your choice, JUDGEMENT DAY, 28th April 2001

New Scientist (2004) News in perspective: Crude estimates, p5 21st August 2004.

Parker, A, A. (1995)"Cycling and urban travel: how much society could save by substituting bicycle trips for short car trips". Urban Futures No 18 June 1995. Commonwealth Department of Housing and Regional Development.

Parker, A. A. (2001) "Making cycling and walking safer in New Zealand and Australia: learning from the Netherlands experience," Conference papers, P155 to 170, NZ Cycling Conference; transport for living 2001, 21st and 22nd September Christchurch.

Parker, A.A. (2002) "A case study of bicycle parking at selected Brisbane rail stations" 25th Australasian Transport Research Forum, incorporating the Bureau of Transport and Regional Economics' Transport Colloquium, Canberra 2002.

Parker, A.A. (2003) Unsustainable transport trends for the journey to work in major Australasian cities 1976 to 2001 26th Australasian Transport Research Forum, Wellington New Zealand 1-3 October 2003.

Parker,A,A (2004 A) The electric powered assisted bicycle; a clean vehicle to reduce oil dependence and enhance the mobility of the elderly, International Conference on Sustainability Engineering and Science Auckland 6-9 July 2004 NZ Society for Sustainable Engineering and Science.
Parker,A,A (2004 B) Unsustainable trends in the ABS Census for the journey to work in Australia, Melbourne and other cities in Victoria 27th Australasian Transport Research Forum, Adelaide 29 September - 1 October 2004.

Parker,A,A (2004 C) Submission to the Review of the the Liquid fuel Emergency Act 1984
Pearce,F (2004) Asian farmers suck the continent dry, New Scientist p6 28th August 2004.

Pfeiffer, D.A. (2003) Eating fossil fuels USA, www.fromthewilderness.com

Richardson, E. (2003). 'The Role of Local Government in Integrated Transport" Hobart International Public Works Conference, 2003.

Roberts, P (2004) The end of Oil: decline of the Petroleum Economy and the rise of a new energy order, Bloomsbury.

Robinson, B.W. 2004. "Individualised Marketing - Travel behaviour change equivalent to discovering another Iraq?". Poster and abstract presented at Third International Workshop on Oil Depletion, Berlin, May, 2004. www.STCwa.org.au/negabarrels

Rose, G. and Cock, P. (2003) "Encouraging E-bike use: the need for regulatory reform in Australia" Working Paper ITS-WP-03-19, 30th December 2003 Institute of Transport Studies, Department of Civil Engineering Monash University, Victoria, Australia.

Samsan Bakhtiari, A.M (2004) World oil production capacity model suggests output peak by 2006-7 Teheran, Nation Iranian Oil Company

SESSWG (2004) Energy supply and demand in Australia - the years ahead, by the Strategic and Energy Supply Working Group, Final report to the Standing Committee of Officials of the Ministerial Council on Energy, March 2004
Simmons & Company International (2004) Issue spotlight - oil & gas reserves Energy Industry Research February 25 2004

Simms, A. (2004)“ It’s time to plug into renewable power” New Scientist 3July 2004 pp 18-19
Skrebowski, C. (2004) Oil field mega projects 2004, Petroleum Review 15 Jan 2004 pp 18 -20

Socialdata, 2004, "Individualised marketing- reducing car kilometres – a global approach, Socialdata Australia Pty Ltd, Institute for Transport and Infrastructure Research. , Poster and abstract presented at Third International Workshop on Oil Depletion, Berlin, May, 2004. www.Socialdata.de, www.PeakOil.net

STC (2004) Oil: living with less, Sustainable Transport Coalition, policy statement, Perth WA, www.stcwa.org.au

Schwartz, P. and Randall, D. (2003) An abrupt climate change scenario and it implications for United States national security, US Pentagon Report October 2003, report available from http:// www.guardian.co.uk/climatechange/story/0,12374,1153530,00.html

Swenson, R., (1998) Alternative futures for humanity, the Swenson Curve www.hubbertpeak.com/scenario.htm

Trounson, A. (2004) Incentives for deep water oil research Australian p 46 12-5-04

Venetoulis,J. Chazan,D.and Gaudet,C.(2004) “Ecological Footprint of Nations 2004: Sustainability indicators program March 2004”, www.RedefiningProgress.org

VicRoads (2003) Driving around Melbourne Melbourne, VicRoads Research and Development Project 2002-03 no 828 conducted by Drummond Research Pty Ltd.

Wackernagel, M. et al (2002) Tracking the ecological overshoot of the human economy, multi-disciplinary study edited by E.Wilson ,.Harvard University. PNAS p 9266-9271,Vol 99 No 14
Wald M.L.(2004) Questions about a hydrogen economy pp 41-47 Scientific American May 2004.Vol 290 No 5.

Welleman, A. G. (1999) The Dutch Bicycle Master Plan: description and evaluation in a historical context, English language version The Hague, The Netherlands, Department of Transport and Public Works and Water Management

Wood Mackenzie (2004) RADAR: new thinking needed for exploration Energy: Horizons (15) January 2004