Uncontrolled oil dependence is a threat to national security that could destroy the economy and increase CO_2 emissions

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1. Introduction

The purpose of this paper is to review and make recommendations from analytical reports published in 2004 and 2005 that show why world oil production peaking is certain to happen. An early oil peak would induce a catastrophic world-wide depression with a late oil peak mitigation of oil dependence over ten years is feasible enabling economies to survive. As Peak Oil is now on the political agenda of world leaders the aim is to stimulate serious discussion on a potentially dangerous energy security issue that was ignored by the Australian government and its agencies prior to 2005 (Aleklett 2005)(BTRE 2005).

Some Oil Industry terminology is used to describe the two basic types of oil reserves referred to in this paper "Conventional oil" and "Non-conventional oil". Also when "CO_2 " emissions are referred to it is shorthand for "all greenhouse gas emissions", as methane emissions from some sources of oil are high and even more potent than CO_2.emissions.

"Conventional oil " is typically high quality, free flowing light oil that is under pressure and in most cases pumps itself out of the ground until about half of the oil had been extracted from an oil reservoir. The "peaking of world conventional oil production" is the sum total of all reservoir production when it reaches a peak and is referred to as "oil peaking" or "peak oil" (Campbell 2005A). Most, of the reserves of conventional oil requires less energy, produces less CO_2 and cost less to extract and refine into fuel and petrochemicals than non-conventional oil.

"Non-conventional" oil reserves are mostly, heavy and tar like requiring a lot more investment and energy to extract from sands or rocks on the surface or under ground and then refine it into usable oil products. It includes some high quality, free flowing light oil that is recovered from oil fields in deep water (<500 m) or from Polar Regions. Non-conventional oil can also be synthesised from coal or gas which will greatly increase CO_2 emissions which needs to be buried underground in safe way that prevents it leaking back into the atmosphere. This is possible by "carbon geosequestration" that is referred to here as "sequestration".

This paper describes why government intervention is necessary to prudently risk manage the unsustainable growth of oil dependence. Planning, researching and developing practical measures to mitigate the potentially disastrous consequences of conventional world oil production peaking is needed at least ten years before the peak. Adapting to oil peaking without boosting CO_2 emissions will be extremely complex, will involve trillions of dollars invested world wide and many years of intense effort by all the developed nations. Oil peaking presents Australia and the world with a risk management problem like that of global warming.

The once affordable conventional oil upon which transport and the world economy are dependent will become costly and scarce. Data are charted showing the "ecological footprint" and other indicators for the 32 major oil producing and consuming countries, providing a world perspective on both future oil scarcity and the growth of CO_2 emissions

Australia has abundant gas reserves but is faced with a reducing energy return on energy invested in extracting non-conventional oil from difficult locations in deep water, the most likely source of any new discoveries. Even so, mainstream transport research is not focused on ecologically sustainable transport that will reduce CO_2 emissions and takes place in an energy security-planning vacuum. It is argued that energy security is vital for national security, which requires a stable economy with assured supplies of energy for transport and industry. In a world of finite resources, frugality and the conservation of oil and gas are just as essential as protection from an invading force for the preservation of a democratic way of life and ecologically sustainable development (Huddle 1976).

Peak oil is certain to happen but its timing is at present unknown until the international energy agencies currently trying to resolve the timing issue have produced accurate oil reserve data. Research shows that timely and viable mitigation of oil dependence on both the supply and demand sides must be initiated more than a decade in advance of peaking (Hirsch 2005). Commonwealth Intervention will be required because the economic and social implications of oil peaking would otherwise be chaotic and dangerous. (Hirsch 2005)(BTRE 2005)

2 The new consensus on the need for quality data on oil reserves

The world oil market has been volatile over the last decade with the, inflation adjusted, price of Brent crude increasing from US$23 a barrel in 1985 to US$64 a barrel in August 2005 an increase of 180%. Strong economic growth world-wide, and particularly in China and India, increased the demand for oil. Consequently, there is now a vigourous mainstream media debate about the ever-increasing demand for oil. China has the world's the fastest growing (US$1.65 trillion) economy and is now the worlds second largest oil consumer that ceased to be self sufficient in oil in 1995 and now imports 3.3 million barrels a day (Pang et al 2005).

There are also growing concerns about the political stability of the Middle East and the poor quality of and political biases in world oil reserve data, which means that we do not know when world oil production will peak and perhaps decline with disastrous consequences (Hirsch 2005)(BTRE 2005)(Campbell 2005 A).

The destruction of oil infrastructure in Iraq and Kuwait in 1990, and further damage in Iraq in 2003, reduced world production capacity. Oil fields aged 50 years or more produced an increasing proportion of sour oil that US oil companies could not use because of their failure to upgrade their refineries, creating supply problems. As a result, oil prices spiked dramatically in the second half of 2004 and then again in 2005 with predictions from some reliable resource investment companies of much higher prices to come (Simmons 2005).

The major oil importing countries are becoming more dependent on oil from the relatively less stable parts of the world which is perceived as a threat to their economic security. So much so, that member governments of the International Energy Agency (IEA) in 2004 were pushing for the IEA to, not only focus on measures to protect them from short term disruptions to oil supplies, but to seriously consider permanent disruptions to long-term oil supplies due to oil peaking. The main concern is about the diminishing and uncertain reserves of conventional oil, needed to produce our transport fuels, industrial oils, plastics, fertilisers and pesticides.

In the decade before the invasion of Iraq there was a insider debate on peak oil between an articulate group of veteran geologists in the Association for the Study of Peak Oil (ASPO) and some neo-conservative economists which surfaced in oil industry and science journals but did not surface in the mainstream media till early in 2004. State planning agency reports, with the notable exception of Western Australia, have ignored the oil security issue, as have most Commonwealth Government reports which, until 2005, were a reflection of the 1990s assumptions of the neo-conservative economists (BTRE 2005).

In the 1990's the veteran geologists argued that by around 2008 half the world's conventional oil reserves would have been used and oil production would peak. They also argued that current measurement of future oil production was flawed since it failed to take into account the increasing amount of energy that had to be expended to extract non-conventional oil, once all the low hanging fruit had been picked from the conventional oil tree. They argued that total demand for conventional oil must be greatly reduced to make existing convention oil reserves last much longer.

By 2001 the veteran geologists had formed ASPO and held their first international conference and gained the support of many environmentalists. They argued that; if enough non-conventional oil was produced to satisfy the predicted growth in the demand for oil without carbon sequestration it would produce so much more CO_2 that there would be a risk of destabilising the climate. To assess that risk they wanted a system of energy accounting introduced, based on "energy return on energy invested" (EROI) and to measure the impact of non-conventional oil production. This is also referred to as the Energy Profit Ratio recommended by CSIRO scientists to asses energy issues (Foran and Poldy 2002).

ASPO argued that the light, clean and once affordable conventional oil is going to peak much earlier if current growth rates continue for much longer. Peak oil is only dangerous because there is no international agreement in place to reduce the flow from the tap on the global oil tank. Therefore, the major oil consuming nations that have no oil conservation agreements in place are in fact putting the global economy, the world climate and world food production at risk. ASPO called for such an international agreement and proposed a "depletion protocol " to overcome the problem, which achieves the following: -

"In outline, such a protocol would require producers to limit production to their current depletion rate, namely annual production as a percentage of what remains, which is a small burden insofar than few can exceed this limit anyway. More important, it would require importers to limit their imports to match world depletion rate. This would have the effect of moderating world prices so as to put them in better relationship with actual cost preventing profiteering and the massive destabilising financial flows that threaten the financial system. In humanitarian terms, moderating world prices would allow poor countries to afford their minimal needs" (Campbell 2005 B). (ASPO 2004).

Up until 2004 the counter view was held by some economists who in many countries held senior positions in academia, in national governments and international agencies. They believed that any oil supply problems would be solved by market forces, that oil production for the next 30 years presented no cause for alarm and that science and technology would came to the rescue with non-conventional oil, more efficient vehicles and a hydrogen economy. They rejected the need for a science based system of energy accounting for many years but more recently had to approve the use of such methods by contract researchers in the estimation of positive and negative external benefits and costs of renewable energy and nuclear energy. Sound research completed in 2004 and 2005 showed that hydrogen economy was 30 years or more away (Bossel & Eliasson 2003) (Wald 2004).

The most interesting consequence of this often heated and emotionally loaded debate was how these two groups found a common cause for agreement after the invasion of Iraq, which in its own way highlighted the importance of oil in the affairs of nations. The 2003 and 2004 international conferences on peak oil, which were organised by ASPO, included representatives of both groups. There emerged a consensus that the estimates of conventional oil reserves were inaccurate and that there was no international accepted standard for measuring when the peak oil would take place. A recent report from the economists' side in the debate bluntly stated the common need for reliable data: -

"Since Shell announced that it had significantly overstated its reserves, its market capitalisation immediately fell by almost £3 billion. However, the greater impact was

probably on the doubt thrown on international reserve estimates. As one commentator put it, 'if Shell doesn't know how much oil it has got then it is likely that the world doesn't know how much oil it has got.' Confidence in the world oil market was further undermined by the record high prices (nominal) reached in October 2004"... *"Some steps have been taken since then, although major benefits are yet to be realised. The Joint Oil Data Initiative, the UN Framework Classification for Energy and Mineral Resources and moves by regulators in the U.S. and the U.K. to incorporate external auditing procedures should all serve to improve reserves reporting and strengthen confidence in oil forecasts"* (BTRE 2005).

Furthermore, peak oil is now on the political agenda of world leaders. On 4-5th February 2005, the G7 Finance Ministers and Central Bank Governors met in London and the following statement confirmed their new concerns.

"We discussed medium-term energy issues and the risks of current oil prices. Market transparency and data integrity is key to the smooth operation of markets. We welcomed concrete actions in improving data provision to oil markets and encouraged further work, including on oil reserves data, by relevant international organisations" (Aleklett 2005).

In 2005 ASPO's concern was about how much time would be required for a stable transition to less oil dependent economic growth. This concern was addressed by the US Department of Energy (DoE), which called for an investigation entitled the Mitigation of the Peaking of World Oil Production. Also the IEA on March 7th 2005 organised a workshop for OECD Ministers of Transport, whose main objective was to identify and review cost effective actions for reducing transport oil demand. The report to the US DoE states that action must start 20 years before peak oil for a easy transition to declining oil supplies but also states that there may far less time for mitigation measures to reduce the demand for that than that (Hirsch 2005).

For the nations that are well endowed with oil, are rich or can guarantee oil imports with military force, refinery conventional oil products will no doubt dominate their transportation fuel market in the next two decades. However, the rapid development of China, India and Asia generally will quickly come to an end if they continue to create transport systems that are even one third as dependent on oil as those of the US and Australia. If that happens Australia's resource sector will perhaps collapse (Pang et al 2005).

President of ASPO Kjell Aleklett said, *"We in ASPO know that the World does not have 20 years, but we must act now"* and many other researchers agree with him.(Hirsch 2005). Until such time as more accurate conventional oil and low CO_2 non-conventional, oil reserve data is available it would be prudent for the Commonwealth to adopt the precautionary principle and assume that nearly all the low lowing fruit have been picked and from now on the price of oil imports will continue to increase. Without mitigation measures to reduce oil dependency, energy conservation, the development of carbon sequestration technology and cleaner processing and extraction methods for non-conventional oil world wide, Australian oil supplies will never be secure and CO_2 emissions will greatly increase (Aleklett 2005) (Gielen and Unander 2005).

3 Reserves of affordable and not so affordable oil

Figure 1 shows the changing global mix of both conventional oil production from 1985 to 2003 and a forecast of oil production from 2004 to 2045 with an increasing proportion of non-conventional oil. The shaded area shows conventional oil production by region, which is refined into transport fuels and used as feed stock for petrochemical producers. This ASPO data includes some but not all reserves of non-conventional oil. The most important feature is the predicted steep decline in conventional oil reserves, which may not change very much when new reserve data becomes available. What are likely to change a great deal are the reserves of non-conventional oil on Figure 1 and additional sources non-conventional.

Figure 1 shows the increasing proportion of heavy oil that is extractable from oil wells after they peak and the reserves of an increasing proportion of natural gas liquids (NGL). Known reserves of oil in deep water and in Polar Regions are also shown; the data were collated by ASPO and graphed by this writer. The heavy oil forecast shown on Figure 1 from 2004 to 2045 is an estimate of what is likely to be extracted with current technology that will increasingly involve both water and sequestration to thin out the heavy oil. It is expected that the cost of extracting oil from deep water (< 500 metres) will require more energy to extract and will produce more CO_2 but the technology is certainly improving (Bruhn 2005) as is in the Polar Regions (Ronning and Haarr 2005)

Figure 1 shows world oil production increasing by 2.2% per year, which is the rate at which it increased in 2004 according the IEA, and then peaking between 2008 to 2012 followed by a 2.2% per annum decline in production to 2045 (ASPO 2005). That means that oil demand should be reduced to balance it with reduced oil production of 2.2% per year as follows:

- 2009 to 2020: reduction of 660 million barrels a year,
- 2005 to 2008: reduction of 715 million barrels a year,
- 2021 to 2030: reduction of 616 million barrels a year,
- 2031 to 2040: reduction of 515 million barrels a year,

Figure 1 World oil and gas liquid production from 1985 to 2045: 2.2% demand restraint to cope with declining production

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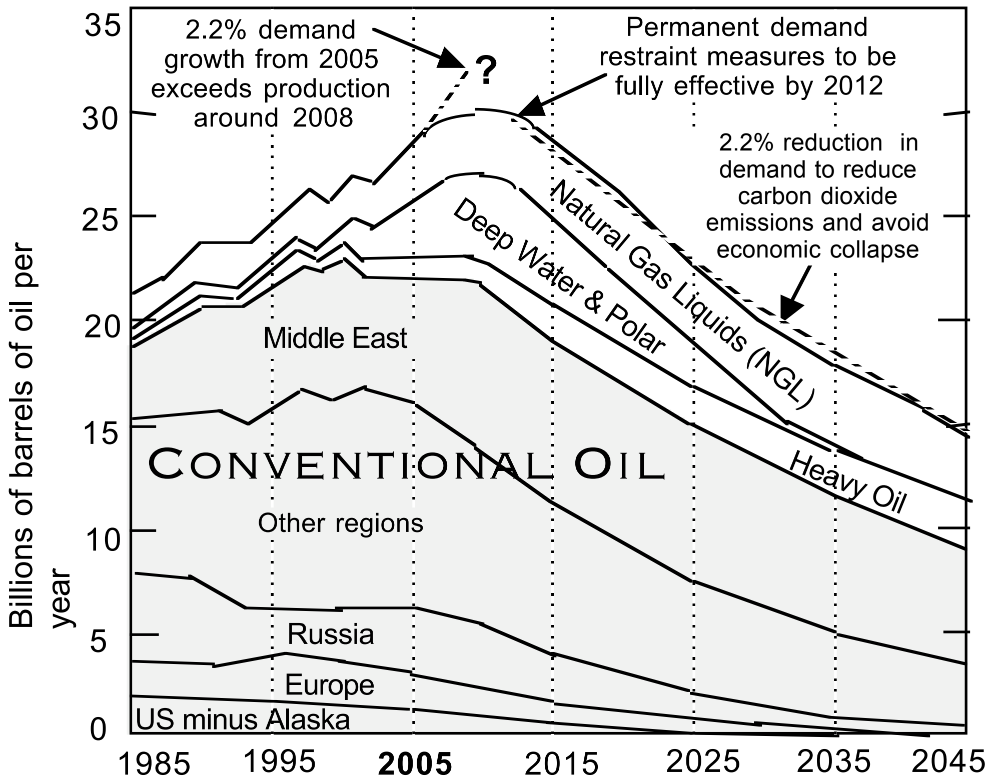


Source: Oil production data from the April 2005 Newsletter of the Association of the Study of Peak Oil www.asponews.org

Figure 1 does not show any non-conventional oil from tar sands, shale or oil oil substitutes synthesised from brown and black coal, because these will greatly increase CO_2 emissions without carbon sequestration. If sequestration technology fails to mature before oil peaks most of these reserves of non-conventional oil may never be produced.

The Commonwealth's policy on energy (Parer 2004) ignored oil for transport and Australian economists predicted that reserves of both conventional and CO_2 intensive non-convention oil would provide the world and Australia with enough additional oil for thirty years. They were very wrong to ignore CO_2 emissions, as well ignoring the 2.3 decline in conventional oil production. As a researcher in the non-conventional oil industry points out:

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

One third of the energy in a barrel of synthetic crude oil made from, tar sands is required to produce it, making it a major emitter of greenhouse gases. A lot more research and development is going to be required to reduce the level of CO_2 (Gielen and Unander, 2005). Producing oil from shale creates a large increase in CO_2, according to the World Energy Council, it requires hydrogen to be added to it and large inputs of energy to produce a useful oil product: -

"The term "oil shale" is a misnomer. It does not contain oil nor is it commonly shale. The organic material is chiefly kerogen, which can be converted into a substance somewhat similar to petroleum. However, it has not gone through the "oil window" of heat (nature's way of producing oil) and therefore, to be changed into an oil-like substance, it must be heated to a high temperature. By this process the organic material is converted into a liquid, which must be further processed to produce an oil which is said to be better than the lowest grade of oil produced from conventional oil deposits, but of lower quality than the upper grades of conventional oil" <www.worldenergy.org/wec-geis/ global/downloads>

Prior to 2004 shale oil was not produced in the US, which has the largest reserves, and large scale commercial production was not expected for 20 to 30 years. In 2005, that expectation changed as the price of conventional oil increased. With further price increases there will be a market for some high quality non-conventional sources of oil from, tar sands and shale oil in Canada the US and Venezuela. The synthesis of oil from gas, brown and black coal will become economic in many countries but in time all the low hanging fruit from these non-conventional oils will be picked.

Past experience has shows that energy technology development including R&D, demonstration and market introduction is often a slow process that may take decades. Sequestration technology will be slow to develop. This means that without carbon taxes in Canada the US and Venezuela. much more CO_2 will be produced. for a decade or so (Hirsch 2005)

4.0 The need for a science based measure of energy efficiency

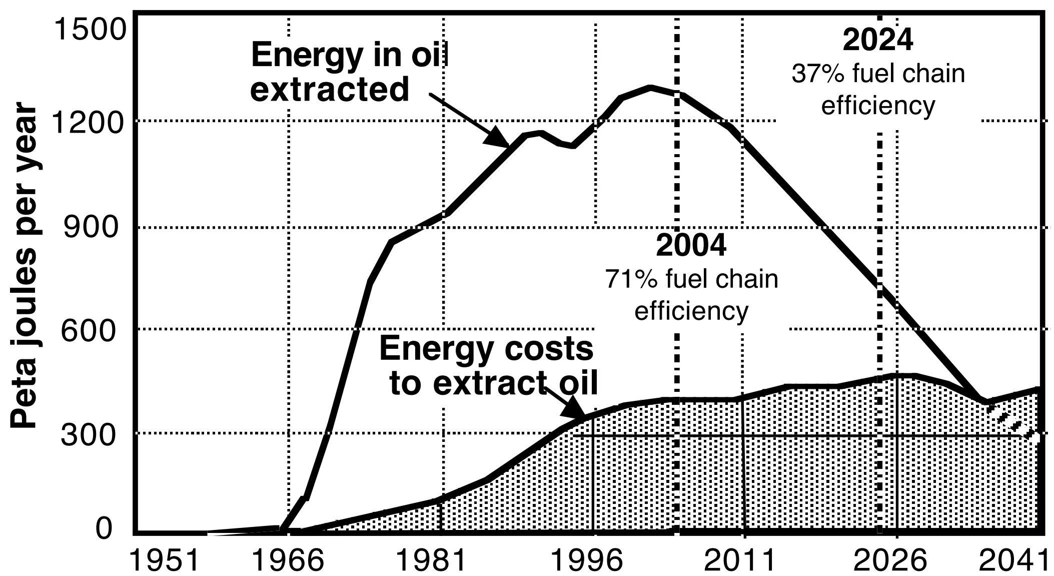
Australian economists have no science-based measure of energy efficiency over time because they ignore the geophysical constraints. For example, if there are large new oil discoveries in Australia they will mostly be in deep water, requiring far more energy to extract than the oil from Bass Strait. CSIRO modelling of the energy costs of oil extraction found that:

"the energy return on energy invested (EROI)" in finding, extracting, transporting and refining oil will decrease. The reality is that the energy costs and benefits of oil extraction do change

for the worse over time, as shown on Figure 2, and CSIRO scientists, 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).
Economists often fail to understand the importance of energy use in keeping our economic system functioning and becoming more ecologically sustainable:-

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

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. The predicted decline in the EROI is a serious issue of concern that shows that the Commonwealth has no science based definition of energy efficiency.

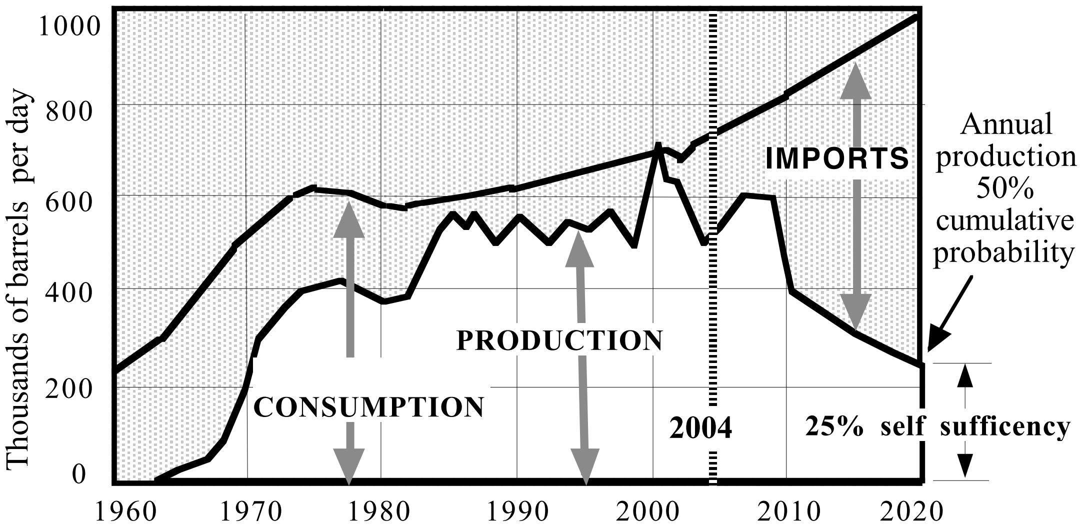
5 Oil dependence is a serious threat to national security

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 has to be reduced as it poses a very serious threat to Australia's future economy (Parker 2004 B)

The Commonwealth does not recognise this growing threat to national security but the decline of Australia's oil production has been documented and is shown in Figure 3. 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. The Commonwealth's policy on energy ignored oil for transport (Parer 2004)

Figure 3 Australian crude & condensate: imports, production, consumption and self sufficiency from 1960 to 2020.

"Oil and Gas Resources of Australia 2002" Geoscience Australia, March 2002.



Even the US under the leadership of president Jimmy Cater 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).

The worst example of government intervention to cope with oil dependence was taken by the US government which spent US$400 billion to invade two countries, to gain access to oil or to safeguard pipelines. The best US energy security example was the mandating of improved home insulation, energy savings in the design of industrial equipment and home appliances and a step by- step increase in gas mileage of all cars and light trucks by President Jimmy Carter. He signed the final energy bills in 1980, and by 2001 America's gross national product has increased by 90 percent, while total energy consumption went up only 26 percent. (Carter 2001)

The best example of the effect of the oil crisis of 1973 was the Japanese economy where oil dependent industries were closed for several months. They formulated the view that national security was 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. They learnt from the once secret CIA report about future world oil shortages that President Carter released for general publication. (CIA 1977)

Japan's energy security policy has reduced oil dependence in the transport sector by creating the finest rail system in the world, which is sustainable because it is reliant mainly on hydroelectric and nuclear energy sources. 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.(Hook, W. 1994)

In 2005 Japan has zero population growth and has transport infrastructure in place that will reduce the impact of future oil shortages. The government recently introduced a national campaign, urging the Japanese to replace their older appliances and buy hybrid vehicles, all part of a patriotic effort to save energy and fight global warming. (ECMT 2001)

ASPO conference workshops identified this threat to national security two years ago and have been calling for a new plan on the scale of the Marshall Plan to cope with coming end of the age of affordable oil and to reduce greenhouse gas emissions (ASPO 2003)

6. Uncontrolled world oil dependence could destabilise the climate

The IEA predicts, that without reducing the demand for oil, global emissions of greenhouse gases will increase by over 60% between 2002 and 2030. Emissions would only reduce by 33% even under a scenario in which governments impose tougher environmental policies to reduce emissions (IEA 2005 C).

The Department of Environment and Heritage has released figures that show that Australia's transport greenhouse emissions has galloped ahead in leaps and bounds. A 29% increase has occurred from 1990 to 2003 but Commonwealth agencies have no policies to reduce further increases. If oil prices increase and there are no major oil discoveries in deep Australian waters, then with current policies, carbon intensive non-conventional oil will be used and carbon dioxide emissions from the oil dependent transport sector will greatly increase (Karvelas 2005).

Times do change and by 2004 Prime Minister Tony Blair had hosted scientific conferences on climate change and called for large reductions in greenhouse gas emissions as had most of his European peers. The recent technical papers from the IEA suggest the need to internalise oil’s 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, and the purchase of more fuel-efficient cars, LCVs, trucks and aircraft. The Greenhouse emissions of passenger cars and light commercial vehicles with IC engines and fuel cells 2004 are shown on figure 4 (IEA 2005 C).

Even former sceptics about climate change like President Bush and Prime Minister Howard, now suggest that nuclear power will be needed for the world to reduce CO_2 emissions and that the US will build more many more reactors and Australia will increase its export of uranium. Arnold Schwarzenegger summarised the current consensus of 2005 well, in his plan to reduce Californian emissions to below 2000 levels in five years to delegates at the UN World Environment Day in San Francisco. In the staccato style of the terminator he said it all:

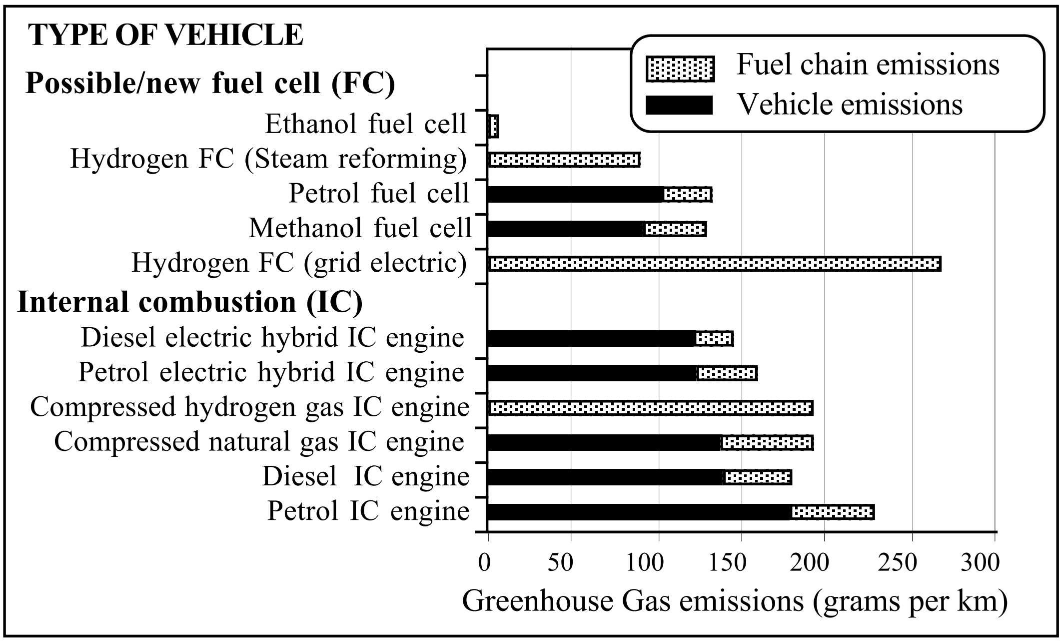
“ The debate is over. We know the science. We see the threat. And we know the time for action is now” (New Scientist 2005).

The Energy Profit Ratio or a similar environment energy accounting measure should be used to evaluate CO_2 emissions of both the low and high quality reserves of non-conventional oil and to determine what should and should not be extracted. Fortunately, since 2001 the OECD have been looking at long term energy security issues. Several research papers show that when CO_2 emissions and other external costs are considered in a rational energy accounting process priorities for mitigation measure can be established (OECD 2003).

Adapting to the peaking of world oil production is a battle against time. Irrespective of what is done internationally this poses a strategic energy policy challenge for Australia and in particular the transport sector of the economy. The Prime Minister and Cabinet have now accepted the need to greatly reduce CO_2 emissions but their is no plan that will reduce CO2 emissions. Their is vague commitment to use new technology that is all. For example the timetable laid out by the Bush Administration in its $1.2 billion "hydrogen economy" policy statements is not credible and is not the quick fix to adapt to peak oil or reduce CO_2. 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."*

Figure 4 Total CO_2 emissions of vehicles with IC engines and fuel cells 2004

Source: US Department of Energy and Wald 2004



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. (Bossel & Eliasson 2003)(Wald 2004).

7 The ecological footprint , C02 emissions, oil use and depletion

From the ecological perspective, if we remove more from nature than can be provided indefinitely we are on an unsustainable track. The ecological footprint is a quantitative 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. Table 3 is ranked in order of per capita national ecological footprint from the smallest to the largest This is an important tool for measuring and analysing natural resource consumption and waste output within the context of nature's renewable and regenerative capacity. (Venetoulis, Chazan and Gaudet 2004).

Table 1 shows per capita GDP, oil consumption, carbon dioxide emissions, and motor vehicle ownership and the years of oil self sufficiency at 2003 rates of national oil consumption.

Table 1. The Ecological footprint, GDP, motor vehicles , CO_2 emissions & oil data for 32 major oil producing and consuming countries

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Country	Ecological Footprint: hectares per capita Year 2000	GDP per capita US$1000 per year 2001 +	Motor vehicles per 1000 population 1997 CIA	Carbon dioxide tonnes per capita 2000 +	Oil consumed, per capita barrels per year +	Proven oil reserves billion barrels 2003 #	Proven oil reserves barrels per capita 2003 #	Years of oil self sufficiency with 2003 usage #
Bangladesh	0.5	1.7	2	0.21	0.2	< 1	< 1	< 1
India	0.76	2.5	12	0.96	0.7	4.9	4	6
Indonesia	0.98	3	21	1.21	1.6	9.4	30	18
Nigeria	1.1	0.8	1	0.35	0.7	25	197	281
China	1.36	4.6	10	2.69	1.4	24	21	15
Cuba	1.53	2.7	-	2.78	5.3	< 1	5	< 1
Algeria	1.67	3.6	87	2.26	2	14	407	203
Iraq	-	2.3	50	3.18	6.8	62	4485	659
Iran	1.85	6.7	23	-	6.6	60	1367	207
Azerbaijan	1.91	3.6	51	3.76	6.3	13	75	12
World BP	**2.18**	**7.8**	**111**	**6.12**	**4.42**	**1148**	**182**	**41**
World #	**2.18**	**7.8**	**111**	**6.12**	**4.42**	**780**	**124**	**28**
Turkey	2.2	7.2	67	3.3	3.6	0.3	4.4	1
Brazil	2.39	7.6	81`	-	4.4	2	46	10
Venezuela	2.42	5.3	110	5.54	6.7	35	1406	209
Mexico	2.59	8.8	138	3.67	6.7	22	144	21
Libya	3.21	6.1	234	7.68	12.1	29	5282	44
Italy	3.26	25.1	566	7.7	11.8	< 1	10	1
Netherlands	3.81	27.1	417	10.82	20.2	< 1	5	1
Japan	3.91	28.7	543	9.62	15.5	< 1	< 1	< 1
Saudi Arabia	4.05	11	336	11	20.4	144	10145	496
Germany	4.26	26.2	488	10.16	12	< 1	4	< 1
Russia	4.28	9.7	124	10.65	6	60	356	59
UK	4.72	25.4	426	9.28	10.3	9.3	155	15
Denmark	5.32	28.8	408	9.53	13.6	1	227	17
France	5.74	25.9	438	6.03	11.9	< 1	2	<1
Australia	**7.09**	**26.6**	**619**	**16.84**	**16.13**	**4.4**	**184**	**11**
Sweden	7.95	26	411	5.2*	10*	< 1	< 1	< 1
Kuwait	8.01	16.9	330	28.8	48.6	60	43266	890
New Zealand	8.13	19.8	560	14.4*	14*	< 1	22	2
Norway	8.17	32.8	494	7.76	16.05	14	2155	134
Canada	8.56	29	563	16.2	22.6	6	157	7
U. A. E	8.97	21.7	193	29.1	51.8	49	14412	278
U.S.A.	9.57	36	782	19.8	24.8	25	86	4

Data Sources: Ecological Footprint 2000, see www.RedefiningProgress.org
= Association for the Study of Peak Oil (ASPO) Aug 2004 No 44 Newsletter.
\+ = www.Nationmaster.com. CIA = Central Intelligence Agency Yearbook.

NOTE: World BP (Beyond Petroleum) estimates and World # (ASPO) estimates differ for oil reserves and self sufficiency. World #(ASPO) data is for regular oil that includes conventional oil condensate, but excludes heavy oil, oil from deep water/polar and natural gas liquids (NGL)

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Table 1 shows inequitable distribution of the oil resources and the vulnerability of the populous poorer countries and many rich countries to any disruption in oil supplies are shown. puts oil dependency and CO_2 emissions into an international ecological context. Clearly, the developed world is on an unsustainable track. The average Australian's footprint is about the area of seven soccer fields and is five times more than the average Chinese.

The rich countries have the largest ecological footprint and have been industrialised for at least 100 years, producing most of the increase in CO_2. In the last 30 years the major oil producing nations have also increased their per capita CO_2 to a similar level as the USA and Australia. This CO_2 will stay in the atmosphere for decades, is changing the climate and is going to reduce food production in developing countries. The world's total footprint in 2000 was at an unsustainable level and is well above the earth's carrying capacity, resulting in one sixth of the human race being chronically under nourished. The rich nations have created a climate destabilising process that is partly responsible for the carrying capacity of the planet being exceeded in the late 1970's. The worlds footprint increase till 1997 before levelling out.

In the year 2000 the US had the largest per capita footprint and by 2004 had 782 motor vehicles per 1 000 population. The energy efficiency of the vehicle fleet decreased due to the growth in the sales of SUV's resulting in the highest per capita oil consumption in the world and creating 25% of the world's CO_2, even though 20% of its electricity is nuclear . To survive without oil imports it could only do so for only four years and the ecological footprint of the US will increase as it exploits non-conventional oil reserves. Table 1 shows that nearly all developed nations have high per capita CO2 emissions, all have high per capital oil consumption levels, but most of them are not self sufficient in oil and some are totally dependent on oil imports. Table 1 reveal some of the more sustainable uses of oil reserves.

- Japan, Italy and the Netherlands have ecological footprints around one third of that of the USA and half that of Australia probably due to the fact that there agriculture is very productive and in the case of Japan 26% of its electricity is generated from nuclear power. Both Netherlands and Japan have got very efficient public transport system and high levels of walking and bicycle use. These nations and many others in Europe have few other fossil fuels and limited renewable energy options compared to Australia (Parker 2001)(Hooke 1994)(NEPP 2001).
- France and Sweden have the lowest per capita carbon dioxide emissions. France generates 78% nuclear electricity and only 6 tonnes per capita of CO_2. Sweden, with 50% nuclear electricity and 32 % renewables, has only 5.2 tonnes per capita of CO_2 compared to 20 tons of CO_2 in the USA and higher still in Australia if emissions from land clearing are added to the 17 tonnes of CO_2 in the table.
- The ecological footprints of India, Bangladesh, Nigeria, Iran, China and Indonesia confirm FAO reports that over a billion people now live in dire poverty in these countries despite increasing economic growth (FAO 2005).
- Table1 indicates that the growth of nuclear energy will be needed just to survive in most developing countries, because most are without oil reserves needed for food production and to build renewable energy infrastructure. They will certainly need to gain access to Australian uranium.

8. Climate change and oil depletion endanger world food production.

Climate change threatens to increase the number of the world's hungry by reducing the area of land available for farming in developing countries. Sixty-five developing countries, home to half the developing world's population, risk losing about 280 million tonnes of potential cereal production as a result of climate change. This loss would have a value of US$56 billion, or 16 percent of the agricultural gross domestic product of these countries. Climate change will drastically increase the number of undernourished people, severely hindering progress in combating poverty and food insecurity (FAO 2005).

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 in a few years. Conventional 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. (Parker 2004 B)

9. Mandating standards for the improved fuel efficiency of cars

The average car in the Australian car fleet is bigger and consumes more fuel in 2005 than a decade ago, despite the fact that engine efficiency has improved. Meanwhile, the world’s best car designers in Germany and Japan have created vehicles that could slowly create more energy efficient car fleets that use far less oil and, in the long term, could mostly rely on off-peak main electric charging as their energy source. Figure 12 shows petrol, diesel, ethanol & electricity energy use of passenger vehicles and aircraft. Conserving oil should have priority over other forms of energy saving. The energy efficiency of the Japanese petrol electric hybrid cars indicates the importance of using hybrids and putting in place fuel efficiency standards to ensure the mass market take up of this technology.

Sound and effective fuel efficiency standards have been mandated in the past by former US President Jimmy Carter. He introduced the Energy Policy and Conservation Act of 1975, which improved the energy efficiency of the US car fleet directly and required US car companies to double the fuel efficiency of their cars over phased periods of years. By providing an incentive to import more energy efficient cars It improved the energy efficiency indirectly of the world’s car fleets.

The US CAFE standards (as they are now known) was very effective when introduced in 1975 when the average car in the fleet consumed 18 litres/100 km. and by 1987 that was halved to 9 litres/100 km It then increased to 9 5 litres/100 km in 2004 because of the failure to upgrade the CAFE standards (Bezdek and Wendling 2005). Bezdek and Wendling have recommended that for new US cars a new standard be phased in to ensure that by 2015 average fuel consumption of the car fleet will be 5.7 litres/100 km and for the SUV and light truck fleet to be 7.6 litres/100 km, giving an overall 50% increase in fuel efficiency.

In 2004 80,000 petrol electric hybrids were sold in the US. Toyota will build a hybrid version of the Camry sedan at its Georgetown, Ky., plant starting in late 2006. It will be the first Toyota hybrid vehicle built outside of Japan. The plant will be able to produce 48,000 Camry hybrids annually. It will cost about $10 million to adapt the plant to build the hybrids. More hybrid car plants are being considered in the US, there are non being considered for Australia, but the technology is under development in China. The petrol electric hybrids family cars on sale in 2005 consume only 5 litres/100 km and the two seater Honda Insight consumes only 3 litres/100 km.. In a few years we may start to see the petrol versus electric ratio shifting in favour of more electricity with overnight charging from the mains electricity grid. Adding battery capacity and plug-in capability for overnight charging are simple modifications to an already-hybridized vehicle. In fact US hybrid owners are already making these modifications themselves. Manufacturers have indicated that Plug-in Hybrid Electric Vehicles may be manufactured as soon as the 2007 model year.
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Direct-injection spark ignition engines designed by the Orbital Engine Co, in WA are already being mass produced in China and used in all new motorcycles for the domestic market because they are clean and fuel efficient. The next step in China is to use this technology in

mini-cars.
An Australian car fuel efficiency standard is needed to ensure that by 2015 average fuel consumption of the car fleet including 4WDs will be 5 litres/100 km and for the SUV and light truck fleet to be 6.5 litres/100 km. giving an overall 50% increase in fuel efficiency.

10. China's fuel efficient vehicles will in time destroy the Australian car industry

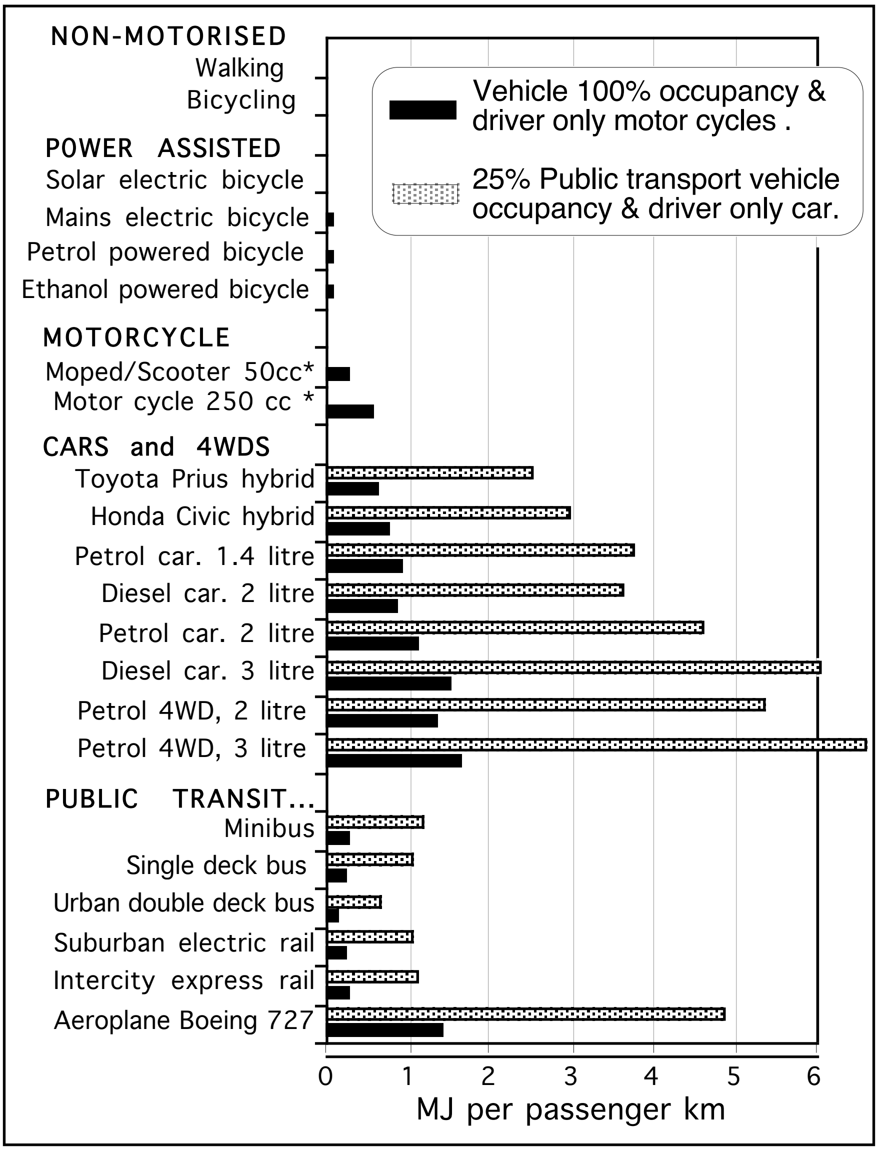
The industrial revolution in China has lifted a billion people out of poverty at a faster rate than i in any other country. China has leapfrogged over the US and Europe to be the world number one producer and consumer of compact fluorescent light bulbs and produces 75% of the worlds solar hot water heaters. In 2005 China will be producing 6 million electric bicycles and 6 million cars with a better fuel efficiency than US cars. Motorcycles with clean direct-injection spark ignition engines are already being mass produced and the next step is to use this technology in mini-cars. The vision of hybrid petrol electric, 3 person mini-cars, using one 1 litre of petrol per 100 km is already being considered by some Chinese manufacturers

Some models of hybrids vehicles will evolve from being gasoline-based with electric assistance into being electricity-based with relatively minor gas, petrol or diesel backup. This will happen because electricity is available, is clean, efficient, safe, familiar and cost-effective. Off-peak overnight battery charging by car owners will better utilise base load generating stations. In time the electricity generators will relish the transportation market share. China will be building nuclear reactors using Australian uranium, wind farms and cleaner coal powered electricity generators to do this, thus leapfrogging into the use of less carbon intensive power generation. The world's most energy efficient cars are likely be produced in China for the following reasons.

1. They are worried about energy security and are concerned that world oil production will peak, and depress their economic growth, well before their population have acquired a higher standard of living (Pang et all 2005).
2. They have smaller average family size because of their "one child policy" and their car designers have already built prototypes of small 3 person family cars.
3. Their stringent fuel efficiency standards will be tightened further because their large cities cannot tolerate any more air pollution. Some cities have already banned power-assisted bicycles, moped and light motorcycles with dirty two stroke engines. (Parker 2004 A).
4. China produced 5 million cars in 2004 making them the world's 3rd largest car manufacturing nation. By 2007 they will producing 15 million cars. Most of their car manufacturing facilities is under construction or remains to be built so they with the latest production techniques and equipment. Chinese ownership was 30 cars per 1000 population in 2004 and they plan for 240 cars per 1000 in 20 years. In 2004 the Chinese minister for transport released data that predicted that by 2030 there would be 370 million more motor vehicles in China. They are well positioned to be the worlds lowest cost producer of cars that are fuel efficient.
5. Already China is working with Japan and South Korea to put together an alternative computer operating system loosely based on Linux. That will lower costs and give their car and growing car parts industry a greater competitive edge. A pledge from China and India in June 2005 to boost growth in the IT sector could signal the beginning of the end of Microsoft's profitable stranglehold on the Asian computer industry (Age 2005)(Flavin 2005).
6. China has leapfrogged over the US and Europe to be the world number one producer of high quality multi-geared bicycles (18 million exported to US in 2004) and have already put Australian and US and many other bicycle manufacturers out of business. China will leapfrog over the worlds car industry to produce the worlds most oil efficient cars.
7. As the real price of petrol and diesel doubles a few years from now and is then rationed a few years later consumers will not be buying gas-guzzlers, and most of the US and Australian Car industry and that of many other countries will perhaps be wiped out. A free trade agreement with China may guarantee the demise of the Australian car industry.

The Australian government needs to ensure that the car industry co-operatively produces petrol electric hybrid vehicles and small cars with direct-injection petrol and diesel spark ignition engines so that fuel economy improvements of the car fleet of 40% (Hirsch 2005) or more can be realised without wiping out the Car industry in the process. An Australian energy security policy is needed to ensure that the Australian car industry can and will produce fuel efficient cars and LCVs and that formal and informal car sharing ensures the most efficient use of the new cars and existiing vehicles as is shown on figure 5. Hopefully there will be enough time before the long slow decline in world oil production.

Figure 5 Petrol, diesel, ethanol & electricity energy use of vehicles



SOURCES: Public transit: European Commission 1992 “The impact of Transport on the Environment”. Greenhouse office fuel consumption guide 2002-2003. Parker 2004 Electric Bike data

10. Bikeway networks the use of electric bicycles for the elderly and lame.

From a strategic transport planning perspective investing in bikeway networks would be cost effective in Australian and NZ cities if they enabled bicycles and electric bicycles (E-Bikes) to be more safely used of instead of cars (Parker 2001) Figure 5 shows that the E-Bike is very energy efficient. E-Bikes have great potential as access modes to public transport in the low-density areas of Australia's capital cities, where most city dwellers reside. For the able bodied in the hilly suburbs of cities E-Bikes are a practical substitute for many urban car trips of less than 10 km. For partially disabled or elderly people many trips are less than 5 km. E-Bikes could significantly increase bike lane usage on main roads and make them safer as a consequence.

The safest E-Bikes are designed made in Japan and weigh only a few kilograms more than bicycles but cannot be purchased in Australia as they would be classified as motor cycles. They have electronically controlled power assistance via sensors in the cranks linked to a computer chip. There is no clutch to worry about after switching on with a key. The power assistance operates automatically on starting, going uphill and combating headwinds. Power cuts out at 24 km per hour so they can be safely used on shared footways (Parker 2004 A). However the Australian Road Rules to be revised to allow E-Bikes of 300 watts power output to be classed as bicycles as they are in NZ.

The E-Bike, coupled with roof mounted solar electric panels for over night recharging, has been proven to be practical in Japan and is the most energy efficient motorised road vehicle ever made (see Figure 12). (Parker 2004 A) The Australian and NZ environment agencies could jointly commission a study to develop a prototype solar PV battery recharging installation for E-Bikes, test the recharging installation over a period of one year and produce a feasibility study for companies willing to market the E-Bike PV battery charging units as a package.

11. Increased energy efficiency for road freight vehicles

According to Volvo highly efficient engines are commercially available for long distance trucks, B-doubles and road trains and there room for further efficiency improvements. Volvo applies a holistic approach in its research, in which greenhouse gases, energy efficiency, energy availability and cost are prioritised. When it comes to future fuels for commercial vehicles Volvo's analysis has known and established scientific data as its starting point. Volvo have been studying in greater detail the following fuels:

- · Ethanol (EtOH)
- · Methanol (MeOH)
- · Diesel (conventional and synthetic)
- · Rapeseed methyl ester (RME)
- · Dimethylether (DME)
- · Methane (natural gas and biogas)
- · Hydrogen (Willkrans 2005)

Volvo's position, which is from an international perspective, is that conventional diesel fuel in spite of CO_2 emissions, increasing costs can will be gradually improved; possibly including synthetic fuel components. Fuel efficiency for the complete vehicle operation will be an area of focus, regardless of the choice of fuel, to ensure the effective use of available energy, the highest potential for CO_2 reduction and the lowest cost. According to Volvo DME is an LPG-like fuel, used successfully some of its trucks, that can be produced from biomass and residual products from paper pulp production. Best well-to-wheel energy efficiency from bio source and close to CO_2 neutral if produced from biomass.

1. Highest efficiency, lowest cost of the gas to liquid (GTL) fuels.
2. Very low exhaust emissions, is energy dense, liquid at low pressure, non-toxic and biodegradable. (Willkrans 2005)

Australia has to imports heavy oil to refine into diesel so Methane (natural gas and biogas, compressed or converted) will also need be used as a fuel for vehicles, due to increasing regional availability and expanding pipeline grids. If peak oil come early there will be a need to conserve diesel use and build up a strategic reserve of diesel for at least one year. The short-term goal should be to reduce road freight, which is in the category of 'taking coals to Newcastle 'as has has been done overseas. To steadily increase the price of diesel and reduce the price of methane (natural gas compressed or converted), so as to deter the growth in diesel freight traffic. DME could perhaps be a niche market fuel in Australia.

Table 2. Summary of oil saving effects of demand constraint policies for passenger transport summed across all IEA countries

Potential oil saving	IEA proposed MEASURE
VERY LARGE 370 million barrels a year	**Car pooling:** large program to designate emergency car pool lanes along all motorways, designate park-and-ride lots, inform public and match riders signals.
	Driving Ban: odd even license plate scheme. Provide police enforcement, appropriate information and signage.
	Speed limits: reduce highway speed limits to 90 km/hr. Provide police enforcement or speed cameras appropriate information and signals.
LARGE 185 million barrels a year	**Transit:** free public transport (set fares to zero)
	Telecommuting: large program, includes active participation of businesses, public information of benefits of tele commuting, minor investment in infrastructure to facilitate.
	Compressed work week: Program with employer participation and public information campaign
	Driving Ban: 1 in 10 days based on license plate, with police enforcement and signal.
MODERATE More than 36 million barrels a year	**Transit:** 50% reduction in public transport fares.
	Transit: increase week end an off peak service and increase peak service business hours 10%.
	Car pooling: small program to inform public and match riders.
	Tyre pressure: large public information programme.
SMALL Less than 36 mill- - ion barrels a year	**Bus Priority:** bus priority usage and convert some other lanes to bus only lanes convert all existing car pools & bus lanes to 24 hour

11 IEA oil emergency demand restraint measures

Many IEA member countries and non-member countries alike are looking for ways to improve their capability to handle oil market volatility and possible supply disruptions in the future. There appear to be opportunities to achieve substantial reductions in transportation oil demand quickly and cheaply – if national leaders are prepared to act and sell politically unpopular demand constraint measures to their people.

The IEA has recommended technical solutions for the restraint of mostly urban road transport that could reduce oil demand on their own without any restraint of intercity freight and air travel of fixed sources of oil use (See table 2). Some measures may make sense under any circumstances; others are primarily useful in emergency situations. All can be implemented on short notice – if governments are prepared. (IEA 2005 C)

The IEA report examine potential approaches for rapid uptake of telecommuting, "eco-driving", free public transport and car-pooling, among other measures. It also provides methodologies and data that policy makers can use to decide which measures would be best adapted to their national circumstances. It maybe prudent to introduce these restraints when the timing of peak is known and between 10 and 20 years away. The longer it takes to introduce IEA demand restraint measures the greater the risk to the economic security of all nations.

12 Conclusions and recommendations

Achieving energy efficiency in all sectors of the economy requires that many actions be taken by individuals, companies and the governments who can encourage and discourage energy efficiency in many ways. Achieving energy efficiency is a change process that can be very costly and the resources available for doing that are limited. So it is necessary to identify those improvements to energy efficiency, after considering the options, which are crucial to the energy security of the nation. Then it is necessary to consider the options available that also allow a reduction in CO_2 emissions and then to determine what should be done.

The need is to prioritise the energy efficiency change process in a way that will guarantee Australia's energy security by reducing the transport sector's over dependence on oil. It does not matter that there is uncertainty about when peak oil will occur, what matters is the consensus that peak oil will occur and the commitment by international agencies to accurately predict the timing. If peak oil occurs early it will be disastrous for the world economy (Simmons 2005). If oil peaks ten years from now, very strong Commonwealth intervention, as in world war 2, with supporting actions by allies could cope. Even if occurs late there is proven need to act now because research shows that a painless adaptation to peak oil by the developed nations will take 20 years. Trillions of dollars, will need to be spent reducing CO_2 emissions from non-conventional oil production and the development of carbon sequestration technology and it should be possible to prudently risk manage the unsustainable growth of oil dependence with a judicious application of the carrot and stick.

To limit CO_2 emissions will involve de-coupling economic growth from the growth in carbon based fuel consumption. This will be no easy task that can be left to market forces to control because over the last 150 years improvements in energy efficiency has been a strong driver of more energy use. Researching and developing practical measures to mitigate the potentially disastrous consequences is needed many years before peak oil. Hopefully the timing of peak oil can estimated with accuracy given the high quality of intellectual resources available and be accepted by the world's major decisions makers without ideologically motivated political intervention. It will take time to accurately predict the timing of peak oil so the following recommendations are made as a risk management package in case oil peaks earlier than later.

Recommendations.

An Australian Energy Security Policy be produced to mitigate oil dependency with both demand and supply side measures. It must fund research to prioritise the most effective mitigation measures taken in conjunction with what has yet to recommended by the IEA. The following recommendations are indicative of the harsh measures that may be needed.

1. Develop Australian car fuel efficiency standard to ensure that by 2015 average fuel consumption of the car fleet including most 4WDs be 5 litres/100 km and for the SUV and light truck fleet to be 6.5 litres/100 km. giving an overall 50% increase in fuel efficiency.
2. Conserve Australian oil reserves by the use of natural gas as a transition fuel; the manufacture energy efficient hybrid electric cars and LCVs.
3. Embody the costs of oil depletion into the price of diesel, petrol and aviation fuel and other green taxes designed to decouple the growth in oil consumption from the growth of GDP. Use the green taxes to rebuild and enhance rail infrastructure.
4. Promote and fund the uptake of telecommuting, eco-driving, car-pooling and Travel Smart programs in all urban areas.
5 Change current land use planning practice to eliminate urban sprawl and provide public transport services in new residential and industrial areas.
6. Change the constitution of road planning and building agencies to make it their responsibility to reduce of the demand for road space and travel by car.
7. Build urban bikeway networks for bicycles and electric bicycles and provide secure bicycle parking at all modal interchanges and railway stations. Encouraging the use of electric bicycles with solar electric and/or over night battery charging
8. The Australian and New Zealand governments support in principle ASPO's call for a new plan on the scale of the Marshall Plan to cope with coming end of the age of affordable oil (ASPO 2004),

References

Aleklett, K. (2005) The ASPO Road from Uppsala to Lisbon President of ASPO Uppsala University, Hydrocarbon Depletion Study Group, Uppsala, Sweden, *ASPO IV. International workshop on oil and gas depletion 19-20 May 2005, Lisbon, Portugal*

ASPO (2004) The ASPO Depletion Protocol, In: "*The Truth about Oil and the Looming Energy Crisis*", Colin Campbell (Eagle Print, Ireland, 2004)

Bezdek, R. H. & Wendling, R. M. (2005) Fuel Efficiency and the Economy: Input-output analysis show how proposed changes to automotive fuel efficiency standards would propagate through the economy, p 132/139, *American Scientist* March -April 2005 Vol. 993.

Bossel & Eliasson (2003) Energy and the hydrogen economy: Switzerland,http://www.methanol.org/pdfFrame.cfm? pdf=*HydrogenEconomyReport2003*.pdf

Bruhn, C. H. L. (2005) How much oil and gas from deepwater? The experience of Brazil, Petrobras E&P Rio de Janeiro, Brazil, bruhn@petrobras.com.br *ASPO IV. International workshop on oil and gas depletion 19-20 May 2005, Lisbon, Portuga*l

BTRE (2005) *Is the world running out of oil? A review of the debate,* Bureau of Transport and Regional Economics, Working Paper No 61.

Campbell, C. J. (2005 A) The end of the first half of the age of oil *ASPO IV. International workshop on oil and gas depletion 19-20 May 2005, Lisbon, Portugal* aspotwo@eircom.net

Campbell, C. J. (2005 B) Introduction to the depletion protocol *ASPO IV. International workshop on oil and gas depletion 19-20 May 2005, Lisbon, Portugal*

Carter, J. (2001) Misinformation and Scare Tactics *The Washington Post* Thursday, May 17, 2001;Page A23

CIA (1977) *The International Energy Situation: outlook to 1985* Central Intelligence Agency report. ER-77-10240- 11 April 1977

Cyclepress (2005) EU Anti-dumping tariffs on Chinese bikes look set to hit 48.5% *CyclePress* No 212 June/July 2005 P 7, Tokyo Japan.

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

FAO (2004) *Background document: Climate change and agriculture*, UN Food and Agriculture Organisation Report.

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.

Flavin, C. (2005) *News letter from World Watch Institute* May 2005

Gielen, G. and Unander, F (2005) Alternative fuels: an energy technology perspective, Report Number EET/2005/01 Paris March 2005, *IEA workshop on Technology issues for the Oil and Gas Sector*, Paris 13-14 January 2005

Hirsch, R.L. Bezdek, R and Wendling, R. (2005) Peaking of world oil production: impacts, mitigation, & risk management" *ASPO IV. International workshop on oil and gas depletion 19-20 May 2005, Lisbon, Portugal,* extracted from former report to the US DoE available from
www.hilltoplancers.org/stories/hirsch0502.pdf
www.projectcensored.org/newsflash/The_Hirsch_Report_Proj_Cens.pdf

Hook, W. (1994) The evolution of Japanese urban transportation and non-motorised transport, Paper No 940954. *Transport Research Board 73rd Annual meeting Jan, Washington DC*"

Karvelas, P. (2005) "On track to meet Kyoto target" p 8 *The Age* 25th May 2005

IEA (2005 A) IEA Warns of Coming Power Failures at 7th May 2005
http://www.energycentral.com/centers/news/daily/article.cfm?aid=5652038

IEA (2005 B) file on their web site. Source:
http://www.iea.org/textbase/work/2005/oil_demand/background.pdfIt

IEA (2005 C) "Saving oil in a hurry: measures for rapid demand restraint in ransport",
http://www.iea.org/textbase/work/2005/oil_demand/background.pdf
Isaacs,E. (2005) Canadian oil sands: development and future outlook, Alberta Energy ResearchInstitute, *ASPO IV. International workshop on oil and gas depletion 19-20 May 2005, Lisbon, Portugal* Eddy.Isaacs@gov.ab.ca

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 (2005). Soundbites p 12 11-6-2005

OECD (2003) *Nuclear electricity generation: what are the external costs*. Nuclear Energy Agency, OECD report NEA 4372 ISBN 92-64-02153-1

Pang, X. Meng, Q. Bai, G.Mariko, N. and Zhang.J (2005) The challenge and countermeasures brought by the shortage of oil and gas in China, Basin and Reservoir Research Centre, University of Petroleum (Beijing), Beijing, China *ASPO IV. International workshop on oil and gas depletion 19-20 May 2005, Lisbon, Portugal* pangxq@bjpeu.edu.cn

Parer (2004) *The Parer Energy Market Review*,

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 Sept Christchurch*.

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*.

Robinson, B. W. Fleay, B.J. and Mayo, S. C. (2005) "The impact of oil depletion on Australia", Sustainable Transport Coalition, Perth, Western Australia, *ASPO IV. International workshop on oil and gas depletion 19-20 May 2005, Lisbon, Portugal* www.STCwa.org.au

Rønning, K. and Haarr, G. (2005)"Exploring the basins of the Arctic" Statoil ASA *ASPO IV. International workshop on oil and gas depletion 19-20 May 2005, Lisbon, Portugal* E-mail: Krik@Statoil.com ghaa@statoil.com

Simmons, M. R. (2005) "Redefining Peak Oil" Chairman and CEO, Simmons & Company International, USA, *ASPO IV. International workshop on oil and gas depletion 19-20 May 2005, Lisbon, Portugal The Economist* (2005) "Special report cars in China; Dream machines"pp 23 to 25 June 4 2005

Wald M.L. (2004) Questions about a hydrogen economy pp 41-47 *Scientific American* May 2004.Vol 290 No 5.

Willkrans, R. (2005)"Future fuels for commercial vehicles" *ASPO IV. International workshop on oil and gas depletion 19-20 May 2005, Lisbon, Portuga*l, AB Volvo, Environmental Affairs, Dept 961 VHKSE-405 08 Gothenburg, Sweden rolf.willkrans@volvo.com