Committee Secretary
Senate Rural and Regional Affairs and Transport Committee
Department of the Senate
Parliament House
Canberra ACT 2600

Dear Sir or Madam

Subject: Senate inquiry into fuel supplies

I am lodging a submission to the Senate Committee's *Inquiry into Australia's future oil supply and alternative transport fuels*.

For the past 18 months, I have been following the issue of peak oil very closely. Peak oil – the phenomenon by which oil production increases sharply at first, reaches a plateau or peak at about the midpoint of reserves, and declines to nothing afterwards – presents perhaps the greatest challenge to modern civilisation.

This phenomenon has been observed in individual fields and in many different countries, including Australia, and many observers are expecting to see a global oil production peak within the next few years. However, some of its symptoms are already being felt: supplies straining to meet increasing demand; escalated political tension in oil-producing countries, particularly in the Middle East; and, of course, increased oil prices.

I submit to the inquiry this document, in which I make the following points:

- Peak oil has already been observed in many oil-producing countries. This is also expected to happen on a global scale, although exactly when and how sharply supply levels will decline after the peak is uncertain.
- The supply of fossil fuels, from which we obtain almost all of our energy, is already stretched to breaking, whether peak oil has already arrived or not. Declining levels of fuel production will only accelerate the onset of shortfalls.
- Not only is Australia not self-sufficient in oil, but we have a policy of exchanging oil with Asian and Middle Eastern nations. This combination could leave Australia vulnerable to supply disruptions.
- Technological advances in oil recovery are unlikely to yield major supply increases.
- Biofuels, such as bioethanol and biodiesel, would be useful as partial replacements to petroleum fuel, although these will not scale to meet our current needs for fuel.
- It would also be beneficial to increase public transport services, particularly in suburban and outer-suburban areas, to decrease the use of private cars.
- The suburban lifestyle, which depends on cheap and abundant energy, will be greatly strained. particularly among middle-to-lower-income earners. Decentralised services, even the provision of food and water, may need to be implemented to reduce the need for transportation between suburbs and major economic centers.

- The global population will also peak within the next few decades and is also likely to undergo a prolonged decline. This is likely to affect both affluent and third- world nations alike.

I am especially concerned that Australia, like most other nations, seems to have no plan at all for dealing with fuel shortages, which could threaten our economy and our way of life. I regularly read a number of internet blogs and mailing lists where environment sustainability, of which peak oil is a significant aspect, is discussed in depth, and I am thankful that these groups exist to help bring these issues into public consciousness. Hopefully, this inquiry is an indication that the government is also interested in solving these problems.

I thank the committee in advance for its consideration.

Yours sincerely

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Part A - Projections of oil production and demand in Australia and globally and the implications for availability and pricing of transport fuels in Australia

The following sections discuss the ability for the petroleum industry, both locally and globally, to meet increasing demands for oil, and the effects this could have on the pricing and availability of transport fuels for Australian consumers.

Hubbert's curve – the peaking of oil production

Dr Marion King Hubbert, a widely-respected geophysicist working for Shell, uncovered a disturbing phenomenon and spent more than a decade trying to alert the petroleum industry of his findings. In his studies of the US domestic oil industry, he noted that oil production out of single wells or deposits followed a bell curve: starting slowly as new oil was discovered and drilled to produce a gusher; increasing in productivity and cost-effectiveness as the deposit was increasingly exploited; reaching a peak once half of the deposit had been extracted; and declining steadily after the peak had been reached. In 1956, Hubbert compiled data from across the United States, showing that both discovery and production follow similarly shaped curves, and predicted that oil production would begin to decline shortly after 1966 and no later than 1972.

History proved Hubbert's estimates to be accurate: oil production in the United States did peak in 1970 and, except for some small increases in the 1980s, has been steadily declining ever since. This was a disruptive phenomenon that led to a large degree of political and economic turmoil throughout the 1970s, both in the United States and in major oil-exporting countries, particularly those in the Middle East. The United States now consumes some 21 million barrels of oil every day – roughly one quarter of global production - though its own production only amounts to about one-third of that.[1] Similar production and discovery patterns have been observed in many other oil-producing countries, including Australia, and it is theorised that the global level of production will do likewise.

Today, many organisations in the “peak oil” movement aim to spread the word of Hubbert's findings and to reach the public consciousness. Along with many local internet-based groups that discuss peak oil, international organisations such as the Association for the Study of Peak Oil and Gas (ASPO) study the current effects of peak oil, when the global peak will actually occur, how pronounced the decline is likely to be, and what issues people will see during the decline. As well as respected scientists, many journalists, environmental commentators and politicians, even those in the mainstream, are starting to speak out about peak oil.[2]

The issue of peak oil has suffered a great many setbacks since Hubbert's original research, which was largely dismissed by the industry and for which Hubbert himself drew a great deal of ire. It is widely believed that the political sensitivity of oil production has a lot to do with why peak oil is not a more widely discussed issue, since it is a problem of

1 Source: http://dieoff.org/42Countries/42Countries.htm. This page also shows annual production curves for 41 other countries, including Australia.

2 Some of these quotes can be read at http://eclipsenow.org and http://www.lifeaftertheoilcrash.net.

unfathomable proportions that will touch every aspect of society, and it is a problem that has no easy solutions.

There is some dispute about exactly when the peak of global oil production will occur, and how quickly oil production will decline. Some believe that the peak will not occur for 20 years; others believe it has already happened. Most recently, Professor Kenneth S. Deffeyes, who worked at Shell with Hubbert but who now teaches at Princeton University, boldly claimed that global oil production peaked on 16 December 2005.[3] The general consensus seems to be that oil production will peak globally at some point in the next six years, after which it will exhibit a steady decline of 2-3% per annum. It is also agreed that this will only be verifiable in hindsight – that is to say, that we will only know we have reached peak production in the years after the peak has occurred.

One problem with predicting when the peak will occur (if it hasn't already) is knowing the production and reserve figures of oil-producing nations. Oil is a highly-politicised commodity, and published statistics, especially about oil reserves, are notoriously inaccurate. In the mid-1980s, the Organisation of Petroleum Exporting Countries (OPEC) invoked a quota system that tied each country's allowed oil production with its reserves. By 1990, OPEC countries had added some 300 billion barrels of oil to their known reserves, while the announcements of specific discoveries amounted to just 10 billion barrels. Some figures also include unproven reserves or reserves of unconventional oil, such as oil shale and tar sands, as though they were conventional crude oil. For this reason, some scientists have predicted that peak oil may arrive sooner than was previously expected.

The Australian government's stance on global peak oil

In 2005, the federal Department of Transport and Rural Services (DOTARS) commissioned a report into the possibility that the world was running out of oil.[4] The report painted a positive picture of the next 25 years of oil consumption, declaring that there remain 70 years of recoverable oil and that the current high prices will ease over the remainder of the decade. Although the report acknowledges the peak oil theory, the authors brush the issue aside, since their data suggests that a peak of world oil production is unlikely before 2030.

Many “depletionists” criticised the level of optimism in the report because its authors were very selective about what was included.[5] Some of the specific criticisms include:

- The report acknowledges that peak oil may happen by 2030, but it is written as if will never happen at all and as if it will not be severe if it eventually does.
- The report fails to take into account the need for exponential growth in oil production to meet similar rates of growth in the economy and population.
- The report devotes a lot more work to justifying the viewpoints of anti-depletionists than it does relating them to the concerns of depletionists.

3 In January 2004, he predicted that peak oil would occur on Thanksgiving – 24 November 2005. He altered his date retrospectively on 11 February 2006, but only by three weeks. More information at http://www.princeton.edu/hubbert/current-events.html.

4 The full report is available at http://www.btre.gov.au/docs/workingpapers/wp61/wp61.aspx.

5 One such critique, written by Matt Mushalik of Sydney Peak Oil, is available at http://www.sydneypeakoil.com/matt/CritiqueATRF04.pdf.

- The report's conclusions also rely heavily on data, such as the OPEC quota adjustments of the mid-1980s and reserve figures provided by the United States Geographical Society (USGS), that are widely regarded in the oil industry as misleadingly optimistic.
- The report does not mention concerns about current supply or demand at all.
- The report claims that the industry predicts oil prices to decline steadily, without mentioning the growing number economists who expect oil to rise to many times its current price.
- Statistics are shown in misleading fashions. For example, the overview mentions that remaining oil reserves could "meet the projected average annual requirements, between now and 2030 70 times over", rather than saying that oil reserves will be exhausted within 70 years. This also fails to take into account that the effects of declining oil production will be felt long before the reserves are exhausted completely.
- While essentially accusing depletionists of scaremongering and "crying wolf", the report fails to mention that the world has actually been observing peak oil since world oil discovery peaked in 1962. More than half of the world's oil-producing countries are already experiencing declines. Globally, we have been consuming more oil than we have been able to produce for the last 20 years; nowadays, we consume many times more oil than we discover each year.

More importantly, though, it shows a failure to understand the theory of peak oil. What is crucial to understand is not just the amount of recoverable oil, but moreover the rate at which that oil can be extracted from the ground, that dictates the economic effects of the oil industry. For example, the figures cited in the report show that anti-depletionists believe that there are about a trillion barrels of recoverable oil more than the depletionists do. If global consumption remains at its present level of 31 billion barrels per year, those trillion barrels could be blissfully consumed over the next 32 years without any need to address any possible depletion (the report says that peak oil is unlikely before 2030 and that there will be very little turmoil before then). However, because the peak occurs at the half-way point of reserve depletion, the estimated year of peak production would be 16 years earlier than the report estimates. Remember that this calculation is based on optimistic reserve figures and does not take growth into account.

A number of Australian politicians have acknowledged peak oil as reality, rather than as speculation or scare tactics. The Greens' Party's Kris Hanna, the South Australian Member for Mitchell, first spoke about peak oil in state parliament in 2004,[6] but the first politician to gain mainstream publicity for his stance was Labour's Andrew McNamara, the Queensland Member for Hervey Bay.[7] Since then, many politicians at state and federal levels have spoken publicly about declining oil supplies, including both Treasurer Peter Costello[8]

6 http://www.parliament.sa.gov.au/catalog/hansard/2004/ha/wh281004.ha.htm
7 Reprinted at Global Public Media: http://www.globalpublicmedia.com/lectures/360.
8 http://www.theage.com.au/news/Business/Were-running-out-of-oil-says-Costello/2005/04/08/1112815725885.html

and former Deputy Prime Minister John Anderson.[9] Even today, the state of the oil industry in Australia remains a highly-charged and highly-politicised issue.

Oil in Australia

Although oil deposits had been reported in Australia as early as 1900, the industry took off in the late 1960s, with the discovery of three large oil fields totalling 2.5 billion barrels of oil off Western Australia. Sadly, this was also the time that oil discovery in Australia peaked.[10]

Australia's peak year for oil production was 2000, during which time the country produced an average of 722,000 barrels per day. In the five years since then, supply has dropped by more than one quarter, the sharp decline most likely due to the concentration of major oil discoveries to a few large fields. Demand for oil in Australia measures some 800,000 barrels per day.

Australia is in an odd position, in that it produces a large percentage of its own oil supply – more than 60%, and previously over 90% - but its refineries' input is predominantly from Asia and the Middle East. This is because Australian crude oil is quite light and "sweet" - making it easy to refine and therefore in high demand – while our refineries can handle heavier grades of crude that others cannot process and therefore don't want. Therefore, it actually makes economic sense for us to sell our own oil on the global market and purchase cheaper, heavier grades from foreign countries for our refineries.[11]

This could prove a less tenable situation, of course, if oil supplies become strained and/or if the price of crude oil increases, since the transport costs will increase, perhaps disproportionately to the price of the oil itself. Another factor is that 20% of our refineries' feedstock is sourced from the Middle East, while 40% comes from Asia. This proportion could shift towards the Middle East as Asian supplies become strained, either by the increased consumption of fossil fuels in China or by the decline of oil production in Asian countries. The reason this could become important is that oil supplies from Asia can reach Australia in two weeks, while Middle East imports take four weeks. Add to this the lead time of securing cargo ships – which could be up to two months – and it is clear that a sudden shortage from one of our two major supply chains could cause disruptions until the other is brought up to speed (if possible).

Here in South Australia, there has been some concern about our ability to store refined petrol. In 1999, the Mobil refinery at Port Stanvac suffered an oil spill in which some 230 tonnes of oil was lost.[12] The facility has since been closed, leaving Birkenhead as the only major storage facility remaining in the state. While RAA disputes the suggestion that this has caused South Australians to pay more for petrol than other states, they do acknowledge that South Australia suffered three fuel shortages in 2005.[13] Instead, they blame the underuse of the facility at Birkenhead, which typically only stores about ten days' worth of

9 http://www.abc.net.au/news/newsitems/200505/s1373262.htm
10 http://www.financialsense.com/editorials/powers/2005/0203.html
11 Australian Institute for Petroleum. *Supply Security.* http://www.aip.com.au/issues/security.htm
12 See the Australian Marine Safety Authority: http://www.amsa.gov.au.
13 The second of these, on 5 October 2005, was reported the next day in *The Advertiser*: http://www.theadvertiser.news.com.au/common/story_page/0,5936,16829012%5E2682,00.html.

fuel, and which, at best, could only store enough fuel to last the state three weeks.[14]

The price of petrol at the pump

It is a safe bet that very few Australian consumers understand how the oil industry works, beyond knowing where to get discounts or on which day of the week petrol is cheapest.[15]

The price of oil fluctuates on the world market due to many factors, such as availability and political tension. In Australia, the pump price doesn't really reflect this, since price of each litre of petrol includes between 39 cents and 50 cents of taxes (including GST), as well as a profit margin. This puts the base price of petrol in Australia today at just over 60c/L – cheaper than milk, fruit juice and many brands of mineral and spring water. Even as oil prices fluctuate, these taxes are not likely to be changed, as market forces will inevitably cause some fluctuations in supply and demand.

The problem with oil is that it is a global market: an increase in the price from one supplier tends to cause an increase in price everywhere. In 2005, Hurricane Katrina disabled much of the oil production capacity in the Gulf of Mexico and southern United States, which sent the price of crude oil to a record US$70.85/bbl.[16] Here in Adelaide, the pump price of petrol approached 140c/L (currently, it floats around 120c/L), despite the absence of evidence that Australia's oil supply routes were affected in any way.

Many analysts predict that the price of oil will surely increase in the coming years, as supply fails to meet demand, and as global peak oil production looms. Tensions in either the industry or the global political climate have many analysts foretelling of a general trend upwards, but an ascent marked by price "spikes". Predictions about these spikes start at US$100/bbl[17] and well beyond.[18] The French investment bank Ixis-CIB, who believe that even Saudi Arabia's oil production is already in decline, predict a US$380/bbl "super-spike" to occur before 2015.[19] Matthew Simmons, a leading energy investor and a former adviser to the current US federal government, mentioned that even a shortfall of 2-5 million barrels per day could increase the price of oil by a 5-10 *times* its current price.[20] By Shell's breakdown, this could send the price of petrol in Australia to some $7/L.

In conclusion

Many people who are conscious of peak oil cite the theory in order to explain why the global supply of oil simply cannot meet global demand, especially in the medium-to-long term. I have speculated that, because of increased demand in western and Asian countries, and because of the apparent inability of oil-producing countries to increase capacity, this

14 http://www.raa.net/download.asp?file=documents\document_758.pdf
15 Currently, this is Tuesday – Wednesday usually marks the beginning of "weekend prices". More information on petrol pricing is available at http://www.shell.com.au.
16 Associated Press. *Most Gulf oil production still blocked.* http://www.msnbc.msn.com/id/9285687/from/RL.1/
17 *Goldman Sachs: Oil Could Spike To $105.* Reuters, 31 March 2005. Also archived at Energy Bulletin: http://www.energybulletin.net/5017.html.
18 *Will Iran dispute push oil to $130?* CNN Money, 7 February 2006. Also archived at From The Wilderness: http://www.fromthewilderness.com/free/ww3/021506_world_stories.shtml.
19 Reported on Adam Porter's *OilCast* audio blog: http://www.oilcast.com. Commentary by *FTW*'s Michael Kane is available at http://www.fromthewilderness.com/free/ww3/060805_380_oil.shtml.
20 Mentioned on Jim Puplava's *Financial Sense Newshour*: http://www.netcastdaily.com/fsnewshour.htm. At the time, the price of oil was around US$58/bbl.

has been happening anyway, regardless of whether we have reached peak oil production yet or not. If the onset of peak oil is not the origin of this problem, it will surely exacerbate it.

In addition to supply shortfalls, we are also likely to see increases in the price of oil, due to the rapid economic expansion of India and China and political tensions in oil- producing nations. Either of these phenomena could see Australia's supply chains for imported oil disrupted or even diverted entirely. As our own oil production peaked in 2000 and has declined sharply since then, we will be increasingly reliant on imported oil to meet our transport needs.

It is difficult to recommend a solution to this. Most countries rely on oil in some way, and will need to have inquiries such as this one at some stage. However, because of peak oil, investing in oil exploration, drilling or refinery capacity is unlikely to solve the problem, since there simply won't be as much oil to go around as there has been in the past. Some measure of alternative fuels will probably be employed, if only to make a tiny dent in our levels of oil consumption; this is discussed in the next part of the submission.

Part B - Potential of new sources of oil and alternative transport fuels to meet a significant share of Australia's fuel demands, taking into account technological developments and environmental and economic costs

This part of the submission deals with the advent of alternative fuels – particularly biofuels – and technological advances that are touted as possibly being able to reduce our dependence on oil for transport fuels. Again, this discussion will be split into several sections.

Potential of new sources of oil

It is difficult for many people new to the theories of resource depletion, of which peak oil is but one, to understand that there are vital resources that will simply run out and that there is very little we can do about it except to slow down. Oil has been cheap and plentiful for more than a century, and we as a civilisation are yet to run out of it. However, we do depend on non-renewable resources, some of which we will have used up.[21]

World oil discovery peaked in 1962.[22] At that stage, global oil consumption was some 6 billion barrels annually, while oil production was at over 55 billion barrels per year. Oil discoveries have been in a steady decline ever since, save for some small fluctuations and a run of new discoveries in the late 1970s. Global oil production overtook global oil discovery in the early 1980s, and the gap has widened so far in the past 20 years that we now consume six barrels of oil for each barrel discovered.

The oil companies, especially the "majors", already know this: they are constantly investing in oil exploration and must know how much oil is being discovered. This may not be the case for much longer. The *New York Times* reported in late 2004 that the world's ten biggest oil companies spent a total of US$8billion on oil exploration in 2003, but the market value of this oil production would only be worth US$4billion, even as the price of oil had increased from less than US$30/bbl to about US$50/bbl and continued to rise.[23]

Another thing to note is that the oil that has been used has been the easiest to get – the oil that is in the largest deposits, closest to the Earth's surface, that is easiest to refine, and that has the least impurities. We call this "light" or "sweet" crude oil. As we use up the "low-hanging fruit" of the oil deposits, we must dig deeper to keep the flow of oil running, which not only requires more energy but which also usually results in a lower quality of crude oil, polluted with sulphur and other impurities that must be extracted. Similarly, as we hope to discover future supplies of oil, it is increasingly unlikely that it will be discovered in large deposits, or close to the surface, or of a high quality.

My response to this would be not to expect major increases in oil supply in the future. Oil-

21 At least, we will use them up to the point where it is not worth producing them any more. If we are mining for energy sources, we will never use them all up, but rather, they will eventually cost more energy to extract and monetise than the fuel itself contains. At this point, we either find another indispensable use for it or stop extracting it.

22 Cited from *The* Guardian on Matt Savinar's web site, http://www.lifeaftertheoilcrash.net.

23 Published in the *New York Times* on 10 October 2004: *Top Oil Groups Fail To Recoup Exploration Costs*, by James Boxell. Also archived at Energy Bulletin: http://www.energybulletin.net/2470.html.

producing countries regularly announce that they will imminently attempt to increase production, but very little of the increase is ever forthcoming, either because oil-producing countries cannot increase production or because they want to control the price of crude oil (or both).[24]

It should also be mentioned that a lot of economic theory is based on growth. In modern times, this growth depends on there being an endless source of cheap energy and materials – as if, somehow, increased demand will increase the reserves and thus supplies of something that takes millions of years to replenish. One needs to consider how an economy based on growth can possibly be sustained in a nearly-closed system that is almost entirely dependent on finite resources.

Alternative transport fuels

This is an area of research that should be of greater interest to the country. Australia is a country that relies on its cars, though the car is only the most iconic of the many forms of transport we use, and the one with which we all identify most readily.

Some 90% of Australia's oil consumption is spent for the purpose of transport: cars, trucks and aircraft all depend on oil products. There are some non-petroleum-based alternatives to our current transport fuel, but there is very little movement towards them.

The most commonly discussed alternative to petrol comes in the form of "biofuels", which are liquid fuels derived from crops and biomass instead of oil. In particular, two of these – ethanol and biodiesel – are receiving a lot of attention, both among environmentalists and in political circles. Ethanol, an alcohol that can be grown from crops such as sugar, is touted as a possible additive to unleaded petrol. Similarly, biodiesel is a replacement for petroleum-based fuel for diesel engines, although it can be blended with petroleum-based diesel in any ratio or even remove the petro-diesel from the system entirely, without engine modification. Different crops lend themselves better to bioethanol than to biodiesel, and different crops and agricultural techniques provide different returns on energy.[25]

So far, there has been very little debate in Australia about introducing biofuels. There has been some political debate in recent years about allowing unleaded petrol to be blended with up to 10% ethanol to reduce our dependence on oil, as well as slightly reducing costs. That said, service stations run by South Australian Farmers' Fuel (SAFF), for example, openly sell biofuel blends of both unleaded petrol and diesel fuel; SAFF also has a fleet that runs on 100% biodiesel.[26] Virtually all passenger cars in Australia run on unleaded petrol (although an increasing number of diesel-powered passenger cars are appearing, particularly from European manufacturers[27]), and virtually all manufacturers have issued

24 Saudi Arabia regularly boasts of its spare production capacity – one example from 2004 is at http://www.signonsandiego.com/news/business/20040510-0755-saudi-oil.html - though many analysts are sceptical of this, and some claim that Saudi production has already peaked.

25 The effectiveness of a fuel can be indicated using the ratio of the energy the fuel provides to the energy spent to make the fuel. This ratio is called "energy returned over energy invested", or EROEI for short.

26 Biofuel blends are often written using E-notation, for unleaded petrol blended with ethanol, or B-notation, for petro-diesel blended with biodiesel. For example, E10 fuel is 90% unleaded petrol and 10% ethanol, whereas B20 would be 80% petro-diesel and 20% biodiesel.

27 Most publicity for diesel models relies on the reduced fuel requirements of diesel engines. This is simply because diesel fuel contains more energy, by volume, than unleaded petrol. Car manufacturers tend not to publicise the use of biofuels.

statements regarding the use of ethanol blends and any warranty issues that the use of ethanol may imply.[28]

Prior to the 2001 Australian federal election, the federal government announced that the production of biofuels in Australia would increase from about 50 megalitres to 350 megalitres per year by 2010. In 2003, the government commissioned a report from ABARE, BTRE and CSIRO discussing how realistic a goal this was. The report projected that, under existing policies and arrangement, production of biofuels would increase to about 115ML/year, and that the other 235ML/year would have to come from focused efforts to expand the biofuel industry. Notably, 205ML of the 235ML required – more than 87 per cent – was to be ethanol; the other 30ML was to be biodiesel, reconstituted from waste vegetable oil. Even if production does reach the stated goal of 350ML/year – and some have already expressed doubt that it will – this will represent just 1.1% of Australia's projected consumption of transport fuel.[29]

It has been suggested that biofuel policy is focused on ethanol because certain unidentified high-ranking government officials have vested interests in making the ethanol industry work. Whether this accusation is true or not, ethanol will likely remain the focus of biofuel policy, simply because of the immense number of passenger vehicles in Australia that run on unleaded petrol. This is despite the obvious technical advantage of biodiesel, which does not require vehicle modifications to use strong biofuel blends.

One must, however, qualify this discussion of alternative fuels with the limitations of implementing them. Obviously, the limits of oil production stem from there being a finite amount of it underground. Switching to biofuels would simply shift the limitation above ground: these fuels are based on crops, and crops require arable land and fresh water. A colleague of mine at work has also told me of concerns regarding the use of foodstock as fuel for machines, should this eventually be regarded as a less important goal than that of feeding living beings. Both are required for our modern economy, but this economy also demands sustained growth, so in the longer term, there may also be some “blowback” as these two goals are played off against each other. Note also that there is very little evidence that a biomass substitute for aviation fuel will appear in the near future.

Technological developments

Many consumers continue to wait for the technological “silver bullet” that will solve any impending energy crisis. This is a popular viewpoint because high technology has been making our lives easier for generations. Another reason, as Matt Savinar describes in *The Oil Age Is Over*, is that waiting for a technological solution is entirely superficial: the question is asked of one and all, but the answer is provided by somebody else and has no other effect on the lifestyle we enjoy today. This is why many peak-oil advocates are cynical of petrol/electric hybrid cars and, especially, the advocacy of hydrogen as a fuel, since hydrogen is not actually a source of energy.

28 The Department of the Prime Minister and Cabinet prepared a report into the use of biofuels, which included submissions from the majority of car and motorcycle manufacturers whose vehicles are sold in Australia. The report can be found at http://www.dpmc.gov.au/biofuels/final_report.cfm.

29 The report can be found at the web site of the Department of Industry, Tourism and Resources: http://www.industry.gov.au/content/itrinternet/cmscontent.cfm?objectID=36D82CF9-C8FA-FF51-2B468B7DD287B9E9.

It is a fallacy to believe that technological improvements are going to reverse any shortages of energy or materials. The cheaper and more efficient exploitation of resources has inexorably run parallel to an increase, not a decrease, in the use of those resources, as noted by William Stanley Jevons in his 1865 book, *The Coal Question*.[30] Jevons opined that Watt's coal-powered steam engine, the most fuel-efficient of its era, had actually increased the rate at which coal was being consumed, since it led to cheaper coal supplies and a larger market for steam engines.

This has continued with the flow of cheap oil, which is far more versatile than coal and far easier to refine into useful products. Practically everything we do now has some dependence on fossil fuels, since almost all of our electricity comes from coal and almost all of our transport fuel comes from oil. Some examples:

- Our food is grown by oil-powered machines and protected by oil-based pesticides and weed-killers. The soil on which it is grown is fertilised with ammonia, which comes from natural gas (another non-renewable fossil fuel) and irrigated by electric pumps, which also depend on fossil fuels. Once it is grown, it is transported to the consumer by oil, and its storage for retail sale depends on coal for electricity. These techniques use up many times as much energy as the resulting food contains.[31]

- Many forms of textiles come from plants grown using these same agricultural techniques, while others are synthesised from oil. Even those natural fibres that are grown organically are woven by electric machines.

- Most electrical and electronic appliances – including the computer on which I am typing this document – consume many times their own weight in fossil fuels during their manufacture alone. (They continue to consume coal as they are used, of course, because they require electricity.)

- Our houses and roads are all constructed using large machines that require oil.

- Anything not produced locally and needing to be transported to the consumer will depend on fossil fuels. Without loss of generality, the further away it is produced, the more energy is required to transport it.

Previously, when people had to move things about, or beat the weather, or prepare food, or clean themselves or their possessions, or build buildings or furniture, they would require large amounts of manual labour for long periods of time. With the ubiquity of both fossil fuels and the means to exploit them, this is has not been the case for many decades. One of the fears of the movement toward environmental sustainability – a concept of which peak oil is but one specific instance – is that so much time has passed without the need for this manual labour or skill that most people will not be prepared to perform these tasks themselves and will be helpless without mechanical aid.

In conclusion

30 This phenomenon is sometimes referred to as the “Jevons paradox”. It isn't really a paradox, though: the observations are not necessarily intuitive, but the results can be reasonably explained by modern economics. See http://en.wikipedia.org/wiki/Jevons_paradox for more.

31 In the United States, this figure is over ten times, according to Dale Allen Pfeiffer's article, *Eating Fossil Fuels*, available at http://www.fromthewilderness.com/free/ww3/100303_eating_oil.html.

With peak oil discovery 40 years in the past and peak oil production looming large, it is unreasonable to expect continuous or increasing supplies of oil, either from existing fields or from new discoveries. It is also unreasonable to expect biofuels to bridge the gap in supply, due to concerns about scalability. I would personally advocate the use of biofuels, simply because they are renewable where oil is not. However, any interest in biofuels, especially commercial interests, *must* be measured against the realisation that they will only ever replace a tiny fraction of existing fuel sources.

The simple answer is to scale down our transport needs. The days during which ordinary Australian families can own and run their own car, or possibly several cars, are severely numbered, as fuel shortages inevitably lead to increased prices. New communities should focus on pedestrian- and bicycle-friendly town planning; where this is not possible, the use of public transport must increase to compensate for the increased cost of maintaining and driving one's own vehicle. Australia is not in a position where we can do away with road transport altogether, but we should aim to reduce it from what is ubiquitous and convenient to what is specific and necessary. Naturally, this will seem like an enormous sacrifice, and both politicians and the general public will doubtless make excuses to resist it until long after the reality of the predicament sets in.

Technology has not caused the problem: indeed, we knew that fossil fuels were finite almost from the moment that we started burning them for energy. In fact, there is much to be gained from technological advances, as energy use becomes more efficient with new techniques and inventions. That said, we exhibit a strong dependence on technology in all areas of modern civilisation, and this has led to the gravity of the problem of fossil fuel depletion, if not the problem itself. In other words, the faith that technology will somehow save us from a problem that technology has aggravated is nothing more than horrendously misguided. Everything has its limits: so we depend on limited resources, so must we exercise discipline in exploiting them.

Part C - Flow-on economic and social impacts in Australia from continuing rises in the price of transport fuel and potential reductions in oil supply

It has been widely expected that the increases in the price of fuels in the past couple of years will continue. Whether or not we will see a peak in world oil production in the next few years, we are already at a point where supply is struggling to meet demand. Obviously, this will have a grave effect on the world's economies, including ours, but it is also likely to bring about a great deal of social change.

Fuel shortages and increased fuel prices

Current figures show both supply and demand for oil over 80 million barrels per day. However, with continued economic growth in western countries, and the new-found economic expansion of China and India, demand is set to keep growing by 2-3Mbbl/d each year, and it is highly questionable whether the supply can keep up. This is the situation today, at which point we aren't sure whether the world's total oil production has started to decline yet; obviously, a decline would make the supply gap grow even faster.

As discussed in the previous part of this document, shortfalls in supply would inevitably drive the price of oil ever higher. Many motorists are already concerned about the price of petrol, and the airline industry is already reeling from increases to the price of aviation fuel. In addition, our dependence on imported oil is likely to manifest itself, simply enough, in supply shortages. South Australia came uncomfortably close to running out of fuel three times in 2005.

With this combination of symptoms, the biggest strain will be on middle- and low-income families, although it will have a noticeable effect on anyone who depends on a private car or lives a long way from where they work. Furthermore, this increase in spending for fuel will create ripples in other areas of the economy, as consumers end up with less and less disposable income. The subsequent decline in consumer confidence would snowball, as the reduced spending fails to satisfy our economy's need for growth.

This growth is the primary reason why we might see shortages of electricity and gas as well, even though our supplies of coal and natural gas are largely domestic. A general downturn in the energy industry might well see prices creep upwards. That said, Adelaide suffered a widespread blackout in January 2006: during four consecutive days of maximum temperatures over 40 degrees, people turned increasingly to air conditioners to cool down, and the system failed to handle the load.[32] The state government blames the privatisation of the energy utilities, but whatever the reason, the system is not equipped to handle Adelaide's demand. This is unlikely to change without additional investment in new power plants, which bring with them sizeable economic risk.

The effect of urban sprawl

Australia's cities are spread out like those of few other countries. Most have a small central business district that is surrounded by low-density suburban housing; in the largest cities,

32 http://www.theaustralian.news.com.au/common/story_page/0,5744,17895373%255E1702,00.html

suburbia stretches to the horizon in all directions. More than half of Australia's population lives in our five most populous cities, and these people depend on cheap, abundant energy, both to move within their cities and to have food, water, goods and services provided to them.

One social observation that would be highlighted by the absence of cheap and abundant energy is that the further away from the city one travels, the poorer the neighbourhoods one will traverse. A recent report by the Urban Research Program at Griffith University observed correlations between suburbs closer to the CBD, the income of these suburbs' inhabitants and the ready availability of public transport.[33] Firstly, people living in outer suburbs or remote centres are more likely to need to travel great distances on a day-to-day basis, such as to and from work. Secondly, these suburbs tend to be poorly serviced by public transport, whereas suburbs closer to the central business district will have better access to public transport. This may seem counter-intuitive – that the people with the furthest to travel have the worst access to public transport – but it makes sense economically, because services gravitate towards major economic centres. All of this bodes ill for the lower socio-economic groups, which are already vulnerable to any large-scale social or economic change.

In the medium-to-long term, the increased price of oil will fan out into the prices of other goods and services that depend on oil – namely, pretty much everything. The economics of scale decree that large, centralised systems are more cost-effective, but this is based on the assumption that the savings offered by centralisation override the increased cost of transportation; this will not be the case forever. With transport costs increasing, people will need goods and services offered closer to where they live, which will likely favour a decentralised system with smaller but more numerous providers in each neighbourhood or locale. People may have to start providing some services for themselves, for example, by growing their own food, catching rain water, or even generating their own electricity.

Over-population

Throughout the 19th century, the world was home to around one billion people. At the end of the 20th century, this figure had exceeded 6 billion. The weekend after this inquiry's deadline for submissions, the figure will reach 6.5 billion.[34]

It is widely regarded that this rapid and unabated population increase was only made possible using industrialised agriculture and medicine. Much of the manual labour was replaced by the advent of oil-powered machines and pumps for irrigation. The petrochemical industry manufactured fertilisers, pesticides and weed killers that improved the yield of each farm without great expenditure on the part of farmers. Doctors and pharmacists were graced with cheap energy, cheap drugs and high-technology surgical devices. Food and water became both plentiful and readily accessible, sophisticated medicine improved life expectancy, and the population exploded.

Of course, the Earth is a closed system – apart from the warmth and light of the sun – and these population figures are not without limitations. These enormous supplies of food,

33 Dr J. Dodson and Dr N. Sipe. *Oil Vulnerability in Australia's Cities.* Urban Research Program, Griffith University. December 2005. http://www.griffith.edu.au/centre/urp/URP_RP6_OilVulnerability_Final.pdf

34 Joanne Glaser. *Earth Hurtles Toward 6.5 Billion*. http://www.wired.com/news/technology/0,70238-0.html

water and medicine are not distributed evenly, and much of the world's population sees very little of these technological advances. Some 1-2 billion people on Earth have insufficient supplies of food,[35] more than a billion people do not have access to potable water,[36] and more than double that have inadequate sanitation infrastructure.[37]

The untamed explosion of population that the world has seen for the past century will not continue without cheap energy inputs. Furthermore, although it is claimed that many people in poor countries live on less than a dollar a day, it is seldom disclosed how much of that dollar comes from the foreign aid donated by richer countries. In an economy that becomes ever more stressed by demands growth, the richer countries may decide they need the money more than their poorer neighbours, and that foreign aid money may one day diminish or even disappear entirely.

This is not to say that wealthier nations are immune from the problem of population. Just as the world has richer and poorer nations, so too does each country have richer and poorer regions, and so too does each city have richer and poorer neighbourhoods. (This was discussed in the previous section.) In all of these situations, it is common for the poor to depend on the rich – either for the provision of goods and services or for employment. If the rich don't have enough wealth to go around even amongst themselves, it is unlikely that the poor will be able to fend for themselves without undermining or removing their dependence on the rich.

The net result of this is that the people who will suffer most – from shortages of food or water, from a lack of warmth or medicine, and from stagnant local economies – will come from the lower socio-economic groups. Sadly, many of these people will die, as neither the Earth's resources nor the local economy will be able to sustain them.

In conclusion

The socio-economic impacts of increased fuel prices will be both broad and deep. There is some disagreement as to whether these changes will happen in a gradual decline, in line with the increasing price of oil, or a precipitous drop that forebodes a bleak economic future. In whatever time frame these changes may come, our economy demands growth, and this growth will no longer be possible without continual input, in the forms of cheap energy and materials, from fossil fuels.

The short answer is that the suburban lifestyle, and all of its implications, are on borrowed time. The provision of even the most fundamental services are highly centralised on large centres of economy and population. As fuel prices increase, the inter-suburban distances that we take for granted today will be problematic for those in lower socio-economic rungs. Those at greatest risk are those who live in outer suburbs; they already depend on cheap and readily available transportation, in order to be connected to the polarised economy, and they already suffer economically for their remoteness, in terms of supply chains and the provision of services such as public transport. The risks for these people will be hardship at best, and depopulation at worst.

35 http://dieoff.org/page57.htm
36 http://www.unicef.org/mdg/environment.html
37 http://www.unicef.org/wes/index_statistics.html

As costs increase, current circumstances suggest that socio-economic groups are likely to grow more and more divided, as distances become prohibitive for providers and consumers alike. One precondition to coping with such a transformation would be the improvement of public transport services to more remote locales. However, lifestyle changes may have to go further, as suburbanites become forced by supply shortages towards self-sufficiency. Communities and even individual households may one day need to resort to growing their own food, catching their own water and generating their own electricity, with smaller, more localised businesses providing other, more specific skills.

Part D - Options for reducing Australia's transport fuel demands

The previous parts of this document have attempted to suggest positive courses of action; yet, they were unable to propose a solution, or set of solutions, to Australia's future needs for transportation. The bad news is that perhaps there isn't one. Current oil supplies struggle to meet current demand, and this will only get worse as demand continues to increase to instigate economic growth. The motor vehicle industry is unlikely to see widespread alternatives to liquid fuel, such as solar power or hydrogen fuel cells,[38] and biofuels are unlikely to replace more than a tiny fraction of our current fuel supply. Part C of this document offered some hope, but it involves a major lifestyle change for many millions of Australians.

Australia's geography poses a special kind of challenge. We take our ability to travel freely and cheaply for granted, and the strains on transportation are likely to be reflected in other social and economic activities. As mentioned in the previous part of this document, the people who stand the most to lose are the people who have the longest distances to travel. One possibility for relief is the idea of decentralising the economy, so that people can do more of their business and shopping closer to their own neighbourhoods. Perhaps more people will start working from home, swapping transport fuel for electricity as they substitute commuting for telecommuting.

It is unwise to suggest that technology will solve the problem: while it may alleviate or postpone any trouble for a few years, it also encourages consumption and may actually make the problem much worse. It is also naïve to wait for demand to reduce naturally because of high prices, since the price of oil has doubled in the last three years and consumption has shown no signs of decreasing.

In a way, it may be a blessing that we do not end up finding easy answers to our current problems. This is not a short-term battle, but a long-term war, fought for the sustainability of our livelihoods and our very future here on Earth. We must confront the challenges before us, and even if we can only afford to take tiny steps toward solutions, that will surely make a difference.

38 The term "hydrogen fuel cell" is something of a misnomer. Hydrogen is not a source of energy, so it is spurious to dub hydrogen a fuel. Rather, it is merely a carrier for energy generated somewhere else – namely, by burning fossil fuels.