



ASPO-Australia

Australian Association for the Study of Peak Oil & Gas

www.ASPO-Australia.org.au

Convenor, Bruce Robinson

61-8-9384-7409 mobile 61 427 398 708

Bruce.Robinson@ASPO-Australia.org.au

Main Submission

Senate inquiry into Australia's future oil supplies

ASPO-Australia is a national body dedicated to the study of the impacts of Peak Oil on Australia and to the necessary risk assessment and risk management of our oil vulnerability. It is a nationwide network of people with a professional interest in the impacts of Peak Oil, and in options for mitigation and adaptation, in a widevariety of fields. Our working-group structure (Appendix 1) is intended to allow professionals to focus on specific parts of the overall impact scenarios, and to make use of their relevant expertise in these areas.

There is a high probability of global Peak Oil occurring soon, before 2010 or 2015.

Peak Oil is one term for the inevitable change from the current rising trend of world oil production to the final decline trend as oil fields age.

The flow-on economic and social impacts in Australia from Peak Oil are likely to be very serious, UNLESS we make serious and courageous decisions to take the obvious sensible precautions very soon.

ASPO-Australia recommends four main options which together are capable of halving Australia's transport fuel usage. All are behavioural options. These four would then lead to a plethora of important but relatively minor changes, including technological options, which in total can make the substantial reductions in demand that we will require before Peak Oil strikes. All are aimed at minimising our automobile dependence. They are:

Community engagement: empowering people to understand the Peak Oil concept and to help decide the best options for us all before we face future oil shortages.

Individualised marketing: a proven, rapid and low cost strategy, offering individual households the information needed to consider options of reducing automobile travel. 13% reduction in car-kms has been achieved in large programs in Australia. It can also be used as well for minimisation of demand for water and electricity and perhaps to be adapted to alert people to Peak Oil probabilities and risks.

Fuel Tax Escalator: Increasing fuel taxes smoothly and incrementally to UK levels (following Margaret Thatcher's 1988 example) would provide a clear signal that we must value fuel much more than we do now. "Unthinkable" measures such as this are essential given the magnitude of the near term risks posed by Peak Oil. Fuel tax increases would provide funds for schools, hospitals, and for sustainable transport infrastructure. The impacts could, for instance, be ameliorated by abolishing fixed vehicle-ownership charges (licence and third party charges) and by lowering income taxes.

Smartcard flexible tradable fuel allocation and pricing mechanism: Providing a basic safety-net ration for modest usage, and extra fuel at an increasing taxation rate for those who want to use more than average. Unused allocations can be traded to reward those with ingenious ways of reducing fuel usage.

Australian and global oil production forecasts

Australia's Bass Strait province started production in 1970, reached its peak in 1985 and has declined steadily ever since. This is typical of trends in all oilfields, and eventually of global oil production.

Australia's overall oil production peaked in 2000 and is declining. Geoscience Australia's 50% probability forecasts (in the graph in the right) show a continual steep decline, while our consumption trend is steeply upwards. The probability of new Australian discoveries even meeting our past peak production is very low indeed.

North Sea oil province production, for instance, peaked in 1999 (UK), and 2001 (Norway) and has been falling sharply since. The Norwegian field-by-field graph (right) shows that big fields are found first. As they finally decline, smaller fields replace them. When the decline rate of existing the bigger fields exceeds the rate of replacement with ever smaller fields overall production drops irreversibly. This will also happen globally.

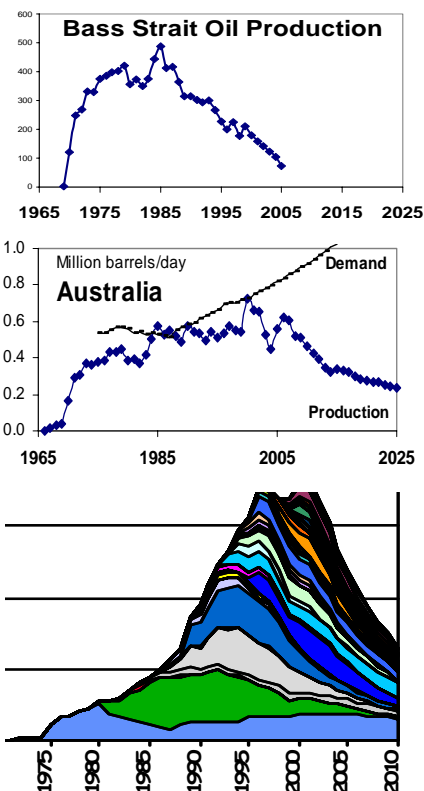
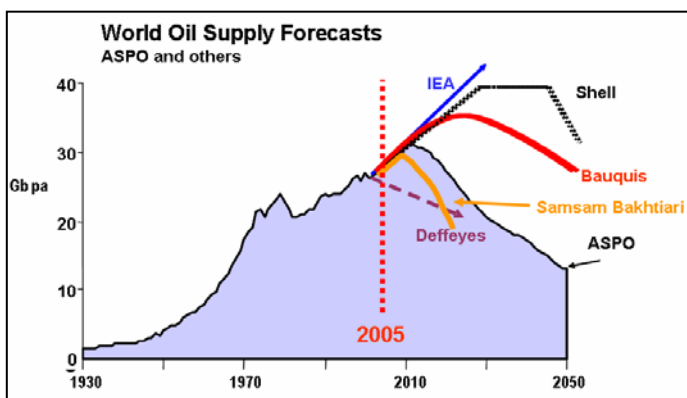
Excluding deepwater oilfields, output from 54 of the 65 largest oil-producing countries in the world is in decline. Global oil production is still rising. However, there are no reliable audited reserve and field by field production data available globally. This means it is not possible for more than uncertain probabilistic estimates to be made of when global production will begin its decline. Serious questions, about the veracity of the official Saudi reserve figures for instance, make the uncertainties higher than many assume.

There are many forecasts of the date of Peak Oil. A straw poll conducted by Eric Streitberg, (ARC Energy managing director) during a key-note speech at Australia's premium oil industry conference, APPEA, in 2005 showed that about a third of the oil professionals in the audience agreed that Peak Oil was here, or very close, about a third disagreed, and another third were undecided. This is very different from the extreme confidence shown in many government and financial circles.

We can express the chances as rough probabilities:-

Peak Oil timing probability estimates

before 2008	10%
before the end of the next Federal parliamentary term	30%
before 2010 to 2015	50%
after 2020	10%

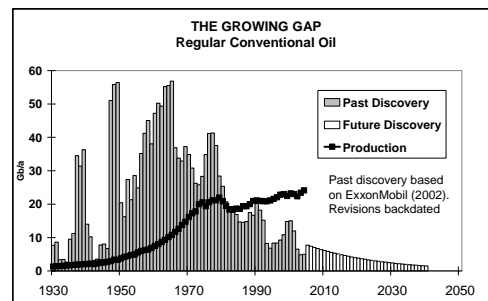


Price Scenarios

When global peak oil occurs, oil shortages, many-fold price rises and possible international and national oil rationing are all plausible scenarios which should be considered seriously in any planning for the future.

Future oil discoveries and new sources of oil

The annual volume of oil discovered globally has been falling steadily since the 1960s (see the graph from Dr Campbell's submission). Australia is also showing declining discovery rates. The probability that these long-established trends will reverse is very low. The yet-to-be discovered oil fields are most unlikely to be able to do more than make the post-peak decline curve less steep.

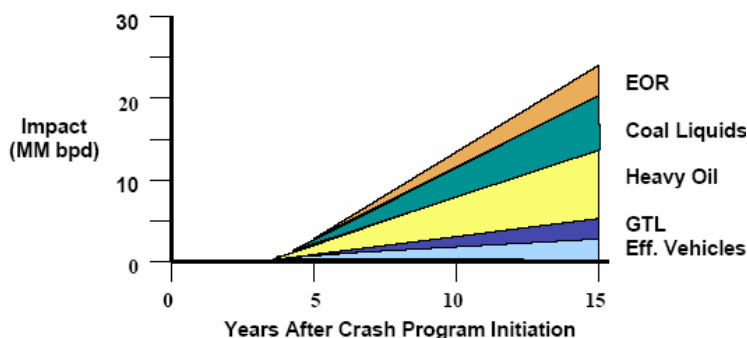


Alternative transport fuels

The recent study for US DOE (Hirsch et al, 2005) (graph below) shows that even with (unlikely) massive crash programs, there will be lead times of decades needed before synthetic crude oil, from coal, or gas or tar-sands can be produced in volumes sufficient to make a serious impact on declining conventional oil production. These measures need to have been started 20 years before the peak to avoid serious shortfalls.

Physical limits, especially dwindling natural gas supplies, are very likely to limit Canadian tar-sand syncrude production below Hirsch's estimates (Alekklett, 2006)

Biofuels: Increasing the production of biofuels also has similar physical limits (for instance the lack availability of arable land not devoted to food and the environmental limits of clearing tropical forests for palm oil plantations). More detail is provided in the ASPO-Australia biofuels working group submission.



Hydrogen: Hydrogen gas is an energy carrier, not an energy source, and it requires a very large energy input for its manufacture. The most common route for hydrogen production is from natural gas (methane) to provide both the hydrogen atoms and the energy for its production. *"The Hype about Hydrogen"* (Joseph Romm, 2004, Island Press) is an objective summary by a former US DOE program manager. The likelihood of the hydrogen economy playing any role in delaying peak oil is very low indeed, <1%. Hirsch omitted hydrogen as a technology which might counteract oil production decline, as fuel cells are not currently available in mass-production. A University of Warwick study estimated Britain would need 100 nuclear power plants for electricity to make hydrogen to replace its existing transport fuel use. This is a magnitude of investment and timeframe that puts glib statements about hydrogen for transport into perspective. The UK uses 2.5 times as much oil as Australia does, so we would need some 40 nuclear plants to make the hydrogen for our transport from electricity. Hydrogen is not a practical transport fuel and certainly not panacea. It is increasingly unlikely that hydrogen will be used for transport in any significant way, especially if battery and light vehicle technology continue to improve substantially. We can predict that far more people-kms will continue to be travelled in Australia by bicycle than by hydrogen vehicle for the foreseeable future.

Natural gas: For Australia, natural gas is the most obvious alternative fuel for transport purposes. Already a proportion of the urban bus fleet runs on natural gas in diesel engines. However, Australia only has some 1.4% of the world's known reserves of natural gas, and our gas extraction rate is growing rapidly. Our natural gas reserves will be depleted relatively quickly, leaving very little for

future generations. Our gas is not a "Magic Pudding" that can be consumed continually while it miraculously regenerates itself. However, many assume that Australia's natural gas can cater for all of the planned and predicted demands such as

- electricity generation
- large-scale LNG export
- replacing oil as a transport fuel,
- manufacture of urea fertiliser and
- for other industrial and domestic uses

It is not physically possible to use our limited natural gas resources for long periods for all these options simultaneously, while at the same time leaving a legacy for future generations. Certainly, history is likely to view the large-scale export of our natural gas at very low prices as a critical national mistake. We could use the gas for our transport needs for the next 50 years (at current usage rates), but only if we halted exports and stopped generating electricity from natural gas.

The flow-on economic and social impacts in Australia

The flow-on economic and social impacts in Australia from Peak Oil are likely to be very serious, **unless** we make serious and courageous decisions to take the obvious sensible precautions very soon.

ASPO-Australia knows of a number of hopeful scenarios; where impacts are predicted and minimised, opportunities grasped and the oil vulnerability of different industry and community sectors is assessed; while mitigation and adaptation strategies are implemented in time and the necessary adjustments and safety nets are provided equitably to minimise adverse consequences.

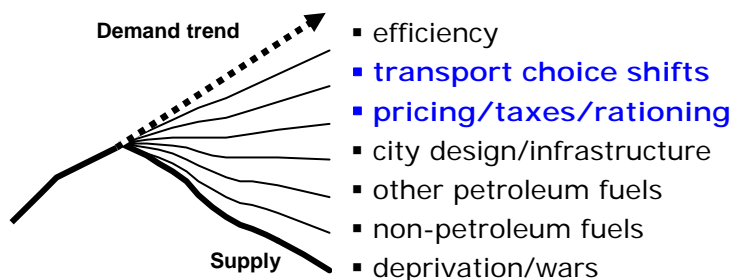
These positive scenarios will require an informed and engaged community, and thoughtful and forward-looking decision-makers and community leaders. We outline below recognised strategies which could help these necessary conditions arise.

The probability of the positive scenarios coming to pass is low on current trends, but the Australian community can rise to the occasion and we do have the power to reduce both the probabilities and the magnitudes of the negative aspects of Peak Oil and to take advantage of the many opportunities which will arise in the Peak Oil future.

There are many relatively recent examples of substantial positive changes in community attitudes and behaviour to unhealthy and inequitable past practices. These include smoking in the workplace, drink driving, attitudes to gender and racial equity, and to many environmental matters. There is a high probability that the community would change its attitudes to fuel usage and its behaviour if people understand the serious risks and costs involved in continuing our current trends.

Options for reducing Australia's transport fuel demands

There are many options for reducing substantially our transport fuel usage. The probability of a smooth demand reduction trend is low, but it is well within the control of the Australian community. This is in sharp contrast with the supply side of the equation, which is almost entirely dominated by global and geological factors completely outside Australia's control.



This scenario illustrates that there will be no "magic bullet" to replace cheap abundant oil. Many measures together can help bridge the growing gap between current demand trends and forecast supply decline. Many attractive options (like more efficient cars) are inevitably slow to take effect and not particularly significant overall. We concentrate on the two areas highlighted, which can be the fastest acting of available options.

President Bush recently acknowledged *"..we have a serious problem: America is addicted to oil, which is often imported from unstable parts of the world"*. ASPO-Australia agrees with the President about the US and recognises Australia is almost as addicted to oil and automobiles as the US. Australia uses a total of over 6 litres of oil per person per day, while the US uses 10 litres/person/day. Energy dependence is discussed from a psychiatric viewpoint by Spencer, 1990 in Appendix 2.

However, we strongly disagree with President Bush that the main hope is in technology. We are certain that our major chance lies in a sea-change in community recognition of the probability and the magnitude of Peak Oil, and subsequently in attitudes and policies after the risks of Peak Oil become widely accepted.

Certainly technology will play a part, but it will be far too slow, and relatively insignificant in magnitude to be effective in meeting the challenges of an early Peak Oil (as outlined in the Hirsch report to the US DOE). Even if crash programs are funded, they need to be started 10-20 years before peak. The chance of such crash programs being underway well before Peak Oil is quite low, as are the chances of them being able to halt the decline in supply after peak oil.



ASPO-Australia is also very sceptical of the other panacea often suggested; the power of the market. "Demand destruction" is a US term indicating the raw power of market forces. A recent news article was entitled *"Demand Destruction: But who will be destroyed?"* This illustrates the risks and inequity of relying on fuel usage reduction by market forces alone. [See the ASPO-Australia Social Services Sector working group submission for some of the probable problems if the market is the final arbiter]

In summary, ASPO-Australia recommends four main options which together are capable of halving Australia's transport fuel usage. All are behavioural options. These four could then lead to a plethora of important but relatively minor changes, including technological options, which in total can make the substantial reductions in demand that we will need to have achieved when Peak Oil strikes. All are aimed at minimising our automobile dependence (or "addiction" to use President Bush's term). They are:

- **Community engagement**
- **Individualised marketing**
- **Fuel tax escalator**
- **Smartcard flexible tradable fuel allocation and pricing mechanism**

1: Community engagement:

It is crucial that Australians comprehend the probabilities and risks of Peak Oil and that we are empowered to suggest, consider and evaluate all possible options. Experience in WA shows a number of successful examples where community engagement can lead to solutions to substantial transport and planning problems being both found and accepted. The necessary tough political decisions can not be made without an informed and supportive community.

Community engagement is critical in the successful development of acceptable policies and decisions in government, the private sector and the community. We know it can be done much better. In Western Australia we have taken a leading role in exploring innovations in community engagement, with 21st Century Town Meetings (Dialogues), Deliberative Surveys, Citizens' Juries, Multi Criteria Analysis Conferences and Consensus Forums.

Details are available on the website of the WA Department of Planning and Infrastructure at

<http://www.dpi.wa.gov.au/communityengagement/727.asp>

<http://www.dpi.wa.gov.au/cityplanning/1208.asp>

These techniques will be essential tools in changing attitudes to our oil vulnerability, and expanding the range of options in urban planning, transport usage choices and in community accessibility and mobility.

Without very substantial changes to reduce our oil usage, we are at very considerable risk.

Attitudinal changes are a vital precursor before decision-makers can change policies to implement oil vulnerability risk management strategies, many of which are contrary to current community views (based as they are on the myths of cheap and unlimited resources continuing well into the future)

2: Individualised marketing

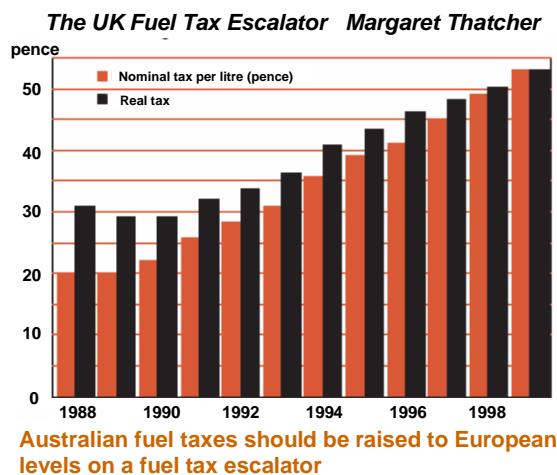
Empowering people to make informed transport mode and trip choices has been proven to make substantial sustained reductions (10-13%) in car-kms driven, in large-scale programmes in Perth, Melbourne and Redlands (outer Brisbane). (Robinson, 2004, Socialdata 2004 and <http://www.dpi.wa.gov.au/travelsmart/1637.asp>)

Individual households are contacted by phone. If interested, they are provided with practical information about their travel mode choices to empower them to change travel habits. A timetable specific to the nearest bus-stop is one example. Australian TravelSmart programs often include individualised marketing as a major plank. Individualised marketing has been shown to have a very high benefit-cost ratio (30:1) and to be able to be implemented rapidly. The resultant travel behaviour changes are shown to be sustained over a period of a year or two at least. This technique, also widely used overseas, can also be used to help people make decisions to reduce water and electricity use, and may be synergically more powerful if used as an overall sustainability enhancement tool.

Individualised marketing is a very powerful tool at our disposal to tackle the challenges of Peak Oil. It might also be further modified to improve awareness of Peak Oil.

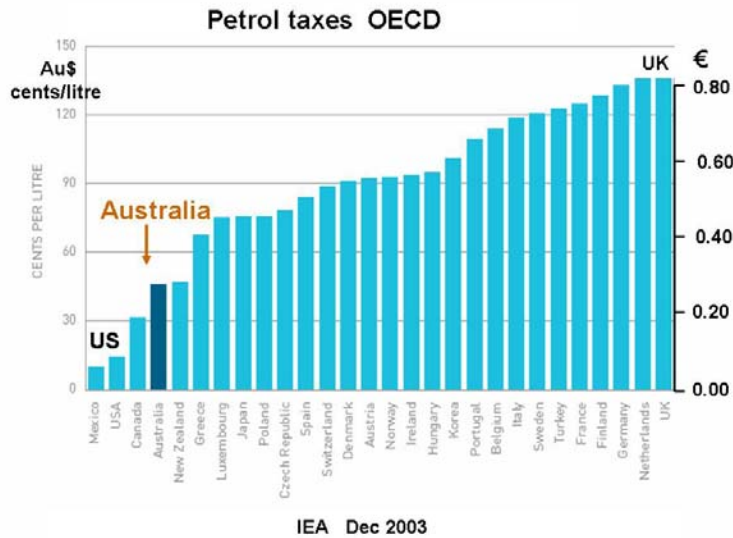
3: Fuel tax escalator

Margaret Thatcher's greatest legacy to Britain may be her implementation of the fuel tax escalator in 1988. This has made Britain far less oil-vulnerable than it would have been without the community knowledge that fuel taxes will rise slowly and manageably but substantially. To minimise our risks of serious Peak Oil impacts, it is essential that Australia follows Mrs Thatcher's lead and sets the nation on a fuel tax escalator. Clearly this first requires the community to



understand the need for such a controversial move.

Currently Australian fuel taxes are very low by world standards, and there is an expanding range of fuel uses which are exempt from fuel excise.



The Economist, 30th April 2005 said *"Add in the geopolitical costs of oil and the case for raising petrol taxes, especially in America, becomes overwhelming"*. The same applies to Australia

Increasing Australian fuel taxes to UK levels would achieve a number of essential aims simultaneously.
 (a). It would provide a clear unequivocal warning that transport fuel prices are going to rise steadily in future, so individuals and businesses can plan well ahead for the changes.

(b). It would provide the resources essential to improve our schools and hospitals and as well to fund sustainable transport infrastructure like light-rail and bicycle networks in our cities. It could also provide funds for income tax relief.

(c). It would avoid many of the problems which will occur if we just wait passively for world oil shortages to dictate the timing and magnitude of fuel price rises. If we leave fuel taxes constant (or reduce them), global oil prices will result in us exporting enormous amounts of money to pay for our oil imports. Raising the price of fuels with taxes allows the extra money to stay in Australia and allows a smoother transition from cheap to expensive fuel. It also provides the funds for us to build the defences against the serious problems Peak Oil will bring and provide the safety nets for those hard-hit by fuel shortages.

4: Smartcard sliding scale fuel pricing and tradable allocation mechanisms

Increasingly high fuel prices (either from taxation or from global markets) will have very serious economic and social impacts on many in Australia, however loud and long the advance warnings have been.

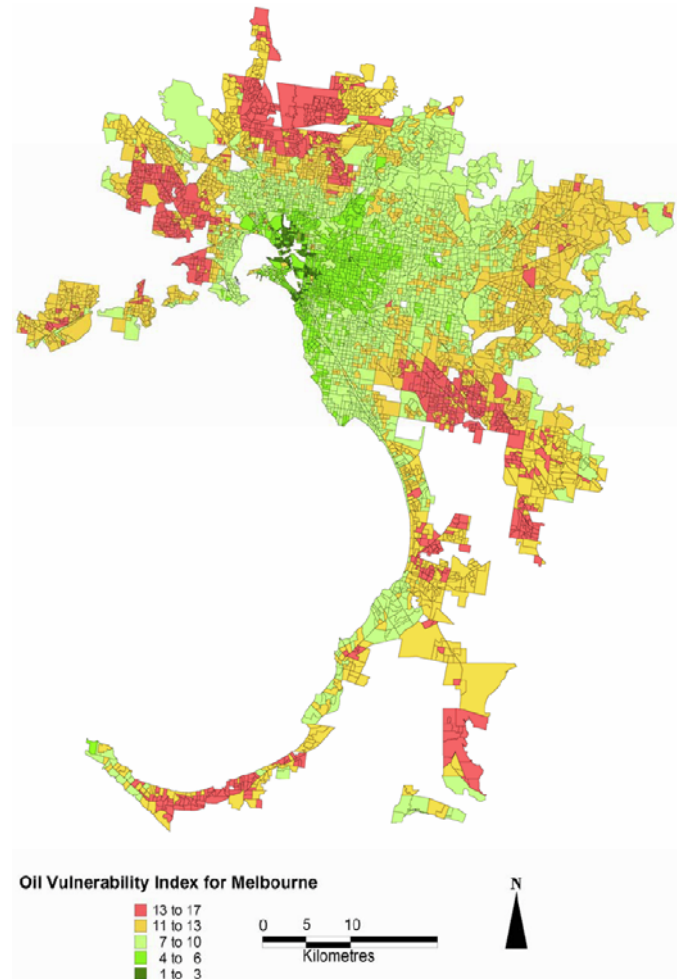
A flexible equitable and transparent mechanism for allocating increasingly scarce fuel will be essential to avoid a market forces crisis where only the wealthy can afford fuel. The Griffith University study (Dodson and Sipe, 2005) provided maps of an oil vulnerability index in Australian cities (below).

Low-income people living in outer suburbs will be very hard hit by sharply rising fuel prices while those in leafy well-off suburbs mostly have shorter travel distances, more public transport options and services like hospitals available closer, as well as more financial options.

A mechanism will also be needed for equitable allocation of fuel for essential services, like Meals on Wheels, staff working night-shifts at major hospitals, Flying Doctor services, food production and distribution, health services, and so on. Allocations to lower priority areas, like essential trades for emergency repairs, will also need to be made. In the event of shortages, non-productive and counter-productive fuel uses, should receive very low priority.

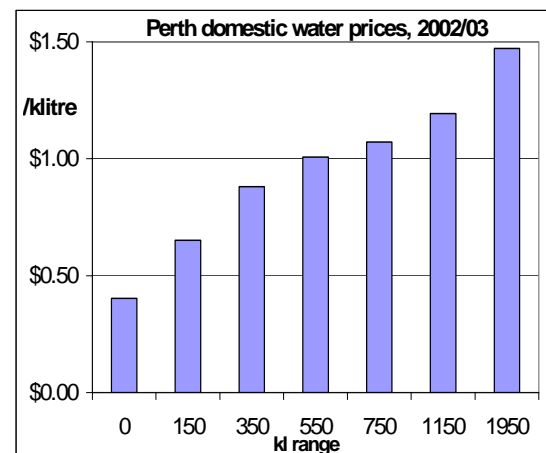
Smartcard technology, using existing petrol station credit-card systems or perhaps either the Medicare card or the proposed personal identity card, could provide a technologically practical mechanism of adopting the sliding scale pricing system now used for other essential commodities, especially water.

Designs of a multi-level tradable rights rationing system should be developed and evaluated. The system should aim to provide every person with a basic personal allowance of fuel, for a relatively modest price (eg the normal or pre-emergency price), and successive increments of allocated fuel at increasing taxation levels. Allowance can be made so those living in country towns or areas poorly served by public transport receive a larger base allowance than those living in a fashionable inner-city suburb close to a train station, for instance.



This would expand upon the model of domestic water pricing used in Western Australia and elsewhere, where a modest household allowance is provided at a low price and those households that use more are charged increasingly more per kilolitre (see diagram at right).

A graded-price tradable rationing system means those who are frugal with their fuel usage can then electronically trade unused entitlements to businesses and people who need more. This offers a substantial financial incentive for innovation in fuel-saving strategies, like car-sharing, using bicycle transport or just in rational trip planning.



The current emergency rationing systems nominally in place in Australia are based on a per-vehicle allowance, or odds-and-evens number plate rationing. This means those owning the most cars get the most fuel. This is firstly grossly inequitable, and secondly it merely encourages people to buy more cars so they have a greater fuel allowance. This is not a rational way to deal with ongoing long-term shortages or a sudden fuel emergency. Both these scenarios have a substantial probability of coming to pass, and existing planning is seriously inadequate.

Like the Fuel Tax Escalator, of which the Smartcard system could form an important subset, any increased fuel tax revenue could be devoted to improving public services like health and public transport, and in covering the increased costs in other areas hit by transport problems at Peak Oil. It should be used to fund the removal of fixed vehicle-ownership costs, such as third party insurance, and to implement, on the New Zealand model, a universal no-fault injury compensation scheme. This would be substantially more equitable than the current third party insurance systems and avoid the current cross-subsidies from frugal vehicle owners to those who travel far greater distances than average (and hence are more likely to be involved in a crash in which someone else is injured).

The allocation of fuel for business purposes would have to be investigated closely. "Business" use of cars would have to be very closely controlled if scarce fuel were to be allocated at the base rate. Encouragement of untrammelled pseudo-business use, as done by the current Fringe Benefits Tax, would have to be reversed. There will no doubt be practical and equitable mechanisms for allocating priority to different business types on the basis of their importance in the event of shortages. Providing fuel to luxury businesses should receive low priority if fuel is very scarce.

Other options for reducing Australia's transport fuel demand.

There are innumerable other options, some of which are mentioned in the submissions from ASPO-Australia specific sector working groups. It is not practical to list more than just a few here

These options include

- dramatically expanding provision of infrastructure for sustainable transport modes, like public transport, bicycle and low-powered vehicle transport (electric scooters/gophers and intelligent power-assisted bicycles), and of course walking as a transport mode. (see ASPO-Australia Active Transport working group submission, and those from other cycling advocate groups)
- the removal of the "perverse policies", especially the FBT, which subsidise heavy car usage [Denniss, 2003], and
- discouragement or prohibition of the supermarket fuel discounts where the grocery bills of the battlers and those frugal with fuel use subsidise the big 4WDs with 150 litre tanks. [Subsidies of \$100 million per annum, have been estimated for the fuel discount schemes from each major supermarket chain]

Urban planning and transport planning clearly can encourage or moderate our automobile addiction. Building a freeway or tollway creates more vehicle travel. *"Build it and they will come"* is one well-known road planning adage describing induced traffic, and there is good evidence that the reverse is true, closing roads can cause traffic levels overall to decrease. (see Urban Transport and Planning working group submission)

Oil vulnerability risk assessment and risk management

Clearly, methodology has not yet been developed for considering Peak Oil probabilities, the assessment of risks and the opportunities likely to arise. Experience is also lacking in the rational evaluation of the various mitigation and adaptation strategies. It is essential that we all, especially Governments, urgently start the process of outlining and refining the probable scenarios which may well arise from global Peak Oil occurring within the next five or ten years, as seems quite likely.

ASPO-Australia is very keen to expand its network of professionals interested in the field and to collaborate with departments, business and industry to help define and control the uncertain future that Peak Oil is likely to bring, probably soon.

Conclusions

WA's Minister for Planning and Infrastructure, Hon. Alannah MacTiernan, has said about Peak Oil in speeches:

“Production itself is likely to peak, maybe as early as 2006, but more conventionally 2010 – 2015”
“It is also certain that the cost of preparing too early is nowhere near the cost of not being ready on time.”

Peter Maas, in the New York Times, in an article about Peak Oil (21st August 2005) said ***“When a crisis comes -- whether in a year or 2 or 10 -- it will be all the more painful because we will have done little or nothing to prepare for it”***. This article appeared, coincidentally, a week before Hurricane Katrina hit New Orleans and found the US quite unprepared for an event which had long been known as a possibility.

Certainly, preparing well in advance for Peak Oil is a very prudent strategy. Many of the possibilities are "No Regrets" options (those that are already justified on social, environmental, health or economic grounds). ASPO-Australia urges the Senate to take very seriously the probability of Peak Oil, and the need for us to take substantial precautions in case the "Early Peak" forecasts turn out to be correct. Sadly, it is very probable that Australia will not be fully prepared, whenever Peak Oil comes. However, there is a chance that we may be, if the Senate inquiry is the start of an on-going process of Peak Oil awareness and action.

Oil Vulnerability Task Forces: As a starting point, ASPO-Australia recommends that Oil Vulnerability Task Forces should be established at all levels of Government and by all individual Government departments, industry sectors, individual businesses and corporations and local communities to review possible impacts of Peak Oil, and the available mitigation and adaption options. These task forces should complement the work already being done by the Queensland Government task force headed by ASPO-Australia patron, Andrew MacNamara, MP. ASPO-Australia would be very happy to collaborate in task forces within the limits of our resources. The multi-level approach is needed, as the impacts and strategies of Peak Oil are likely to be quite different within different levels and sectors of industry, society and the economy. There are innumerable opportunities at every scale for people to minimise risks and take advantage of the opportunities which forewarning of Peak Oil will bring.

References

Andrews, S and Udall, R (2003) "Oil Prophets: Looking at World Oil Studies Over Time" Proc. 2nd International Workshop on Oil Depletion, Paris, France, May 26-27, Ed. K. Aleklett, C. Campbell and J. Meyer, <http://www.aspo-australia.org.au/References/Andrews-IWOOD2003.doc>

Bakhtiari, A M Samsam (2004) "World oil production capacity model suggests output peak by 2006-07", Oil & Gas Journal, 102 (16) April 26th 2004
<http://www.aspo-australia.org.au/References/Bakhtiari-O&GJ-April%202004.doc>

Denniss, R (2003) "Implementing policies to increase the sustainability of transport in Australia". Proc. 'W.A.: Beyond Oil?' conference, Perth, February 2003 see www.STCwa.org for more information about this conference.
http://stcwa.org.au/beyondoil/implementing_policies.pdf

Dodson, J and Sipe, N (2005) "Oil Vulnerability in the Australian City"
http://www.griffith.edu.au/centre/urp/URP_RP6_OilVulnerability_Final.pdf

Hirsch, R.L, Bezdek, R and Wendling R, (2005) “Peaking of World Oil Production: Impacts, Mitigation and Risk Management” prepared for the US Dept of Energy
http://www.netl.doe.gov/publications/others/pdf/Oil_Peaking_NETL.pdf

MacTiernan, A (2004). “Is there an oil crisis?”. Ministerial speech opening the STC "Oil: Living with Less" conference, Perth, 9th August 2004.

Robinson, B W (2004) “Individualised Marketing - Travel behaviour change equivalent to discovering another Iraq?”. Poster and abstract presented at Third International Workshop on Oil Depletion, Berlin, May, 2004. <http://www.stcwa.org.au/negabarrels>

Robinson, B.W and Powrie, S. (2004) Oil depletion: the crucial factor in transport planning. , Australasian Transport Research Forum, Adelaide, October 2004. Appendix 4
<http://www.aspo-australia.org.au/References/ATRF-57-Robinson-2-refs.pdf>

Robinson, B.W, Fleay, B, Mayo, S.C., (2005) “Impact of Oil Depletion on Australia” Abstract and powerpoint slides from the ASPO Fourth International Workshop on Oil Depletion, Lisbon 2005.
http://www.aspo-australia.org.au/References/Abstract_Lisbon_Robinson.pdf Appendix 3
http://www.aspo-australia.org.au/PPT/ASPO2005_Robinson.ppt

Socialdata (2004) “Individualised Marketing- Reducing Car Kilometres – A Global Approach”, Socialdata Australia Pty Ltd, Institute for Transport and Infrastructure Research. , Poster and abstract presented at Third International Workshop on Oil Depletion, Berlin, May, 2004.
http://www.aspo-australia.org.au/References/Berlin%20SocialdataPeakOilPoster_LargeRes.pdf
<http://www.aspo-australia.org.au/References/Berlin%20Abstract%20Socialdata%20IndiMark.pdf>
See also www.Socialdata.de

Sustainable Transport Coalition (2004) “Oil: Living with Less”, policy document, Perth,
<http://www.stcwa.org.au/papers/STCpolicy04Oilprf.pdf>

Appendices

Appendix 1:

Information sheet about ASPO-Australia and its working group structure

(A number of the ASPO-Australia working groups have made separate submissions to the Senate inquiry).

Appendix 2:

"The Energy Dependence Syndrome" John Spencer, 1990, Dept of Psychiatry and Behavioural Science, SCGH, Search 21(8), 251-254, December 1990, ANZAAS

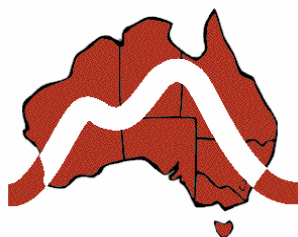
Appendix 3:

“Impact of Oil Depletion on Australia”, Robinson, B.W., Fleay, B.J.and Mayo, S.C., (2005) ASPO Fourth International Workshop on Oil Depletion, Lisbon 2005.

Appendix 4:

"Oil depletion: the crucial factor in transport planning", Robinson, B.W and Powrie, S. (2004) , Australasian Transport Research Forum, Adelaide, October 2004.

Appendix 1: Information sheet about ASPO-Australia and its working group structure



ASPO-Australia

Association for the Study of Peak Oil & Gas

2 Barsden St, Cottesloe WA 6011

Phone 61-8-9384-7409 Mobile 0427 398 708

www.ASPO-Australia.org.au Bruce.Robinson@ASPO-Australia.org.au

ASPO-Australia is a nationwide network of people with professional interest in the impacts of Peak Oil and in options for mitigation and adaptation, in many fields. It is the only body dedicated to the study of these impacts on Australia and to the risk assessment and risk management arising from our Oil Vulnerability. ASPO-Australia was launched by the President of ASPO-International, Prof Kjell Aleklett of Uppsala University, in November 2005

Working group structure at February 2006

Finance Sector
Social Services Sector
Remote and indigenous communities
Active transport (bicycle and pedestrian transport)
Construction Industry
Biofuels
Agriculture, Fisheries and Food
Urban planning sector
Media and communication
Health Sector implications
Oil & Gas industry sector
Transport planning sector
Behavioural change sector
Local Government sector
Young professionals working group
Public servants working group (restricted)
Freight sector

Public transport sector
Defence and Security
Economics
Water Industry
Conservation movement sector
Peak Oil and Permaculture
Electricity from diesel
Australia's gas reserves and needs
Hydrogen: a viable alternative fuel??
Tourism

Sydney
Brisbane
Melbourne
Adelaide working group (Adelaide Peak Oil)

The working groups are intended to allow interested professionals to focus on evaluating the impacts of Peak oil within a relatively defined area, and to suggest possible mitigation and adaptation strategies within that field. An overall "big-picture" approach is important, but the mid-level view is also important to show that many sectors in our community are individually impacted by Peak Oil and that they can take steps to reduce and manage the probable risks and recognise opportunities. Naturally some of these working groups are more active than others, and some may well lapse, or be replaced or subsumed by others, as volunteers and issues come and go.

Contributions to these working groups and suggestions and offers to assist in new working groups will be very welcome indeed.

(A number of the ASPO-Australia working groups have made separate submissions to the Senate inquiry)

Appendix 2:

"The Energy Dependence Syndrome" John Spencer, 1990, Dept of Psychiatry and Behavioural Science, SCGH, Search, 21(8) 251-254 December 1990, ANZAAS



Turning the addicted to the ways of goodness and modest energy use will demand forceful persuasion.

The Energy Dependence Syndrome

John Spencer Department of Psychiatry and Behavioural Science, Sir Charles Gairdner Hospital, The Queen Elizabeth Medical Centre, Nedlands, WA 6009

THE CONCEPT OF DEPENDENCE was described 12 years ago by Edwards and Gross (1978) in an attempt to objectify and classify behaviours associated with substance use which had previously loosely been described as 'addiction'. Whilst the dependence syndrome may not be the final key to our understanding of this complex set of human behaviours, it has generated useful discussion and provoked research.

The dependence syndrome is a set of behavioural responses with several

clearly identifiable elements. It is recognizable, consistent and measurable by standardized behaviour rating scales. Several writers have noted that the dependency paradigm can be broadened considerably from its narrow focus on substance use to include other compulsive behaviours such as gambling (Fink 1961), exercise (DeCoverley Veale 1987), eating and work (Hodson & Miller 1982).

Whilst there is increasing concern over the AIDS epidemic which is presently being fuelled by addiction to intravenous drug use, there is another, less obvious type of dependence which is just as sinister since it is not yet perceived as a form of dependence. As a result, solutions are being sought by try-

ing to treat symptoms and not causes, a result which workers in the addictions field know only too well to be futile. Our consumption of energy fits the dependency model in many ways and can usefully be conceived of according to the paradigm. Furthermore, I believe this view is more than metaphorical as some of the underlying causal factors are the same.

There is presently increasing concern and discussion over the problems of the survival of the environment in which the human species exists. However, despite the possible serious consequences of the almost daily warnings, there is little global action to slow down the increasing production of the factors which are alleged to contribute to this forthcoming catastrophe. This sophisticated form of cognitive dissonance and failure of the species to take action over what many regard as self-destructive behaviour is a similar collective psychological mechanism to the denial and dissociation observed in individuals while suffering from alcohol or other drug dependence. The major features of the energy dependence syndrome would match closely the seven characteristics common to other types of dependence.

Tolerance With continued use the dependent person is able to tolerate increasing quantities of the substance in question without apparent harm. These increasing amounts are required to



The current concern about oil supplies would not be as great had not consumption levels rebounded so quickly after the time of relative abstinence in the 1980s.

achieve the same inner psychic gratification previously obtained by a small dose. Similarly, the demand for energy-consuming technology is continually increasing. Household equipment which used to be operated manually is now almost entirely power driven and access to personal transport is almost considered an inalienable right. Increases in efficiency are offset by the number of gadgets and frequency of use.

The increasing personal use of energy has brought about a corresponding acceleration in the pace of daily life. In turn, this contributes to increasing life stress in all its forms which we somehow tolerate at levels which would have been intolerable even a decade ago. Many of these stresses are the direct hazards of increasing energy use such as accidents, pollution, environmental damage and the general deterioration of lifestyle in large urban centres.

Withdrawal Phenomenon There is a phenomenological parallel to the loss or removal of the addictive substance. When the source of supply of energy ceases both psychological and physical consequences occur. A common energy withdrawal syndrome occurs during and following a prolonged and unexpected power cut. The personal and social chaos includes traffic accidents, industrial losses, increased breaking and entering, looting, petty crimes, disruption of transport schedules and unplanned pregnancies. Our

increasing reliance on computers leads to social and industrial chaos when their energy supply fails.

Relief from Withdrawal Syndromes

Relief from these chaotic symptoms occurs quite dramatically and quickly when the commodity in question (energy in this case) is reinstated. The breakdown in behaviour and social disorder is quickly resolved and normal behaviours resume.

Subjective Compulsion Compulsion implies a craving or a strong desire to behave in a particular fashion. The desire to consume energy in all of its forms is compelling and often unchallenged. In the home energy is increasingly consumed in the form of the electrical apparatus. Hand whisks, carpet sweepers, hand rules, saws, manual lawn mowers and hedge cutters all now belong to a previous era and we are urged and coerced by both inner

psychic and outer market forces to employ power-assisted and energy-consuming equipment and to discard all those which are driven by human muscles. In industry, power-assisted machinery and electronic computers have ousted millions of human beings who previously predominated at the factory bench. Similar changes are occurring in the sport and leisure industry where computers and mechanization have been introduced into such activities as golf, boating, speed sports, holiday travel and tourism. The essence of compulsive behaviour is the unconscious, seemingly illogical human desire to obtain as much as possible as rapidly as possible and with a minimum of human effort. The desire for instant gratification is partly assuaged by increased acceleration, greater speed and more power. It is these obsolete, unconscious human urges which power the compulsive phenomenon. It is this craving which leads to the problem of

'Few Australians or New Zealanders are ever far from the internal combustion engine or the electrical power point.'

impaired control over the offending substances which is so characteristic of dependence upon substances and other behaviours such as eating, gambling or exercise.

ALCOHOL AND ENERGY DEPENDENCE COMPARED

ALCOHOL	ENERGY
Tolerance	Ever-increasing demand for energy-consuming equipment
Withdrawal phenomena	Social disruption, commercial disorder, personal/domestic inconvenience
Relief by further drinking	Relief when energy supply returns
Compulsion and craving	Urge/desire to purchase the new and discard the old manual power
Narrowing of behavioural repertoire	Human behaviour increasingly governed by proximity/availability of supply
Salience	Increasing priority to maintain consumption despite consequences
Re-instatement of use after abstinence	Return to former consumption levels following period of scarcity



Narrowing of Behavioural Repertoire Most of modern life depends upon a constant supply of energy in order to function either at home, at work or at leisure. Our lives are to a large extent governed and directed by the location and presence of energy outlets. We plan our daily schedules around the bus, the car or the train service. Energy-consuming technologies direct how we work and our children's recreation depends on transport to and from the various venues involved. Few Australians or New Zealanders are ever far from the internal combustion engine or the electrical power point.

'Scolding from friends and relatives has its equivalent in the warnings of environmentalists.'

Salience The increasing priority given to consumption of an addictive substance despite obvious unpleasant consequences is a central feature of the energy consumption dilemma. Most of the recommendations and strategies developed to prevent environmental catastrophe give priority to maintaining rather than decreasing energy use despite the environmental consequences. Scolding from friends and relatives has its equivalent in the warnings of environmentalists, but is often countered by industry as a failure to understand the real issues.

Reinstatement of Use After Abstinence Because modern civilization is never placed in the situation of absolute energy abstinence, the comparison

with alcohol is difficult. Alcoholics do find abstinence surprisingly easy to maintain but dependence can be readily reinstated. We do know that when we have been forced to use less energy (rather than abstain), such as during the fuel crisis in the early 1980s, we are able to survive without any difficulties, yet when the crisis resolves we are fairly quickly reinstated into our earlier patterns of increased energy consumption. One reason for the current conflict in the Middle East is that oil consumption in the US had returned to its peak in the 1970s.

If energy dependence is a valid concept, then there are serious implications. If everybody emulated the average energy consumption of the North American, the sheer enormity of the side effects in terms of heat and pollution would overwhelm the world's ecosystems. Nevertheless, consumer industries still appear from their advertisements to be striving towards this goal and governments continue to cherish expansion and increasing gross national production.

If it were possible to persuade our leaders that energy use did follow addictive principles, the task of withdrawal and rehabilitation would be considerable. Should we recommend maintenance therapy like fixed doses of synthetic opiates for heroin users? Should we develop special treatment centres for the more dependent sufferers? What should be regarded as a safe daily personal level of energy consumption? This has now been worked out for alcohol using internationally agreed units called standard drinks. Chilean economist, Manfred Max-Neef (1982) defined an equivalent unit, an 'Ecoson', as the optimum drainage of resources required for a person to attain an acceptable quality of life. Perhaps some form of energy rationing system could be calculated mathematically which might then lead to the introduction of controlled energy usage. One basic principle in the management of problem drinking is to persuade drinkers to 'cut down' before damage and dependence occur. This advice contradicts the persuasive attempts of the liquor industry whose major goals of profit and expansion are at variance with the future health of the consumer. The parallel with the energy-consuming gadgetry industry is obvious.

Finally, I believe it is relevant to comment that during the past few years the prevalence of addictive behaviours in both Western and developing countries has shown a marked increase. Large sums of money are made by illicit international agencies in producing, distributing and establishing markets for cocaine, heroin and amphetamine drugs. Equally massive funding is di-



rected by governments at surveillance, interception and policing in an attempt to stem the flow of these commodities to the millions who have acquired a drug dependency problem. Meanwhile, the illicit suppliers of nicotine and alcohol products increasingly focus their attentions on developing countries by massive advertising campaigns directed at young people in an attempt to encourage them to take up dependency behaviours which when acquired will require continued substance use for life.

Many respected thinkers have pondered on the cause of this recent epidemic of dependency behaviour. Karl Jung believed that following the demise of religious and spiritual values the human species now suffers from a collective neurosis of emptiness. Victor Frankl, following a similar tack, sees the species as suffering from an 'exist-

'What should be regarded as a safe daily personal level of energy consumption?'

ential neurosis in which an absence of meaningfulness is the major pathology.' It is also sobering to recall that over 2000 years ago Buddha hypothesized that the origin of suffering is due to uncontrollable craving. The increasing use of drugs, alcohol, gambling, computer games, and perhaps energy and all its associated gadgetry is a modern response to meaninglessness and emptiness as we continue to search for our souls. If this is the case, then the

task of persuading the citizens of the world to control these excessive behaviours is an even greater challenge than it first appears.

References

- DeCoverley Veale, D. M. W. (1987) Exercise dependency. *Brit. J. Addiction* **92**, 735-740.
- Edwards, G. & Gross, M. M. (1976) Alcohol dependence provision descriptions of a clinical syndrome. *Brit. Med. J.* **1**, 1058-1061.
- Fink, H. K. (1961) Compulsive gambling *Acta Psych. Scand.* **9**, 251-261.
- Hodson, R. & Miller, P. (1982) Workaholism. In: *Self Watching — Addiction Habits, Compulsions — What To Do About Them?* Methuen Press, London.
- Lederman, S. (1956) *Alcohol and Alcoholism, Volume 1*. Presses Universitaires de France, Paris.
- Max-Neef, M. H. (1982) *From the Outside Looking In*. Dag Hammarskjöld Foundation, Stockholm.

THE IMPACT OF OIL DEPLETION ON AUSTRALIA

B.W. Robinson, B.J. Fleay and S.C. Mayo

Sustainable Transport Coalition,

Perth, Western Australia,

BruceRobinsonSTC@hotmail.com, BFleay@inet.net.au, SherryMayo@aapt.net.au

www.STCwa.org.au

I. SUMMARY

The impact of global oil depletion on Australia is likely to be very severe, unless substantial mitigation and adaptation policies are implemented urgently. Many available options will have substantial social and economic benefits as well as reducing oil dependence. However, the likelihood of significant Government action before an oil depletion crisis is currently very low.

Hirsch et al., [1], have outlined for the US DOE the requirements to start countermeasures 20 years before the peak of global oil production. This is in line with the Noah analogy presented at the first ASPO workshop [2]. It is best to finish the ark before the flood. Western Australia's Minister for Planning and Infrastructure, Hon. Alannah MacTier-nan has said *"It is also certain that the cost of preparing too early is nowhere near the cost of not being ready on time."* [3]

Australians are largely urbanised with 66% of the population living in sprawling cities along the south and east coast. The rural and remote parts of the country are very sparsely populated, and are highly dependent on oil for transport. The countermeasures suggested here for Australia could be applicable in many other countries, both those with largely urbanised populations and those with large land areas and long transport distances.

II. AUSTRALIA'S OIL PRODUCTION

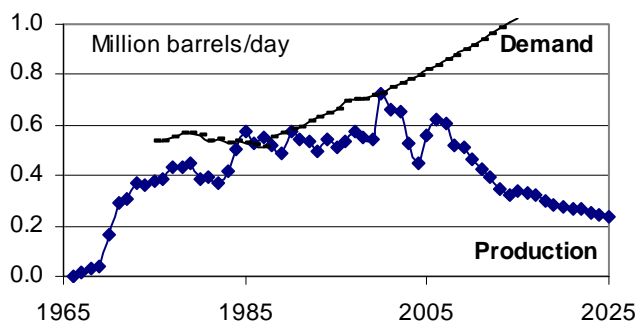


Fig.1. Australian crude oil and condensate production and demand to 2004, and forecasts [4,5,6].

Australia's domestic oil and condensate production became significant in 1967, reached a peak in

2000, and is now starting a post-peak decline phase.

III. OIL CONSUMPTION AND TRANSPORT

Australia's population is 20 million people and there are 13.2 million motor vehicles, each travelling an average of 15,300 kilometres pa. Petrol taxes are the lowest in the OECD outside North America. About 80% of Australia's petroleum liquids use is in road transport and 10% for aviation.

Australia uses about 0.74 million barrels of oil products each day, about half as much oil per capita as does the United States. Crude and condensate production in 2004 was about 0.45 M bbl/day, imports were 0.63 M bbl/day and exports 0.34 M bbl/day [5]. Australia is still about 60% net self-sufficient in oil, but our imports are currently about 85% of daily usage, and balanced by high exports. This high import dependence makes us vulnerable to short-term international supply shortages.

Two recent Government reports summarised Australia's petroleum use. The Energy White Paper, [7] is not forthright about declining future domestic oil supplies and completely avoids mention of global oil depletion. It may come to be regarded as a significant "intelligence failure". The review of the Liquid Fuel Emergency Act [8] concentrates on short to medium term supply disruptions and our responsibilities under IEA agreements.

Australia is extremely "automobile-dependent" [9]. Our cities and transport-intensive economy have been shaped by cheap oil. There are innumerable policies which heavily subsidise car use, the domestic car industry and road freight, and which penalise users of more sustainable transport modes. Subsidised freight transport centralises production at the expense of local industries. Some of these "perverse policies" are outlined by Denniss [10]. Even our supermarkets offer petrol discounts so that those without cars subsidise heavy fuel users through increased food prices.

Australia is a dry continent and its soils are generally nutrient deficient. Agriculture in Australia is dependent on increasing fertiliser inputs, mecha-

nised farming and long distance transport. It is becoming a way of using land to convert petroleum into food. Encouraged by cheap oil and fertiliser, these practices have depopulated many rural communities. Australian farmers will be faced with re-inventing their industry including returning to using natural nitrogen fixation with legumes.

IV MITIGATION AND ADAPTION OPTIONS

A: *Post-Peak Options*

A simplified diagrammatic scenario, Fig. 2, shows how the growing gulf between current demand trends and forecast supply might be accommodated. It is important to realise that there can be no single panacea, but there will be many partial solutions. Some options could be implemented quickly (for example tax changes and rationing), but many will require a very long time and much capital investment.

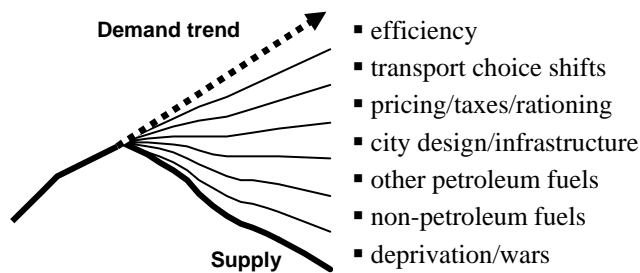


Fig.2. Post-Peak scenarios, filling the gulf between demand trend and forecast supply [11].

Some unusual strategies used successfully in Perth are included here as analogies for what could be achieved to reduce oil consumption.

B *Public discussion and debate*

Australian Governments at all levels have been reluctant even to mention the taboo topic of our oil vulnerability. The Western Australian Government leads marginally, with oil vulnerability discussed in its State Sustainability Strategy [12] and its Cabinet briefed by Dr Samsam Bakhtiari. However, even in WA there has been little done to discuss publicly the risks of oil depletion. USGS geologist Les Magoon [13] suggests correctly that the first thing to do is to "Talk about it, talk about it. You can't solve a problem until you know you have one."

A substantial Government communication programme is needed to make the community aware of approaching oil depletion and its impacts before action can be implemented to reduce our oil vulnerability. Participatory democracy strategies like public forums will be essential to engage the community. These can empower people and businesses to work for the greater common good and find equitable ways to make the difficult changes needed. Such forums are being used in Western Australia to solve complex issues in transport and planning [14].

Once the community is aware of the risks of oil vulnerability, governments must lead with policies and countermeasures to minimise future impacts, providing the framework for crucial individual, community and corporate initiatives. Then stakeholders can actively consider possible oil shortages when buying a house or a car, expanding a business or restructuring neighbourhoods.

C: *Rational Pricing Structure: The Water Analogy*

Water has long been recognised as scarce in many parts of Australia. Perth, like other cities, has a rational pricing structure for household water use.

A basic household water allowance is relatively cheap, and increasing consumption above that is on a sliding scale where the higher the water use, the more the cost per kilolitre. Watering gardens with sprinklers is also restricted to two days per week in the morning or evening. These sensible water conservation measures are now well accepted by the community.

Similarly, when the community fully understands the risks of oil depletion and its possible impacts, an analogous incremental fuel pricing system and usage restrictions would also be accepted, as was wartime fuel rationing.

D: *Individualised Marketing Demand Management*

A significant proportion of Perth has seen successful cheap travel demand management (TDM) implemented, reducing car-kilometres by 13% on average. These Individualised Marketing programs, (TravelSmart) are being used in other Australian cities and around the world [15], with benefit-cost ratios of 30:1.

Empowering individuals to change oil-intensive travel habits is a "No-Regrets" option, already justi-

fied on health, social and economic grounds. Globally, TDM could save 5-10% of transport oil consumption.

E: Government Policy and Action Possibilities

A list of some possible actions is provided to show the wide range of options available to ameliorate the impacts of oil depletion often while enhancing community wellbeing.

Governments should :-

1: Issue repeated credible warnings that oil shortages are approaching us. Advise the community openly of the various estimates of the timing and the impacts of peak oil.

2. Engage the community, through participatory democracy, to create practical, equitable options and countermeasures, and to select preferred steps. Many perceived "options" like the "hydrogen economy" are most unlikely to be realistic until long after oil shortages impact and should be identified as such.

3. Dismantle the many "perverse policies" [10] that subsidise heavy car use and excessive freight transport. Examine all subsidies taxes and charges to weed out those that encourage car-dependency.

4. Instigate policies, taxes and pricing regimes that encourage frugal use of fuel, and disadvantage profligate users. A fuel tax escalator such as that introduced by the UK Thatcher Government in 1988 is a proven example. Australian fuel taxes should be incrementally raised to European levels to reduce usage, and to provide funds for improvements to health and education and for the needed sustainable transport infrastructure.

5: One novel policy would be to set up a Smart-Card personal fuel allocation system. This would provide a modern adaptable mechanism for handling short-term oil shocks, similar to those of 1973 and 1979 and as well for encouraging people to reduce their fuel usage. Each person would receive an allocation of an amount of fuel sufficient for modest car travel at a base price. Increasing amounts of fuel would be available at an increasing tax-rate per litre. In addition, those who are able to avoid using their entire allocation would be encouraged to trade the unused rights on an open electronic market.

6. Recognise the psychological and social dimensions of automobile dependence as well as the physical aspects, and implement the cheaper people-oriented solutions as well as technologically based alternatives. Focus on the social benefits of reduced

transport use.

7. Implement nationwide "individualised marketing" travel demand management campaigns.

8. Divert infrastructure funding to less oil-dependent urban structure and transport options. Rail, cyclepaths and public transport will be far better investments than more urban roads.

9. Priority access to remaining oil and gas supplies must be provided for food production and distribution and other essential services. Remote indigenous communities will have special needs. Practical, flexible priority fuel allocation mechanisms can utilise the electronic Smart-Card system.

10. Promote through the United Nations a Kyoto-like protocol to allocate equitably the declining global oil production among nations. An international tradable sliding scale allocation mechanism is one hypothetical option. Every nation would be entitled to a base amount of oil, on a per-capita basis at a modest cost. Increasing amounts per capita would be available at increasingly higher costs to encourage conservation. Nations which use less than their base allowance can trade the excess to their more profligate or wealthy neighbours. This provides a significant incentive for demand reduction and conservation everywhere. This is an international equivalent of the system suggested above. Global oil allocation procedures are now based solely on price, so rich nations get the bulk of the oil and the poor countries get very little. Another undesirable but quite possible future allocation mechanism is the real threat of resource wars over the remaining oil.

F: Conclusion

Many of the policy options to reduce fuel usage and the impact of oil depletion on Australia will also lead to healthier, happier and more equitable communities and improve local and global pollution levels. Failure to take action now will lead to severe future economic and social impacts on Australia.

REFERENCES

A full list of references and links is available at www.STCwa.org.au/aspo

- [1] Hirsch, R. L et al., 2004. "Peaking of World Oil Production: Impacts, Mitigation and Risk Management", report for US Department of Energy.
www.hilltoplancers.org/stories/hirsch0502.pdf

- [2] Samsam Bakhtiari A.M, 2002. "A Middle East View of the Global Oil Situation"
www.peakoil.net/IWOOD2002/iwood2002proceeding.html
- [3] MacTiernan, A, 2004. Is there an oil crisis?. Ministerial speech opening the STC "Oil: Living with Less" conference, Perth, 9th August 2004.
www.ministers.wa.gov.au/mactiernan/docs/speeches/OIL.pdf
- [4] Geoscience Australia. "Oil and Gas Resources of Australia", published annually with a lag of 18 months.
www.ga.gov.au/oceans/projects/ogra.jsp
- [5] ABARE. "Australian Mineral Statistics", published quarterly, Australian Bureau of Agricultural and Resource Economics www.abare.gov.au/
<http://abareonlineshop.com/product.asp?prodid=12988>
- [6] APPEA, Australian Petroleum Production and Exploration Association www.APPEA.com.au
- [7] Australian Government Energy White Paper, 2004. "Securing Australia's Energy Future",
www.dpmc.gov.au/initiatives/energy.cfm
www.dpmc.gov.au/publications/energy_future/index.htm
- [8] Liquid Fuel Emergency Act Review, 2004. "Discussion paper", www.aciltasman.com.au/clients/LFE
- [9] Newman, P. and Kenworthy, J., 1999. "Sustainability and Cities: Overcoming Automobile Dependence", Island Press
- [10] Denniss, R, 2003. Implementing policies to increase the sustainability of transport in Australia.
www.STCwa.org/beyondoil
- [11] Robinson, B. and Powrie, S, 2004. "Oil depletion: the crucial factor in transport planning"
www.STCwa.org.au/beyondoil
- [12] WA Government, State Sustainability Strategy, 2003
www.sustainability.dpc.wa.gov.au
- [13] Magoon, L B, 2000 "Are we running out of oil?" US Geological Survey summary poster
<http://geopubs.wr.usgs.gov/open-file/of00-320/>
- [14] MacTiernan, A, 2005.
<http://www.ministers.wa.gov.au/mactiernan/index.cfm?fuseaction=consult.main>
- [15] Robinson, B, 2004. "Individualised Marketing - Travel behaviour change equivalent to discovering another Iraq?" Poster, ASPO Berlin.
www.STCwa.org.au/negabarrels and
www.socialdata.de/info/publ_e.php
- [16] Fleay, B J, 1995. "Decline of the Age of Oil: Petrol politics, Australia's road ahead" Pluto Press, Australia Ltd, Annandale, NSW
- [17] Fleay, B J, 1998. Climaxing Oil: How will Transport Adapt? Proc. Chartered Institute of Transport in Australia National Symposium, Launceston Tasmania 6-7 November 1998
<http://www.wistp.murdoch.edu.au/publications/projects/oilfleay/climaxingoil.html>

Appendix 4: "Oil depletion: the crucial factor in transport planning", Robinson, B.W and Powrie, S. (2004) , Australasian Transport Research Forum, Adelaide, October 2004.



27th Australasian Transport Research Forum, Adelaide, 29 September – 1 October 2004

Paper title: Oil depletion: the crucial factor in transport planning

Author(s) name(s): Bruce Robinson and Sam Powrie

Organisation(s): Sustainable Transport Coalition
Bicycle Institute of South Australia

Contact details:

Postal address: 2 Barsden St, Cottesloe WA 6011

Telephone: 08-9834-7409

email: BruceRobinsonSTC@Hotmail.com

Abstract (200 words):

As a result of steeply declining domestic oil production and forecasts of dwindling world supplies, Australia is very vulnerable to temporary and permanent oil shocks in the short, medium and long term. Transport planning priorities (both large scale planning and road design) must be changed dramatically to minimise the impacts of the coming oil shortages. The current reluctance of decision-makers even to consider oil depletion will rank high on the list of missed opportunities and 'intelligence failures'. There is a great deal that can be done to prepare for the likelihood of future oil shocks and hence to ameliorate the effects when (or if) they hit us. Current transport infrastructure projects, with only a few exceptions, are planned without any consideration for the effects on our oil dependence. A much more precautionary approach should be adopted now to reduce our vulnerability when oil supplies become limited, as appears to be almost certain within the service lifetime of most transport infrastructure projects. Many of the policy options to reduce fuel usage will in addition lead to healthier, happier and more equitable communities and improve local and global pollution levels. They will also require substantial changes in the way that transport is viewed by planners, engineers, politicians and the general public.

Introduction

Perhaps the most compelling (but still largely unrecognised) evidence of the lack of even short-term transport sustainability in Australia is our very serious dependence on rapidly declining petroleum sources. Petroleum is currently essential for agriculture and most facets of Australia's community life and economic systems as well as for transport. Most transport decision-makers have assumed, wrongly, that medium and short-term supplies are assured. There is rapidly mounting evidence from the oil industry itself that this complacency about future oil supplies may well be very misplaced, for example Akehurst (2002).

Almost 80% of Australia's petroleum use is in transport. 55% of road transport fuel is petrol, 39% diesel and 6% is LPG, and Australia uses about 45,000 megalitres of petroleum each year.

Compared to other regions, Australia has a good level of understanding of practical demand management strategies (especially from successful and long-standing water conservation measures). This knowledge coupled with our existing still unallocated reserves of natural gas provides an encouraging opportunity for us both to forecast and to weather the coming oil shortage storms better than many other regions. It is particularly important that the issues are tackled seriously and urgently by decision-makers.

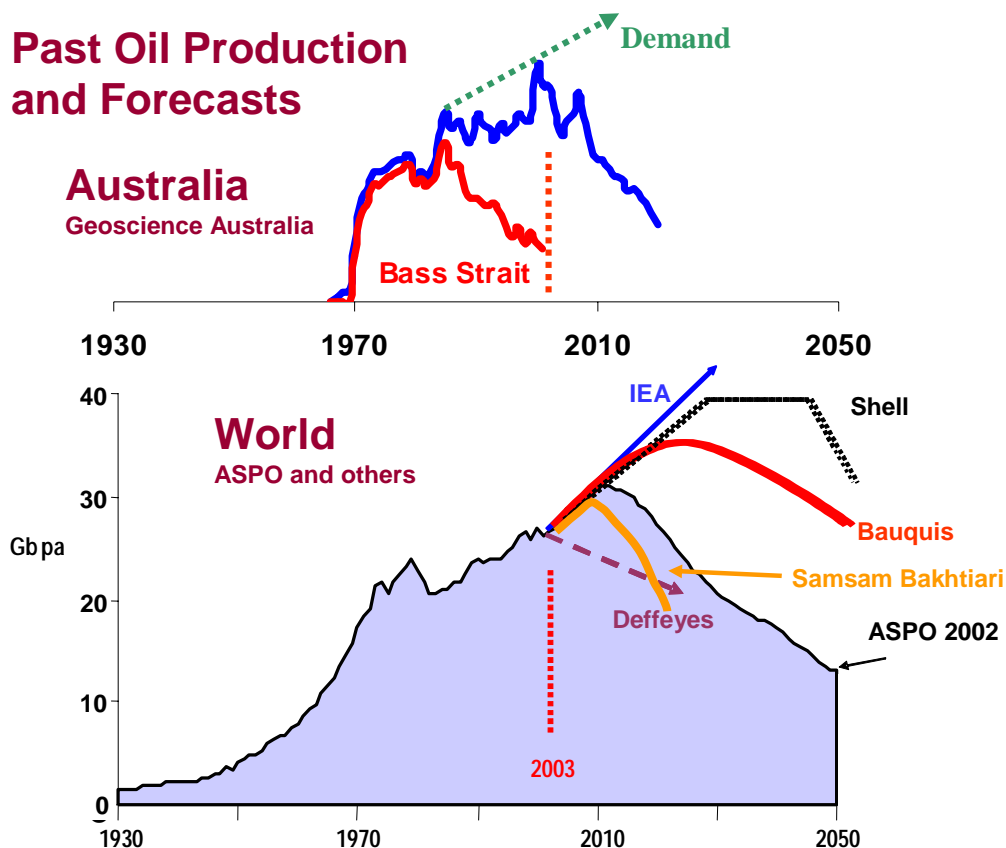


Figure 1: Australia's vulnerability to oil depletion is shown in these diagrams of past Australian and world oil production and future decline predictions. (Australian data and forecasts from APPEA (2004). Global predictions after Bauquis (2004). IEA is the International Energy Agency; ASPO is the Association for the Study of Peak Oil & Gas. A majority of estimates of the peak of world oil production cluster between the present and 2020 (Andrews and Udall (2003))

Australian oil production decline

Australia has been shielded from past oil shocks by our domestic oil production from Bass Strait. Hence, as a nation we have not learnt as much about oil conservation and transport planning as European countries, especially the Netherlands which radically changed its transport planning policy to reduce its oil dependence after the 1973 oil crisis.

However, Bass Strait production has been declining since 1985 and until now other fields have filled the production gap. Reliable recent predictions by Geoscience Australia and Woodside indicate that Australia's oil and condensate production will fall substantially in the next decade (Akehurst (2002), APPEA (2004)).

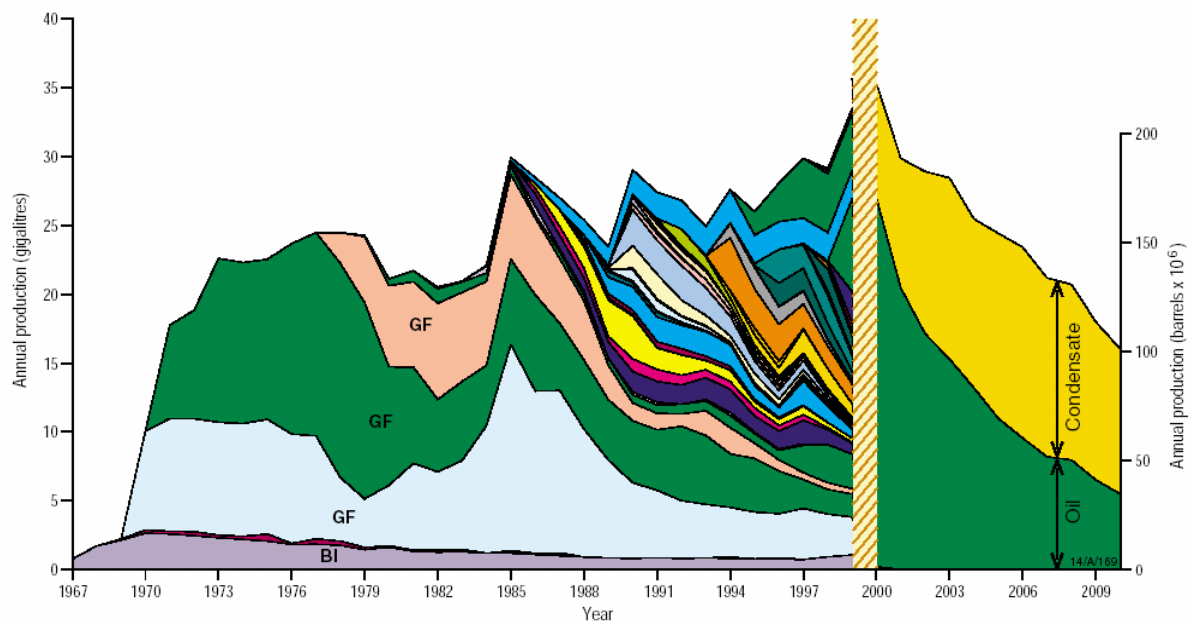


Figure 2. Oil and condensate production profiles of individual Australian fields, and the forecast cumulative production at 50% probability derived from industry data, Powell (2001), Akehurst (2002). BI denotes Barrow Island; GF denotes giant Gippsland Basin Fields.

The dominance of a few large fields, shown in Figure 2, is typical of oil regions. The giant fields are normally found first. An increasing discovery rate of usually progressively smaller fields is needed to keep production relatively constant as the giant fields decline. Then inability to keep finding adequate volumes in ever-smaller fields leads to an overall decline. Australia is now using three times as much oil as is being discovered, and this will lead to the forecast production decline as shown in the graph (Akehurst (2002)).

Australia's rapid domestic oil production decline is taking place not long before it is predicted that the overall world oil production will also commence to decline. As a result, Australia is becoming increasingly vulnerable to serious oil shortages, in the short term (within a year), in the medium term (within 5 years) and in the long term (within one or at most two decades). Self-sufficiency is expected to decline from an average of 80-90% over the past decade to about 20% by 2020 (APPEA (2004)).

World oil production decline predictions

A world-renown US Geological Survey petroleum geologist, Les Magoon, visited Australia in November 2001 as the Distinguished Visiting Lecturer of the Petroleum Exploration Society of

4 Oil depletion: the crucial factor in transport planning

Australia. He gave talks around Australia entitled "Are We Running Out of Oil". As reported (Australian Energy News (2001), Magoon (2001)), he describes the "Big Rollover" as the change from the current world oil buyers'-market to a world sellers'-market when global production starts to decline. Various forecasts have put the "Big Rollover" date at sometime around 2003, 2007, 2010 or by 2020 (Andrews and Udall (2003)). *"At BP, our best estimate of when global oil shortages will begin to bite deeply is between 20 and 40 years"*, Greg Bourne, Regional President of BP Australasia, told the 5th Energy in WA conference in Perth in March 2003.

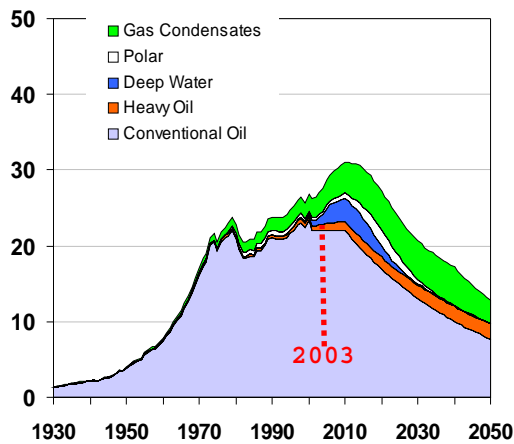


Figure 3a: Current forecast of future world oil production, including non-conventional oil. (ASPO (2002)). Scale is in gigabarrels of oil-equivalent per year. The peak of the curve is the "Big Rollover"

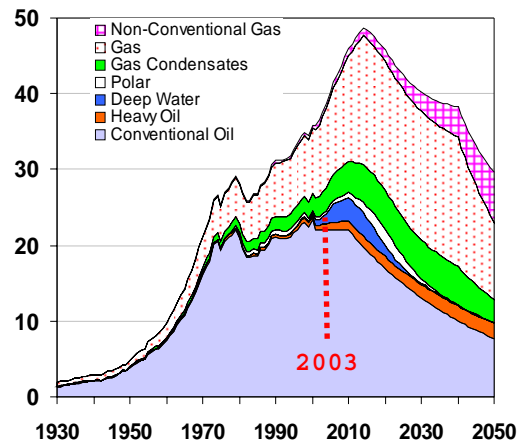


Figure 3b: Current forecast of future world oil and gas production, (ASPO (2002)). The inclusion of gas does not change the shape of the global hydrocarbon depletion curve substantially.

Prof. Pierre-René Bauquis of the French Institute of Petroleum told a combined meeting of the Society of Petroleum Engineers and the Petroleum Exploration Society of Australia in Perth that he expected global oil production to start its terminal decline in about 16 years (Bauquis (2004)). He does not see any significant renewable energy substitutes for petroleum over the next 20-50 years. He was also dismissive of hydrogen as a transport energy carrier and foresaw the use of nuclear energy to help manufacture synthetic hydrocarbon fuels

As can be seen in Figure 1, there are some considerably more optimistic forecasts of future oil supplies. The most optimistic ones are driven by economic and political perspectives, rather than by geology and engineering constraints, for example see Lynch (2002). There are very considerable grounds on which to doubt the forecasts published by the International Energy Agency. The IEA takes without question the oil reserve data provided by all the national governments. Many of these estimates are clearly misleading as they either increase dramatically without any matching exploration success, or they remain constant for years in spite of substantial production which must reduce the actual oil reserves. Conflicting definitions and national and political priorities make the IEA figures as dubious, for example, as similar audited and glowing accounts of the financial strength of HIH and Enron just before their catastrophic corporate crashes.

Shell has recently revised its "proven reserves" downward by 23%, showing that oil-company reserve claims are subject to uncertainties and mistakes. The scope for analogous errors and misrepresentation at the national level is very substantial. Mexico has twice halved its claimed reserves since the mid 1990s. Recent presentations by Matthew Simmons (Simmons (2004), (2004a)) cast considerable doubt on the reliability of the claimed Saudi oil reserve figures.

Similar doubts about OPEC's overall reserves are also raised by Salameh (2004). In the case of Saudi Arabia, any substantial errors in reported reserve estimates are of very serious global significance. There is of course the complementary but lower probability that some reserves may have been understated, but most concern has been expressed about over-optimism.

International Workshops on Oil Depletion

Annual International Workshops on Oil Depletion are held in Europe by the Association for the Study of Peak Oil and Gas, ASPO. The most recent, and by far the largest and most prominent, was hosted in Berlin by the German Geological Survey, BGR in May 2004. Unfortunately, there has been no attendance at all from anyone from Australia professionally involved in transport, government or the oil industry. However, the Sustainable Transport Coalition has been represented at all three held so far. Papers and presentations are available at www.PeakOil.net. Oil depletion experts from the US, Europe, Russia and the Middle East gather to discuss the growing body of evidence that world oil production will reach a peak then decline relatively sharply within a decade or at most two. At the first workshop APSO also released the first edition of its "Statistical Review of World Oil and Gas", a nation-by-nation evaluation of reserves and production rates, based on the most reliable technical data available. The ASPO data differ substantially from those published in oil trade journals and by the IEA which have very serious commercial and political biases and inconsistencies. Evaluation of non-conventional oil is now included in the current predictions shown in Figure 3a. Non-conventional oil includes heavy oil (which needs to be heated to flow adequately), oil from deep water (>500 metres) and from polar regions and condensates from natural gas. These sources will in part offset the rate of decline of conventional oil after the "Big Rollover"

Presenters at the International Oil Depletion Workshops included Matthew Simmons, a prominent energy-sector investment banker from Houston who advises President Bush.

Simmons said, *"I have studied the depletion issue intensely for too long now to have any remaining doubts as to the severity of the issue. But I am still amazed at the limited knowledge that exists, even in the U.S. or within our major oil and gas company's senior management about this topic and its dire consequences"*, (Simmons (2002))

"Most serious scientists worry that the world oil supplies will peak [and then decline]. Peaking of oil can not be predicted accurately, but the event will occur. Peaking turns out to only be clear through a 'rear-view mirror'. By then, an alternative or solution is too late. My analysis leads me to worry that peaking is at hand, not years away. If I am right, the unforeseen consequences are devastating. The facts are too serious to ignore." (Simmons (2003))

Dr Samsam Bakhtiari, of the National Iranian Oil Company, provided a pessimistic view of future oil supply decline and of its effects: -

"Seen from a Middle Eastern perspective, the present global oil situation can be summarised within five major and inescapable trends:

- *The world's super giant and giant oil fields are dying off;*
- *There are no more major frontier regions left to explore besides the earth's poles;*
- *Production of non-conventional crude oil has been initiated at great costs --- in Venezuela's Orinoco belt, Canada's Athabasca tar sands and ultra-deep waters;*
- *Even OPEC's oil production has its limits;*
- *No major primary energy rival can possibly take over from oil and gas in the medium term.*

Adding up these five trends, one can envision a global oil crunch at the horizon --- most probably within the present decade....."

6 Oil depletion: the crucial factor in transport planning

"...It would take a number of miracles to thwart such a rational scenario. Now, a single miracle is always a possibility, but a series of simultaneous miracles is not --- for there are limits even to God Almighty's mercifulness". (Samsam Bakhtiari, 2002)

Samsam Bakhtiari has also since published simulations of the World Oil Production Capacity (Wocap) model which suggest that global oil production will peak at a point near 81 million barrels per day well before the end of the decade, likely by 2006-07 (Samsam Bakhtiari (2004)). Dr Samsam Bakhtiari visited Australia recently, presenting seminars in four cities. He also briefed the WA Cabinet about oil depletion risks on August 9th 2004.

A paper in December 2002 by Exxon Mobil Vice President, Harry J. Longwell (Longwell (2002)) contains the world oil discovery decline curve (Figure 4) which agrees well with those published in Aleklett and Campbell (2002). Declining past oil and gas discovery success rates foreshadow future production decline rates, and acknowledgment of this by a major oil company is very significant. There is an often-overlooked truism that oil production can only follow oil discoveries. Longwell also showed a peak of global gas discovery in about 1970 with a sharp decline in natural gas discovery rates since then.

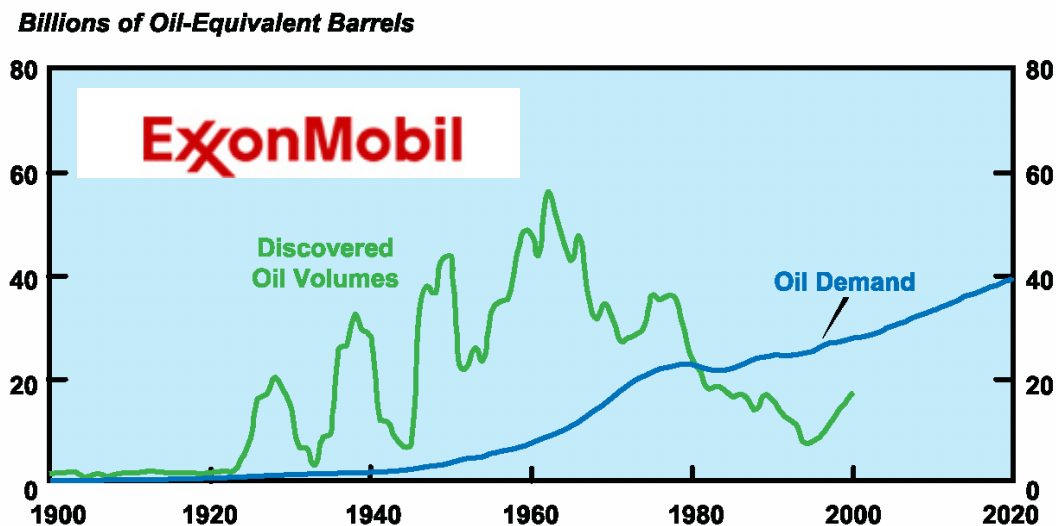


Figure 4: World oil discovery rates have been declining since the early 1960s as now acknowledged by Exxon Mobil. (Longwell, (2002))

More recently, there has been an increasing level of coverage of oil depletion issues in the scientific and general media. Some examples follow.

New Scientist ran a cover story (2nd August 2003). "Crisis looms – When demand for oil outstrips supply"

"... we could be in for a big shock: we are going to run out of cheap oil. That's not oil per se, but we're approaching the point when global demand for oil will outstrip supply. It is not clear when we will reach this tipping point. The economists say we have about 35 years before oil production peaks, while geologists think we have only a decade. At present the geologists' argument is in the ascendant, having won the backing of some investment banks and oil consultants."

Oil & Gas Journal editorial (18th August 2003)

"...can a peak in production be anything other than imminent? That question breeds others. How rapidly will production decline after the peak?"

The Guardian (2nd December 2003) "Bottom of the barrel – The world is running out of oil - so why do politicians refuse to talk about it?"

"Every generation has its taboo, and ours is this: that the resource upon which our lives have been built is running out. We don't talk about it because we cannot imagine it. This is a civilisation in denial."

Richard Miller, BP Exploration UK, wrote in a letter to the Oil & Gas Journal (12th January 2004) sharply refuting a statement from an extreme economic optimist (Maugeri, O&GJ, Dec 15th 2003) who had claimed *".. just as the Stone Age did not end because of the scarcity of stones, the Oil Age will not end because of the scarcity of oil. Rather oil will inevitably be surpassed in convenience by a new source of energy in the future"*.

Miller stated *"This is the classical economist's view: something will turn up, when the price of oil is high enough, because something always does. But there isn't anything conceivable that could replace conventional oil, in the same quantities or energy densities, at any meaningful price. We can't mine the oil sands in sufficient quantity because there isn't enough water to process them. We can't grow bio-fuels because there would be no land left to grow food. Solar, hydro, wind, and geothermal don't yield enough energy, hydrogen (from water) takes more energy to make than it can yield, and nuclear fission and fusion are presently off most political agenda. The oil consumed directly and indirectly by the average American is equivalent to the work output of 135 slaves, unfed, unclothed, unhoused, and paid \$2 a day between them. When oil gets too expensive, surviving Americans will still obtain energy from alternative sources, but in much smaller amounts and at much higher prices. Westerners will have to live with only a handful of slaves."*

Christian Science Monitor, 29th January 2004 "Has Global Oil Production Peaked?",".

The question now making the rounds in energy circles: Has production already peaked?

West Australian, March 10th 2004 "End looms for the days of cheap oil"

"Oil companies are now raising their doubts. They voice it softly, but clearly they are starting to feel if they don't raise any doubts, the public will be hostile to them".

This well-researched long article was taken from an international newswire service. The fact that the West Australian was probably the only newspaper in Australia which ran the story may illustrate the reality of the community taboo against discussing oil depletion.

As production outside the Persian Gulf declines, the balance of oil power will shift more and more towards OPEC and the Middle East. Substantial short-term disruptions, for instance from a revolution in Saudi Arabia (Bauquis (2004)) and large market-force pressures in the medium-term are quite possible. The permanent decline phase will start once the Middle East production starts falling as forecast, possibly in about 2010 or so. Physical constraints in addition to market forces and geopolitical factors will then limit oil availability. Rising world demand, for instance from China and India, will add enormous pressures to the oil market. The past oil shocks have been predicted to be mere ripples compared to the changes which will probably occur in the next decade or two.

These reliable forecasts of declining domestic production and uncertain world supplies indicate that Australia is very vulnerable to "Oil Shocks" in the short term (2 months), medium term (2 years) and long term (within 1-2 decades).

The declines in Australian and world oil availability are likely to be much faster than any alternatives can be brought on stream in significant volume and much faster than the necessary structural and efficiency improvements can be made, unless extraordinary measures are taken very soon.

Preparation for probable oil shocks

There is a great deal that can be done to prepare for the likelihood of future oil shocks and hence to ameliorate the effects when (or if) they hit us. Many possible precautions will be "no-regrets" options already justified on equity, environment, health, social or economic grounds. Australia's existing reserves of uncommitted natural gas coupled with local understanding of demand management (especially in water use efficiency and TravelSmart individualised marketing) provide an encouraging opportunity for the nation to both forecast and to weather the coming storms better than many other regions. It is particularly important that the issues be tackled seriously and urgently at all levels in the community. WA Planning and Infrastructure Minister, Alannah MacTiernan (2004) said, in opening the "Oil: Living with Less" conference *"It is also certain that the cost of preparing too early is nowhere near the cost of not being ready on time."*

Communication about potential solutions and their limitations

It will be crucially important that there be open and informed discussion about oil depletion. Broad consideration of the various strategies for reducing our oil vulnerability; especially their limitations and the input energy needed, the time required and the costs needed to implement them are essential precursors to effective decision-making.

Contrary to many common predictions, it is highly unlikely there will ever be a single "Magic Bullet" panacea for our oil vulnerability. A major aim should be to reduce our very high levels of automobile dependency. Some of the possible oil-use reduction and replacement strategies are outlined in Figure 5.

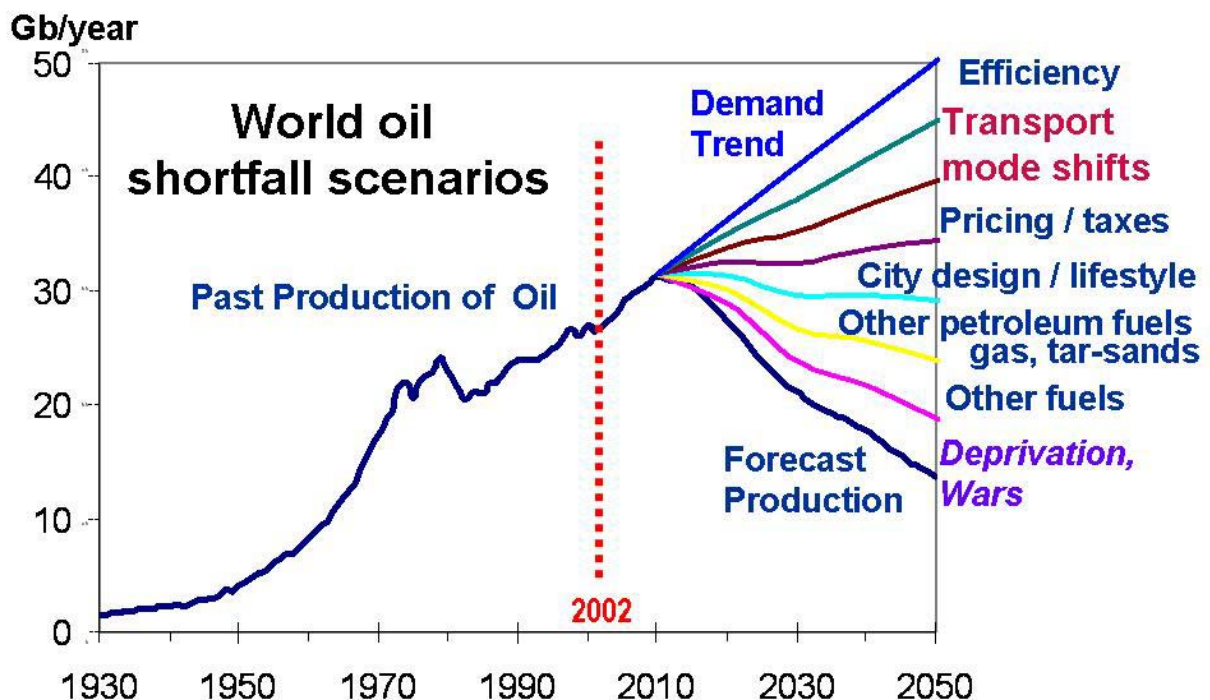


Figure 5. An adaptation of the scenario outlined by Swenson (1998) of the various mechanisms of bridging the coming gulf between growing current world demand for oil and the forecast decline in the production of conventional oil (Robinson (2002)).

Travel mode shifts: Individualised Marketing

Very substantial changes have already been triggered in existing urban travel patterns when people are given personalised information about the travel choices available to them.

Empowering people in this way has resulted in sustained decreases of 8% to 19% in car-kms travelled. The oil saved by these voluntary travel pattern changes is very significant, and shows that reducing car-travel demand is more cost-effective than exploring for more oil.

Australia leads the world in the application of Individualised Marketing to make very significant reductions in car travel rates. Programmes have been completed or are underway in several states. WA has the most extensive record with a number of very successful and well documented programmes. The average reduction in car-kms travelled in the completed WA projects is 13% at a benefit:cost ratio of 30:1, far higher than those of most transport projects. Similar results have been obtained in Europe and the US, (Robinson (2004), Socialdata (2004)).

The TravelSmart Individualised Marketing programmes in WA have covered suburbs with some 158,000 people to date, and have resulted in the annual saving of some 115 million car-kms, or 11 million litres of petrol (John (2004), MacTiernan (2004)). Extrapolated to Australia's urban population, this would equate to about a thousand megalitres of oil saved each year. Globally, this level of travel reduction and mode shift would save each year oil amounting roughly to the annual production of Iraq, as an example.

Alternative Fuels

All alternative fuels to replace petrol and diesel have severe constraints to their introduction. Enormous volumes are required to replace a sizeable proportion of our current liquid fuel usage, and the timescale for their provision in these volumes is very short. For instance, diverting Australia's entire wheat crop to produce ethanol would replace less than 10% of our oil usage. Hydrogen is an energy carrier, not an energy source. It requires large amounts of energy for its manufacture and for its distribution. For the foreseeable future, the vast bulk of the world's hydrogen will continue to be made from oil and gas. The 'Hydrogen Economy' may well turn out to be just a pipe-dream like fusion power. Concentration on hydrogen diverts attention and resources from practical and immediate fuel conservation options. The most likely alternative for our current cheap plentiful oil will also be oil, but much more expensive and less plentiful oil.

Technological changes

It will be very risky indeed to rely on unproven technologies becoming available on such enormous scales within a decade or so, which is the timeframe likely to be required if the Big Rollover forecasts are accurate. There are around 14 million motor vehicles in Australia, and at only \$25,000 each, a fleet replacement exercise to change them to other technologies or other fuels would need the outlay of \$350,000 million, which would be diverted from other community and Government needs. Currently half the registered motor vehicles are more than ten years old, and 20% more than 20 years old. Normal fleet changeover rates are actually very slow. Half of today's new cars will still be on the roads in 20 years (BTRE (2002))

For instance, it has taken Australia almost two decades since 1985 to switch from leaded to unleaded petrol (Figure 6), a very much simpler technological change indeed than a conversion to fuel-cell cars, for instance. This change was mandatory for all new cars purchased from 1st January 1986.

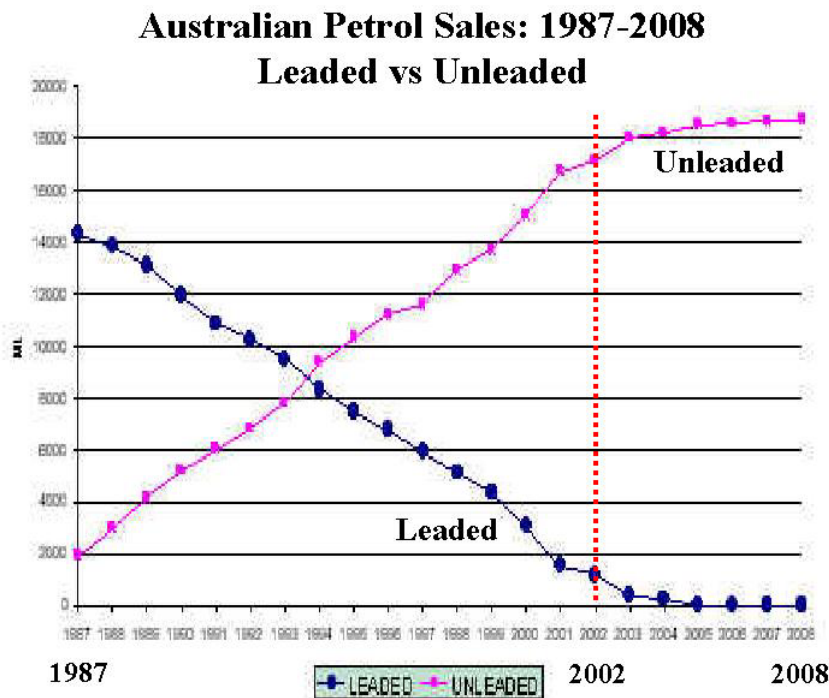


Figure 6. Example of the inevitably slow rate of introduction of new technology into Australia's vehicle fleet. Unleaded and leaded (or LRP) petrol sales, Australia, from 1987 and extrapolated to 2008, (Australian Institute of Petroleum at www.aip.com.au), following mandatory introduction of emission-control engines in new cars in 1986. The introduction of hybrid vehicles and fuel cells is likely to be much slower as the technological differences are much greater.

Suggested Oil Dependence Reduction Measures

Australia is very wasteful of energy in general, and of petroleum fuels in particular, and there are a great many measures which can reduce this wastage while either improving or not diminishing our quality of life. Changes to the built environment can substantially improve transport energy efficiency if our automobile-dependent perspective is cast aside. Sadly, all too many planners and transport decision-makers give an impression of having a windscreen-shaped view of the world. There is great scope for simple and cost-effective steps to make our cities and towns far less automobile dependent and much friendlier and more efficient for walking and bicycle transport.

In its submission to the COAG Energy Markets review, BP recommended :-

*"Achieve a step change in energy efficiency –
BP knows from its own experience that significant cost savings are available through greater energy efficiency. Better energy efficiency is the “low hanging fruit” of the energy challenge.” (BP (2002))*

There is a wide range of oil consumption reduction measures outlined by Denniss (2003), in Robinson (2002) and (2003) and by the Sustainable Transport Coalition (2004). A crucial first step would to review and remove the inequitable perverse subsidies which fund and encourage excessive private motor vehicle use in our cities and towns.

"Perverse policies, that is policies which actually reduce the sustainability and efficiency of the transport sector, continue to be implemented, and continue to receive the support of various levels of government in Australia". (Denniss (2003))

These include 10% Federal tariff subsidies to fuel-inefficient urban 4WD vehicles; FBT regimes which reward heavy car use and penalise modest usage; and the GST which increased

the price of public transport while leaving that of petrol unchanged. There are massive Federal funds to build freeways, but no specific allocation at all to build cycleways. State Governments have high fixed "vehicle ownership" charges rather than "vehicle use" charges (especially for third party injury insurance). These mean that those frugal with car use are forced to subsidise the profligate users. Local Government ratepayers are forced to pay more for planning and engineering staff who live long distances away (because of high company car package costs) than they do for local staff who are of more value to residents because of their better local knowledge. The provision of salary-packaged vehicles mean that most decision-makers do not pay directly for their petrol and hence tend to have an automobile-dominated outlook. Even supermarket chains like Coles and Woolworths now force shoppers who use cars only rarely to subsidise the gas-guzzlers due to the inequitable petrol discount schemes, funded by increased supermarket food prices.

Like BP, the authors recommend starting with the low-hanging fruit, of simple good engineering and urban planning to end the addiction to continual expansion of facilities for motor vehicles. For example, the overall disjointed and low standard facilities for pedestrians and bicycle transport users are an indictment of past and current planning and engineering practices throughout Australia.

Transport researchers must look now towards evaluating the oil shortage scenarios outlined, so there is much more information on which to base the crucial decisions which must be made soon. The current National Oil Supply Emergency Committee rationing plans are just one minor example. These need a rigorous review and a much broader community input to make them far more equitable and suitable for long-lasting shortages. Making decisions by default, using the current business-as-usual forecasts will prove extremely costly to nations, communities and individuals.

There is enormous scope for economic gains and for the avoidance of serious losses if the community, the professions and governments can turn away from car-dominated thinking. Transport planners who take notice of the oil storms now appearing on the radar screens will be far better equipped to help the community survive the large changes that are very likely to sweep through Australia in the near future.

Acknowledgment

The authors would like to express special appreciation to Brian Fleay for his pioneering interest in oil depletion (eg Fleay (1995) (1998)). This paper is derived in part from the background paper prepared for the WA State Sustainability Strategy (Robinson, (2002)). The efforts and encouragement of Prof Peter Newman in this area amongst others should be recognised. Inspiration and assistance from members of the Sustainable Transport Coalition is also gratefully acknowledged.

References

- Akehurst, J (2002) *World Oil Markets and the Challenges for Australia* Woodside Energy's Managing Director's presentation to ABARE Outlook 2002. Canberra 6-March-2002, www.woodside.com.au/NR/Woodside/investorpack/SG3682_3_ABARE.pdf
- Aleklett, K and Campbell, C (2002) *Proceedings of the First International Workshop on Oil Depletion*, Uppsala, Sweden, 23-25 May. www.peakoil.net/IWOOD2002/iwood2002procceding.html
- Andrews, S and Udall, R (2003) *Oil Prophets: Looking at World Oil Studies Over Time* Proc. 2nd International Workshop on Oil Depletion, Paris, France, May 26-27, Ed. K. Aleklett, C. Campbell and J. Meyer, www.peakoil.net/iwood2003

APPEA (2002) *A Crude Oil Development Strategy for Australia* Australian Petroleum Production and Exploration Association

APPEA (2004) *Potential Crude Oil and Condensate Supply and Demand* Australian Petroleum Production and Exploration Association

ASPO (2002) *Statistical Review of World Oil and Gas*, Association for the Study of Peak Oil, first edition, Proc. 1st Intl Workshop on Oil Depletion, Uppsala, Sweden, Eds. Aleklett, K. and Campbell, C. www.peakoil.net/TWOOD2002/ASPO/ASPO-Stat-Rev.html

ASPO (2004) *The general depletion picture. Oil and gas liquids, 2004 scenario* Newsletter 44, July 2004, Association for the Study of Peak Oil & Gas. www.PeakOil.net

Australian Energy News (2001) *Oil Production Curve cause for concern*. Dec 2001, p30, 31 & 49. Review of Les Magoon's "Are we running out of oil?", invited presentation to the Petroleum Exploration Society of Australia, Canberra, 4th November 2001 AEN is published by the Australian Department of Industry Tourism and Resources. Copy at www.energiekrise.de/e/index.html

Bauquis, P-R (2003) *Reappraisal of energy supply-demand in 2050 shows big role for fossil fuels, nuclear but not for nonnuclear renewable*. Oil & Gas Journal, Feb 17th 2003

Bauquis, P-R (2004) *The Medium (2020) and Long Term Future (2050) of Oil, Natural Gas and Other Energies* Soc. Petroleum Engineers Distinguished Lecturer tour, Feb 2004

BP (2002). *Changing course: A sustainable energy future for Australia*, submission to the Council of Australian Governments (COAG) Energy Market Review. www.bp.com.au/news_information/issues/COAGsubmission.pdf

BTRE (2002) *Fuel Consumption by New Passenger Vehicles in Australia*, Information Sheet 18 www.dotars.gov.au/btre/docs/is18/is18.htm

Campbell, C J and Laherrère, J H (1998) *The End of Cheap Oil*, Scientific American, March 1998. Copy at www.hubbertpeak.com/sciam983.htm

Denniss, R (2003) *Implementing policies to increase the sustainability of transport in Australia*. Proc. 'W.A.: Beyond Oil?' conference, Perth, February 2003 see www.STCwa.org

Fleay, B J (1995) *Decline of the Age of Oil: Petrol politics, Australia's road ahead* Pluto Press, Australia Ltd, Annandale, NSW

Fleay, B J (1998) *Climaxing Oil: How will Transport Adapt?* Proc. Chartered Institute of Transport in Australia National Symposium, Launceston Tasmania 6-7 November 1998

John, G (2004) *TravelSmart results from Perth*, pers.com.

Lynch, M C (2002) *Forecasting Oil Supply; Theory and Practice*. The Quarterly Review of Economics and Finance 42, 373-389

Longwell, H J (2002) *The future of the oil and gas industry: Past approaches, new challenges*. World Energy, 5(3). Harry J. Longwell is Executive Vice President of Exxon-Mobil

MacTiernan, A (2004). *Is there an oil crisis?*. Ministerial speech opening the STC "Oil: Living with Less" conference, Perth, 9th August 2004. www.ministers.wa.gov.au/Speeches/A09/OIL.pdf

Magoon, L B (2000) *Are we running out of oil?* US Geological Survey summary poster <http://geopubs.wr.usgs.gov/open-file/of00-320/>.

Magoon, L B (2001) *Are we running out of oil?*. An illustrated summary of the series of talks given by Les Magoon USGS in November 2001 to the Petroleum Exploration Society of Australia, BTCE and TransScan (Perth), compiled by Bruce Robinson

ODAC (2004) The Oil Depletion Analysis Centre, has a very good website with lots of useful links www.ODAC-info.org .

Powell T G (2001) *Understanding Australia's petroleum resources, future production trends and the role of the frontiers*. Geoscience Australia. APPEA Journal 2001, 273-287

Robinson, B W (2002) *Global Oil Vulnerability and the Australian Situation* Issues and background paper for the draft State Sustainability Strategy, available on the CD in the printed State Sustainability Strategy, and on the website at www.sustainability.dpc.wa.gov.au/BGPapers/BruceRobinsonOilVulnerability.pdf

Robinson, B W (2003) *Australia's Oil Vulnerability*. Proc "W.A. Beyond Oil? Conference, Perth, February 2003. www.STCwa.org.au

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

Salameh, M G (2004) *How realistic are OPEC's proven oil reserves?*. Petroleum Review, August 2004 26-29 www.odac-info.org/welcome/documents/SALAMEH-PETREVIEW.pdf

Samsam Bakhtiari, A M (2002) *A Middle East View of the Global Oil Situation* Proc. 1st Intl Workshop on Oil Depletion, Uppsala, Sweden , Eds. Aleklett, K. and Campbell, C. www.peakoil.net/IWOOD2002/iwood2002proceeding.html

Samsam Bakhtiari, A M (2004) *World oil production capacity model suggests output peak by 2006-07*, Oil & Gas Journal, 102 (16) April 26th 2004

Simmons, M R (2002) *Depletion & U.S. Energy Policy* Proc. 1st Intl Workshop on Oil Depletion, Uppsala, Sweden , Eds. Aleklett, K. and Campbell, C. www.peakoil.net/IWOOD2002/iwood2002proceeding.html or www.simmonsco-intl.com

Simmons, M R (2003) *Is The Glass Half Full or Half Empty?* Proc. 2nd International Workshop on Oil Depletion, Paris, France, May 26-27, Ed. K. Aleklett, C. Campbell and J. Meyer, www.peakoil.net/iwood2003 also at www.SimmonsCo-Intl.com

Simmons, M R (2004) *The Saudi Arabian Oil Miracle*. Presentation to the Center for Strategic & International Studies Washington, D.C. February 24, 2004, www.SimmonsCo-Intl.com

Simmons, M R (2004a) *Saudi Arabian Oil: A Glass Half Full Or Half Empty?*. Presentation to the Hudson Institute, Washington DC, July 9th, 2004 www.SimmonsCo-Intl.com or www.simmonsco-intl.com/files/Hudson%20Institute.pdf

Socialdata (2004) *Individualised Marketing- Reducing Car Kilometres – A Global Approach*, Socialdata Australia Pty Ltd, Institute for Transport and Infrastructure Research. , Poster and abstract presented at Third International Workshop on Oil Depletion, Berlin, May, 2004. www.Socialdata.de, www.PeakOil.net

Sustainable Transport Coalition (2004) *Oil: Living with Less*, policy document, Perth www.STCwa.org.au

Swenson, R (1998) *Alternative Futures for Humanity, the Swenson Curve* www.hubbertpeak.com/scenario.htm