Energy Futures for Australian Transport

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1 Introduction

At the 27th Australasian Transport Research Forum (ATRF) Conference in Adelaide in 2004, two papers were presented relating to oil futures.

Lyn Martin, an economist with the Bureau of Transport and Regional Economics (BTRE), reviewed the evidence for and against the proposition that the world was running out of oil (Martin 2004). While she did not attempt a conclusion one way or the other she asserted that the key issue was not the outcome of the debate regarding future oil supplies, but the appropriate Government policy response.

> *From a policy perspective the main issue is ... the efficient operation of the oil market ..*

She pointed out that although the cost of motoring is a politically sensitive issue in Australia, the price of oil and the cost of motoring are not the same thing.

> *A doubling of world oil prices (from $20 to $40 a barrel) increases the variable costs of motoring by less than 20 percent.*

(At the time of writing in early August 2005, the price of oil is around $60 per barrel).

Bruce Robinson, on the other hand, with a scientific background, was more pessimistic and suggested that the finite nature of oil resources invalidated the normal assumptions of economics. He presented the case not that the world was running out of oil but that the world was running out of cheap oil (Robinson, 2004). He concluded by asserting that

> *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 likely to sweep through Australia in the near future.*

That this issue is not yet on the radar of many authorities was amply demonstrated in November 2004 when the NSW Department of Energy, Utilities and Sustainability (DEUS) published an Energy Green Paper (DEUS, 2004) for the state. It referred virtually exclusively to power stations and electricity generation, despite a convincing estimate (ABARE, 2004) that transport accounts for about 44 percent of final energy use in NSW now.

The National Committee on Transport (NCTR) of Engineers Australia has been concerned about energy futures for transport for some time. The warning voices have been loud for many years. In 1998 the Chartered Institute of Transport (as it then was – it has now evolved into CILTA) mounted a National Symposium ("Beyond Oil") to examine this question, and after the symposium took the unusual step of issuing an unambiguous Outcomes Statement (CITIA, 1998) much of which we reproduce here.

> *We are at the climax of the fossil fuel age. The Chartered Institute of Transport in Australia draws attention to this fact following its 1998 national symposium "Beyond Oil: Transport and Fuel for the Future". Unlimited use of our greatest ever source of*

> *cheap energy may soon contract and the "Petroleum Age" in which we live can now be seen to be approaching an eventual end.*
>
> *The symposium heard that a clear consensus is emerging that cheap oil production outside the Middle East will begin permanent decline around the year 2000, to be followed by permanent world decline within 15 years.*
>
> *We have reached a crucial stage in the development of our local, national and international transport services. Our present path is leading us into potentially serious economic, social and environmental problems. New directions are needed for our future transport fuels and vehicles. "More of the same" in our current transport plans and ways of thinking is no longer tenable.*
>
> *The unlimited use of cheap oil that has characterised this century will end and we will be faced with one of the greatest transformations of human affairs. The signs are already there. Risk of chaos, disorder and conflict will arise unless we face up to this great challenge and make the difficult decisions essential to the future well being of us all. These decisions must be based on the care of people and of the environment if we are to proceed down the path of constructive change.*
>
> *Congestion, pollution and diminishing oil supplies are the central drivers of this change. Communities across the world are increasingly going to be faced with the need to revise their transport systems in response to these drivers. Congestion and pollution are already major factors in some cities - the diminishing fuel supplies will increasingly become apparent as the next century progresses.*
>
> *Should self interest predominate, we could become locked in conflict, unable to adapt and with the likelihood that we will dissipate unproductively the scarce high quality petroleum fuels so essential to a safe transformation to a world "beyond oil".*

CITIA – or CILTA, as it is now known (the Chartered Institute of Logistics and Transport in Australia) – is a very conservative body not known for extreme views. If it was sufficiently concerned to call (CITIA, 1998) for

> *the development of greater understanding and awareness of these crucial issues and for their consideration attention in all policy formulation and decision making relative to the future of transport and fuel in Australia*

then we should now be extremely concerned, because little has happened between 1998 when that was written and 2005.

In this paper, on behalf of NCTR, I review the available evidence on both supply and demand. A longer version of this paper is available in the Kilsby Australia website (Kilsby 2004). My conclusion is that transport is heading for a crisis within ten years unless urgent steps are taken now. In the long run the economists would probably be right - if we had that long, but we don't.

2 Analysis

2.1 General : Why is Peak Oil important?

Figure 1 encapsulates the issue.

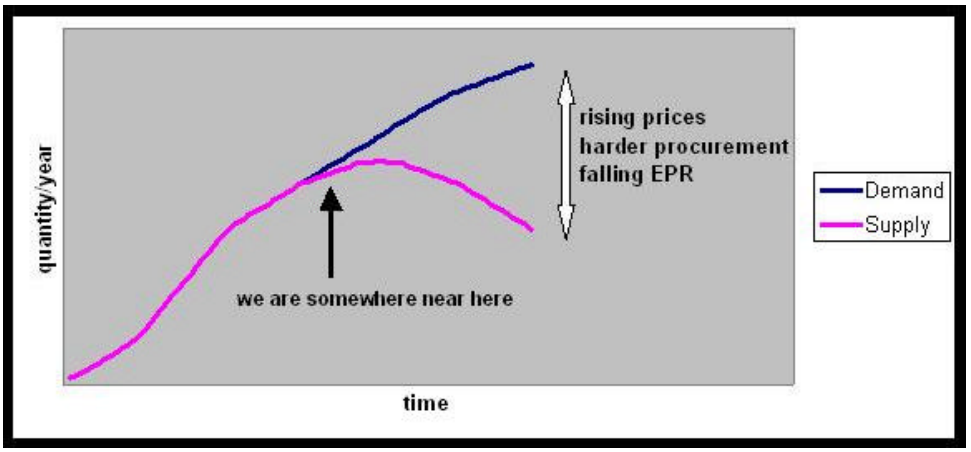

Figure 1: Peak Oil

The world is in no danger if running out of oil soon. However it is likely that the peak of oil production is close.

For all of the last century, the supply of oil kept pace with the rise in demand. It was therefore a buyer's market.

Once at or past the peak, however, the further supply of oil will not rise and sellers will become more dominant than buyers.

A gap will open up between supply trends and demand trends. Economists are of course quite right that this will not happen – the price mechanism ensures that it will not. It will not be possible to consume more than is produced. The price of what is consumed will rise, and this in turn will be a spur to technological development to extract more of what has already been produced and to commercial increases in production from known reserves. However the world's endowment of oil is finite, and increases in production now will lead to earlier depletion than would otherwise be the case. And another predicted effect, that of encouragement of the development of alternatives to oil, is unlikely to happen because of oil's unique suitability as a transport fuel, and even if it did we would lack the production and distribution infrastructure which has evolved over the last hundred years or so to service transport.

Not only will the price of oil rise and its procurement become harder, but increasing amounts of energy will need to be devoted to extracting the dwindling amounts of oil left in the oil fields. The energy "yield" will therefore drop (the EPR, Energy Profit Ratio, or equivalently the EROEI, Energy Return on Energy Invested).

There is also the possibility that the financial measures which drive the developed world's economic growth will be much reduced in effectiveness because they depend on continuation of future growth, which in turn depends on future increases in energy use. If energy use was constrained in future, at least for transport, then economic development would be choked and the assumptions on which our global financial markets are based would no longer be so applicable.

2.2 Supply Issues

The factors that will make oil less cheap are:

- The plateau-ing of supply, as some known fields become depleted or exhausted and insufficient new discoveries are made to replace them.

- The continuing increase in demand for transport energy, giving rise to a growing gap between supply and demand unless the price changes.

Not only will the prices rise and procurement become more difficult, as a growing number of potential users chases a steady or declining supply of oil, but it will become physically harder to maintain present levels of supply. This is because it requires more energy to extract a given amount of oil from a field which has past its production peak than it does to extract the same amount of energy when the field is new.

The federal government recently issued an Energy White Paper "Securing Australia's Energy Future" (Department of Prime Minister and Cabinet, 2004). This clearly showed that transport, already the dominant user of energy in the year 2000, is expected to increase this dominance over the next twenty years. And, of course, while reticulated electricity is the power source for some urban rail systems, the major power source for transport has to be portable. It is oil.

A rather misleading graphic (Figure 2) showed domestic flows of oil in Australia. When the scale is taken into account, this shows that the majority of crude oil (60%) produced domestically in Australia is actually exported, while the majority of crude feedstock for Australian refineries (67%) is imported. In addition to crude oil refined in Australia, net imports of imported products add a further 22% to our petroleum products. Transport consumes about 75% of all petroleum products in Australia.

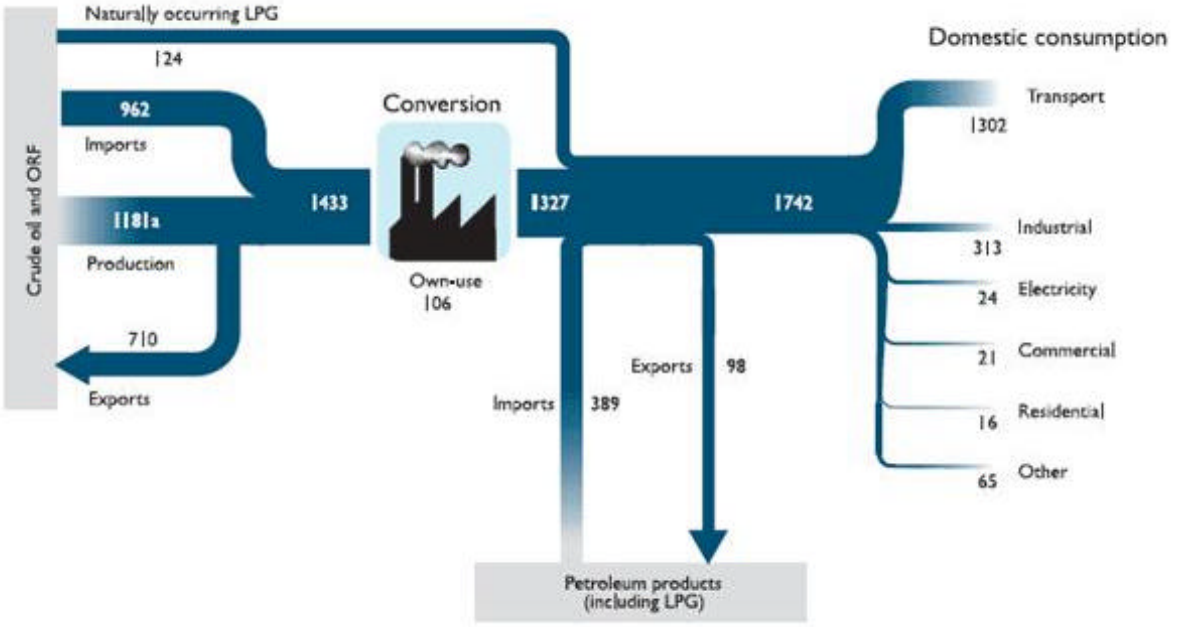

Figure 2: Petroleum flows in petajoules in Australia 2004-05 (Source: Department of Prime Minister & Cabinet 2004, based on analysis by ABARE)

ASPO (the Association for the Study of Peak Oil, a European think-tank) has estimated past and future global production of oil as shown in Figure 3.

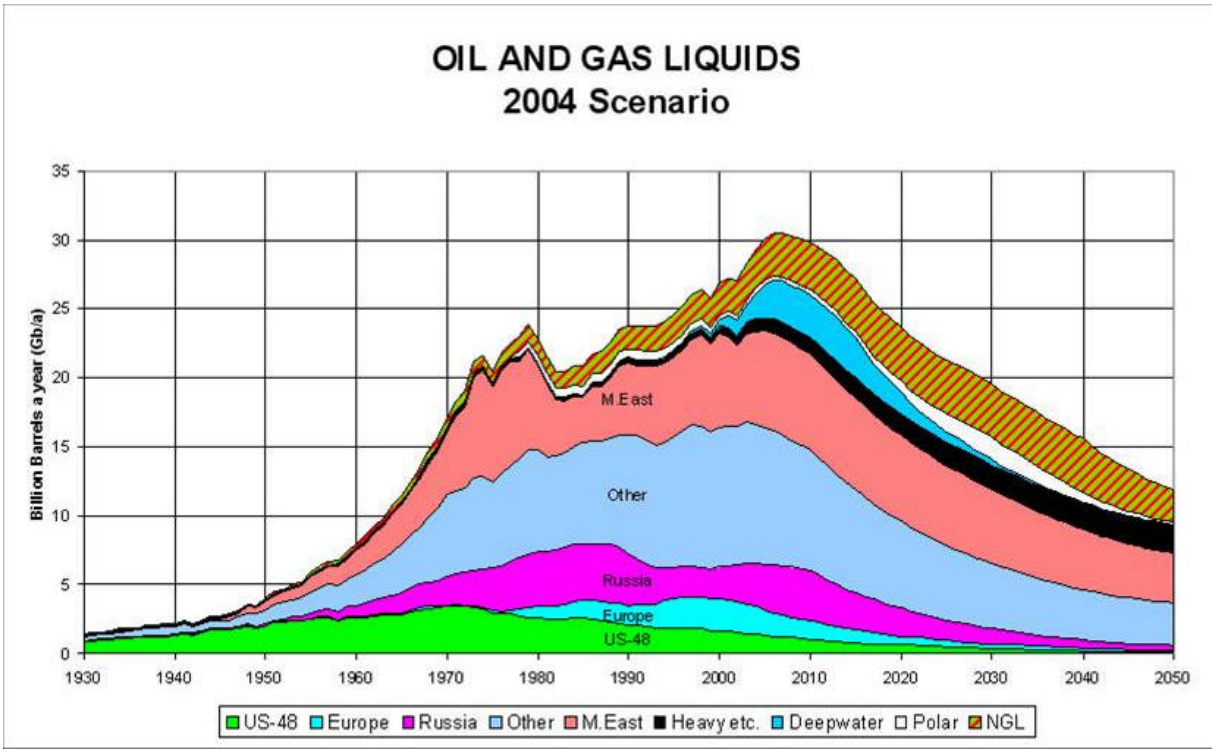

Figure 3: Estimated production of oil to 2050 (source: ASPO 2004-05)

It is now well established that the production profile of an individual oil field is a bell-shaped curve over time, with the second half of the oil more difficult to extract than the first half. World oil production is the sum of a lot of such individual profiles, and is itself bell-shaped, as shown.

The figure suggests that while it is not easy to assess when the peak is (except with hindsight), it is not far off. On the other hand, the timescale for the commercial development of alternative energy sources for transport can be measured in decades (World Business Council for Sustainable Development, 2004).

2.3 Demand Issues

There is little doubt that the demand for transport energy will continue to rise.

Figure 4 shows the predictions for final energy demand for transport in Australia over the next 20 years, taken from the 2004 Energy White Paper. Projections in the Auslink White Paper on transport infrastructure, released at around the same time (Department of Transport and Regional Services, 2004) show all principal sources of transport demand (freight, aviation passengers, urban car traffic) rising over the next twenty years, in some cases by dramatic amounts.

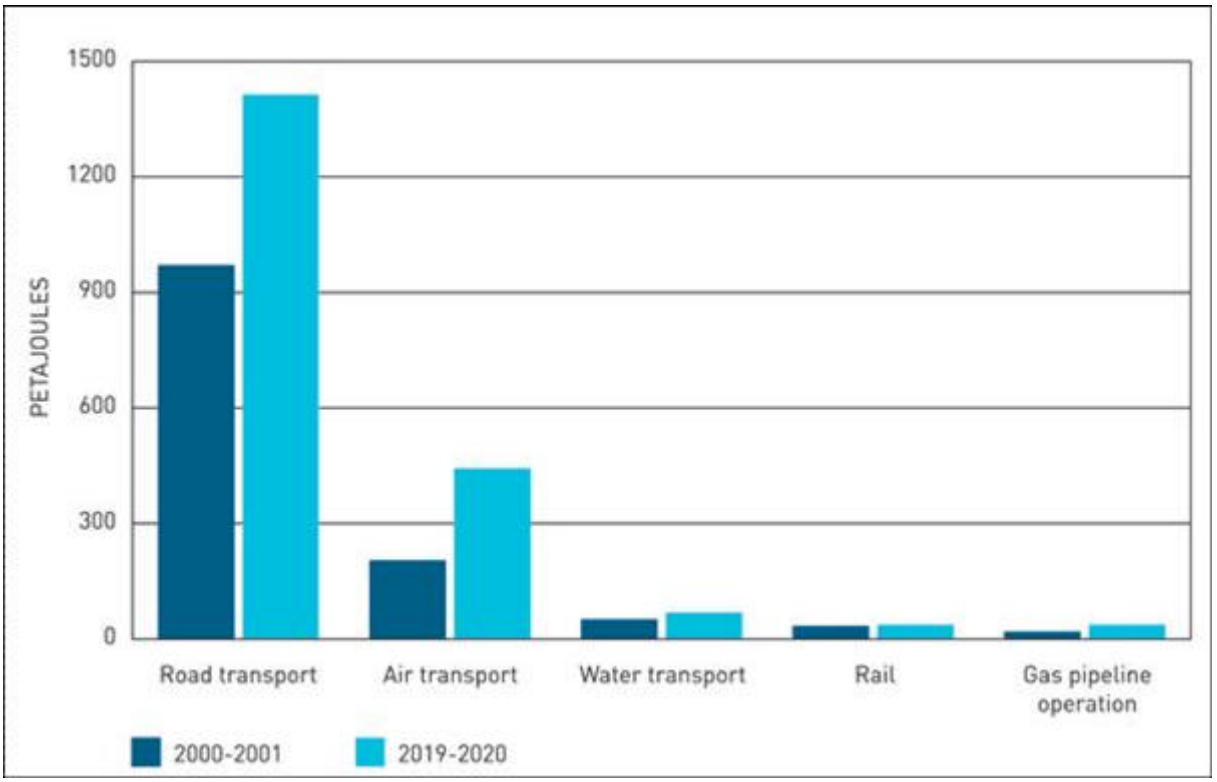

Figure 4: Forecast transport energy needs for Australia 2020 (Source: Dept of Prime Minister & Cabinet, 2004)

The largest absolute demand is exoected to be from road transport, which is almost entirely dependent on oil. Road transport displays the largest absolute growth as well.

The next largest absolute demand is from aviation, which is also almost entirely dependent on oil and also with fewer potential alternatives than road transport. This sector also shows the second largest absolute growth.

In comparison, rail transport, sea transport and transport by pipeline do not have significant growth in energy requirements.

Demand from other countries is also rising, especially from developing countries (and particularly from China).

3 Evaluation

3.1 Depletion: We're fast using up what we have.

There is considerable professional disagreement about the world's oil reserves.

At one extreme is the US Geological Survey, which is extremely optimistic and suggests a figure of around three trillion barrels (3,000 gigabarrels).

More soberly, ASPO relies mainly on scientific data produced by experienced geologists and suggests the world's reserves of conventional oil are under 1 trillion barrels.

This degree of variation in professional estimates is staggering, given its importance to the global economy.

Figure 5 shows some recent estimates of the global amount of oil ultimately recoverable. Definitional niceties are important: there is no agreement about reporting conventions (and the available data is very rubbery). While ASPO is at the "pessimistic" end of the range of estimates, they appear (to the NCTR) to be also at the more credible end of the spectrum. They estimate that the total world supplies of conventional oil once amounted to 1.85 trillion barrels. Of that, we have discovered 92% of it, with another 8% still to be found somewhere (this is obviously an estimate). More worryingly, we have already used half of all the oil there probably is, or 54% of what we have discovered.

Source	Year of Estimate	Global oil reserves (Gb)	Status of estimate	Past production
ASPO[1]	2004	760	Estimated production from known fields to 2010: excludes "yet to find" 145 Gb	945 Gb
EnergyFiles[2]	2004	1,004	Excludes "yet to find" 270 Gb	990 Gb
BP[3]	2003	1,150	"proved reserves"	Not given

[1] ASPO 2004-5
[2] (EnergyFiles are consultants to the energy industry) World Oil Resources & Peak Oil Production 2004
[3] BP 2004

Figure 5: Some estimates of global oil reserves

In 2003 Dr Michael Smith of Energyfiles estimated that of 99 countries in the world that produced oil, have produced it or potentially will produce oil in the future, 60 countries are already at or past their peak and a further 12 are very near to it (Californian Energy Commission, 2003).

The current rate of discovery of further sources globally is far less than the current global rate of consumption.

When "unconventional oil" is added to the picture (oil from coal, shale, bitumen, heavy oil, deepwater oil, polar oil and gasfield liquids – any of which may more trouble to extract than it is worth) ASPO's estimate of ultimately recoverable reserves rises to 2.4 trillion barrels (or the equivalent thereof), of which about 43% has already been consumed.

World production of conventional oil is estimated by ASPO to peak this year, 2005, and the world market will increasingly come to rely on the giant middle eastern oilfields for its sources of oil as alternatives become exhausted.

3.2 Historical perspective of "the Age of Petroleum".

With a short -term view, the world has plenty of oil and the forecast is not that it will run out but that growth in the production rate will cease and eventually go into reverse.

One commentator has taken an extremely long-term view of this, in which oil consumption appears as a mere blip in the timeline of human history. Oil was discovered, it was mostly used up in a short space of time, and then we stopped using it because we had none left.

What will happen afterwards?

The conclusion is that the end of the age of cheap oil on which transport (and agriculture, and defence, and many other activities) depends is not far off.

The addition of energy from gas to the picture will extend the duration of the blip slightly but that too is finite and when the gas is mostly used as well as the oil, the earth's geological legacy of fossil fuels (except coal) will be all spent.

The global consequences of oil depletion will be:

- Rising oil prices
- Harder oil procurement, leading to prioritisation of uses between and within sectors
- Need to devote greater amount of energy to extracting last of oil
- Increased tension between developed and developing nations
- Greater power to Middle East producers
- Greater geopolitical tension
- Need for a transition to a world "beyond oil"

There is considerable disagreement amongst informed sources about when the problems will be encountered, but not whether.

The prevailing view held by the energy and automotive industries, economists and governments is that problems are at least twenty years away. The prevailing view among environmentalists and scientists is that the problems will be felt within ten years, probably sooner and are possibly starting to impinge already.

The onus should be on those who believe that cheap oil will last for a long time yet to substantiate their views, rather than asserting that there is nothing to worry about because the opposite case has not been proven beyond doubt (this is surely the precautionary principle of ESD).

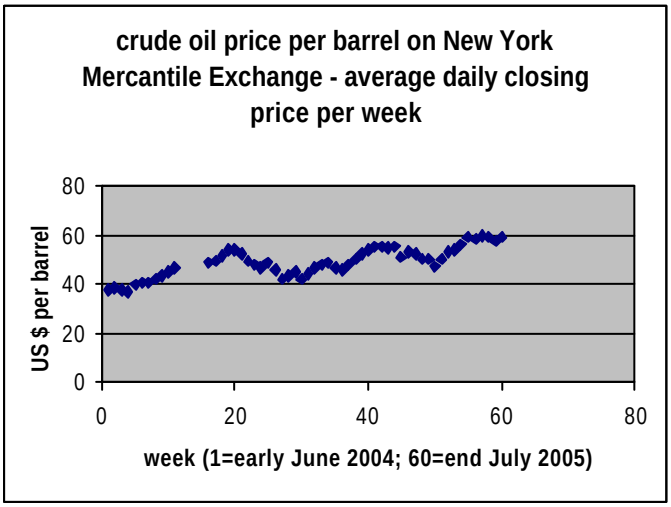

Figure 6: Movement in price of crude oil start June 2004 to end July 2005.

It is instructive to consider movement of the price of crude oil per barrel on the New York Mercantile Exchange between June 04 and July 05 (Figure 6). The price goes up and the price goes down, but somehow it never seems to go down by quite as much as it goes up, with associated angst in the media every time it breaks through a new "psychological barrier" for the first time. This has happened at $30, $40, $50 and recently at $60. Figure 6 only displays the average weekly market variation – the price also varies within each week and indeed within each day. This evidence is quite compatible with a scenario of a steadily rising price as global production reaches its peak, but not with the scenario anticipated by some of an oil price spike followed by a return to the sort of prices we have been used to in the past.

3.3 Implications for Australian transport

The potential consequences for Australian transport in particular will be:

- Less and more expensive diesel and petrol
- Higher priority for road freight relative to personal transport
- Impact to hit road freight first because of national lack of heavy oil
- Car-dependent suburbs, eg in outer Sydney, to experience major difficulties
- Need to develop alternatives to car travel for many personal journeys
- Lower returns to investors in private road infrastructure
- Need for higher fuel efficiency in car and truck fleets
- Possible constraints on air travel – consequent impact on tourism industry
- Growing importance of public transport, bicycle and pedestrian networks
- Potential civil unrest as limits appear on personal mobility

What can our planners do to mitigate the consequences?

- Do nothing. This should be rejected as an option.
- Business as usual ("BAU") – application of BAU policies to greater degree than has been contemplated so far. Land use/transport integration, development of better public transport, pedestrian and low-energy networks (eg cycle paths), etc. The Warren Centre at Sydney University conducted an extensive inquiry into "Sustainable Transport in Sustainable Cities" in the period 2000-2002, and concluded that simultaneous action on six fronts was needed to develop more sustainable systems. This is probably as good an indicator as any of what "business as usual" would lead to in future, although it also impinges to some extent on the other approaches considered below. The six fronts were (Warren Centre, 2003):
    - engaging the community
    - monitoring and reporting on transport performance
    - optimising the performance of what we have
    - modifying the shape of the city
    - introducing better planning, pricing, funding, new technology and infrastructure
    - lowering barriers to change
- Technological development – alternative fuels, more fuel-efficient automobiles, intelligent transport systems, promotion of hydrogen and electricity in transport, etc.
- Economic instruments – reliance on market forces, government intervention via taxation and other pricing policies where necessary. Optimists (eg the Economist, 2005) point out that the same depletion fears had been raised in the past about finite global supplies of minerals, which are now cheaper and in more abundant supply than ever thanks to new discoveries, more advanced extraction technology , more efficient usage and the development of substitutes. If these factors apply to finite global oil supplies as well, there would be little need for intervention – but for the reasons outlined in this paper, they are unlikely to apply to transport energy.

- Behavioural change – public education and awareness campaigns, behaviour change programs, encouragement of individual responsibility.

Several years ago the Institution of Engineers Australia convened a Transport Task Force to consider the role transport might play in contributing to a more sustainable energy culture in Australia (Engineers Australia, 1999). As well as making a number of recommendations on issues where the Institution or individual engineers could make a difference, the Task Force made a number of recommendations to government that encompass these four areas:

- Taxation and fiscal policy instruments should encourage sustainable transport (economic instruments)
- There was a strong case for increased investment in transport infrastructure that offered the opportunity to develop a transport system that was integrated, more sustainable and less greenhouse gas intensive (business as usual).
- The market was the appropriate mechanism to allocate resources between individual transport modes, but where market forces fail to deliver environmental and social objectives governments should intervene (economic instruments).
- More holistic approaches that integrate environmental considerations into transport policy, planning and investment decisions were needed. They should go beyond current Commonwealth and State and Territory environmental impact evaluations in order to examine wider impacts on health, sustainability and greenhouse gas emissions (business as usual).
- There was a need for industry, innovation and research and development policies and commitments to support the development of cleaner transport fuels and technologies (technological development).
- Additionally, there was a need for research into transport pricing, economics and demand-management technologies (economic instruments, behavioural change).

While there has been a little progress on some of these recommendations, it is disappointing to reflect that much the same could be said today, six years on.

4 Conclusions and recommendations

The availability and price of oil will deteriorate quite soon (probably starting within ten years). National government energy policy places priority on coal-related technologies, which will aid power generation sector but will not aid transport. Transport, particularly road transport and aviation, is highly dependent on oil rather than coal. The social, economic and environmental consequences for Sydney of reaching and passing the global peak of oil production are immense. Our present forward planning processes do not recognise this as an impending problem.

The possible consequences of reaching the peak of global oil production are so far-reaching that they cannot be ignored in transport planning processes. Precautionary planning against future oil constraints should be an essential part of the management of risks.

There are perhaps five options, of which the first ("Do Nothing") will lead to an undesirable future and should be rejected. The others are not mutually exclusive and should all be strongly supported. The options are:

- Do nothing.
- Business as usual ("BAU") – application of BAU policies to greater degree than has been contemplated so far. Land use/transport integration, development of better public transport, pedestrian and low-energy networks (eg cycle paths), etc

- Technological development – alternative fuels, more fuel-efficient automobiles, intelligent transport systems, promotion of hydrogen and electricity in transport, etc.
- Economic instruments – reliance on market forces, government intervention via taxation and other pricing policies where necessary.
- Behavioural change – public education and awareness campaigns, behaviour change programs, encouragement of individual responsibility.

All the available options (except "do nothing") should be deployed.

In particular, the following actions should be given high priority:

- The Australian Transport Council should become better informed about Peak Oil issues and implications.

- All appropriate jurisdictions that are not already doing so should take the initiative to build knowledge of peak oil issues and develop a precautionary strategy.

- For our major capital cities, urban transport corridors should be defined and a multi-modal strategy for each one developed. Plans that boost travel conditions for one mode and do little or nothing to improve others in the same corridor should be unacceptable except in the context of the prior planning strategy for the corridor.

- A Taskforce should be established to revise the evaluation procedures for multi-modal options, in particular requiring a constrained energy position to be included in the future scenarios used for assessing options, and the energy costs and benefits of planning options to be included in the evaluation of alternatives.

- The shortening of trip lengths by the fostering of local centres with surrounding residential consolidation, and the provision of better alternatives to car use, to be encouraged.

- Alternatives to car use, for instance in inner and middle Sydney, should be encouraged. Strategic bus planning skills for major conurbations are very important and should be strengthened.

- Alternative fuels and distribution infrastructure should be supported. More fuel-efficient vehicles via regulation should be supported via regulation and standards and transport infrastructure (eg use of more Intelligent Transport System technology). Support for lighter vehicles, including powered bicycles, could be implemented through differentiation in licensing charges,

- Pressure should be continued in searching for ways of internalising externality costs in transport pricing.

- Public awareness programs should be implemented to gain acceptance of the nature of the problem. This is the "pre-contemplation" stage of the classic five stages which change behaviour. The five stages, as used in health programs and Travelsmart programs, are: pre-contemplation (needs information); contemplation (needs options); preparation (needs plans); action (needs public support); and maintenance (needs long-term commitment).

- Outside metropolitan areas, the prioritisation of food production and distribution over other types of non-metropolitan travel should be prepared for.

- The conversion of rural and regional vehicles to run on gas or other alternative fuels rather than petrol or diesel, should be encouraged by arguing for Commonwealth revision of pricing differentials and by State support for distribution infrastructure for alternative fuels.

The strategic directions emerging for most major Australian capital cities (centres, densification, encouragement of alternatives to car use etc) are appropriate and would be even more necessary if the worst fears regarding peak oil were to be realised. Urban areas that are built around the use of the private motor vehicle (for instance all of Canberra) would face major changes.

There is considerable uncertainty over what the future holds but the possibility that these directions will turn out to be inescapable rather than precautionary is very real indeed.

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