World Oil Supply Short Fall - The Importance of Walking

Brian Fleay

Abstract

The world reduced dependence on cheap Persian Gulf oil after the 1970's oil crises by developing supplies elsewhere, substituting coal and natural gas for oil and by pursuing energy efficiency. Persian Gulf oil was used as a last resort. This strategy has run its course.

Non-Persian Gulf oil expected to peak through 2001 and the supply focus is shifting to the Persian Gulf where 60 per cent of the world's remaining oil is located. These countries are not investing on the scale needed and an oil shortage is expected from 2001, ushering in a complex period expected to end with the global decline of oil extraction and the Persian Gulf supplying half the world's oil. A summary of the status of world oil will be given.

Australia's oil self-sufficiency is likely to decline next decade with imports reaching unaffordable levels. Natural gas is an alternative land transport fuel in the medium term.

Some issues and scenarios arising will be discussed with a focus on oil supply security, economic stability, food supplies and transport. A major short-term response in countries like Australia can be substitution of walking, cycling and better use of public transport for short car journeys in urban areas. This perspective will be discussed in the context of the Western Australian Transport Department's Travelsmart program.

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Brian's professional life was spent with the Water Authority of Western Australia, mainly in the operation and maintenance of Perth's water sources. He has a Bachelor of Engineering from the University of Western Australia and a Master of Engineering Science in Public Health Engineering from the University of New South Wales. He is an Associate of the Institute of Sustainability and Technology Policy at Murdoch University in Western Australia where he pursues his long standing interest in the connections between ecology, economics and energy and the future of petroleum supplies and the consequences for transport, agriculture and population. His book, *The Decline of the Age of Oil*, was published in 1995. He comes from a pioneer farming background in the Avon Valley to the east of Perth.

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Introduction

This conference on walking as a transport mode is being held when oil prices are on a roller coaster ride. Why is this so? This paper argues that another world oil supply crisis has begun.

There is reluctant acceptance in the petroleum industry that oil from fields outside the Persian Gulf is reaching its peak and is about to decline; that the focus of supply has shifted to the Gulf countries. But they are not investing on the scale required to expand output to meet the world's growth expectations. Political obstacles, volatile prices and financial uncertainty are inhibiting investment. A supply shortfall is emerging.

The peaking of US oil production in 1970 enabled the Persian Gulf countries to use oil as a political weapon in the Israeli-Palestinian dispute. We had the 1970's oil crises. There never was an oil shortage and large discoveries were waiting in the sidelines. Consuming countries minimised their use of cheap Persian Gulf oil and companies developed expensive oil elsewhere. Gas and coal replaced oil and energy efficiency was pursued. Economic growth slowed and oil consumption declined after 1979 when a huge supply excess developed and oil prices collapsed in 1986. However, consumption has now reached new heights and the supply excess has finally disappeared.

The Persian Gulf has 60 per cent of the world's remaining oil, supplies 30 per cent and can expand production cheaply for some years yet after which permanent world decline should begin. By 2010 the Persian Gulf may produce 45-50 per cent of the world's oil.

However, esoteric debates on what the ultimate extraction of *conventional* oil might be and deducing from that when "the world peak" might occur are now of secondary importance to the dominant position held by these Persian Gulf countries. More important are their petroleum investment strategies, the political, economic and production consequences of these and the huge problem they have feeding a rapidly increasing population largely dependent on food imports funded from oil export revenue. It is not in these countries or the world's interests for them to rapidly deplete their remaining oil at low prices. We are on the edge of a different and uncertain world.

There is no immediate solution other than to progressively limit consumption. Reducing short car trips in urban areas in favour of walking, cycling and public transport is one quick way of doing so at low cost. The importance of papers promoting walking in this conference need to be viewed from this perspective. Essential freight traffic and agriculture must get priority for oil supply ahead of such short car trips whose elimination also has many long-term health, social and environmental benefits.

Interpreting the petroleum data base

Hydrocarbons range from natural gas, through light and heavy liquids to solid tars and bitumen. However, the light free-flowing oils comprise over 85 per cent of production and about 60 per cent comes from a few giant sized oil fields mostly at very low cost and is known as *conventional oil*. Low cost natural gas liquids comprise six per cent and together these power our transport, agriculture and industrial systems.

The world has been sufficiently explored by the most advanced techniques for confident estimates of ultimate recovery of *conventional* oil to be made. Three retired petroleum geologists, Colin Campbell and Jean Laherrere from Europe and LF. Ivanhoe from the US, are leading the debate on this issue in oil industry circles.

By contrast, *non-conventional oil* is mainly derived from tars, bitumen and heavy oils and is very expensive to produce. Tars and bitumen are mined, heated and processed to obtain an oil requiring further refining to produce the equivalent of crude oil. The massive scale of these operations, their high-energy consumption and environmental problems precludes significant cost reduction and most production will occur after world oil peaks.

Oil is hidden in deep geological formations and only statistical estimates of oil-in-place and of that economically extractable are possible. There are no rigorous international standards on definitions, assessment and reporting of reserves and reporters can choose criteria to suit their convenience. Hence reported reserves data must be regarded first as political statements and interpreted with care.

A feature of Campbell and Laherrere's work is their rigorous attention to definitions and correct use of statistics and of the failings of others in this regard. A consensus is converging on the 1800 to 2100 billion barrel range for ultimate *conventional* oil production. These and other issues are well covered in Campbell and Laherrere (1995), Campbell (1997) and Fleay (1999). See also Campbell and Laherrere (1998). It is *conventional* oil that matters.

Discovery

Figure 1 shows *conventional* oil discovery and production from 1950.

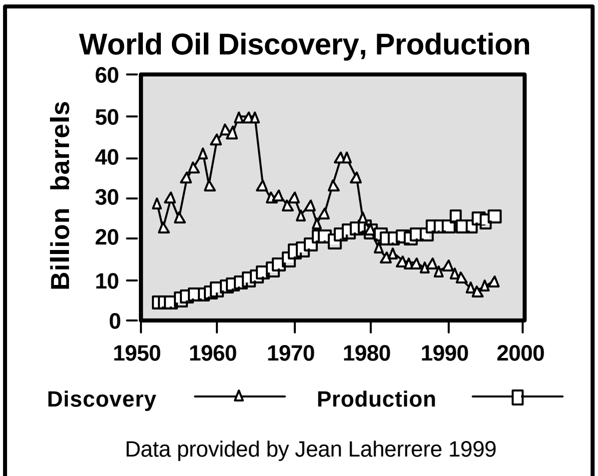


Figure 1

Discovery peaked in the early 1960's, is now one quarter of annual production and only a limited amount is left to find. Campbell and Laherrere (1995) say over 60 per cent of *conventional* oil has been found in 360 giant oil fields, less than one per cent of all fields. Giants held more than 500 million barrels on discovery and sophisticated techniques are not needed to discover them, they are usually found first. Giant discovery peaked in the early 1960's and has slumped since 1980. Recent discoveries under the Caspian Sea will see a discovery "spike" for 2000 and were expected.

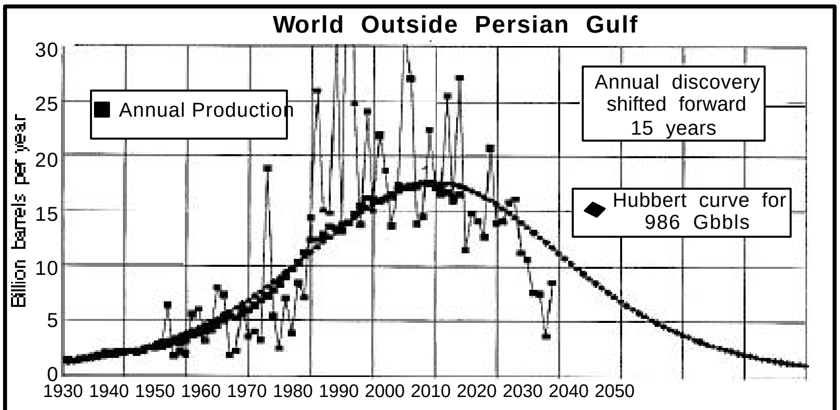
Most *conventional* oil has been and will continue to be produced from giant oil fields. 80 per cent comes from fields over 25 years old, most are ageing and many are in decline (Campbell and Laherrere 1995).

Most published data for annual changes in reserves include both revisions as well as new discoveries. Revisions account for three-quarters of additions to reserves since 1980, giving a misleading picture on the quantity of new oil actually being discovered. In the presentation of the data here revisions of reserve estimates in fields discovered in past years are backdated to the year of discovery.

Most fields yield about 35 per cent of the oil-in-place and the best achieve 60 per cent. Enhanced recovery techniques can increase yields by changing the physical properties of both the oil-in-place and of the formation, all inherently expensive and energy intensive operations. However, lower yields are mostly from fields with heavy viscous oils and/or tight formations while higher yields occur where the oil is light and free flowing, or the formation is porous. These and related issues are discussed in Fleay (1999). Enhanced recovery is mostly in the *non-conventional* class based on cost and low net energy yields.

World production profiles

MK Hubbert pioneered the use of the logistic equation to describe the discovery and production profiles for oil in major provinces. In 1956 he successfully predicted the time and magnitude of the 1970 peak of US oil production. These profiles are normally bell-shaped and the peaks occur near the mid-point of ultimate economic production or discovery. Figure 2 illustrates these points for world *conventional oil* outside the Persian Gulf.



Laherrere Fig 2.5 in Fleay & Laherrere 1997

Figure 2

The plot of discovery has been shifted forward 15 years to illustrate how the production profile to 1995 is mimicking the discovery profile with a 15-year time lag. A Hubbert curve is plotted for an ultimate of 986 billion barrels. Clearly the non-Persian Gulf peak is near. The logistic equation can be extended to multi-peaked situations each reflecting several phases of discovery and development.

Figure 3 shows actual production and future estimates for the world and some major regions (Campbell and Laherrere 1998). Increasing the world ultimate from 1800 to 2100 billion barrels only shifts the mid-point of production forward about five years. See Fleay (1999) and Campbell (1997) for further discussion.

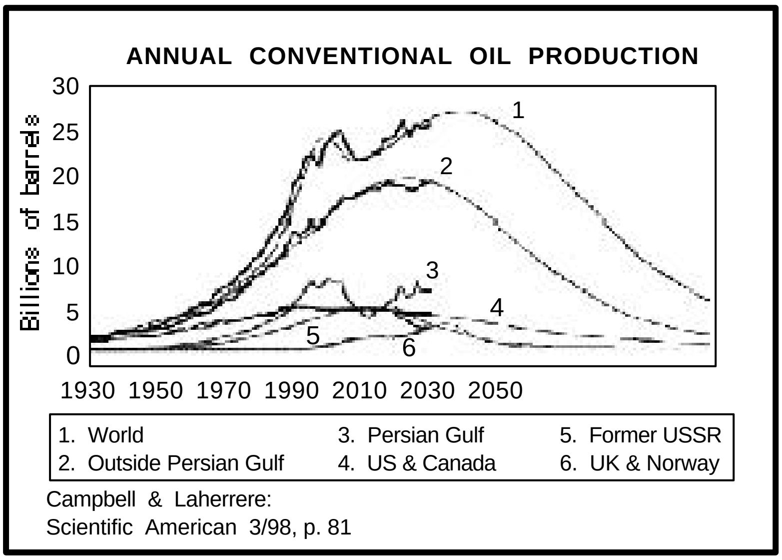


Figure 3

Australian oil and gas

The Australian Geological Survey Organisation's (AGSO) estimates of crude oil and condensate production compared to forecast consumption to 2010 are shown in Figure 4 along with projected imports at A$50 a barrel (AGSO 1999).

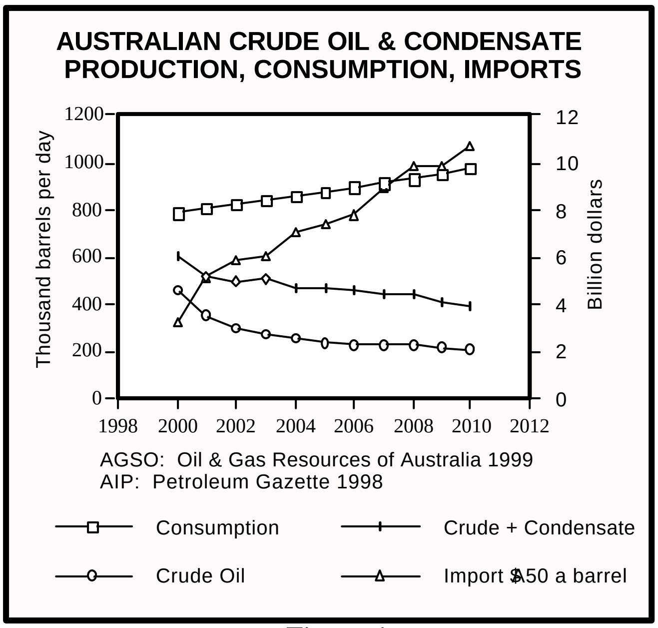


Figure 4

Condensate is liquid stripped from natural gas. The AGSO (1999) says about half of Australia's ultimate oil production has been produced.

The Timor Sea province is the least explored where operations are expensive due to ocean depths and distance from shore service bases. Several good-sized giant fields need to be found to change this perspective and it is getting late in the day for this to happen. Australia's only two giants were discovered in Bass Strait in the 1970's.

The Bureau of Resource Sciences (1996) estimated that Australia's ultimate endowment of *conventional gas* was four times greater than for oil on an energy equivalent basis. So far we have produced nine per cent and about 80 per cent is off the north west coast of WA. However, nearly 20 per cent is a long way off shore in water over 1000m deep and will be expensive to develop. We do not have as much cheap gas as many people think and it is the only local fuel we can rely on to operate our present land transport and agricultural systems from 2010. It must not be squandered unwisely.

The transition begins

The 1986 oil price collapse put the international oil companies through the financial ringer. Downsizing has been the order of the day ever since, particularly in exploration and development services where they have been confined to the high cost world outside the Persian Gulf.

The industrialised world's 20-year strategy to minimise the use of Persian Gulf oil has run its course. Only this region can provide additional supply at moderate cost until around 2010 when world *conventional* oil production is also expected to decline a decade will see the transition from plenty to scarcity. This time the world has to face the consequences of oil depletion. There are no North Seas waiting on the sidelines.

Asian oil consumption fell during the 1997-99 financial meltdown there, just when the Organisation of Petroleum Exporting Countries (OPEC) was increasing production. By early 1999 oil prices were at an historical low of US$10 a barrel (constant dollars) and OPEC reduced their production quotas which were adhered to in the ensuing months. From mid-1999 Asian economies recovered and together with a booming US economy fuelled higher world consumption which was exceeding supply by October, OECD stocks of crude and refined product declined to critical levels and oil prices exceeded US$30 by March 2000 when OPEC increased quotas and again in June. On each occasion oil prices at first increased then fell and rose again to over US$30 a barrel. By August only Kuwait, the United Arab Emirates and Saudi Arabia had some spare production capacity, elsewhere wells were producing to the limit (IEA 2000).

There is a growing consensus that production outside the Persian Gulf will peak through 2001, now openly discussed in oil industry journals (Petroleum Review 2000, Campbell 2000, Salameh 2000, Skrebowski 2000). Production is declining in the USA, North Sea, China, Argentina, Egypt, Syria, India and Colombia while Venezuela and Mexico are only holding their present level by heroic efforts (IEA 2000). The focus is shifting to the Persian Gulf producers. But can they meet the shortfall?

New wells in Saudi Arabia have increased from 70 ten years ago to 320 in 1998 (Salameh 2000). A UN Security Council team inspected Iraq's oil facilities and concluded that without spare parts and urgent oil field refurbishment production would decline and permanent damage to oil fields was possible (Petroleum Review 2000a).

Campbell (1997), Campbell & Laherrere (1998) and others have long predicted that non-Persian Gulf oil would peak around 2000 and Persian Gulf production about 2012-15, but they assumed that the investments would take place where and when needed. At current prices about US$8,000 is required for each barrel per day of new capacity in the Persian Gulf and to meet modest consumption growth to 2005 requires an investment of around US$80 billion (Ismail 1994, Petroleum Review 2000a). Half is required to sustain present production and to repair war-damaged facilities in Iran and Iraq. This investment program has yet to commence. So it could be 2003-05 before production much beyond 2000 levels is possible. This scale of investment is beyond the financial and technical resources of these countries. What are the obstacles to investment?

Firstly**,** there is insufficient awareness of the realities of oil depletion. Secondly**,** the excess supply capacity since the early 1980s and low oil prices have strained budgets. Rapidly growing populations plus low oil prices have substantially reduced these countries per capita export income needed to pay for food imports. After food, welfare for the elite and the masses, plus high military outlays, little has been left for oil investment. The population of the region is about 100 million and at present growth rates could double in 25 years. Half are under the age of 21. About 75 million people depend on food imports paid for from oil export income (Youngquist 1999).
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Thirdly**,** US inspired sanctions effectively prohibit external petroleum investment in Iraq and Iran and these are unlikely to be lifted until after the US Presidential elections. The scale of outside investment needed is an extremely sensitive internal political issue. It is in the long-term interests of these countries to ration oil at high prices, but not at a level that damages the world economy or provokes oil substitution. The narrow margin of supply over demand is reducing their ability to pretend there is a large supply excess.

So the world faces from 2001 the progressive development of an oil supply shortfall of unknown duration and magnitude.

Alternative fuels for transport

The Persian Gulf countries are volatile, politically unstable and by 2010 may be supplying half the world's oil. Add the problems of feeding and employing a growing population and you have a scenario where oil supply can be subject to unexpected interruptions. There is no certainty that the high investments required in their oil industry will always take place, nor that oil field infrastructure will be maintained in good working order, issues of immediate relevance to every country.

There are alternative transport fuels but none that can match oil as we now know it and time has run out for immediate introduction of such substitutes. Petroleum products are unique because of their high power-weight ratio, the fine control possible and their ease of storage and transport. Furthermore, the oil from giant fields in their most productive years has been extremely cheap, but their best years are passing. Natural gas is the next best substitute followed by electricity, which, however, has inferior storage and transport characteristics. Coal is an inferior transport fuel because it is a solid. Hence there are no equivalent transport fuels to replace petroleum products, either in quantity, economic quality or performance. The real cost of powered transport is going to increase and a decline in its scale and scope is inevitable. Conversion to alternative fuels requires massive investments and takes a long time. Natural gas is the most adaptable in this regard and is the critical fuel to see Australian transport and agriculture through to an era "beyond petroleum" (Fleay 1999).

Supply priorities will be needed and essential freight transport and agriculture must have first call on limited oil supplies. The main sacrifices will have to come from urban car travel in Australian cities, especially for short car journeys that are within the scope of walking and cycling. Rapid reductions in car travel in favour of walking and cycling are possible with many positive health gains and the revitalising of local community life. The Western Australian Transport Department’s Travelsmart program for Perth, suitably expanded, is well placed to lead this change.

Travelsmart’s potential

The Western Australian Government’s Metropolitan Transport Strategy 1995-2029 (MTS) expected total daily car trips to reach 4.7 million in 2029 and aims to reduce these to 3 million by trebling walking and cycling trips and increasing public transport trips four fold. These targets do not exhaust the potential for shifting from car travel to other modes. Travelsmart (1999) is one initiative that aims to shift short local car trips from driver only to public transport, bicycles, walking and other alternatives. A central feature, in co-operation with local government, is face-to-face “dialogue marketing” with 500,000 residents in inner and middle suburbs. Travelsmart programs have commenced in the inner suburbs of South Perth, Victoria Park and Subiaco.

Other papers at this Conference discuss Travelsmart in more detail. This paper will examine its potential to be rapidly expanded in scale and in scope to include the outer suburbs as well. Travelsmart’s "grassroots" approach that mobilises local initiatives makes such an accelerated agenda ideally suited as the initial response to the coming shortfall in oil supply. Under this stimulus more far reaching change is possible. Who knows what creative ideas might arise in these challenging circumstances, given the right leadership and support. Travelsmart is a minimalist program that just tests the waters.

Travelsmart has identified that 35 per cent of trips by all modes, now made by car, are open to more environmentally friendly options, but only aims to capture less than half of these, largely because it only targets the 60 per cent of people who so far have volunteered to participate. This suggests a more pro-active approach drawing attention to the insecure fuel supply future and related balance of payments problem Australia faces could double the Travelsmart shift from cars to other modes, including walking.

Also 40 per cent of car trips have been identified as not open to mode change, including transport of grocery goods. My family uses a converted pram to both collect groceries in the supermarket and then wheel them home. There must be considerable scope here for transferring trips from car to walking by promotion of such options and the commercialisation of a range of trolleys for the job, including electric ones. A program of improvements to the walking environment would be needed, especially at major road crossings.

Most teachers travel by car to schools and half of the children are driven to and from school by car. The systems of appointment and promotion of teachers as negotiated between the Education Department and the State School Teachers Union give scant attention to the travel implications for teachers and often lead to them travelling across the urban area to their school. Convincing both bodies to re-negotiate these systems to minimise travel has the potential to put many teachers within walking or cycling reach of their school, opening the way for other such initiatives. There must be scope for such changes in other employment areas.

Electric bicycles need serious consideration for Perth's middle and outer suburbs in strategies to adapt to the era of oil supply shortfalls. Already the elderly are using electric golf buggies in the outer Hills suburb of Kalamunda. A wide range of electric bicycles and similar vehicles are on sale in Japan and the Netherlands.

The federal Fringe Benefit Tax regime encourages employers to offer salary packages with car and free parking benefits. Prohibiting these packages but making them available for cycling and cycling facilities, along with elimination of the goods and services tax on public transport fares and bicycles would encourage a shift away from cars for commuting to Perth's central business district. 65 per cent of Central Perth's 85,000 workers currently arrive by car and use 47,000 all-day parking bays. A campaign is needed in conjunction with inner city local governments and residents to progressively reduce parking provision. Inner city residents are becoming increasingly hostile to the torrent of cars accessing the central business district through their communities.

Town Planning

For 40 years Town Planning practice in Perth has separated commercial centres and light industry zones from residential ones such that most can only be accessed for trading and employment by car. A strategy is needed to integrate these zones with residential ones so that they can be accessed by walking and cycling.

Perth suburbs built in the 1950's and '60's, now the middle suburbs, have large lots with houses on septic tanks. These areas are currently being sewered and are starting to undergo higher density re-development. Acute conflicts are arising between old residents and new development that has outgrown the existing town planning prescriptions developed in the era of outward expansion of the city.

Changes to Town Planning and local government legislation will be needed to support these initiatives allowing more flexible less prescriptive streamlined democratic processes than currently exist. "Bottom-up" approaches as well as "top-down" ones with appropriate and equitable conflict resolution procedures are needed. Such rapid change always has its stressful moments when tensions rise while equitable compromises acceptable to everyone are reached.

Conclusions

The world is faced with an immediate oil supply deficiency as non-Persian Gulf oil production peaks and the supply focus shifts to the Gulf countries who are not investing on the scale required to meet the shortfall. Obstacles to investment in oil infrastructure plus political instability in these countries makes it impossible to forecast when or if circumstances might change. There are no substitutes in sight to replace petroleum products to power transport, either in quantity or comparable economic performance. Therefore a real increase in the cost of transport will occur and a decline in the scale and scope of powered transport is inevitable.

Australian agriculture is heavily dependent on petroleum, given our nutrient deficient soils and climate. Agriculture and essential freight transport must have first call on our remaining petroleum fuels. Urban car travel must bear the brunt of the decline of oil.

Travelsmart, with its focus on replacing short car trips with walking, cycling and public transport, accelerated and expanded in scope, provides a framework to empower people at the local level to rapidly reduce urban petrol consumption. Walking has a central place in this framework. A launching pad can be established to more fundamental structural change by releasing the creative potential of local communities. Leadership and changes to planning and local government legislation are needed that facilitate this adaptation to shrinking oil supply. Urban transport funding needs to shift from roads to a multi-modal approach with a greater emphasis on demand management programs such as Travelsmart.

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