The Oil Transition and its Implications for Cities and Regions

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The Global Oil Peak

In 1956 M King Hubbert first suggested that the US would peak in oil production in 1970; despite being greeted with derision by many economists it happened. The US began to import oil which led to the strengthening of OPEC and the geopolitics of oil in the last part of the 20th century. The US now imports half of its oil and by November 2006 this cost was $350 billion (the website zfacts.com shows a continuous scrolling total of what oil imports are costing the US).

This chapter is premised on an even deeper crisis than that faced by the US in the past few decades: the global oil production peak and what this may mean for our cities.

Global discoveries of oil peaked in the 1960's as shown in Figure 1. The Figure also shows how global oil production has followed the general shape of the Hubbert curve apart from reductions due to the three oil crises of 1973, 1979 and 1991 before following a general upward trend until 2005. 2006 has seen reductions in oil production despite there being growth in oil demand of around 2 to 3% (mainly due to China and India though together they still only take 12% of world oil production while the US takes 26%). Some believe that the peak in conventional oil production has now happened.

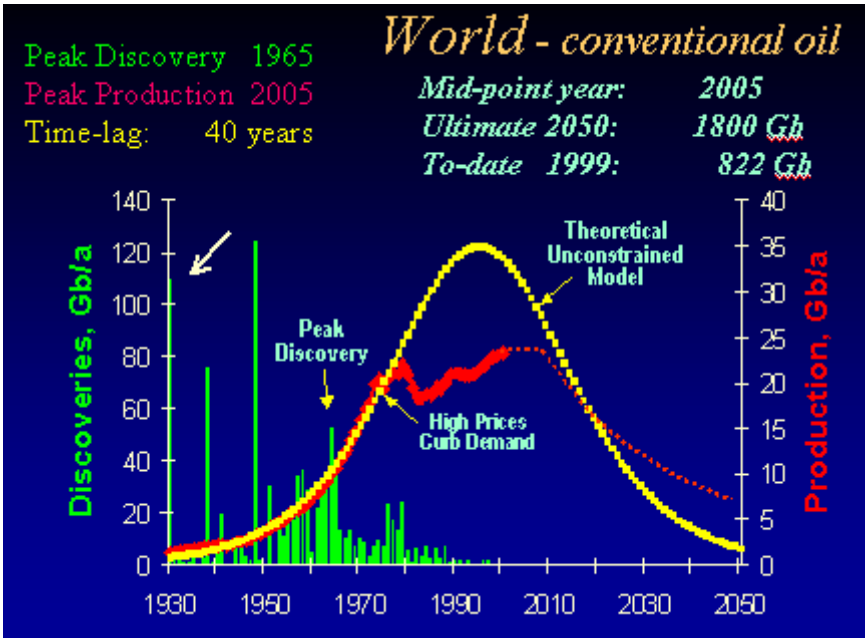
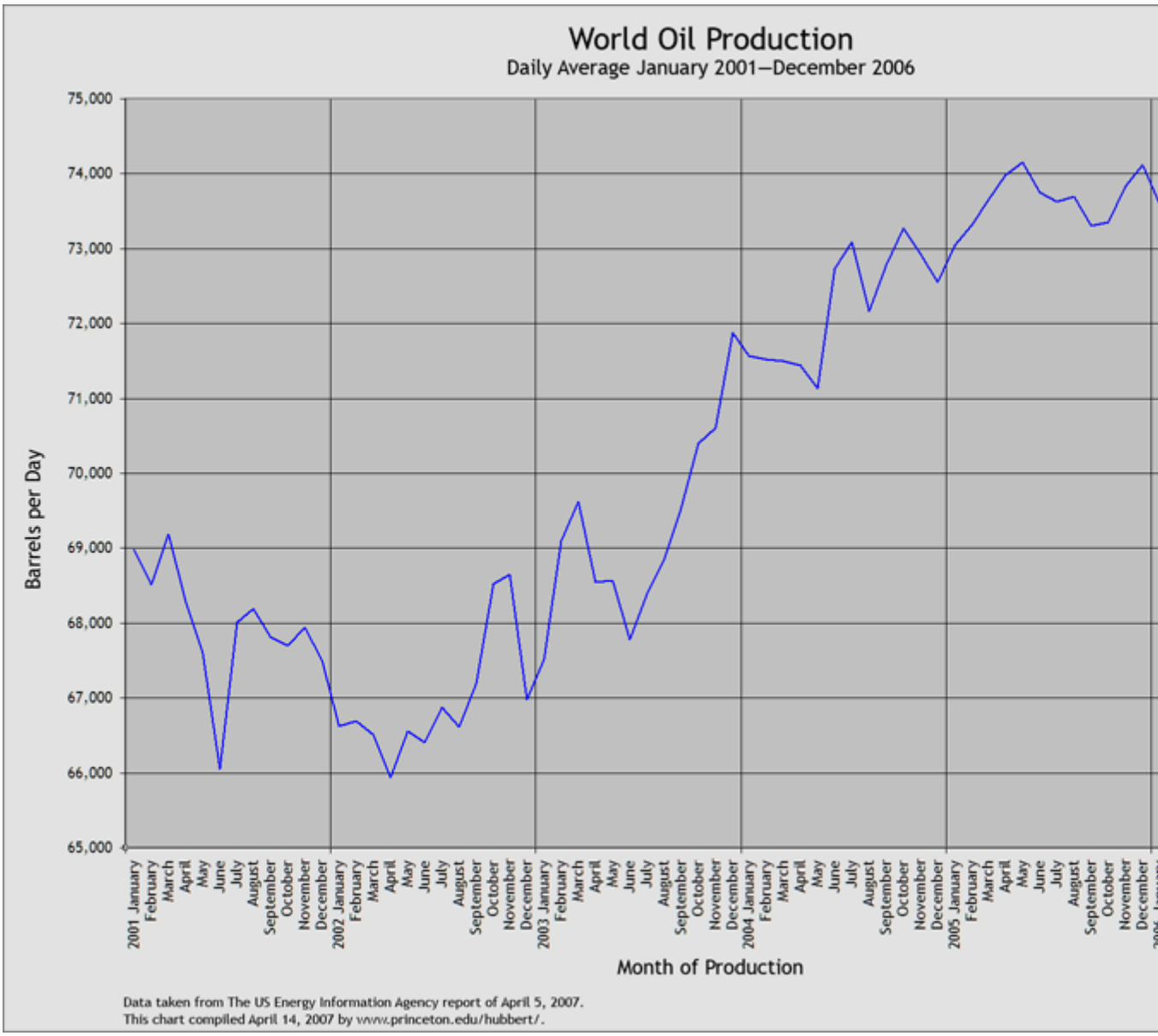


Fig 1 Peak oil in discoveries and production as well as the Hubbert Model. Source: Association for the Study of Peak Oil (Australia), www.aspo-australia.org.au

Enormous effort has gone into trying to discover more oil and to extract more from the reserves that remain. Oil reserves are now growing at a much slower rate than oil is being consumed. A peak in global oil production is therefore inevitable. There are

various estimates of when the peak will occur but they cluster around the early part of this century, with a few (now mostly discredited) way out into the future. C J Campbell, an oil geophysicist who founded the Association for the Study of Peak Oil, says that conventional oil peaked in 2004 and all oil liquids will peak in 2010. Deffyes (2006) has calculated an exact date for the peak at the 16th December, 2005 and then found that he was a few months out as May 2006 appears to have been the peak in conventional oil (see Figure 2 on World Oil Production, 2001-2006).



There is much debate about whether the peak is only short term, whether we bounce along on the top of the curve for a decade or so, or whether we begin a precipitous decline. Campbell (2004)says:

> *'The real point is not so much the exact date of peak but the statement that the First Half of the Oil Age, which was characterized by growing production, is about to be followed by the Second Half when oil production is set to decline along with all that depends upon it. On that at least we can stand firm. '*

An Australian television show on peak oil (ABC Catalyst, November,2005) reported an Australian oil company CEO who had asked the attendees at the previous Australian Petroleum Production and Exploration Association conference whether they thought the global oil production peak had already occurred - half raised their hands. Global oil production has declined by about 1% globally in 2006/7.

More conservative estimates from government sources in the UK and US are saying that the peak (including non-conventional deep sea oil) is sometime around 2010 to 2020 (Morita et al, 2001; IEA, 2006). Michael Pacheco from NREL National Biotechnology Center says that 'We need to start working toward replacement fuels 20 years before that peak' (Consumer Reports, 2006). So, whatever the peak (and it is probably earlier rather than later) we are already well behind schedule in responding adequately to this challenge.

Oil companies tend to give statistics on oil availability based on how long it will last at present rates of consumption. This tends to be around 30 to 40 years, but this is misleading as oil will not keep being produced at the same rate then suddenly stop.

The second half of the production cycle is harder so there is physically less and less available each year once the peak is passed. In an economy used to increases each year this is a significant difference. The peak is the critical change point.

Despite attempts by OPEC in recent times to increase production, global oil seems to be at or close to its full capacity. This level may hold for a few years then it will inevitably fall. This is happening just as China and India have entered the global oil market in a big way – China is now the world's second biggest consumer of oil. Supply to consumers in the west will be constrained by physical capacity and by the new players in the global market. The reality is the Golden Age of oil is over. A rash of academic and popular articles has supported this perspective, including respected trade journals like Oil and Gas International (a number of the key books are listed in the references).

Why has there been a growing awareness and concern around this issue? A number of geophysicists and industry insiders have 'blown the whistle' with their misgivings, especially on how real the oil reserves actually are. Most oil reserves are in the hands of OPEC but these analysts were concerned about the reality of some Middle Eastern reserves (especially Saudi Arabia); they were able to demonstrate that 'phantom reserves' had been created in the past decades in order to create higher OPEC quotas on production. Quotas on production were a license to make money in a world willing to pay for more oil. Re-evaluating the known geophysical data by people like Campbell, shows we are close to the peak, if not already there, and that oil will soon be subject to major physical shortages.

There are many conferences on this topic now, especially by the Association for Peak Oil. A key presenter at their International Oil Depletion Workshop in 2002 was Matthew Simmons, a prominent energy-sector investment banker from Houston and author of ‘Twilight in the Desert’ which shows that Saudi Arabia’s reserves are not what the world had been relying on. 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 cannot 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)*

Bentley (2002 p205)from the Oil Depletion Analysis Centre in London published an article overviewing oil in *Energy Policy* and concluded:

> *“The date of this resource-limited global peak depends on the size of Middle-East reserves, which are poorly known, and unreliably reported. Best estimates put the physical peak of global conventional oil production between 5 and 10 years from now. The world contains large quantities of non-conventional oil,*

and various oil substitutes. But the rapidity of the decline in the production of conventional oil makes it probable that these non-conventional sources cannot come on-stream fast enough to fully compensate. The result will be a sustained global oil shortage."

A report prepared for the US Department of Energy by Hirsch et al (2005,page 64)confirmed such warnings:

> *... the world has never faced a problem like this. Without massive mitigation more than a decade before the fact, the problem will be pervasive and will not be temporary. Previous energy transitions were gradual and evolutionary. Oil peaking will be abrupt and revolutionary.'*

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 summarized 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.....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 ,page 3).

Dr Bakhtiari has since published simulations of the World Oil Production Capacity model which suggest that global oil production will peak before the end of the decade, and most likely by 2006-07 (Samsam Bakhtiari (2004)). Dr Bakhtiari visited Australia presenting seminars in four cities in 2004 and also briefed the Western Australia Cabinet about oil depletion risks – one of the few times a 'peaker' has been able to speak directly to decision-makers.

Oil companies are now beginning to break with their traditional approach of only giving 'years of oil remaining'. A paper in December 2002 by Exxon Mobil Vice President, Harry J. Longwell (Longwell 2002) contains the world oil discovery decline curve which agrees well with those published in Aleklett and Campbell (2002) and shown earlier. Acknowledgment of this by a major oil company is very significant as it is clear 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.

Denial?

Although there is growing awareness of the problem, there is also widespread ignorance and denial, in most sectors of the community. Why? The reality of the dominance of economics with its inherent optimism about resources is the core reason why most serious people don't take 'peakers' seriously. Obviously oil companies don't want to talk up looming shortages due to the impact on their share price, though 23% of Shell's reserves stated from 1997 to 2004 were found to be 'phantom reserves' which led to the resignation of their CEO in 2005 and some real share price issues after they were fined $122 million for accounting fraud by the Securities Exchange Commission. .

Governments can take their share of responsibility for not wanting to jump into this issue as well; it is rarely in their interest to disturb people about something as fundamental as their oil dependence, despite the odd statement like President Bush's 2006 State of the Union comment about the US 'addiction to oil'. But most of all, the community at large seems unwilling to think about the implications of increasing oil scarcity and just wanting the price to be kept down. The Guardian (2nd December 2003) in an article called "Bottom of the barrel – The world is running out of oil - so why do politicians refuse to talk about it?" concluded:

> *"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 civilization in denial."*

This is an 'elephant in the bedroom' issue. We prefer to go on with life as though it weren't there. It challenges every aspect of life. We have spent the past 50 or more years building our cities and rural regions around the free availability of cheap oil.

Are there alternatives to oil?

The alternatives to oil are set out in Box 1

Box 1. Alternatives to oil.

1. **Non-conventional oil** which is mostly from deeper wells and some heavier oils (this is usually included in most scenarios, even though it still requires considerable technological development to extract economically);
2. **'Dirty oil'** which is from tar sands and oil shale and which have serious environmental problems as well as requiring huge amounts of water and natural gas to extract from their sand and rock, making them large greenhouse contributors (these are also usually included but are only small contributors);
3. **Biofuels** such as ethanol from corn or sugar cane, and biodiesel from soybean and waste oil (promising but limited as soon hits food conflict, see below; needs to be a breakthrough in cellulose to fuel technology);
4. **GTL and CTL** which are gas-to-liquids and coal-to-liquids which are known technologies and are small operations that could be increased (though each take a lot of energy to create the diesel, are capital intensive and worse in terms of greenhouse);
5. **Hydrogen** which requires an energy source to split it from water and can then be used in hydrogen fuel cell vehicles (however this is not yet past the experimental phase in most vehicles and requires a complete overhaul in infrastructure to provide, though in the long term is likely to be favored as long as it comes from renewable sources).

The response from most economists to peak oil is that supply and demand will create the necessary change and these alternatives will seamlessly fill the gap; technological modernism and the idea of substitutability of resources due to price, is still the most powerful paradigm of our age. 'The Stone Age didn't end with a shortage of stones' is a statement frequently heard when oil depletion is debated. However there seems to be something quite different and challenging about oil as it is so fundamental to everything we do and is likely to involve a considerably more expensive set of alternatives that have not easily emerged despite 30 years of 'oil crisis' in the global economy.

BP Exploration Manager Richard Miller(2004, p10), in response to the statement about ‘stone shortages’, said that:

> *“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 agendas... When oil gets too expensive, surviving Americans will still obtain energy from alternative sources, but in much smaller amounts and at much higher prices.*

The true size of the gap that is opening up between demand and supply gives some idea of the task that is required if we are to continue by switching to alternatives. The amount required by 2030 is equivalent to 6000 500MW power plants. None of the alternatives get anywhere near being able to provide even a reasonable proportion of this.

In the US there has been a sudden growth in ethanol as the possible replacement for gasoline and biodiesel for diesel. This has meant that ethanol production (mostly from corn) rose to 4.8 billion gallons in 2006 and biodiesel (mostly from soybean oil and

waste grease) to 75 million gallons; however it is worth seeing that this is less than 2% of the gasoline consumption and a mere 0.2% of the diesel consumed. They are bit players only.

Much has been suggested as being possible with biofuels because Brazil has managed a much higher proportion of their fuel from distilling sugarcane (Worldwatch, 2006). Lester Brown (2006) has suggested that there is a growing conflict developing between food for people and food for cars. He shows that grain reserves worldwide have been depleted by this sudden use of US corn and that a doubling of ethanol production (which seems almost certain) will induce a major crisis in the price of grain; this is occurring when nearly a billion people in the world remain malnourished. In 2007 30% of US grain crop went into bio fuel leading to a tripling of world grain prices. To convert the entire grain crop of the US would produce just 12% of the gasoline and diesel supply in the US – this will not happen as regulations on the amount of food going to make fuel will be applied.

The UK Minister for the Environment from 1997 to 2003 Michael Meacher says: *'Alternatives like biofuels, ethanol or biomass can play a marginal role but nowhere near on the scale required. When the oil runs out the economic and social dislocation will be unprecedented.'* (Meacher, 2006 page?). He goes on to quote Exxon Mobil's John Thompson who foresees that by 2015 we will need to find and develop 8 out of the 10 barrels of oil (and gas equivalent) that we are now producing from. This is just 'not available', he concludes.

What all this suggests is that conventional oil and natural gas are in a league of their own. As they become less available the alternatives are going to take a lot more work to provide and hence are bound to be more expensive. The era of cheap oil seems to be incontrovertibly over.

Alternatives such as the 'dirty oils', and coal to liquids are likely to be highly marginal as they require so much energy to produce them. The Canadian tar sands for example require substantial quantities of natural gas to extract the oil from the sand and hence require subsidies. And this does not include the external costs of their environmental impacts or their greenhouse impacts which are substantial.

The biofuel alternatives are also quite marginal as substantial energy is needed to distill them from their carbohydrate base. Some potential exists for reductions in this ratio if the conversion of cellulosic material (agricultural and forestry waste for example) to ethanol can be commercially developed (WorldWatch, 2006).

Critiques of peak oil

For the past few decades of debate on peak oil the International Energy Agency (IEA) has been a peak oil skeptic. They have always said that there is much more to be found that will enable us to proceed for 50 years as we have been doing. The International Energy Agency in 2006 released a report to analyze where peak oil pundits have got it wrong. It does little to ease concern. In the IEA (2005) report, "Resources to Reserves: Oil & Gas Technologies for the Energy Markets of the Future," Claude Mandil, the IEA's executive director, says:

"Soaring oil prices have again spotlighted the old question. Are we running out of oil? The doomsayers are again conveying grim messages through the front pages of major newspapers. 'Peak oil' is now part of the general public's vocabulary, along with the notion that oil production may have peaked already, heralding a period of inevitable decline." (page 6)

Mandil however says "the IEA has long maintained that none of this is a cause for concern (p6)" Then the report looks at the data and says most countries outside of OPEC:

"…have passed their peaks in conventional oil production, or will do so shortly…Their world is one of maturing oil fields. Their exploration and production costs are typically higher but they limit OPEC's monopoly effect, thus operating with smaller margins. Cost reduction is therefore a constant concern. Proven reserves to production ratios are small, averaging around 15 years and production in the older fields is declining (page 46)."

This is the exact problem that 'peakers' have been trying to highlight for some time. The report goes on to confirm that the peak oil theory did describe accurately what happened in the US in the 1970's:

"The striking success of Hubbert in predicting the peak of U.S. production suggests that such conditions were more or less met in the U.S. during that time period." (page42)

This has never been admitted before by the IEA.

The report then questions the current relevance of Hubbert to global oil production suggesting that:

"The controversies surrounding peak oil in the literature revolve around four main points. Does the Hubbert model apply to oil production worldwide? If the Hubbert model does apply, when will the peak in worldwide oil production be? What happens after the peak? How fast will the decrease of production be? What role does technology play in such models?(page 42)"

After admitting that a peak could be approaching (maybe even 2010) the report opts for new technologies and increased investment as the way to counter any production inflection. But the level of investment suggested as being necessary is almost beyond belief. It will need by 2030 around $5 trillion or about half a billion dollars a day between now and then. It is hard to imagine such numbers but $5 trillion is half of the entire GNP of the United States. The report concludes that:

"Neither private enterprise nor national companies necessarily have the incentive to assume the risk…. Furthermore, private industry cannot be relied upon to invest in research on technologies that are too far from being economical.(page 119)"

If this is the good news about peak oil then it is understandable why many people are getting worried. The IEA have only confirmed the unease that we have about the oil situation. The peak oil crisis to them is a capital crisis to create more oil from expensive hard to get sources and certain alternatives. They too can see that the era of cheap oil is ending. The IEA have finally recognized that *conventional oil is peaking* and may decline by as much as 5%. This is a remarkable admission. But they then suggest that unlike all the other oil fields that have been declining the next batch will

be pushed much harder so that they will not decline in the traditional manner. They believe much more can be squeezed out of conventional wells to ease us through the next few years and then the alternatives will flow. Considerable questioning about the potential for pushing conventional oil was raised by critics of this report, eg Brown (2006), but the amount of alternatives that can be produced to fill the looming gap received the biggest critique (Cohen, 2006; Kunstler, 2006).

This is the motivation for casting this chapter around peak oil. The only real solutions being proffered by groups such as IEA are part of the problem. I would suggest that there are many more cost effective solutions facing us in our cities and rural regions. A capital crisis which is beyond our capability is just as real a crisis to the future of our cities; we have pushed our cities into a new realm of potential vulnerability if not possible collapse.

Natural gas…savior or same problem?

Natural gas is the obvious transition fuel to help ease the problem of oil depletion. It can be converted to diesel as well as being used in vehicles itself. Natural gas has already been used to replace heating oil in many homes and to replace oil used in commerce and industry. In Australia oil went from 57% of the fuel mix in 1980/81 to 48% in 1997/98 whilst natural gas went from 13% to 20% as boilers, kilns, stoves and heaters all shifted to natural gas (Productivity Commission, 2005).

The next stage would appear to be to switch to greater use of natural gas in transport as trucks and trains can use CNG or LNG in their diesel engines and cars can be switched over as well (particularly if the manufacturer makes them as standard as occurred in Sweden when the government committed to gas cars for their vehicle fleet). The attraction is that natural gas is already in place in terms of distribution infrastructure although actual filling stations are not in place.

The conversion to natural gas is an obvious step in places like Australia where there is a good supply of natural gas available. However in Europe and in the US this is not the case. Europe is going to far away places in the east to bring their gas and already some signs of an OPEC-like protection of the resource are developing. In the US natural gas has already peaked and they are now looking to import it using LNG tankers – starting an overseas dependence similar to the oil issue when they peaked in local oil production in 1970.

Global natural gas production has had similar estimates on its peak to oil, and they range from 2010 to 2030 (eg Fleahy, 2002; Caruso, 2003). The peak in discoveries was in the late 60's to early 70's so the same pattern as oil seems to be evident. It is not surprising that oil and natural gas are working in tandem as they have similar geological origins in marine sediment (unlike coal which comes from ancient forests). Also oil prices and natural gas prices are closely linked so as oil goes up in price the same is likely to occur for natural gas. Natural gas can only be a small part of the transitional arrangements for oil; it cannot be seen as the long term replacement.

With natural gas in short supply the world must come to grips with another energy source for use in commercial and residential heating, cooking, water heating and even

electric power… as that has replaced oil in many parts of the world. Natural gas is much more critical in industry and is likely to attract a premium for its use there. But the agenda now must be building houses and offices where they can use solar and renewable fuels as well as designing to use less fuel overall. This will be one of the key focus points for the chapter along with how gasoline and diesel can be reduced in transport.

Industrial and petrochemical uses of oil and natural gas, freight diesel, and aviation, would appear to be premium applications of oil. As oil peaks these premium uses will mean that the decline in availability for private transport and buildings will be even more obvious, the need to do something about replacing them will be even more critical.

It is sometimes stated that nuclear power and coal can take up the slack with these fuels. However nuclear and coal are for electricity and bear little relationship to the issues being considered here. Coal can be converted to liquid fuel though it is a minor option in most scenarios due to the compounding of the greenhouse problem as well as the expense of conversion. Electric vehicles are not yet a viable alternative although electric transit is and will be promoted here though it will not increase the need for electric power much as electric transit is very efficient compared to cars (Tokyo's electric rail system achieves over 6600 miles per gallon equivalent). But transit helps reduce travel in total so good transit should be associated with considerable reductions in travel distances as cities are rebuilt in more efficient patterns. Electricity can be used for home heating also but it is extremely expensive compared to oil and gas so it is much more likely that solar building will be cheaper,

especially when greenhouse impacts are included in the costs. The *Solar City* agenda is to reduce heating oil, natural gas and electricity as well as tap into renewable sources of electricity that can replace all fossil fuels and nuclear – eventually(http://www.greenhouse.gov.au/solarcities/)

The Agenda

Figure 3 sets out the production cycle of conventional and non-conventional oil and natural gas as concluded from the various global studies. This figure suggests that conventional oil peaking is occurring now and that this will ensure the price of oil remains high. It concedes that we may have a few years of non conventional oil and gas where we can continue some small growth although there are indications that maybe all fossil fuel liquids combined has peaked as discussed above (Mushalik, 2007). Available evidence points to a critical turning point around 2010 when even with all the non-conventional oil and natural gas on-stream, the global peak will occur. The period between then and now is when conventional oil and natural gas are peaking and will enter a serious decline phase. It is time to respond seriously to these trends. The demand curve is set to grow at a much lower rate than previous growth as the price goes up, but there is still going to be growth in demand that is linked to forecast growth in the population of our cities and regions. What can they do?

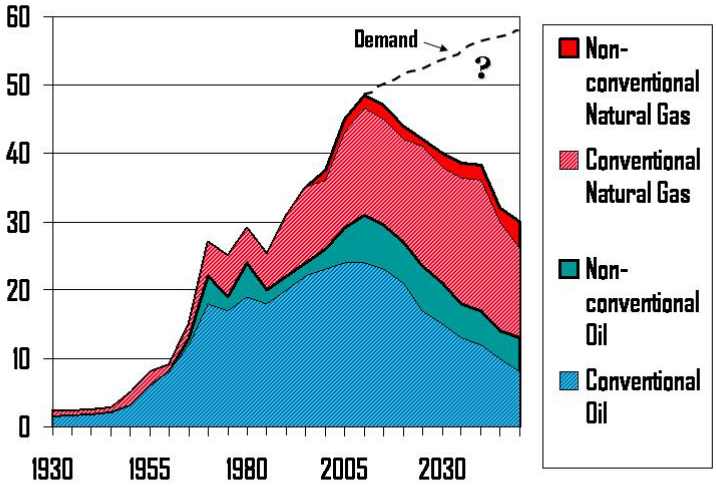


Fig 2.2 Production cycle of oil & natural gas including nonconventional sources

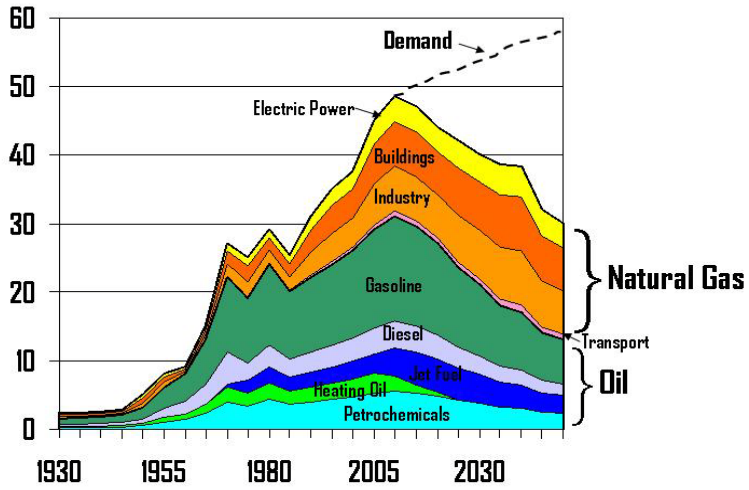


Fig 2.3 How we use oil and natural gas & how this may change as they peak in production

Peter----can you give the Source for your figures if they are not yours THEY ARE MINE.

In order to gather some perspective on the transition to the future it is important to see how current fuels are used and how each one is likely to change. Figure 4 sets out this same figure with the various components and uses of oil and gas divided roughly into

the functions and fuels that these resources have been put into, plus some idea as to how they will continue into the future as they decline.

Diesel is presently used for small scale power stations and for pumping water; these can now be easily replaced by solar and wind technologies and thus diesel for non-transport purposes should be immediately phased out (Barlow et al, 1993; www.rise.org.au). Some extra premium is applied to diesel for freight and agriculture and also aviation fuel but these can only last for awhile so these functions must also begin to decline if they are only able to access these fuels. Heating oil is rapidly replaced and probably is already being phased out by refineries in favor of other grades of oil. Gasoline, the biggest part of the oil pie, inevitably must enter a steep decline phase. Natural gas is seen to take up a small proportion of the transport and building task but along with its other functions, natural gas too begins its inexorable decline, especially in the less premium functions for commercial and residential buildings.

The focus of this chapter is on the large area contained by the question mark. What can replace the growth in demand (for liquid fossil fuels) that has been driving our cities and regions for the past century? What will take up the slack as decline sets in? The answer from this chapter is set out in Figure 5 and Figure 6.

In terms of alternative fuels there are ways that could enable the decline to at least be set to zero rather than the 5% decline expected (see Figure 4). This is highly optimistic for a number of the options. All non-conventional oil and natural gas is already assumed in the supply figure even though much of this needs to be developed

in deeper and more remote areas. Of the alternatives , natural gas will fill some of the gap before it leads into the use of Hydrogen from renewable sources perhaps by around 2020; electricity will increase in its use for transport through electric rail and electric vehicles; some ‘dirty oil’ will be produced from Tar Sands and Oil Shale before their greenhouse impact and their low energy ratios mean they are not pursued; coal to liquids will be increased but not much as its greenhouse problems and energy ratios will soon show it to be a nineteenth century solution; and biofuels will take the largest share of the gap, expanding into the future.

INSERT FIG., 5 and 6 ABOUT HERE

There are many who do not think that this quantity of alternatives can be produced and their infrastructures built in the time required. I have been reasonably optimistic, perhaps too much. But it still leaves us with a yawning gap opening up. Thus Figure 6 suggests we will fill this gap with conservation, due to:

- reducing the need for travel in our cities and regions through rebuilding in new forms together with lifestyle changes;
- alternative transport options such as transit, bicycling and walking;
- vehicle efficiency; and
- solar buildings and renewables.

These, together with the alternative fuels, will be the basis for the new economy in our cities. Innovative cities are beginning to show the way on this agenda but it is a long way from becoming main streamed enough to create the changes necessary to achieve what is illustrated in Figure 6.

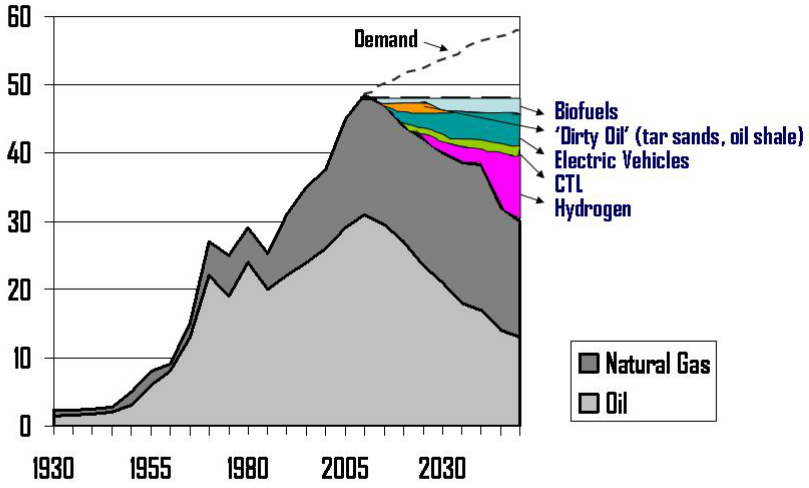


Fig 2.4 How we may adapt to the peak in production of oil & natural gas

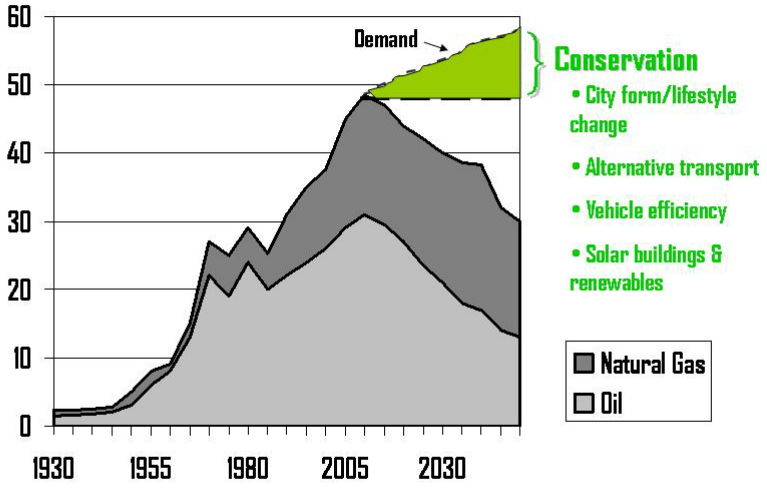


Fig 2-5 How we may adapt to the peak in production of oil & natural gas

The oil and natural gas context suggests we are facing a serious challenge. Most cities face a future where they are expecting an increase in cars and an increase in buildings.

However, there are serious questions about whether this can happen. From here on cities wanting to grow in their use of cars will need to do so with less and less oil. This will mean either alternative fuels or reduced need for cars. From here on cities wanting to grow their number of dwellings and other buildings will need to do so with less and less heating oil and natural gas - not more. This will require alternative fuels, renewables and reduced need for energy.

How quickly will the decline set in?

As suggested in Figure 4 the conventional oil decline could be as much as 5% per year. The goal for Campbell (2001) is that we must cut demand by 5% per year through to 2050. Even if a more conservative 3% per year decline in availability of conventional oil and natural gas became the normal setting for cities, what would this mean? To begin with, there will be a clear case for some uses to continue with their functions as they are so critical to the functioning of cities. As outlined above it is likely that cities will have to use dramatically less oil and natural gas in buildings and transport as other uses capable of paying premium prices take it up. Thus instead of growth in these fuels for transport and buildings we are facing perhaps more than 5% per year declines in these normal household uses. This will mean alternative fuels will be essential but also we will need to better manage the design for these functions. We will rapidly need different buildings which don't need as much heating;or cooling and it will mean differently configured cities which rapidly reduce their need for cars.

Responding to this challenge is necessary even if the oil crisis was not happening (see other chapters about health and environmental issues associated with car dependence),

but it makes the agenda of managing the car and making more use of the sun even more vital, if not critical to the future of cities. If we don't respond then what is likely to happen?

City Futures

Cities have grown strongly in the age of cheap oil. Cities are presently growing globally at 2.3% per year and rural areas at 0.1% which means people are still leaving the country for the city. Today around half of humanity live in cities. Nearly all cities participate in a global economy which has been built around the availability of cheap oil.

There are no models we can easily use to understand how cities will manage in the age of reduced oil availability. All Australian cities have recently had strategic planning studies done for the next 30 years of development. Although the studies have recognized that there is a need to reduce automobile dependence and save on oil, they have not intervened in any radical way to stop oil-consuming behaviours, and they have assumed continuing growth in population and jobs – growth which peak oil could throw into doubt. What will happen to such cities as oil peaks? I am suggesting four possible scenarios.

1. Collapse

Many forecasts of the consequences of peak oil are taking on an increasingly apocalyptic tinge. The work of Jared Diamond (2005) on how civilizations in the past have collapsed is often related to this issue. A Republican Senator, Roscoe Bartlett, after discovering peak oil said 'Civilization as we know it will end soon.' Websites

that discuss this possibility talk about the ‘die-off’ scenario where billions will die as the world’s cities are unable to adapt to the decline phase of the oil cycle.

I would not want to discount this as a possibility, history is littered with cities that did not adapt. But I would point out that there are many cities that use hardly any fuel (such as Chinese and Indian cities at around 2 GJ per person per year) many that are very wealthy use only a modicum of oil and could easily adapt to almost nothing (eg Tokyo and Barcelona use 8 GJ per person) whilst most US, Canadian and Australian cities use frightening amounts of fuel (Australian and Canadian cities average around 30 GJ, US cities average 56 GJ with Atlanta the highest at 103 GJ per person; also see Newman and Kenworthy, 2007).

Thus some cities could easily collapse but most are likely to be able to adapt. The emerging sub-prime mortgage meltdown in the US has started the collapse of some outer and fringe suburbs as people cannot afford to pay their mortgages due to increased transport costs which they are highly vulnerable to in these areas.

2. Ruralised City.

Some people believe that our cities will respond to this possibility of ‘collapse’ by dispersing and we will then create a more sustainable semi-rural lifestyle where we will all be responsible for a large proportion of our own food. This would be reflected in suburban agriculture, permaculture villages or hobby farms (Trainer, 1995; Gunther, 2001; Holmgren, 2002, 2005) where most of the economy we now see has been devolved down to small groups or even individual households. It is a ruralisation

of cities. Holmgren (2005) sees the suburbs as a farming opportunity waiting to happen:

> *'Suburban sprawl' in fact give us an advantage. Detached houses are easy to retrofit, and the space around them allows for solar access and space for food production. A water supply is already in place, our pampered, unproductive ornamental gardens have fertile soils and ready access to nutrients, and we live in ideal areas with mild climates, access to the sea, the city and inland country.'*

Fundamental to this scenario is population decline as a quick calculation shows that the available land to enable small scale production would quickly disappear if all of our cities were pushed out onto agricultural land. The transition is never described but it would seem that the 'Killing Fields' would be a playground by comparison. It is sometimes euphemistically called 'the die-off scenario'. It is however often discussed with some relish as the anti-population, anti-urban movements often link together to imagine a ruralised city as the preferred future. Peak oil is thus sometimes grabbed hold of with glee. Such ideas are rarely challenged and their currency grows daily under the frightening scenarios of peak oil.

I do not believe it is a likely scenario. The broad sweep of history shows that although cities have collapsed as they depleted their soils or were unable to manage their settlements or were destroyed by invaders, they have not gone back to a rural Eden: cities tend to be rebuilt, and have endured and grown.

The reason we rebuild and adapt cities is that our choices for returning to nature are very limited and to most people, are not acceptable. Not only do we not want to become totally dependent on foraging or hunting for our food, we mostly do not want the responsibility for food production at all. The attractions of doing other things that are only possible if we are freed from food production, drives us to cities.

The example of Havana in Cuba is often presented as a city that had to develop its own agricultural response to being cut off from oil when the Soviet regime collapsed. This was an important phenomenon but the reality is that Havana kept going as a city it did not just evolve into a permaculture paradise. We are going to have come to terms with a new kind of agriculture and a new kind of city, but we are not likely to reverse 13,000 years of urban history. Nor would we want to as the consequences for rural production as occurred in the forced ruralisation programs of Mao and Pol Pot were disastrous.

Cities are our likely habitat for the foreseeable future. We need to constantly adapt our urban technology and lifestyles to ensure cities are more sustainable: in their resources, in their ecological base and in their human livability. They can collapse if we don’t adapt. In the same way rural production will still need to be the source of food, minerals and materials. Such activity however will need to adjust to being done without oil, or it also will collapse. The core argument of Jared Diamond is not that there are physical limits which exist but that our ability to adapt to these is the real test of our civilization.

3. Divided City.

The response in this scenario is that some people (those with the economic means mostly) will move to centres where electric transit and short walkable destinations are easily available. Highly efficient healthy buildings full of solar technologies ensure that those who can afford to can live even better than before. Outside of these dense eco-centres are the dispersed suburbs which become poorer and poorer, descending into a kind of collapse that is depicted in the Mad Max films with gasoline being the resource that warring gangs fight over (George Miller's movies were apparently inspired by reading about peak oil).

There are many signs of this possibility occurring. The wealthy are moving to central locations and especially to transit-oriented-developments(TODs). The poor are increasingly having to pay a higher and higher proportion of their income on transport (STPP, 2005). The market will move quickly to enhance this option as fuel prices rise and we are beginning to see the first signs in the US of abandoned outer suburban developments and rapidly accelerating inner urban enclaves of wealth. This Divided City could become significantly worse quite quickly and it is not hard to imagine.

4. Resilient, Sustainable Solar City.

This is obviously how we must try to move. It is a city where all that the wealthy are seeking in Divided City is provided for across the whole city with genuine walkable city centres being built in all of the suburbs linked by quality electric transit. It may mean abandoning some of the far flung scattered rural hobby farms around cities where no real urban services can be provided without excessive driving. These areas are seen to be ideal land uses by some in the permaculture movement but invariably they are heavily car dependent suburbs where neither rural nor urban functions

survive well. It is a conflict that must be resolved before the price of oil causes real pain for such residents.

So what should we do to achieve such cities?

1. **Take it seriously – create Peak Oil Strategies.**

Awareness of this issue needs to go through a similar process to the one that the world has adopted over climate change. Global conferences of nations need to be established through the UN, in order to set goals and begin sharing information on how the world economy can be weaned off oil. States and cities need to create Peak Oil Strategies. In Western Australia, in our State Sustainability Strategy there is a section on Oil Vulnerability, the Gas Transition and the Hydrogen Economy (Government of WA, 2003). This set out the peak oil issue and began a process of examining what it could mean. It was a major reason why the state backed a Hydrogen Fuel Cell Bus trial as well as a revamped electric rail system, as it helped us to begin to work on these issues of transition away from oil. Two cities have now developed Peak Oil Strategies – Portland and Brisbane (City of Portland Peak Oil Taskforce, 2007; Maunsell, 2007). Both were developed by a Peak Oil Taskforce set up to contain activists, industry and government. The Brisbane Taskforce included climate change as the two issues of course overlap though oil may be more imminent. Such reports need to be followed up with government structures such as an Office of Oil Vulnerability**.**

2. **Plan and build compact cities based around transit.**

The world's cities existed and thrived before the age of oil; it is possible to imagine them transitioning to a future where oil is no longer needed. Car dependence is the

problem that drives oil vulnerability .Thus cities must plan and build to overcome car dependence (Newman and Kenworthy, 1999).

The solution to car dependence is a combination of transport infrastructure and land use policy as well as household education programs which have successfully reduced car use (eg. TravelSmart). This set of policy approaches has been recognized by all Australian cities in their Metropolitan Strategies and all suggest a policy of centres and transit-oriented corridors which can provide travel alternatives in every suburb.

The major problems are not in the central and inner city areas as these have similar fuel consumption per person to Asian and European cities (6 to 17 GJ per person per year), they are comparatively well off in terms of public transport infrastructure, and they are dense and mixed in their land use. They will easily adapt to peak oil. However the newer suburbs in the outer areas of cities across the world, built in the past 4 or 5 decades, are heavily car dependent with fuel consumption similar to US cities (average 56 GJ per person per year). There are real equity issues here as the wealthy live mostly in inner areas and the poor increasingly are trapped on the fringe. There are signs that this is now happening in US cities with some outer area households using 40% of their income just to travel around to jobs and services. This will become intolerable after peak oil.

The need for more compact, mixed use development in centres can also assist with the need for buildings to use less energy. Newton, Tucker and Ambrose (2000) have shown that in Australian conditions denser development will also save on building energy, mainly through a shared insulating effect. Direct attempts to increase these

savings and to use green materials, green appliances and renewable power in the buildings will also be required.

This strategy also requires ensuring social housing initiatives in any new centres and a crash program in public transport infrastructure for the middle and outer suburbs. Extensions of electric rail lines are the obvious way to go along with integrated local buses that can provide a service at least as quick as that provided by cars. Time savings will remain a bigger factor in determining mode of transport even under very high fuel costs.

The Australian House of Representatives Report on *Sustainable Cities* (2005) recognizes all of these things and recommends that infrastructure funds (especially for rail) be provided for cities, especially in the middle and outer suburbs. Most national governments do this, even US cities already do this, and all countries need such a mechanism to cope with peak oil. Partnership funding of the required rail systems and integrated transport programs would follow if an Urban Infrastructure Program was begun.

Perth's new rail system is unusual across the world as its $2 billion cost (which has given the city a 180 km modern electric rail system with 72 stations) was built without any Federal funds, though the Freeway it passes down was funded almost entirely from Federal coffers. This railway (which is much cheaper than in many other cities due to government owning the land and only having to build two bridges) has been justified over many elections as a way of oil-proofing the city. There are many new developments planned around its stations to take advantage of this insurance and

its obvious amenity now, which will become even more critical in the future. The new rail system has removed 100,000 cars from the road system and it is set to double again in the next decade. But there is much of Perth that remains highly vulnerable to peak oil as in most Australian and North American cities.

We cannot afford to build further and further out in cities as this inevitably builds car dependence. Most city plans now recognize that the main task is to redevelop in the present urban area, especially in Transit Oriented Developments around rail lines. Cities need to be more urban and the countryside more rural. However there are many still who believe cities should be dispersed into rural areas as outlined above. Getting serious about oil depletion means that rural lifestyles on the edge of the city cannot be facilitated and subsidized as they have been. There is a real clash between those who want to ruralise cities and those who realize the problems this creates in car dependence.

This does not mean that we do not try to create local eco-villages where people in cities can be more reliant on each other with reduced oil consumption as a result. Such places, like Christie Place in Adelaide, Somerville in Perth or Vaubun in Frieburg are essential to help us through this transition. But if they are an excuse to extend the city into areas that are better left rural, then they are not going to help.

3. Rebuild peri-urban agriculture.

A lot of the literature on peak oil suggests that the biggest impact is going to be on agriculture. Certainly agriculture has become very dependent on diesel. In the analysis

above I have tried to show that I do not expect our cities to begin taking over from rural producers in the production of food and fibre. In fact the loss of good agricultural soils to fringe urban suburbs and hobby farms has to stop as they are generally very unproductive as well as being highly car dependent. The fringe areas of Australian cities ,where agricultural soils have been sacrificed to scattered suburbs and rural hobby farms like the Central Coast north of Sydney and Mornington Peninsular in Melbourne, exhibit 3 to 4 times the average fuel consumption per person and 8 times that of the inner city. If we are serious about oil depletion and sustainability in general we need to ensure that the countryside is more rural as well as the city being more urban. This would also sustain the current attractiveness of Australia's cities and rural hinterlands from a tourist point of view.

One of the ways we can do this in Australian cities and I suspect in any city across the world, is to establish Horticultural Precincts immediately adjacent to cities. These areas need to set aside the good soils and ensure they are retained in perpetuity for horticulture rather than always being seen as superannuation for the next suburb. In these areas we can then get serious about recycling wastewater. Water Corporations cannot invest in the pipes and technology for this important new approach to urban technology unless they have certainty about the future for an area.

Agriculture will need to adapt by growing its own biodiesel, using gas and switching to more efficient rail transport rather than trucks. This transition will need assistance and subsidized diesel is not helping. A crash program in diesel phase-out could change peri-urban agricultural oil vulnerability in a five year period.

One of the obvious ways that agriculture will need to change is to become more localized. There may be a reduction in choice as regional produce will be favored over imported produce but this can be part of regional identity and the slow food movement, rather than deprivation. Cities should not need to import vegetables from other regions, especially by plane. Wheat and other grains however are a bulk commodity which can be transported by train and ship at low oil or no oil cost. Agriculture needs to be more localized for the particular cities in its bioregion, as well as creating surpluses which are traded for the benefit of regional and urban opportunity.

4. Facilitate localism.

James H Kunstler (2005) in the Long Emergency says that in response to peak oil 'Our lives will become profoundly and intensely local.' Localism is the required modus operandi for the post peak oil world, just as globalism was for the cheap oil era. Globalization of the economy began with the first cities that began to trade beyond their immediate region – probably 4000 years ago – and it will continue under a post peak oil world. But its character will alter as the extent of trade and movement cannot be expected to continue as though its transport costs were unimportant. As mentioned above there are social movements that are beginning to push us more towards localism anyway: the need for local identity and sense of place; the slow food movement and its base in local foods; the ecocity movement with its desire to enable local community to be the basis for managing local resources and local infrastructure; the local enterprise movement that has shown business development is best done with local social capital as its base (Sirolli, 2001).

The value of the internet and video conference facilities on our phones will become even more obvious to maintain the global interaction that we have tasted and will not easily give up. But in the same way that governments have facilitated businesses to export globally and have pushed international tourism, we now need to facilitate localism. I would suggest we need an Office of Localism with a program to fund innovations in localism. This can help to fund demonstrations of new urban technologies where there is a need to create distributed energy and water infrastructure (involving less energy for distribution and pumping), localized industrial ecology of businesses that can share their wastes as resources or work together to ensure local resources are used and re-used; where local food linkages need to be linked up between peri-urban growers and urban communities to take direct supply of whatever is fresh; where local enterprises can be facilitated based on local resources and talents; where local tourism can be marketed to local people…

5. **Regulate for the post-oil transition.**

A systematic review of regulations will show that at present we subsidize oil consumption, whether it be through fuel rebates to producers, tax rules on cars and fuel, the subsidy on land development at the urban fringe (around $40,000 per block in most Australian cities without considering health and education services, see Newman and Kenworthy, 1999), as well as the subsidy given to road users in the form of state-based road building grants. Proactive regulation is also required to phase out the excessive use of four wheel drives and other gas guzzling cars with a clear phase-in program for gas-based electric hybrid cars.

The past twenty years saw a move away from regulation on vehicles and the result was declining overall fuel efficiency in the fleet. This cannot be allowed again – we must regulate for motor vehicles to transition away from oil and the first signs of this are now apparent in California. Governments can begin by regulating for their own fleets.

Aviation is a special case. There seems to be no alternative to oil on the horizon. The only solution it seems will be to allow gradual price increases to reduce unnecessary travel, to switch to fast trains for medium distance journeys, and to do more and more by internet conferencing (including family events). However, it would seem there would be a case to ensure that aviation had some priority on remaining fuel – this would also require some kind of regulation.

Conclusions

Australia, and probably most advanced countries, have developed highly complex scenarios for dealing with terrorism. There are no such scenarios for dealing with oil vulnerability and its implications for our cities. Strategic analysts and policy leaders need to take oil depletion seriously and see what must be done in short, medium and long term scenarios for reductions in oil supplies. The start of a process was there with the development of thinking about the Hydrogen Economy but this is long term. We need to see how we can reach the future where there is no oil in a series of steps in urban development. We cannot afford to depend on the market to handle this as it will always seem that cheap supplies of oil from the Middle East are the only thing we need to worry about and while they were expanding, we were not in trouble. Global supplies of oil are not expanding any longer and we cannot just hope that they will

continue to grow again. A new urban world is emerging where we must adapt to using less non-renewable resources and using different technology and different urban forms or our vulnerability to oil will be seriously exposed.

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