Cairns Oil Vulnerability

Final Report

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NOT GOVERNMENT POLICY

For Discussion Purposes Only

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1. INTRODUCTION

1.1 This report has been produced by Kilsby Australia , with the assistance of Phil Hart.

1.2 It aims to establish just how vulnerable the Cairns Area is to a future where fossil fuels are neither as plentiful nor as cheap as they are today.

1.3 This is not a problem confined to Cairns, of course. Section 2 reviews global issues relating to oil production and consumption, and concludes that the risk of a "Peak Oil" future happening within the next 5 years, is very real.

1.4 Section 3 reviews issues that require either a whole-of-Australia or a whole-of-Queensland response. It finds that official plans are more suited to a future where any oil shortage is temporary rather than a sustained feature of life.

1.5 Section 4 looks at regional issues. This considers the unique position of Far North Queensland, and Cairns City in particular. It looks at what sectors the regional economy depends on, how much oil is used, where it comes from and in what way the economy would be affected if the worst fears of Section 2 came to pass.

1.6 Section 5 is a case study of how one large local employer, Cairns City Council, could be affected. This is principally a financial assessment, assuming that Council's services continue in some form. In practice the services may still get performed in future but in a more energy-efficient way.

1.7 Section 6 broadly considers mitigation or adaptation measures that could be undertaken, and their timing.

1.8 Section 7 brings together some conclusions from the previous five sections.

2. GLOBAL ISSUES

Peak Oil

2.1 It is stating the obvious to say that the world functions on oil. There are unmistakeable signs that the age of cheap oil is coming to a close. Figure 1 shows the essence of the problem.

2.2 The world's production of oil has been rising for at least 100 years, keeping pace with the rising demand for the product. But the world's endowment of oil is finite, and this cannot continue indefinitely.

2.3 Once the global production of oil reaches a peak ("peak oil"), then oil will become more expensive and prices more volatile, increasingly hard to obtain and more difficult to extract (ie the Energy Profit Ratio, the amount of energy that has to be input to obtain a given quantity of output, will fall). [1]

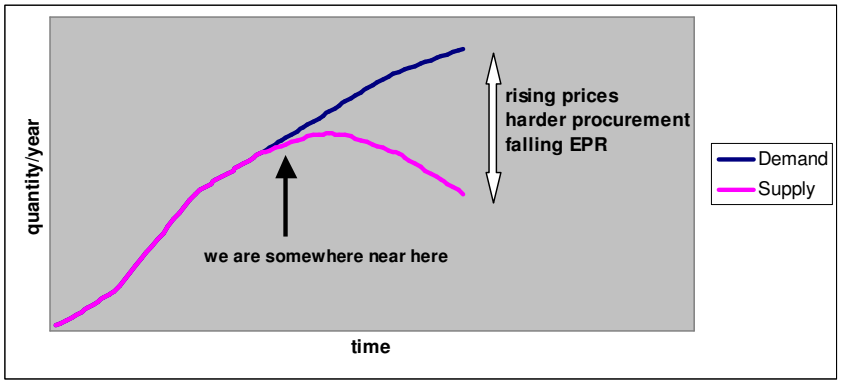

Figure 1: Peak Oil

2.4 Figure 1 is of course nonsense economically, because it is not possible to use more than can be produced. The price mechanism is one of the main ways that demand is reduced to match the available supply. Oil will cost more (assuming that the oil market is still working efficiently). The Interim Report [2] of the recent (2006) Senate Inquiry into Australia's Future Oil Supply and Alternative Transport Fuels noted the increasing propensity for long-term supply arrangements (favoured, for instance, by China)–essentially energy treaties – to replace trading, and warned that "it should not be assumed that surplus energy will be available for purchase, even if countries like Australia and the US have the finance".

2.5 To the extent that modern technology is used to counter declining production, the eventual decline curve will be that much steeper when it comes, as it must given that the amount of fossil fuel available is finite

When will Peak Oil occur?

2.6 While this will only be known with certainty in hindsight, a number of independent academics and energy analysts (see Table 1) have concluded that oil may soon reach its peak. More optimistic estimates by the International Energy Agency (IEA) and forecasters like ABARE have reassured governments in the past, but the credibility of these estimates is now being challenged from a number of quarters.

Peak Year Range	Number of forecasts
2010 or before	11
2011-2015	6
2016-2020	4
2021 or later	2
No peak	3

Table 1: Forecasts of peak year for global oil production

Source : from [3], para 3.86

2.7 In November 2005 the Commonwealth government initiated an inquiry, which tabled its report in Parliament in February 2007. It noted the warning in the IEA's latest "World Energy Outlook 2006" [4] that "Current trends in energy consumption are neither secure nor sustainable – economically, environmentally or socially' and stated that "The essence of the peak oil problem is risk management".

2.8 One of the individuals who gave evidence to the Inquiry [5] was an Iranian, Dr Ali Samsan Bakhtiari, formerly a senior executive with the National Iranian Oil Company. Among other things he was asked "how will we know when we have reached the peak?" "Simple", he replied, "just watch two things – the production and the price."

Production

2.9 Using recently published data [6], Matt Mushalik (a member of ASPO Australia, based in Sydney) has shown that world oil production is no longer rising and that peak production was actually in December 05 (Figure 2). The exact shape of the production profile is not of great importance: what this suggests is that we are

already into a “bumpy plateau” of production and possibly already into the post-peak oil era, and the more optimistic forecasts of a distant peak year do not apply.

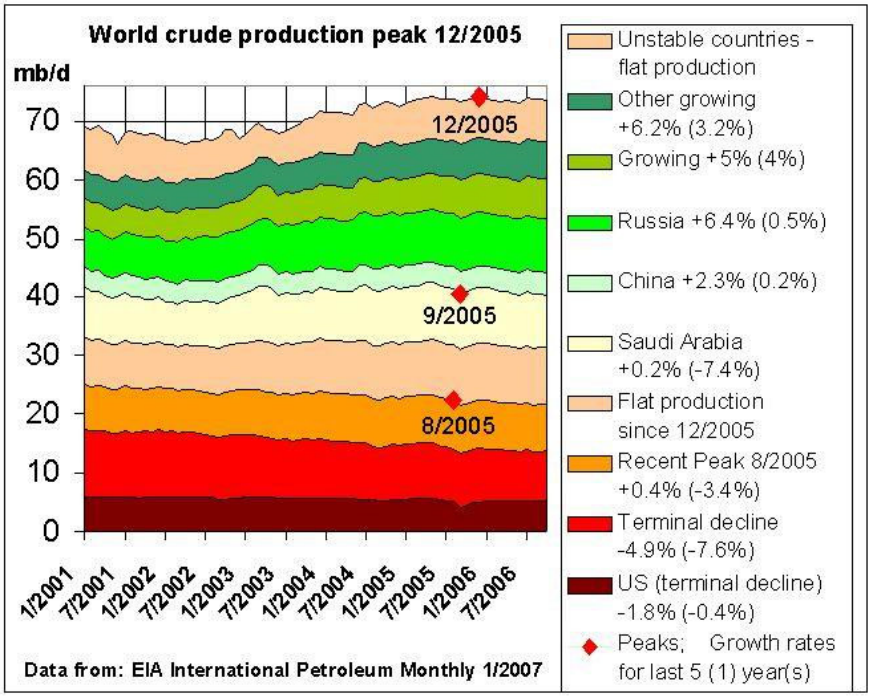

Figure 2: Global Oil Production by country or country group 2001-2006

Source: Matt Mushalik .2007

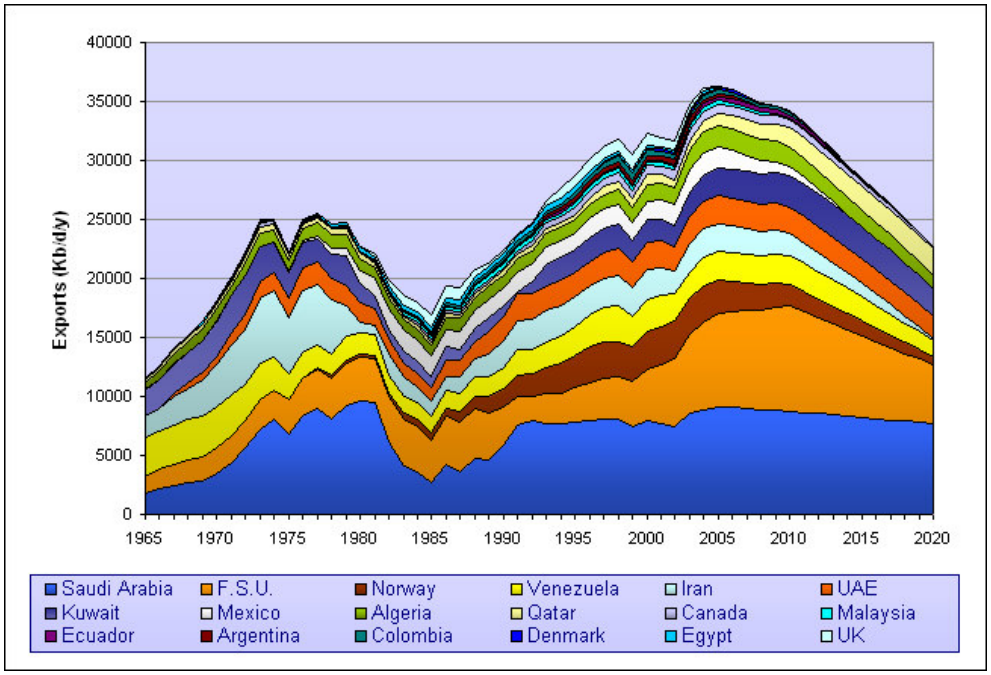

Figure 3: Oil for export 1985-2020

Source: [7]

2.10 When countries pass their peak of production, their ability to produce oil for export is affected as demand for domestic consumption catches up with national production. Figure 3 (from The Oil Drum, a well-informed US web site [7]) shows how the availability of oil for export is expected to vary in future for each oil-exporting country. This shows a peak of oil availability around 2005, with Saudi Arabia and the Former Soviet Union dominating export supply by 2020. NB this assumes that the Saudis can produce what they say they can – this is increasingly being questioned. Internal consumption is rising on the back of record oil revenues and strong growth, and as production is flat or falling, exports decline quite rapidly.

2.11 There are a few countries where production is rising, through new projects, but this is more than offset by the number where production is decreasing as existing oil fields are depleted. This applies particularly to the "super-giant" oil fields – Mexico's Cantarell field, Kuwait's Burgan field and (some argue [8]) to the biggest of them all, Saudi Arabia's Ghawar field.

Price

2.12 Figure 4 below shows the average closing price per week, from early June 2004 to mid-February 2007, on the New York Mercantile Exchange for a barrel of crude oil to be delivered in one month's time. (Note that the prices are in American dollars, and the exchange rate with the Australian dollar is also a relevant factor for determining the price in Australia. It is the hitherto related TAPIS price on the Singapore Exchange from which the Australian price derives – see 2.13). Notable features include the heavy fall from over $70 US per barrel around August 2006, when the Israel-Lebanon war was in full swing, to about $60 US per barrel, some weeks of stability at $60 followed by a further price fall and then a rise back up to around $60 per barrel.

2.13 This movement in the oil price has caused many to conclude that the peak oil problem has been exaggerated and that it is one thing that does not have to be worried about, at least yet. The price was pushed to the high levels of August 2006 mainly by geopolitical conditions (the Israel and Lebanon conflict) but partly by the speculative activities of the hedge funds, who are likely to be more conservative now. But it should be pointed out that little fundamental has changed, and the price of oil is more likely to resume its upward climb than it is to remain where it is. The demand continues to rise, and is at its highest in Q3 (which we have not reached yet for 2007). The recent fall and then rise in price can be attributed to forecasts of a mild winter in the United States and Europe, followed by a heavy demand for heating oil when a cold snap arrived. There is some evidence that the high crude oil prices have caused a drop in consumption in developed countries, and also that the price of refined gasoline (ie petrol) futures has been rising much faster than the price of crude oil futures. Several US refineries are currently closed down for regular maintenance, which could partly explain the latter effect. If the US economy

heads into recession, the crude oil price could fall even lower – as it does whenever the market gets bad economic news, We can expect the oil price to be volatile, but consumption must be reduced because the supply will fall. If these changes are not made fast enough, prices will keep rising.

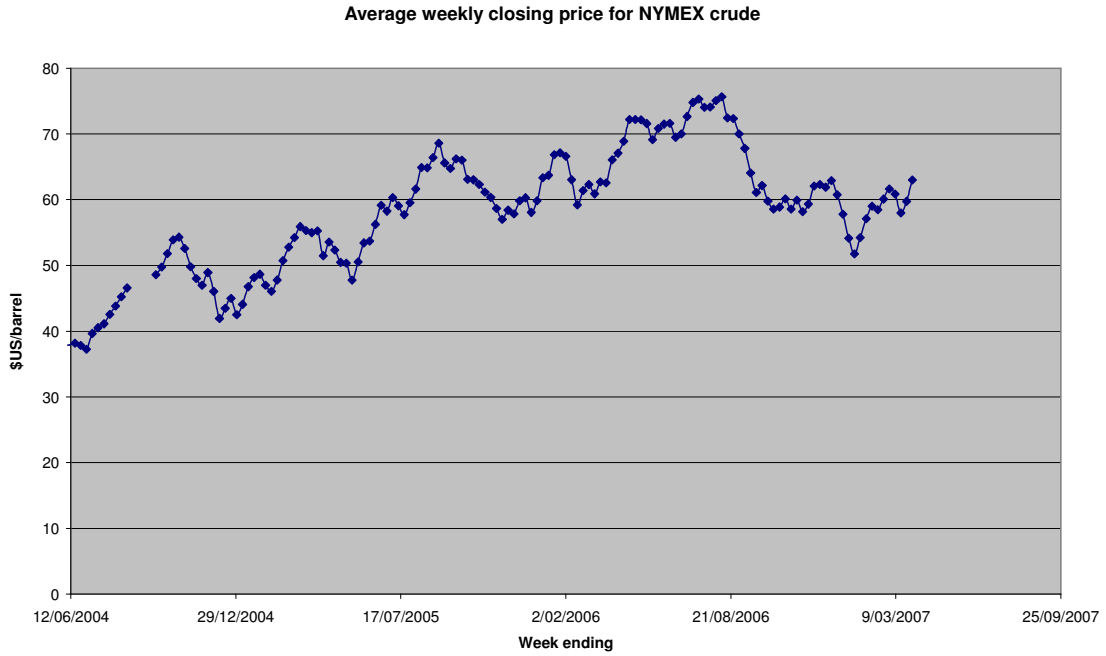

Figure 4: Weekly average closing price for crude oil 1-month futures on the New York Mercantile Exchange (Nymex) in US$ per barrel from early June 2004 to mid March 2007.

2.14 The price of petrol and diesel in Australia is governed by the crude oil price (TAPIS is the benchmark) on the Singapore Exchange rather than the New York (NYMEX) price. The TAPIS price is usually about $2 US per barrel higher than NYMEX, but Figure 5 shows the movements of the two are very closely related and this report will continue to use the more commonly quoted NYMEX price. At the time of writing the gap between the TAPIS price and the NYMEX price has widened, indicating strong demand for oil in Asian markets.

Conclusions

2.15 The risk of global oil production becoming insufficient to meet rising global demand is a very real one, probably within five years. The early signs of this will be high price volatility for crude oil, followed by price rises and a series of transitions to 2020, each of which will be marked by a slightly higher rate of physical decline in production than the one before.

2.16 This calls for a risk management approach, In this, local communities are not helpless but should do as much as they can to guard against the effects of peak oil, irrespective of national policy settings.

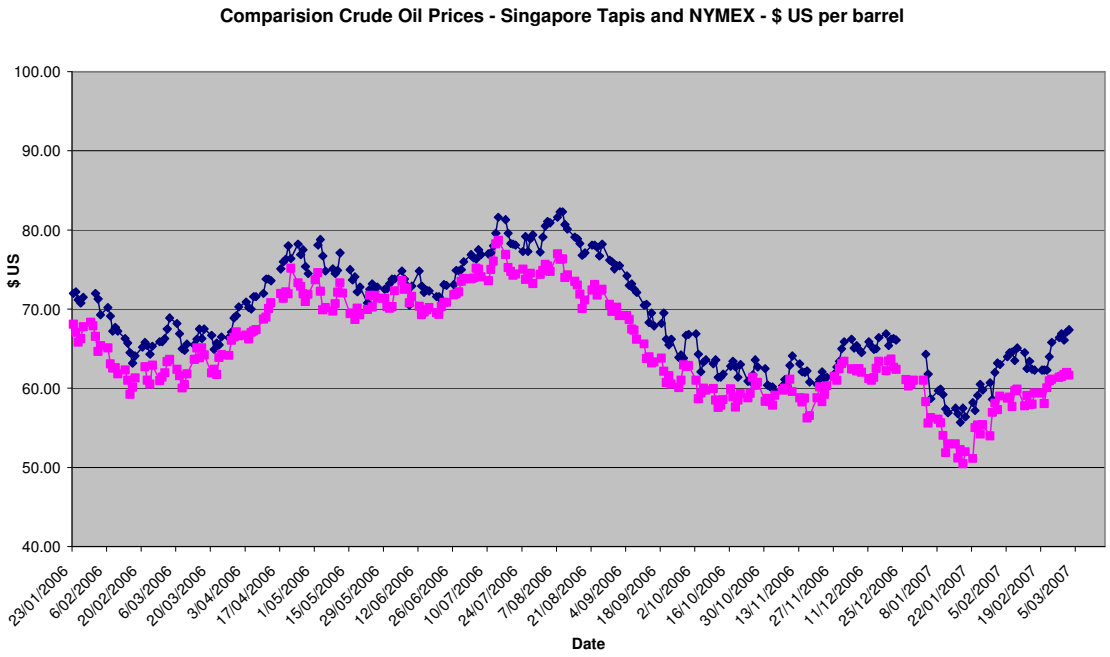

Figure 5: Comparison of NYMEX and TAPIS prices Jan 2006 – Feb 2007.

3. NATIONAL & STATE ISSUES

Energy Security[1]

3.1 Petrol, diesel, jet fuel and LPG make up over 90 per cent of the consumption of petroleum products in Australia. Almost 90 per cent of the petroleum products consumed in Australia are produced by Australian refineries. Because of its location closer to Asian refineries, Cairns is an exception to this. Australian refineries source 60 per cent of their crude oils from overseas markets.

3.2 Australia has a commitment to the International Energy Agency [9] to keep 90 days of net oil consumption in hand. It chooses to do this by counting all oil in the private sector supply chain (ie including the oil and petroleum products stored in tanks at refineries, unused petrol in car petrol tanks, oil in tankers bound for Australia etc). The length of the crude supply chain in Australia is on average a few days to a week for Australian crudes, 10 days for crude sourced from Asia and around four weeks for crude sourced from the Middle East. Refineries on average hold five days worth of crude oil in their tanks, two days worth of product in the refinery, ten days worth of product stock at the refinery terminals, three days in service station stocks and an average of three days in the motor car.

3.3 Australian stocks of crude and petroleum products are held voluntarily by industry throughout the supply chain. Total stocks of petroleum products at the end of August 2005 amounted to 47 days consumption cover including:

- 23 days of crude oil;
- 30 days of LPG;
- 16 days of automotive gasoline;
- 23 days of aviation turbine fuel; and
- 15 days of automotive diesel oil.

3.4 In 2002, total Australian refining capacity was 870,000 barrels a day with demand of 770,000 barrels a day.

3.5 The IEA's 90 day period, or Australia's 47-day response to it, assume that any oil crisis will be short-lived in nature with consumption eventually settling down to where it was pre-crisis. It does not allow for the possibility of a permanent decline in production.

[1] Much of this information comes from the website of the Commonwealth Department of Primary Industry, Tourism and Resoources

The National Oil Supplies Emergency Committee (NOSEC)

3.6 Australia's dependence on transport to sustain its economic and social activities makes it vulnerable to oil supply disruptions. Australian Government policy is, where possible, to allow industry to manage fuel supply shortfalls without government intervention. In the isolated incidents where a regulatory response is required, Australia's State and Territory Governments have constitutional responsibility for planning and coordinating emergency responses within their territorial boundaries in the first instance. Each State and Territory has its own emergency fuels legislation and has developed a response plan to implement this legislation.

3.7 In the event of a fuel shortage having national implications or the need for Australia to meet its obligations to the International Energy Agency (IEA), the Australian Governor-General may, upon prior consultation with State/Territory Governments, declare a national liquid fuel emergency under the Liquid Fuel Emergency Act 1984 (Commonwealth).

3.8 The LFE Act provides the authority for Commonwealth action to prepare against and manage available resources during a national emergency, and to implement measures to meet Australia's obligations as a member of the IEA. These obligations include requirements that Australia maintain a petroleum product demand restraint program which can be readily activated, and hold reserve oil stocks equivalent to 90 days net oil import consumption. The emergency powers of the LFE Act give the Minister for Industry, Tourism and Resources wide-ranging powers to control the drawdown, transfer and sale of industry stocks of crude oil and liquid fuels, and to control bulk and retail sales of fuel across Australia.

3.9 There is a National Oil Supplies Emergency Committee (NOSEC), the main executive channel through which Australian Governments, in cooperation with industry, formulate the overall management response to a widespread fuel shortage. NOSEC reports to the Ministerial Council on Energy and comprises officials from the Australian Government (Chair), the State and Territory Governments and the oil industry.

Queensland

3.10 The Queensland Minister of Energy or his nominee is the State Government's representative on the NOSEC Committee. There is an LFE Act (Queensland) which gives the Energy Minister the power to ration fuel should it become necessary, but does not mandate any level of reserves. A departmental advisory committee exists to assist the Minister to exercise these power,

Jet Fuel Supply Shortage

3.11 In September 2003 there was a shortage of jet fuel supplies to Sydney Airport, caused mainly by production difficulties at one of Sydney's two refineries. It was

necessary to introduce rationing for a brief period, as additional jet fuel supplies could not be delivered quickly from Singapore. After this incident and a subsequent Inquiry, a Jet Fuel Assurance Model was adopted by industry. This model aims to ensure that a more comprehensive picture of the national jet fuel supply situation is held by relevant organizations, and an independent overseer was appointed. As a further mechanism to reduce the risk of a jet fuel supply disruption, a National Operating Committee (NOC) chaired by industry was established. From 1 December 2003, the NOC has facilitated detailed forward weekly supply assessments. The NOC has also developed a communications protocol in the event of another jet fuel supply disruption..

Climate Change

3.12 Peak Oil is not the only challenge of a global nature which Far North Queensland faces. Given the dependence of the regional economy (and that of Australia and Queensland in general) on tourism, the effect of climate change on one of the region's principal tourist attractions (the Barrier Reef) is potentially devastating [10]. Damage to the reef equals fewer tourists equals less regional income.

3.13 Not all responses to peak oil would be appropriate for climate change, or vice versa. The two are linked, of course, and it is important to select responses that will not hurt one while aiming at the other. This would be the case, for instance, with the adoption of alternative fuels (in the interests of mitigating peak oil issues) at the expense of significantly increased net greenhouse gas emissions.

Biofuels

3.14 This leads to the question of biofuels, and whether agribusiness would be better off using sugarcane land for growing crops for fuel (ethanol) rather than for crops to eat. Sugarcane is a better source of ethanol than grain, and if the technology develops to use what would otherwise be waste products (lignocellulose, bagasse) it may be appropriate for FNQ to keep developing biofuels.

3.15 The recent Senate Inquiry into Australia's future oil supply and alternative fuels was not optimistic about biofuels as an alternative to fossil fuels, citing a number of barriers to more widespread use, including:

- *EROEI (the Energy Return on Energy Invested).* If it takes more than the equivalent of a barrel of oil to grow and process the crops to provide the equivalent of a barrel of oil's worth of energy output, what have we gained?
- *Capacity.* Biofuels cannot be produced in sufficient quantity for petrol substitution throughout Australia because there is not enough land suitable for it. However where land does exist (eg in FNQ) it might render biofuels as a local option.
- *Food v Fuel.* Sugar is the main export commodity of Cairns, and to the extent that the cane fields are switched to growing sugar for ethanol, there would be a

corresponding diminution in export income from sugar. Moreover other producers face the same problem. It has been estimated that if all the cornfields of the United States were used to produce ethanol feedstock, than the resulting energy would cover maybe 10% of US transport consumption, but there would be no bread to eat in that country and no grain to export from the US. Those countries which rely on exported grain to maintain their national diet may object if they find their food imports diverted to produce domestic fuel by the former exporter.

- *Sustainability.* Here ethanol has the distinct advantage over biodiesel, the other leading biofuel. Biodiesel is made from oily plants, with such products as palm oil lending themselves to plantation farming. Where freshly deforested land is used for this purpose there are clear sustainability problems. Ethanol, on the other hand, may be able to be made from otherwise unusable waste matter.

- Effect on engine warranties. Ethanol is an alcohol, and over time may lead to corrosion of some engine parts, This has led to some vehicle manufacturers declaring that their engine warranties are null and void if ethanol is used as a fuel, and even if this problem is overcome it will leave behind significant driver reluctance to use ethanol in their vehicles.

Conclusions

3.16 Current official plans are more suited to a future where any oil shortage is temporary rather than a sustained feature of life.

3.17 Peak oil is not the only immediate challenge facing Far North Queensland: climate change is another, and responses should be sought that do not address one at the expense of the other.

4. REGIONAL ISSUES

The regional economy

4.1 The principal sectors of the FNQ economy that attract income from beyond the region are agriculture, conventions, education, fishing, manufacturing, mining, retail and tourism. Of these, mining and a large part of the agricultural sector are based outside Cairns. Table 2 quantifies the value of these or otherwise indicates the scale of activity

Sector	Value of resources – Cairns	Scale of Activity – Cairns	Value of resources – FNQ
Agriculture	$55.3m crops $1.2m livestock	Sugar - principal export from Cairns Seaport	$614m crops $138m livestock
Conventions		522 functions involving more than 30 people 2003/04 at Convention Centre	
Education		JCU educates and trains local population. The Cairns campus is smaller than the Townsville one.	
Fishing	$144 m fish	"Cairns supports the largest fishing fleet in Australia with over 800 vessels fishing regional waters for prawns, reef and freshwater fish, crabs, bugs and lobsters. Of particular note are live reef fish and sashimi quality tuna, both of which are exported via direct air links to Japan, Singapore and Hong Kong.	
Manufacturing		"Sugar, timber milling and boat building are the most significant segments making up the regional manufacturing sector. "	
Mining		Mostly outside Cairns but	$394m produced

Sector	Value of resources – Cairns	Scale of Activity – Cairns	Value of resources – FNQ
		Cairns is regional capital	(mainly bauxite and gold) 2000/01
Retail		"A high concentration of the retail industry is based in Cairns, as are more specialised businesses such as financial and legal services, medical specialists and specialised retail and wholesale outlets."	
Tourism		2.26m visitors 2003/04 (65% domestic). Most numerous overseas visitors were the Japanese (34% of visitors, 23% of bednights), followed by the British (17% and 22%).	

Table 2 Snapshot of Cairns Economy (source: [11])

4.2 The main economic sectors of the Far North Queensland economy that generate external income for the region are: agriculture, conventions, education, fishing, manufacturing, mining, retail and tourism. This regional income supports other sectors which are more internal to the region, such as construction.

4.3 All these sectors depend on continuing cheap oil being available, to:

- keep the cost of road and air transport low to give access to markets
- ensure personal access to workplaces, educational opportunities etc
- run the heavy machinery or vehicles needed to generate regional income

Where does the region's oil come from?

4.4 The region has no oil resources of its own, so all petroleum products are imported. The two nearest domestic refineries are in Brisbane, owned by BP and Caltex. Products are also imported directly from Asian refineries.

4.5 The Cairns Port Authority operates the terminal which transfers petroleum products from vessels to the three fuel farms owned and operated by Caltex, Shell and BP[2]. Petroleum products are the principal import cargo of the Cairns Port Authority. In 2003/04 the amount imported was 543 thousand tons, some 83% of the total import quantity. By contrast exports in the year amounted to 513 thousand tons (79% of the import volume), of which the highest component was 281 thousand tons of sugar.

4.6 In the 05/06 financial year, 45 vessels delivered 690 million litres of petroleum products from Brisbane and Asian refineries to the Cairns Port Authority. Typically, each vessel carries more than one type of fuel and each fuel delivery is allocated to more than one of the fuel farms.

4.7 An additional amount (approximately 70 million[3] litres) of petroleum products is shipped from refineries directly to Weipa, for Rio Tinto mining operations and other marine and aviation customers.

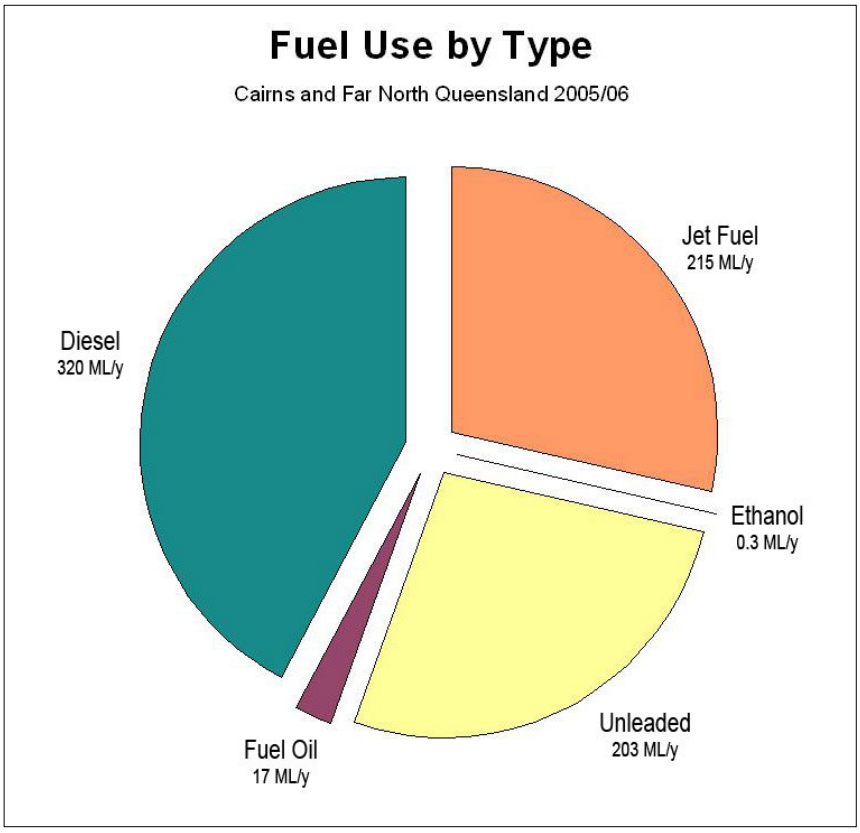

Figure 6: Fuel Use by Type[4].

[2] The fuel farm now owned and operated by BP was a joint venture with and operated by Mobil until late 2006.

[3] At the beginning of 2006, BP took over from Shell as operator of the Weipa terminal on behalf of Rio Tinto.

4.8 Figure 6 presents the breakdown of petroleum products used in Cairns and far north Queensland by type. Diesel is predominant accounting for 42% of total petroleum fuels. Jet fuel and unleaded petrol account for just over a quarter each. These quantities have remained reasonably stable over the last three years. Fuel oil, a heavier component of crude oil used for large marine vessels and supplied through Weipa, makes up 2%. Although sales of E10 are increasing, the ethanol content still represents less than 0.1% of total fuel use.

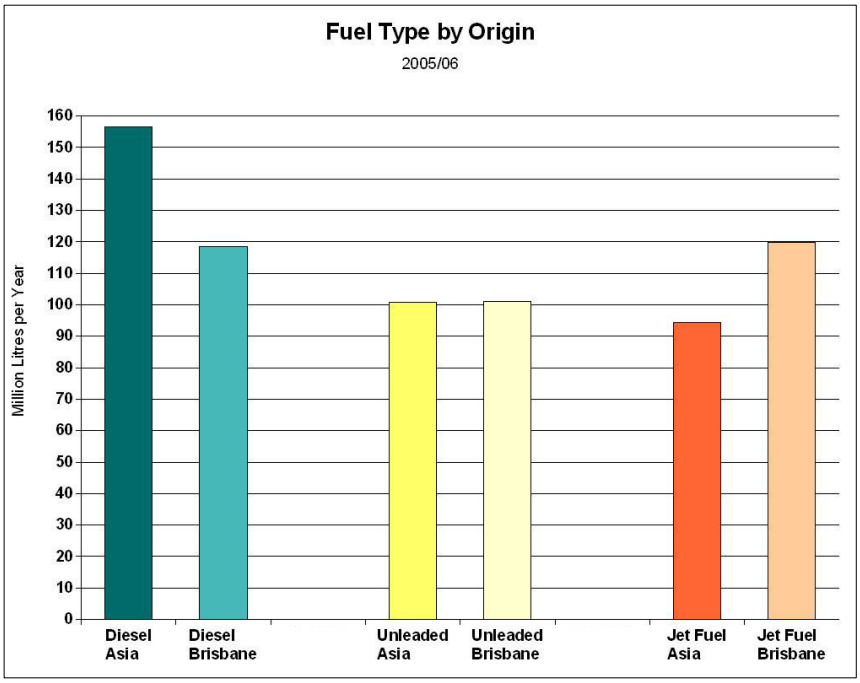

Figure 7: Fuel Type by Origin[5].

4.9 The origin of unleaded fuel delivered to Cairns is equally split between Brisbane and Asian refineries. Diesel fuel originates slightly more in quantity from Asian refineries (57%) while jet fuel has a similar level of bias in origin towards Brisbane refineries, as shown in Figure 7. Total liquids fuels are thus split close to equally in origin between Asia and Brisbane.

[4] Fuel Oil figures for 2005/06 are estimated based on data from previous years.

[5] This plot is for products delivered via the Cairns Sea Port so does not include Weipa deliveries.

Where does the region's oil go to?

4.10 A complex arrangement exists, both logistically and contractually, between the three fuel farms and their customers. A network of distributors, resellers and carriers delivers the fuel products to more than sixty service stations and other end users.

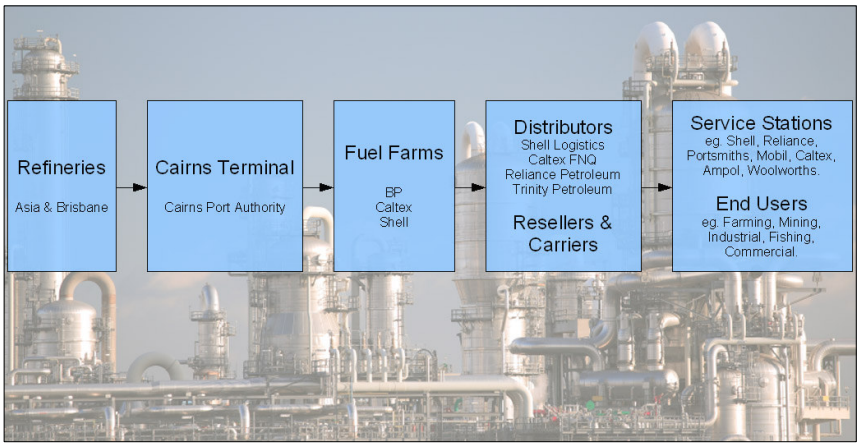

Figure 8: Schematic of Petroleum Product Flow.

4.11 The complexity of the fuel supply chain (Figure 8) makes it difficult to accurately allocate product use to economic sectors. An estimated breakdown of diesel fuel use in different economic sectors is presented in Figure 9. Mining and fishing customers are significant end users in their own right, with 15% of total use each. 'Other Marine' includes tug boats, navy and international sales. The commercial category (3%) includes industrial users and transport fleet operators (trucks, buses, taxis etc). Agriculture is here estimated to account for 7% of diesel end use, but this is a substantial underestimate. The clear majority of diesel fuel is sold through retail service stations and a large fraction of farm use of diesel will be purchased within this category.

4.12 For unleaded fuels, almost 98% is sold through retail service stations, with less than two percent allocated to commercial end users and even smaller amounts in other sectors. A significant volume of unleaded petrol (and diesel) used directly by tourists and tourism operators falls under this retail category.

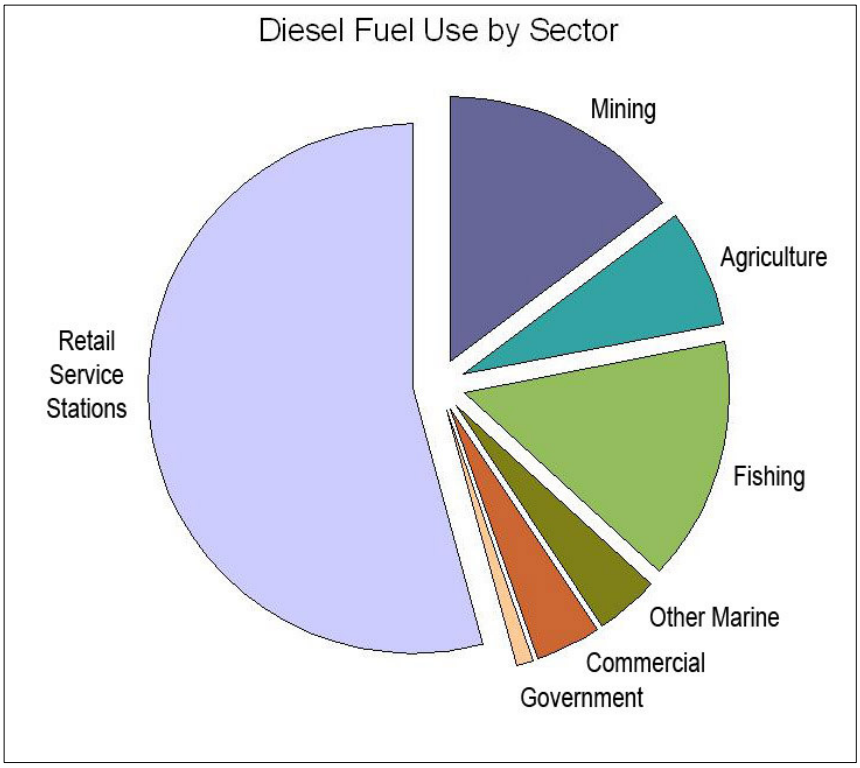

Figure 9: Diesel Fuel Use by Sector.

National Average

4.13 While definitional issues and the basis of data (years, units) vary between data sets, by making a few "heroic" assumptions[6] it is possible to get a comparison of Cairns oil consumption with the national average as shown in Table 3. We would expect difficulties in comparing the Cairns region with other areas for similar reasons. It is not possible to break down the sales from service stations between Cairns LGA and the rest of the region, but the consumption figure in terms of litres per capita per

[6] All unleaded petrol imported to Cairns is devoted to road transport
Some 55% (from Fig 9) of diesel imported to Cairns is used by road transport
The population of Cairns and FNQ grew from the 2001 census figure by 1.8% and 1.4% respectively per annum, as expected in the Cairns 2020-2050 Buisness Research Manual
The national energy consumption for Australian transport in 2004-05 was as reported in Table 47 of ABARE's "Energy in Australia 2006", in Petajoules.
Energy used by sea, air, rail and pipeline transport is not relevant, either because the mode is not significant in Cairns (rail, pipeline) or because a per capita fuel consumption has little meaning (sea, air).
The energy density in terms of Megajoules per litre was as given in the ABARE publication Table 56

year can be bracketed by assuming that all relevant refined oil products can be distributed across the population of Cairns only, or the whole population of FNQ.

	Cairns only	FNQ	National average
Unleaded petrol	1600	850	950
Diesel used for road transport	1400	750	400

Table 3: Comparison of annual petrol and diesel consumption (litres per capita) by transport 2004 for Cairns/Far North Queensland and Australian average, rounded.

4.14 The Table shows that for unleaded petrol, the annual consumption per capita probably lies in the range 850-1600 litres, which encompasses the national average of 950. For diesel used for road transport, however, the national average consumption of 400 litres per capita per year falls way below the calculated range for the Cairns region of 750-1400 litres.This is probably due largely to the remoteness of the region and hence a much longer than average distances traveled by diesel vehicles..

Trends

4.15 While the data does not allow precise characterisation of trends in fuel use across different economic sectors, some observations can be made based on qualitative information:

- Strong growth in the mining and resources sector is, as expected, resulting in increased consumption of petroleum products.
- The local retail market has historically grown around 3% per year, although steep price increases in recent years have moderated this growth to some extent.

Regional vulnerability

4.16 The picture is thus one of a regional economy highly dependent on oil, much of which is refined in Asia.

4.17 From Table 2 the dangers listed in Table 4 from Peak Oil can be hypothesised. Each risk calls for its own risk management approach. The final column of Table 4 suggests ways in which the risk might be managed. It is for stakeholders to review Table 4 and possibly replace it with their own version.

Sector	Source of risk	Nature of risk	Possible risk management measures
Agriculture	Fertiliser, pesticides & other petroleum products	Inability to grow sufficient crop products.	Prioritisation of use of oil and gas (most fertiliser is from gas)
			Optimisation of fertiliser manufacturing location.
	Fuel for Road freight	Inability to access markets for produce adequately	Conversion of HGV's to run on compressed natural gas (CNG).
	Competition for land between food and transport	Possibility of productive agricultural land being used to produce biofuel for transport instead.	Clear State policy required.
Conventions	Fuel for air transport	Prohibitive air travel costs for attendees.	To be determined.
Education	Fuel for road transport	Deterioration of access to JCU campus.	Better bus and bicycle access to JCU campus.
Fishing	Fuel for fishing boats	Higher costs and/or reduced catch.	To be determined.
	Fuel for air transport	Prohibitive costs to access overseas or distant Australian markets.	To be determined.
	Fuel for road transport	Inability to access Australian markets effectively.	Conversion of (refrigerated) HGV's to run on CNG.
Light industry and manufacturing	Fuel for road transport	Rising distribution costs.	(Imports for local consumption are likely to be worse hit, Only goods destined for export are likely to be badly affected).
	All oil-based chemical products	More expensive manufacturing activities	Substitution of oil-based products in manufacturing where possible.
Mining	Fuel for road transport	Rising cost of road freight.	Greater use of rail or sea freight at expense of road.
	Fuel for heavy equipment	Inability to extract sufficient product	Conversion of heavy equipment to alternative fuel (preceded by investigation of options).
Retail	Falling discretionary household incomes	Reduction in level of activity to serve due to falling discretionary household incomes.	Economic development of less oil-dependent sectors.

Sector	Source of risk	Nature of risk	Possible risk management measures
	Fuel for road transport (for goods distribution)	Difficulty in restocking outlets and sustaining "just-in-time" inventories.	Conversion of HGV's to run on CNG.
Tourism	Fuel for air transport	Reduction in number of inbound or outbound air travellers. (see text)	Concentration on specific markets.
	Petrol	Reduction in number of visitors arriving by car or hiring vehicles locally.	Whatever technical measures are being adopted more widely to reduce oil dependency of transport.
	Climate change	Reduction in number of visitors arriving by car or hiring vehicles locally.	Requires national action to reduce carbon dioxide emissions and Cairns will probably have to meet its share of reduction targets. Many of the measures listed above will reduce emissions as well.
All	Fuel for road transport	Increased cost and difficulty of maintaining access to workplaces, retail/recreation sites etc.	Development of cycling and public transport networks.

Table 4 Risks to FNQ economic performance from Peak Oil

4.18 It should be noted that peak oil is not the only threat the Cairns economy faces. Climate change – related to but separate from peak oil - brings a number of challenges, such as potential damage to the region's principal tourist attraction, the Great Barrier Reef (see for instance [10]) This has the potential to reduce the visitation of tourists to the region. Data on the Cairns International Airport website clearly shows that, while both terminals are highly seasonal, the Domestic Terminal handles far more visitors than the international. Domestic passengers are growing (2004-2007) while international ones are declining. The fall in International visitors corresponds with a period of rising jet fuel prices, passed on to the traveller by the airlines. Data on the Advance Cairns web site suggests that domestic visitors now represent 65% of the total visitation. At present the domestic market is a bigger one for Cairns than the international in terms of numbers of visitors. Hence it is necessary for Cairns that the Boeing approach to aircraft development be favoured over that of Airbus (more growth in patronage on smaller planes, not mega-jumbos) - if either can be fuelled!

4.19 Activity internal to Cairns, eg in the construction sector or the financial services sector, depend on a healthy local economy that generates sufficient regional income to support these sectors..

5. LOCAL ISSUES - CASE STUDY

Cairns City Council (CCC)

5.1 Cairns City Council is a major local employer, with 960 staff in 2005/06 [12] and a total expenditure budget for 2006/07 of $193 million. We are grateful to CCC for agreeing to provide data on fuel usage and to act as a local case study. Table 5 shows the data received from CCC.

	Litres	Cost ($)
2005-06		
Unleaded Petrol	297,366	324,775
Diesel	382,322	442,333
Total Fleet Fuel Expenditure		1,723,000
Total CCC Expenditure		185,000.000
2006-07		
Unleaded Petrol (to date)	220,142	243,887
Diesel (to date)	281,602	322,149
Total Expected Fleet Fuel Expenditure		1,615,000
Total CCC Expenditure Budget		193,000.000

Table 5 : Cairns City Council fuel use, 2005/06 and expected 2006/07.

Paying for fuel

5.2 The “total fleet fuel expenditure” includes the amount purchased with cards, which was the biggest component of fleet fuel expenditure in 2005/06 (55%). To date in 2006/07 this is down to 53%. Any driver of a Council vehicle is entitled to use a card to pay for his/her fuel at a service station. Council petrol and diesel users include the Environmental Health Department (garbage trucks), social serves, and staff cars.

Annual Expenditure

5.3 Fuel accounted for only 0.94 % of Council expenditure in 2005/06, and this is expected to fall to 0.84% in the financial year 2006/07. This reflects a trend towards diesel powered assets in the fleet, which have better fuel economy.

5.4 However we note that at the time of writing the financial year is 75% over, and while the consumption of depot-based petrol and diesel is just under 75% of the previous year the cost of that consumption is just over 75% for unleaded petrol and just

under 73% for diesel. But if the same proportion of fuel expenditure paid for by card occurs in 2006/07 as occurred in 2005/06 (55 %), with the same fleet composition – neither of which apply - then the expected fleet fuel expenditure would already be at 85% of its expected annual level. This illustrates the difficulty of managing fuel costs in an environment where the price of oil (and hence petrol and diesel) is volatile and beyond council control. In fact the proportion of fuel purchases made by card has fallen slightly and the fleet has become slightly more economical

Oil Vulnerability

5.5 Table 6 shows the effect on the expected fleet expenditure for 2006/07 under three scenarios : if the price of petrol and diesel remained at levels expected in 2006, if the use of cards is running at 2005/06 levels at current prices and with fleet composition as it was in 2005-06 (since when the price of petrol has risen slightly but the price of diesel has fallen by a small amount), and if the price of petrol and diesel rose by 50%. The refinery price is only one component of the retail price of refined products and would have to more than double to be solely responsible for a 50% rise in the pump price of petrol [13]. (This could happen in future).

Scenario	Total expected fleet fuel expenditure ($m)	Change ($)
1. As expected in 2006	1.615	0%
2. With card use at 2005-06 percentage of costs, and petrol/diesel costs for 75% of year as recorded	1.649	$34,000 (2.1%)
3. With 50% increase in cost of refined fuel	2.423	$807,500 (50%)

Table 6 Effect of fuel price scenarios on total expected fleet expenditure for Cairns City Council

5.6 It should be noted that the 2005/06 financial outcome (and presumably the 2006/07 budget) was larger than in previous years. The 2006-06 Annual Report [12] explained it thus:

> *Total revenue increased by 42.8% from the previous year. This was due to significant operational and capital grants, increases in net rates and utility charges and a substantial increase in capital contributions revenue.*
>
> *Total expenses increased by 22.1% compared to the 2004-05 financial year. There are a number of factors that have influenced this increase over the last 12 months. A significant factor was the repair works undertaken as a result of Cyclones Monica and Larry. The increase in property development and building activity in the region has also has a major impact on the expenses incurred by Council.*
>
> *While the building activity has a positive impact on Council's revenue, it also increases the burden on Council's operations. Growth such as this increases the demand for services in the areas of town planning, building compliance and infrastructure maintenance and therefore, to be able to meet the expectations of the community, Council's costs in employee costs and materials and services has increased. Added*

to this is the impact of normal increases in costs due to wages in line with enterprise agreements and the inflationary increases in materials and services purchased.

5.7 While the sums directly at risk from Peak OiIl are not large in comparison to the total budget, it can be seen that Council's budget is highly dependent on its ratings base and hence on the prosperity of the region. New Caledonia provides an example of what can happen to a region highly dependent on tourism when the tourists stop coming in the expected numbers. A brand new hotel in Noumea has been abandoned and now lies derelict. The main impact of peak oil in Cairns is likely to be not in the price of fuel for Councils' operations but in the impact on the tourist industry and the level of economic activity that Council is required to serve. Nevertheless the effect on council's fuel bill could be significant, well beyond inflation.

6. MITIGATION AND ADAPTATION

6.1 The so-called “Hirsch Report” to the US Department of Energy [14] dealt with the issue of how to manage the risks posed by peak oil in the USA.

6.2 It introduced the concept of “mitigation wedges”. Each “wedge” relates to a specific policy. From the time that it is introduced, there is a lead-in period when no effect is noticeable. Thereafter (possibly five years later) the effect starts to be noticeable and increases over time. But no one wedge will have an effect of the magnitude that is required, so action on a number of fronts simultaneously is required, in order that the cumulative effect of the wedges can reach the required level in future.

6.3 Three mitigation scenarios were tested. The thing that differentiated them was the number of years before peak oil that action was begun. The first assumed that no action would be taken until the peak of oil production was reached. The second and third assumed that action would be taken in anticipation of peak oil occurring ten years and twenty years before the event.

6.4 The conclusion was that the sooner action was taken the better, with only the 20-year scenario being relatively free of hardship (a global deficit in fuel supply). Peak oil is perhaps now no more than five years into the future, so the Hirsch report has already been overtaken by events, and in any case the options associated with each of the wedges are technological ones which may be appropriate for the United States but the mix elsewhere may be different.

6.5 Nevertheless the clear message of the Hirsch report is that whatever you do, it should be done as soon as possible. It presents the dilemma as a classic risk management problem, but as Western Australia’s Planning Minster observed in 2004: “It is also certain that the cost of preparing too early is nowhere near the cost of not being ready on time."

6.6 Another approach to a peak oil future is adaptation rather than mitigation. Adaptation would involve learning to live with less oil, instead of looking to technology to come up with a way of allowing us to maintain existing lifestyles.

7. CONCLUSIONS

7.1 The risk of global oil production becoming insufficient to meet rising global demand is a very real one, probably by within the next five years. The early signs of this will be high price volatility for crude oil, followed by price rises and a series of transitions to 2020, each of which will be marked by a slightly higher rate of physical decline in production than the one before.

7.2 This calls for a risk management approach, In this, local communities are not helpless but should do as much as they can to guard against the effects of peak oil, irrespective of national policy settings.

7.3 Current official plans are more suited to a future where any oil shortage is temporary rather than a sustained feature of life.

7.4 Peak oil is not the only immediate challenge facing Far North Queensland: climate change is another, and responses should be sought that do not address one at the expense of the other.

7.5 The Far North Queensland region is highly vulnerable to a tightening of oil supply or a rise in oil prices (or both), as set out in Table 4.

7.6 Table 4 is only a guide. We believe it would be in the interests of stakeholders to identify and implement the most appropriate measures to manage (reduce) the risks identified in Table 4.

7.7 Using the fuel bill of Cairns City Council as an example of the impact on a major local employer, we have shown the magnitude of the sums directly at risk due to peak oil. However, in the case of Council, the impact of peak oil is more likely to be felt indirectly via its ratings revenue base than directly via its fuel bill.

7.8 It may be too late already for some effective mitigation measures, in which case adaptation is the only option remaining.

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