Peak Oil and its Implications for Hong Kong

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Executive Summary

The looming peak in global oil production represents a huge risk to Hong Kong and the world. Yet the concept of Peak Oil and its consequences remain poorly understood. This briefing document provides a high level overview of the issue, its implications and some initial recommendations for the HKSAR government.

What is Peak Oil?

Everyday, businesses, governments and households make decisions based on the assumption that oil will be cheap and plentiful forever. However, powerful evidence is emerging to suggest otherwise.

Peak Oil refers to the fact that after a certain point in time, the global level of oil production will inevitably go into decline. The concept of Peak Oil is agreed, there is only difference over the timing of when it will happen. Peak Oil does not mean that we will 'run out of oil from one day to the next' it means that we will have *ever declining amounts available at ever higher prices with increasing instability of supply*.

Currently, 37% of global production is proven to be in decline (with a further 20% at risk or possibly in decline). Experts forecast that a peak is likely be reached within the next decade. Recent developments, including the peaking of two of the largest oil fields in the world, seem to support this notion. Irrespective of the exact timing of a peak, current production and consumption figures show that supply is not keeping up with demand. Hence, any small deviations in the supply chain (from extraction to delivery) could lead to major price spikes and possibly shortages. The risks to the global economic system are therefore substantial.

What are the implications of Peak Oil for Hong Kong?

Historical experience shows that shocks to oil prices and supply can be very damaging to economic and political stability (e.g., Energy crises of the 1970s).

Given that supply and demand conditions are so closely matched today; we believe that even small and short term disruptions could have severe consequences for the Hong Kong economy, energy security and overall political stability.

- **Economic development:** Higher oil prices (>US$100 very possible) could spark a major recession. Energy and oil intensive sectors such as airlines, local transport, and construction will suffer first. International trade would be severely crippled by Peak Oil, jeopardizing Hong Kong's status as a major regional hub for logistics and sourcing, and exporter for Chinese goods.
- **Energy security:** Hong Kong could face difficulties in securing access to oil and other alternative energy sources in the face of intensifying international competition to obtain energy supplies.
- **Political stability:** Peak Oil could have serious ramifications on a humanitarian level – in addition to severe economic, social and political consequences. Low income groups will be most vulnerable to food scarcity, energy rationing and economic malaise.

How should Hong Kong tackle the issue?

Hong Kong's unique position in China and indeed in the region could be permanently damaged, should Peak Oil materialize. Although we do not intend to be alarmist, recent evidence suggests that the peaking of global production should no longer be an abstract debate.

We believe that the downside risks are substantial enough to justify immediate action.

Specifically, the HKSAR government should err on the side of caution by managing risk and pro-actively preparing for Peak Oil. This report recommends that the HKSAR Government needs to (Refer to Section 3 for detail):

- Establish responsibility
- Identify the risks
- Develop contingency plans
- Devise mitigating strategies
- Communicate with stakeholders
- Raise community awareness
- Communicate with cross-boundary authorities

Assigning a task-force or organization to study the impact of Peak Oil in greater detail, and to coordinate these initiatives could be a first step in preparing for a potential crisis, before things spiral out of control.

An Overview of Peak Oil

THE FUNDAMENTALS OF OIL

Oil is a *critically* important resource to mankind; one that has powered phenomenal economic and population growth over the last 150 years.

Cars, planes, ships, agriculture and industrial production are all powered by oil derived fuels. Even daily household items from plastic kettles to lipstick are produced from derivatives of refined crude oil (See Exhibit 1). Oil currently accounts for approximately 42% of the world's total fuel consumption[1] and 95% of global energy used for transportation.[2] Significantly, for every one joule of food consumed in the United States, around 10 joules of fossil fuel energy have been used to produce it.[3]

It is therefore no exaggeration to say that our modern societies would be paralyzed if our access to oil was endangered.

Exhibit 1[4]

Illustration of products in a typical home that are derived from oil

[1] *IEA, Key World Energy Statistics 2006, pg 28*

[2] *WBSCD Sustainable Mobility Project, SMP Model Document July 2004*

[3] *Dale Allen Pfeiffer, Eating Fossil Fuels, October 2003. See http://www.energybulletin.net/281.html*

[4] *Sarah Leen, End of Cheap Oil, National Geographic Magazine, June 2004*

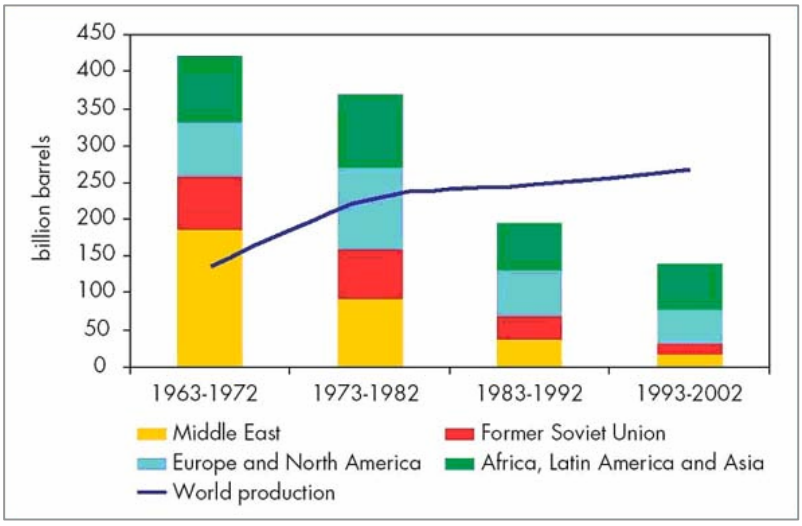
However, we often neglect the fact that oil is also a *finite* and *non-renewable resource*. The sustainability of our oil supply depends on two factors: the rate of (i) Oil discovery (ii) Oil production.

Oil discovery. Oil companies have, naturally enough, extracted the easier-to-reach, cheap oil reserves first. During the 19th and 20th centuries, oil came from large oil fields, located on land and near the surface. The oil pumped out under pressure was light and 'sweet' (meaning high quality with low sulfur content) and therefore easy to refine into gasoline.

Over time, however, we have depleted these big and easy reserves and have had to seek new, more difficult and expensive to find smaller reserves of lesser quality (i.e. offshore reserves in deep water that are far from markets). Publicly available data shows that *conventional* oil discovery around the world effectively peaked in the 1960s (see Exhibit 1). Today we consume several barrels of oil for every barrel of oil we find. If we cannot replace declining old fields with new discoveries, our available resource base will inevitably shrink over time.

Exhibit 2[5]

World conventional oil discovery versus production – an unsustainable trend that is only getting worse.



Oil production. The production profile of an oil field generally follows a bell curve function. In the beginning, an oil well is full of high pressure oil, which is easily extracted. However, eventually, so much oil has been extracted that the well pressure and hence rate of production begins to drop. At this stage a well has passed its peak in production. Over time, an entire oil field reaches a peak in production, as more wells peak than come online. Modern techniques can be used to increase the amount of oil that can be

[5] *International Energy Agency World Energy Outlook, 2004*

accessed from a field and slow the natural decline rate of a field. However, geology always wins out in the end.

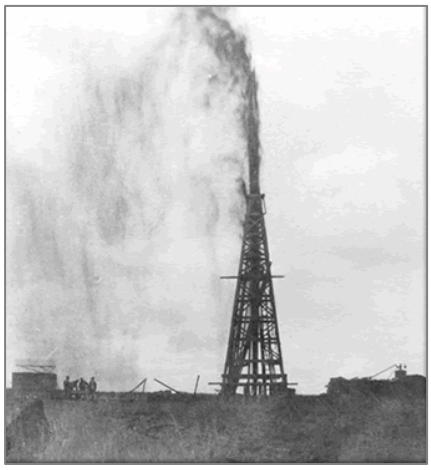


Exhibit 3
The good old days of oil production. Oil used to pour out of onshore wells, now we need expensive offshore rigs to tap smaller, more difficult to reach reserves in deep water

THE CONCEPT OF PEAK OIL

'Peak Oil' refers to the problem of energy resource depletion, or more specifically, the peak in global oil production. The rate of oil production (currently around 84 million barrels/day), has grown in most years over the last century. However, Peak Oil, as a theory, says that once the number of oil fields declining surpasses the number of new fields coming on line global oil production will permanently decline – hence 'peak.'

To be clear, Peak Oil does not mean that we will 'run out of oil from one day to the next', it means that we will have *ever declining amounts available at ever higher prices with increasing instability of supply*. For societies leveraged on ever increasing amounts of cheap oil, the consequences could be dire. Without significant and effective preparation, economic and social instability is a serious risk.

Hubbert's Curve and the Birth of Peak Oil

In 1956, a geologist working for Shell, *Marion King Hubbert*, predicted that oil production in the United States would peak between 1965 and 1970. Hubbert had noticed that oil discoveries graphed over time tended to follow a bell shape curve and posited that the rate of oil production would follow a similar curve – now known as the Hubbert Curve.

Hubbert's prediction was contradictory to accepted industry and government estimates, which in the 1960's still projected increasing US oil production for decades to come.

Exhibit 4 shows that Hubbert's predictions were indeed correct. Oil production in the US peaked in 1971 (at 11 million barrels/day); creating the conditions for the energy crises of the 1970s, not to mention a major shift in geopolitics and US statecraft.

The peaking of production in the US has been dramatic and irreversible – decline, unfortunately, is a geological certainty. Despite advances in technology and a huge exploration effort since then (including the discovery of a giant field in Alaska), *oil production in the US is today around half of its 1971 output and projected to continue declining.* The US was able to import oil from elsewhere, and life continued with minimal disruptions. However, when global production peaks, there will be no outside source to import oil from.

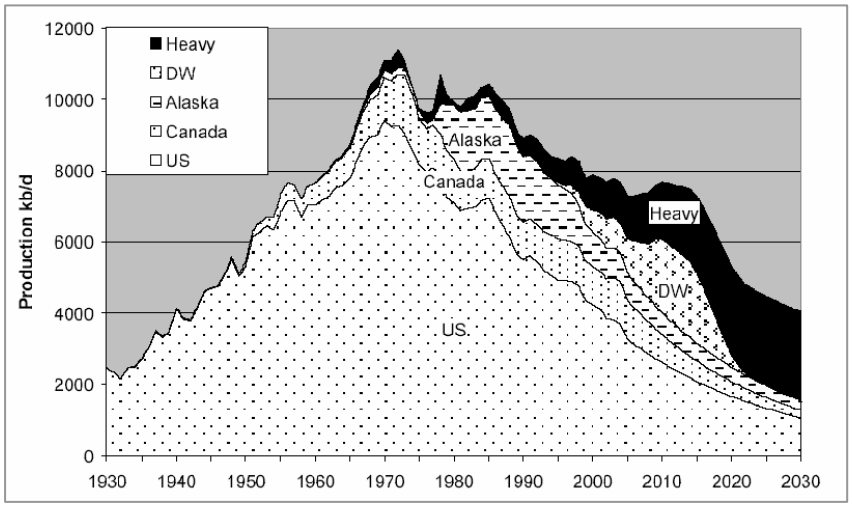


Exhibit 4[6]

Oil production in North American, 1930 - 2030

DW: Deep water
Heavy: Canadian tar sands

GLOBAL OIL PRODUCTION PEAK

The US is not alone. Many others countries have peaked in their oil production. In fact 36 of the world's 48 largest oil provinces are now in decline.[7] The list of major

[6] *The Association for the Study of Peak Oil and Gas ("ASPO"), Newsletter No. 72 – December 2006*

[7] *Chevron Corp, full page advertisements in major U.S. newspapers, July 25, 2005. The ASPO claims that 54 of the 65 largest oil producing nations in the world have already peaked.*

oil producing nations that are officially in decline is staggering: US (1971), Indonesia (1991), UK (2001), Norway (2001), Kuwait (2005), Mexico (2006) and so on.

Detailed analysis shows these countries represent roughly 37% of total global production,[8] and are declining on average at an annual rate of around 4% (the range is wide: Norway, for instance has declined by roughly 4% annually since its peak in 2001; while Cantarell in Mexico, the second largest oilfield in the world, declined by 20% in 2006 alone).[9]

Once a critical mass of oil producing nations has peaked, global oil production will decline irreversibly. The overall outcome will likely be determined by the peaking of Russian and Saudi Arabian production (which today account for 25% of global oil supply). Although Saudi Aramco claims that it is far away from peaking, its major oilfields are already very old (Ghawar, its largest field, was discovered in 1948),[10] and it refuses to allow independent audits of its claimed reserves.

When will oil peak globally?

Predicting the timing of Peak Oil is a complex subject which is subject to much fierce debate – forecasting oil and gas reserves (and hence the midway point) is a complicated business and reserve data can be difficult to verify and open to interpretation.

Experts are divided on the timing of global Peak Oil; some say that we are already at the peak, others say it is decades away. Exhibit 5[11] below shows a sample of expert forecasts.

These forecasts can have unintended negative consequences. Overly pessimistic *doomsday-esque* forecasts (that miss the mark) can damage the credibility of Peak Oil as a serious and legitimate global problem. Equally, overly optimistic forecasts tend to underplay the seriousness of the issue and lead to complacency among policy makers.

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[8] *Detailed analysis of BP Statistical Review, 2006. http://www.bp.com/productlanding.do?categoryId=6842&contentId=7021390*

[9] *Wall Street Journal, Mexico Tries to Save A Big, Fading Oil Field – April 5 2007. http://online.wsj.com/article/SB117570687954959825.html*

[10] *Matthew Simmons best selling book, Twilight in the Desert (published in 2005) suggests that Saudi Arabia has already reached its peak*

[11] *Robert L. Hirsch,* Peaking of world oil production: Recent forecasts*, World Oil Magazine, April 2007*

We believe that it is impossible to predict the exact timing of Peak Oil based on reserve data alone, given the complexities and the simple fact that no-one can have perfect knowledge of how much oil exists below ground. Therefore the only means of tracking Peak Oil is by closely following global production data. This means that we may not realize that the peak has been reached until 2 or 3 years after the event.

Exhibit 5 **Expert predictions on timing of Peak Oil**

Pickens, T. Boone[12] (Oil & gas investor)	2005	***Pessimistic predictions***
Deffeyes, K.[13] (Retired Princeton professor & retired Shell geologist)	December 2005	
Herrera, R.[14] (Retired BP geologist)	Close or past	
Bakhtiari, S.[15] (Former Iranian National Oil Co. planner)	Now	
Simmons, M.R.[16] (Oil industry investment banker)	Now	
Westervelt, E.T. et al.[17] (US Army Corps of Engineers)	At hand	
Groppe, H.[18] (Oil / gas expert & businessman)	Very soon	
Goodstein, D.[19] (Vice Provost, Cal Tech)	Before 2010	
Bentley, R.[20] (University energy analyst)	Around 2010	
Campbell, C.[21] (Retired oil company geologist; Texaco & Amoco)	2010	
Skrebowski, C.[22] (Editor of Petroleum Review)	2010 +/- 1 year	
World Energy Council[23] (World Non-Government Org.)	After 2010	
Meling, L.M.[24] (Statoil oil company geologist)	A challenge around 2011	
Pang, X., et al.[25] (China University of Petroleum)	Around 2012	
Koppelaar, R.H.E.M.[26] (Dutch oil analyst)	Around 2012	
Laherrere, J.[27] (Retired major oil company geologist)	2010-2020	
Volvo Trucks[28]	Within a decade	
de Margerie, C.[29] (Oil company executive)	Within a decade	
al Husseini, S.[30] (Retired Exec. VP of Saudi Aramco)	2015	***Optimistic predictions***
Merrill Lynch[31] (Brokerage / Financial)	Around 2015	
West, J.R., PFC Energy[32] (Consultants)	2015-2020	
Maxwell, C.T., Weeden & Co.[33] (Brokerage / Financial)	Around 2020 or earlier	
Amarach Consulting[34] (Ireland)	Within 15 years	
Wood Mackenzie[35] (Energy consulting)	Tight balance by 2020	
Total[36] (French oil company)	Around 2020	
Shell[37] (Major oil company)	2025 or later	
UBS[38] (Brokerage / Financial)	Mid to late 2020s	
EIA[39] (U.S. DOE energy analysis)	After 2030	
CERA[40] (Energy consulting)	After 2030	
ExxonMobil[41] (Oil company)	No sign of peaking	
Lynch, M.C.[42] (Consultant)	No visible peak	
Browne, J.[43] (BP CEO)	Impossible to predict	
OPEC[44]	Deny peak oil theory	

Unfortunately, recent developments in 2006 support more pessimistic predictions, namely:

- The second and third largest oil fields in the world, in Mexico and Kuwait respectively, have already peaked
- Saudi Arabian oil production declined by 8%. If 2007 does not show a rebound then the world's most important exporter of oil may have peaked
- Supply and demand in the global oil market tightened significantly, with spare capacity a mere 1.5 million barrels/day – this despite rising prices

The peaking of two of the largest oil fields in the world is potentially ominous. Of the 45,000 oil fields in the world, these two alone were responsible for some 4.5% of total global oil production. Indeed the 100 largest oil fields in the world are

responsible for over 50% of production, and the average age of these fields is now over forty years.

> *"The threat to the world's energy security, especially on oil and natural gas, will reach serious dimensions in the next 10 years"*
>
> International Energy Agency (IEA) Chief Economist Dr. Fatih Birol, Dec 06

SUPPLY AND DEMAND OUTLOOK – HOW BAD IS THE PROBLEM?

The scale of Peak Oil as a problem is best put into context by analyzing official publicly available forecasts of oil supply and demand.

In Exhibit 6[12], we show the potential gap in supply and demand under two cases: (i) Peak Oil and declining production (ii) tight (unchanged) supply conditions mirroring the current environment.[13] These estimates are meant for illustrative purposes only.

Exhibit 6 Supply and Demand outlook for oil, 2006-2011

CASE STUDY 1: PEAK OIL
Units: '000s barrels per day

	Current oil supply w/ 3% decline		Oil supply from new projects		Total global oil supply		Total global oil demand w/ 1.7% growth		Surplus / (Deficit)
2006	84,500		1,200		85,700		84,000		1,700
2007	83,064		2,700		85,764		85,428		336
2008	81,651	+	3,500	=	85,151	-	86,880	=	**(1,729)**
2009	80,263		4,250		84,513		88,357		**(3,844)**
2010	78,899		4,900		83,799		89,859		**(6,060)**
2011	77,558		5,250		82,808		91,387		**(8,579)**

CASE STUDY 2: NORMAL SUPPLY CONDITIONS
Units: '000s barrels per day

	Current oil supply w/ no decline		Oil supply from new projects		Total global oil supply		Total global oil demand w/ 1.7% growth		Surplus / (Deficit)
2006	84,500		1,200		85,700		84,000		1,700
2007	84,500		2,700		87,200		85,428		1,772
2008	84,500	+	3,500	=	88,000	-	86,880	=	1,120
2009	84,500		4,250		88,750		88,357		393
2010	84,500		4,900		89,400		89,859		**(459)**
2011	84,500		5,250		89,750		91,387		**(1,637)**

[12] *Data for oil supply from new projects from: Robeluis F., Giant Oil Fields – The Highway to Oil, Uppsala Universitet, Mar 2007.*

[13] *Assumptions are conservative. Demand: assume demand growth of 1.7% which is consistent with IEA World Energy Outlook 2006 projections and historical demand growth from the BP Statistical Review 2006. Supply: factor in cumulative new production capacity expected to come online over the next 5 years. Assume, in the case of Peak Oil, an average annual decline rate of 3% which is consistent with current decline rates*

Even without Peak Oil, global oil supply is not growing quickly enough to satisfy global demand growth (driven mostly by the development of China and India). Our back-of-the-envelope calculations show substantial daily deficits in oil supply by 2010 (coinciding with the peak in total non-OPEC production). Such tight supply and demand conditions mean that any small disruptions in supply (e.g., natural disasters, geopolitical crises, terrorism) could lead to serious dislocations. *Our estimates show that a crisis could be at hand, as early as 2008* – unless a number of major oil fields are discovered and brought online quickly, or demand slows significantly.

Major oil discoveries have been few and far between over the last few decades, and take many years to ramp up to full capacity. Demand for oil continues to grow at a rapid pace, and experts have predicted that our global thirst for oil may reach anything from 115 to 130 million barrels/day by 2030.[14] If supply is relatively fixed, demand growth must be carefully managed in order to avoid a shortage in oil – a difficult and politically sensitive issue.[15]

In sum, the world faces very serious risks given the current supply and demand outlook for oil.

CAN WE MITIGATE THE RISKS ASSOCIATED WITH PEAK OIL?

In 2005 the US Department of Energy commissioned a report ("The Hirsch Report") on ways to mitigate the impact of Peak Oil through alternatives[16] (unconventional oil, alternative energy, and energy efficiency). The report highlights just how difficult the transition could be, but given enough preparation and effort it concludes we could successfully transition to a post oil world. However, it is worth noting that the report also concludes that *it would require up to 20 years of 'Manhattan Project' levels of investment prior to Peak Oil, if we are to make that transition.* But do we really have 20 years?

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[14] *International Energy Agency World Energy Outlook, 2004*

[15] *China is currently responsible for roughly 30% of growth in oil demand, yet its consumption of oil on a per-capita basis is still less than 8% of that of the United States. China's continued growth will require access to significant oil resources*

[16] *Robert L. Hirsch et al,* Peaking of World Oil Production: Impacts, Mitigation & Risk Management*, United States Department of Energy, Feb 2005*

Unconventional Oil

How about unconventional oil? People say that the reserves of the tar sands in Canada, the heavy oil in Venezuela and the shale oil in America are larger than all of the conventional oil found to date in the world. Yet these unconventional oil sources have shortcomings. Firstly, the required extraction processes can be highly energy intensive and hence uneconomical. In the case of tar sand oil, it takes as much as the energy equivalent of one barrel of conventional oil to obtain two barrels of tar sand oil (in the case of shale oil: the oil input exceeds the oil output, a net energy loser). Secondly, reserves do not necessarily equate to real production capacity. The most optimistic production projections show tar sands producing merely 3 million barrels/day by 2030 and Venezuelan heavy oil around 1 million barrels/day by 2020. Shale oil is not projected to become economic any time soon. So in short, whilst these reserves might be huge (and therefore could in theory produce oil for decades), they are *unlikely to produce even 5% of world oil demand* in the next two decades.

Alternative Energy

Primary alternative sources of energy include: Natural gas, coal, nuclear energy, renewable energy (wind, solar, hydro, biomass) and bio fuels. Of these options only natural gas, coal and bio fuels can be used as conventional fuel substitutes – with gas and coal being turned into liquids (GTL and CTL respectively). Nuclear energy and renewable energy are energy substitutes, but their applications in transport are limited as approximately 95% of the worlds' transport fleet runs on oil.

Natural gas and GTL are not long term solutions as natural gas will peak not long after oil according to the International Energy Agency (IEA). However, if the massive investment could be made right now it could help in the medium term to offset growing oil demand.

There are still large deposits of coal (especially in China, Russia and the US) to make CTL. Whilst CTL technology is immature and very expensive (only South Africa has semi- commercial plants) it does hold potential if massive investment is made and oil prices rise significantly. However, coal is a major pollutant and green house gas, therefore using large amounts of coal to make CTL will result in increased climate change. Also, if CTL becomes a major use for coal, increased competition for coal with traditional electricity consumers will lead to increased prices, which will affect electricity affordability.

Biofuels can offset some crude oil use. Brazil leads the way through use of sugar cane to produce ethanol. This ethanol is either used in a pure form or blended with

diesel. The US has started producing large amounts of ethanol from corn, however this is the worst way to produce ethanol as it takes around 1 barrel of oil equivalent energy to produce 1 barrel of ethanol – there is no net energy gain. In addition, diverting sugar, corn and other crops (not to mention land) to make biofuel means less available food for human consumption. This competition for crops has already driven up prices for corn and other staple agricultural commodities significantly (corn alone has increased over 100% in price in the last 6 months).

Renewable energy and nuclear power have significant potential for expansion and do not cause climate change. However, they are not really a substitute for oil unless large scale electrification of mass transport takes place. Therefore whilst their use will increase dramatically in the future they will have a limited impact on the coming liquid fuels crisis.

Technology

Technology can help because it provides new ways to find oil, as well as ways to increase the amount of oil extracted from a field. New technologies can be used to prolong field life through secondary recovery techniques (e.g., injecting water and carbon dioxide to maintain field pressure or 'wash' out remaining oil). However, even though this technology has been applied in earnest in the US and the rest of the world, the facts remain sobering:

- only one giant oil field has been found in the last 30 years (in Kazakhstan)
- oil production continues to decline in countries that have peaked, and
- oil fields using secondary recovery techniques are still dying.

At best technology has delayed the peak of global oil production by a few years, but eventually geology trumps technology.

Hydrogen is a much touted replacement for oil. However hydrogen is not a primary energy source; it has to be produced, and that requires a lot of energy. Furthermore, Hydrogen is an energy carrier (like a battery), rather than a fuel source. Therefore whilst it will clearly have some uses, it is not an alternative in any sense.

CONCLUSION

Peak Oil is ultimately an issue of risk management. We are confident that a peak in oil production is coming; our only doubt surrounds the exact timing – and the evidence suggests that this is sooner rather than later.

However, we believe that Peak Oil is not receiving the respect and attention that it deserves from policy makers and the general public. Everyday, businesses, governments, and households around the world make decisions based on the assumption that oil will remain plentiful and affordable. In addition, *the amount of ignorance and complacency that exists is truly frightening, given the risks involved.* The general public remains poorly informed, and even industry professionals are confident that "things aren't that bad" or "technology will find solutions."

The evidence simply does not square with this consensus. Even current supply and demand figures (excluding assumptions of Peak Oil) are stretched and show that there is substantial risk in the system – any small deviation in supply could lead to serious shortages.

Furthermore, there is no easy technological solution or silver bullet to the Peak Oil problem. All of the typically suggested alternatives have limitations, and must be used in combination to offset the voracious appetite of the developed and developing world.

Lastly, to successfully implement these alternatives, a massive and coordinated investment effort is required 20 years before we arrive at the peak – which is probably already less than a decade away. Clearly, Peak Oil should be right at the top of any serious policy makers' agenda.

The next section discusses some of the potential implications of peak oil for Hong Kong in more detail.

Implications for Hong Kong

GLOBAL AND FAR-REACHING IMPLICATIONS

Our industrial societies and our financial systems have been built on the assumption of continual growth; growth based on the availability of cheap fossil fuels. Oil is clearly the most convenient and multi-purposed of these fossil fuels.

Oil is so central to our everyday lives, that a peak in its production will have vast and dramatic implications geopolitically, socially and economically. Historical experience illustrates that shocks to oil price and supply can be very damaging to economic and social stability.

> ***Oil shocks and stagflation in the 1970s:*** One historical example is the geopolitically motivated Arab Oil embargo in 1973, which cut world oil production by 6 to 7 percent and led to a major world recession. As a result, oil prices rose by 50 percent in October 1973 alone and doubled by January 1974. In the United States, GDP growth fell from around 4% (average 1960-73) to 1.8% (average 1973-1982), productivity growth dropped from 2.5% in 1966 to less than 1% by 1979, unemployment rose from 4.8% in 1972 to 8.3% by 1975, inflation-adjusted wages declined by 6% between 1973-1979. A combination of high inflation and unemployment (not possible by the conventional economic theory of the time) led to the coining of the term 'stagflation.' The above example refers to an energy crisis whose root causes are geopolitical and fundamentally solvable. Peak Oil, however, refers to an energy crisis whose root causes are geological and permanent
>
> ***The Cuban oil crisis:*** The experience of Cuba, which lost half of its oil supply after the collapse of the Soviet Union in 1990, although extreme, is also highly instructive. Cuban imports and exports both fell by approximately 80%, GDP dropped by more than one third. Transportation, industry and electricity production experienced major disruptions. Agricultural production dropped drastically. Coupled with the US trade embargo, Cuba was unable to import enough food, and the average daily caloric intake dropped by one third. These implications are sobering, considering Cuba's relatively low (1950s) level of development and

dependency on oil; particularly compared with most industrialized nations today

The devastation of Hurricane Katrina in 2005: A recent experience, which illustrates how stretched current oil supplies are, as well as the potential impact of shortages. The US lost roughly 24% of its production capability (~1.5 million barrels / day), in addition to significant refinery capacity along the Gulf coast.[17] Oil prices, as a result, rose to over US$70/barrel. However, in spite of these high prices, no additional supply was forthcoming – due to a lack of spare capacity in global oil production and refining. Crucially, the Katrina and Rita experiences show that in the event of a shock to oil production (whether caused by natural disaster or permanent geological decline), critical supplies of oil can be disrupted; leading to a total lack of electricity, basic amenities and general chaos as experienced in New Orleans. Simply put, there would be no way of "buying your way out" of future disruptions to supply; disruptions which could become increasingly common as global production peaks.

WHAT DOES PEAK OIL MEAN FOR HONG KONG?

Basic economic theory suggests that in a market where oil supply and demand are mismatched:

Long term oil price will rise: Predictions abound on the long term equilibrium price of oil. Oil prices reached a record of almost US$100 per barrel (inflation adjusted) in the late 1970s (see Exhibit 7). Some respected oil analysts have forecasted prices in excess of US$150 over the next few years.[18] Although oil prices today appear to be high at close to US$65/barrel, they remain low by historical standards.

Short term oil prices will become more volatile: Dramatic price fluctuations will become more common as supply and demand conditions are imbalanced

Oil supplies will become less reliable: Small disturbances at any point in the supply (production, refining or delivery) chain will lead to immediate and

[17] *http://www.mms.gov/ooc/press/2006/press0222.htm*

[18] *Charles Maxwell, Weeden & Co. – Interview with Barron's, October 2006. Smilarly, Goldman Sachs Investment Research estimated that prices could easily breach US$100/barrel*

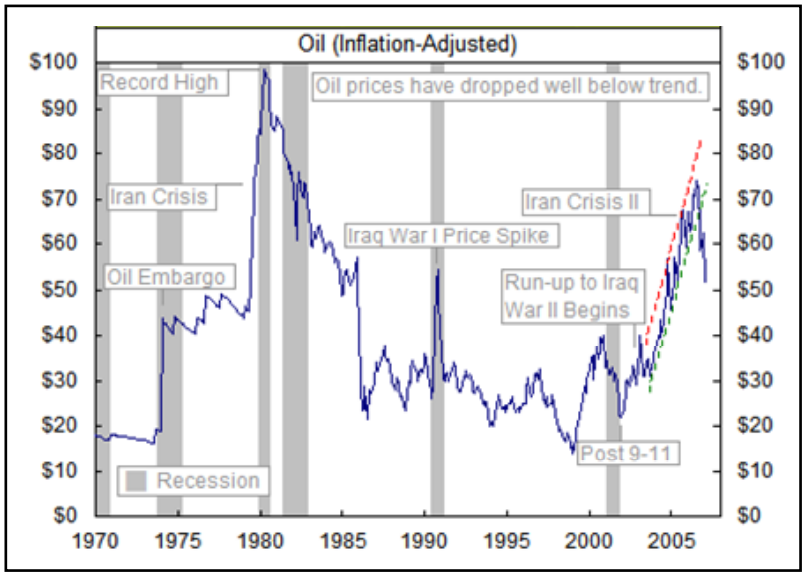
disruptive shortages. As highlighted in the case of Hurricane Katrina, Peak Oil means much more than expensive oil; it could mean a breakdown in oil supply

Exhibit 7[19]

Oil price / barrel

(inflation adjusted),

1970-2006



Any or all of the above outcomes could occur as and when Peak Oil becomes a reality. What do these outcomes mean, though, for Hong Kong as a society, economy, and positioning as a hub for Asian trade and investment?

HOW BAD: GRADUAL DECLINE OR SUDDEN SHOCK?

Various scenarios for Hong Kong are possible, depending both on when a peak in global production arrives and how severe the impact is on global oil supply. On one hand, a gradual and long term transition towards scarce and expensive oil would allow time to plan for and potentially mitigate the impact of Peak Oil. The Hirsch report suggests that a heavily oil dependent economy such as that of the United States would require at least 20 years of aggressive full-scale preparation and investment in order to avoid a crisis. On the other hand, a rapid decline or oil shock could lead to very serious disruptions, and clearly a limited ability for Hong Kong to respond – the HKSAR Government would have to dedicate a significant share of its resources in order to deal with a very sudden and potentially severe problem.

[19] *http://www.peak-oil-crisis.com/index.htm*

POTENTIAL IMPLICATIONS

Hong Kong, needless to say, is a world class business center and a leading economy in the region. Hong Kong's economy is highly dependent on international trade and service activities. It has a unique role, today, as a regional corporate base, as well as a major hub for logistics, sourcing, and pan Asian business travel.

On one hand, Hong Kong appears to be less vulnerable to rising fuel costs compared to the global average. Oil and naphtha related fuels account for roughly 33%[20] of Hong Kong's primary energy requirement, while fuel costs account for only around 2% of total business costs.[21]

Yet, on the other, Hong Kong is almost 100% dependent on imported goods and services (as it has limited agriculture, manufacturing and no natural resources). In addition, both Hong Kong's key economic activities and positioning as a hub is highly sensitive to the availability of affordable oil. Disruptions in oil supply and permanently higher prices could jeopardize these activities, and undermine Hong Kong's status as a regional hub.

Specifically, we believe that Peak Oil could be potentially disruptive to Hong Kong in the following areas:[22]

Economic development

The risk of a major economic recession for Hong Kong is high. Historical experience (see Exhibit 6) shows that Hong Kong's economy has been highly sensitive to spikes in oil prices in the past. High oil prices on a sustained basis would damage sectors such as airlines, local transport, construction; and in particular, trade.

> **Overall economic effects:** It is beyond the scope of this document to analyze the economic impact of Peak Oil in a detailed manner. Nevertheless, high oil prices will lead to higher prices for goods and services (massive cost push inflation), leading to reduced consumer purchasing power (higher oil prices serve as an 'oil tax') and consumption. Higher unemployment is also likely to increase as businesses struggle to adjust. Indeed, stagflation – not unlike that of the 1970s – could return.

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[20] *Betty Yuen,* Energy Security for Hong Kong*, CLP Power Hong Kong, Oct 2006*

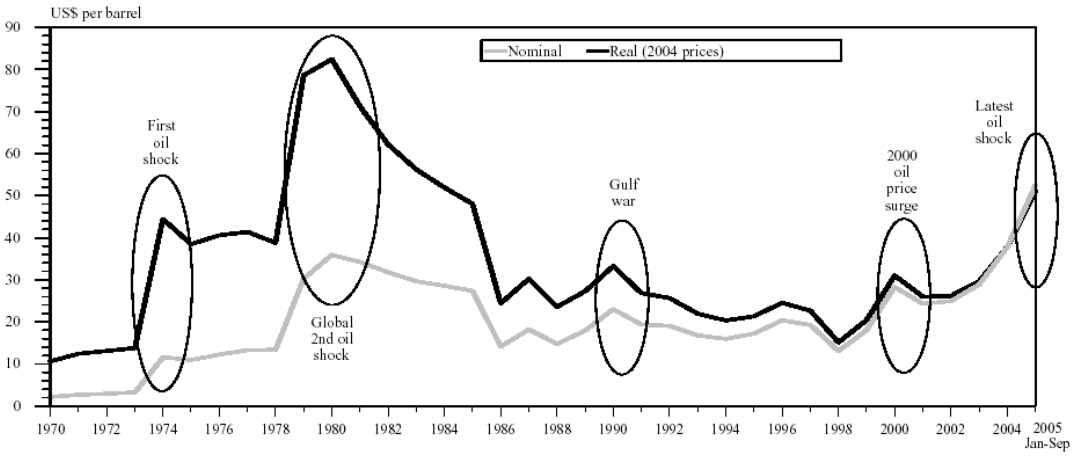
[21] *Economic Analysis Division of the HKSAR Government,* 2005 Economic Background and 2006 Economic Prospects*, 2006*

[22] *This is not an exhaustive analysis of the potential risks to Hong Kong. We intend to highlight the major issues in this briefing document. We recommend that the HKSAR Government undertake a separate, independent, broad and detailed analysis of risks and mitigation*

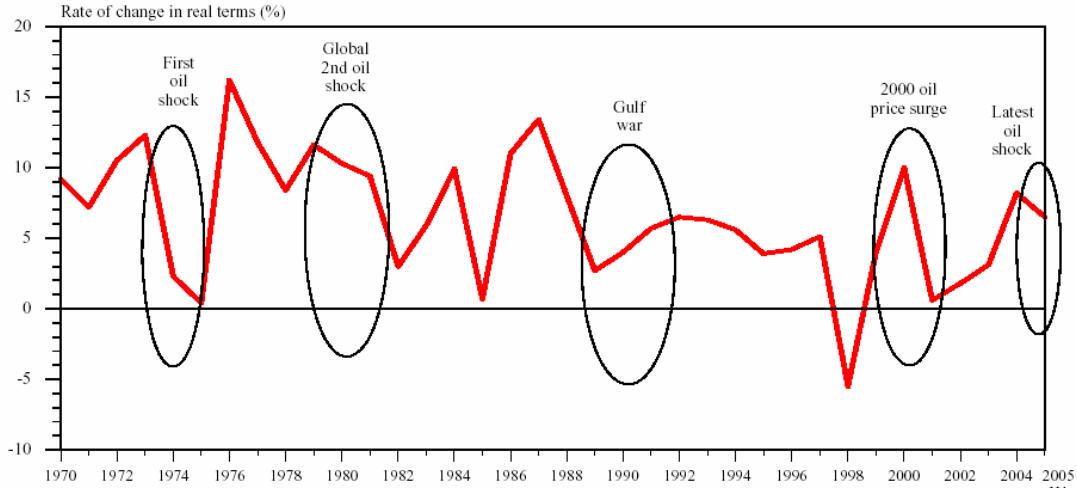
Earlier econometric studies have estimated that for every US$10/barrel increase in oil prices, Hong Kong's GDP growth would decline by 0.6%[23]. Clearly, Hong Kong would be in a recession (based on the official definition of two consecutive quarters of negative economic growth) if oil prices return to 1970 levels (roughly US$100/barrel adjusted for inflation).

Exhibit 8[24] – Impact of oil prices on Hong Kong GDP growth, 1970-2005

US$ per barrel



Inflation Adjusted Rate of Change in GDP



Sector / business impact: Energy and oil intensive sectors such as airlines, local transport, food and construction will suffer from higher oil prices and supply shortages.

[23] *Economic Analysis Division of the HKSAR Government,* 2005 Economic Background and 2006 Economic Prospects, *2006*

[24] *Economic Analysis Division of the HKSAR Government,* 2005 Economic Background and 2006 Economic Prospects, *2006*

For example, higher costs for airline carriers could lead to less business travel, airline bankruptcies and potentially undermine Hong Kong's status as a regional hub for business travel.

International trade, one of Hong Kong's key economic drivers, could be severely damaged by Peak Oil. Hong Kong, today, is a sourcing center, logistics hub and one of the world's largest exporters of manufactured goods. In 2005, the Kwai Chung / Tsing Yi terminals handled over 230 million tones (22.6 million containers) of cargo making it the world's second busiest container port.

A sustained spike in oil prices could permanently reduce the volume of trade. At first, a global economic depression would reduce the flow of goods between countries. Longer term, higher distribution costs would weaken the economic case for globalization and international supply chains (e.g., raw materials from Latin America, manufacturing in China, and packaging in Japan). As a result, Hong Kong would also lose its status as a sourcing and logistics hub

Peak Oil also means that the amount and variety of food produced (and reaching our shelves) will decrease; and food will cost more. This is because modern food production systems are highly energy intensive (e.g., fertilizers, irrigation, tractors and other farm equipment which are used to grow and process our food). The production of nitrogen fertilizer, for example, requires natural gas, and there is no practical substitute currently available. As oil (and therefore natural gas prices) rise, the use of nitrogen fertilizers will decrease, resulting in a reduction in food production. Also, a vast majority of food in Hong Kong is imported from faraway places. Food routinely travels thousands of miles (by ship, plane, truck) to reach our tables. In a very real sense, we are eating fossil fuels. In the future food will have to be imported from sources closer to home.

Energy Security.

Hong Kong does not have any natural resources to speak of – it imports 100% of its oil needs (roughly 280,000 barrels of oil per annum)[25]. Peak Oil means that Hong Kong could face difficulties in securing access to oil, and potentially energy. The increasing scarcity of oil in the future, combined with intensifying international competition by nation states to secure this critical resource may mean that price will

[25] *Central Intelligence Agency,* The World Fact Book*, 2007*

no longer be the primary determinant in obtaining supply of oil. Geopolitics may influence the supply as much as price. Even access to alternative energy sources such as natural gas, coal, and nuclear power may become threatened (i.e. become increasingly strategic) as oil becomes increasingly scarce.

This raises questions regarding Hong Kong's long term strategic positioning in the region, and whether it has the clout to secure access to sufficient energy in the future. The US military certainly has concerns as outlined below[26]

> *"The supply of oil will remain fairly stable in the very near term, but oil prices will steadily increase as world production approaches its peak. The doubling of oil prices in the past couple of years is not an anomaly, but a picture of the future.*
>
> *Peak Oil is at hand with low availability growth for the next 5 to 10 years. Once worldwide petroleum production peaks, geopolitics and market economics will result in even more significant price increases and security risks.*
>
> *To guess where this is all going to take us is would be too speculative. Oil wars are certainly not out of the question. Disruption of world oil markets may also affect world natural gas markets as much of the natural gas reserves are collocated with the oil reserves."*

Political stability.

Hong Kong has had prior experience in crisis management. Indeed, the SARS experience was a full-blown humanitarian crisis with severe social, political and economic ramifications – a crisis which took Hong Kong some time to recover from. Yet SARS was a one-off, 'short term' event. The peaking of global oil production will neither be one-off nor short term. The resulting economic dislocation (high rates of inflation, unemployment, and recession) could pose a serious risk to social cohesion and political stability in Hong Kong.

Clearly, low income groups will be most vulnerable to anticipated impacts from Peak Oil. Indeed, a combination of food scarcity, energy rationing, and economic malaise could lead to very unpleasant consequences for Hong Kong – an optimistic scenario is one of distress and social unrest; a pessimistic scenario could even lead to social and political disintegration.

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[26] *U.S. Army Engineer Research and Development Center,* Energy Trends and Implications for U.S. Army Installations*, Sep 2005*

CONCLUSION

Irrespective of the exact timing of a peak in global oil production, the risks to a shock in oil prices and supply – within the next decade – have increased substantially, as evidenced by the current production and utilization data (Exhibit 6).

Supply and demand are so closely matched today, that even small and short term disruptions could have severe and long term consequences for the Hong Kong economy, energy security and overall political stability. In particular, Hong Kong's unique position in China and indeed in the region could be permanently damaged. Although we do not intend to be alarmist, we believe that Peak Oil has moved beyond the point of being an abstract debate to being a very real risk.

Given these potential risks, the HKSAR Government should take Peak Oil seriously and err on the side of caution by managing risk and pro-actively preparing to mitigate the damage. The next section provides some initial recommendations.

Recommendations

WHAT ARE OTHER COUNTRIES AND CITIES DOING?

As we have already intimated, Peak Oil is ultimately an issue of risk management; we know it is coming, but the timing and impact is uncertain.

Countries all over the world are waking up to the risk of Peak Oil and beginning to make preparations. From the US and UK to Australia and China, Peak Oil task forces, ministerial groups and academic studies are now being put in place. Countries like Sweden and Iceland have already pledged to remove oil voluntarily from their economies and some cities like Portland in the US are taking the lead to safeguard their own future at a local level.

At the beginning of 2007 the US Government Accountability Office (GAO) and the Australian Senate released reports on Peak Oil – both contained serious warnings on the risks and recommended actions to be implemented *immediately*.

RECOMMENDATIONS FOR HONG KONG

The growing world-wide interest in Peak Oil is beginning to attract attention in Hong Kong, as reflected in various talks and newspaper reports. We believe that the HKSAR Government should now take the initiative to address Peak Oil, so as to ensure a full and balanced debate and that such action as can be taken is put in hand. Otherwise the risk is that extremist views on the issue will dominate – either on the side of the scaremongers or of those who do not see the radical difference between a terminal decline in oil production and the politically inspired, short term, shortages we have experienced in the past.

Every country and city is unique and therefore, whilst we should study what others are doing, Hong Kong must assess its own vulnerabilities and decide how best to prepare for Peak Oil. We do not propose specific remedies or actions, but set out below a framework for action, with some illustrative ideas on what might be considered under each heading.

A FRAMEWORK FOR ACTION

Within Hong Kong, the HKSAR Government needs to:

- Establish responsibility
- Identify the risks
- Develop contingency plans
- Devise mitigating strategies
- Communicate with stakeholders
- Raise community awareness

Externally, the HKSAR Government needs to

- Communicate with cross-boundary authorities

Establish Responsibility

Addressing Peak Oil will require effort from many departments in Government and close cooperation between the public and private sector. The HKSAR Government is the only body that has the capability and authority to implement this coordination role. Because the issues will cut across traditional boundaries of work, we suggest that the Chief Secretary for Administration be charged with directing Government's efforts, assisted by a lead Policy Secretary who would coordinate and where necessary advise on the work of other Policy Bureaus.

Identify the Risks

We have suggested that the main risks are for the economy, energy security, and political stability. These are high level risks, which encompass a host of contributory elements that require further analysis. Many sectors from public transport and aviation to food related industries and finance will be affected.

For example, for transportation Peak Oil could at different times lead to shortages, sporadic supply and high prices for oil based products (possibly well over $100 per barrel). What implications would this have for public transport (demand and fares), private transport, marine and air transport, and commercial transport? For food, what

are the risks to our supply chains? For our people, what are the risks for employment?

And within this, how would we cope if the refineries in Singapore which supply our oil fuels were shut down for any reason? World production is already under severe strain to meet demand, and temporary refinery shortages (as caused by Hurricane Katrina) can no longer be made up through production elsewhere.

Develop Contingency Plans

Having identified the risks, contingency plans should be reviewed. For example, are our strategic fuel reserves adequate to weather sudden shortages or interruptions in supply? Are we ready if necessary to implement rationing systems? What is the position on food reserves?

Devise Mitigating Strategies

Our dependence on oil and other energy sources is such that we cannot adjust to sudden reductions in supply without great adverse impacts. However we can prepare for such through implementing energy efficiency, energy reduction and alternative energy strategies.

Energy efficiency for oil may include setting minimum fuel efficiency standards for new vehicles, and more broadly energy efficiency may include a review of building regulations for new and also existing buildings, or a change to energy efficient lights and electrical appliances.

Energy reduction for oil may include reviewing fuel taxes, with a view to introducing increases which could be weighted against the more inefficient vehicles. More broadly energy reduction may include the strengthening of programs recently started to reduce air conditioning use and encourage energy conservation. This may also include the introduction of a carbon tax to discourage unnecessary use of energy (with the possibility of funds raised being hypothecated for energy efficiency and alternative energy programs).

On alternative energy, Government may review the practicalities of introducing ethanol/biodiesel into vehicle fuels, as is done elsewhere. A 10% blend would reduce our oil needs by a corresponding amount.

On energy in general, Government may include promoting clean electricity generation technologies to allow greater exploitation of electricity as an oil substitute

where possible (ie additional mass transit projects) whilst controlling climate change/air quality impacts. This could include promoting domestic and utility scale wind, solar and wave generation of electricity, further expanding the use of nuclear energy and speeding up development of LNG.

Communicate with Key Stakeholders

Under this heading key stakeholders are the main energy providers and users. Government may establish proactive discussions with the electricity companies, the gas companies, and the fuel companies to alert them to the issue, and seek their thoughts on how the impact on Hong Kong might be mitigated, and how Hong Kong's interests may best be protected.

On users, Government may consider contacts with the major public transport operators (rail (albeit they rely on electricity), bus, public light bus and ferry), other key transport operators such as in aviation and shipping, and food providers***. Each should be asked for their views and mitigation and other plans.***

Raise community awareness

Public education is a critical factor in addressing Peak Oil. The public should become a major ally in doing what can be done, and will need information if they are to act effectively. An ill-informed public will take what actions it deems necessary – witness the various runs Hong Kong has experienced in recent years on cake shops and supermarkets, and previously on banks.

If the public can be made aware of Peak Oil and what it means, they will slowly adapt their behaviour, and understand better the underlying causes which may require quite far reaching action from time to time.

The Government will need to devise ways to inform the public. This can be done through workshops, seminars, academic research, and straightforward promotion of information through the various existing information channels. The media may be encouraged to take an interest in the subject. Government may also put out direct messages concerning the importance of Peak Oil through speeches and even in the Policy Address.

Communicate with cross-boundary authorities

Energy issues and energy policy are pressing concerns for the PRC. They have long had to contend with demand which far outstrips supply, as witness shortages of diesel

fuel and electricity in neighbouring Guangdong. They are already one of the major world importers of oil, and are conscious of the difficulties of ensuring supply. They have aggressively addressed their energy demands through a series of bilateral deals with oil and gas suppliers, and are developing major policies on oil reserves.

Given our close economic ties, and the importance of the mainland as our key supplier of food, we should open discussions with mainland counterparts at the Central and Provincial levels to establish better bilateral understanding of needs and problems. Furthermore, it is possible that as a result of Peak Oil, globalization will reverse and localization and regionalization will become increasingly important.

CONCLUSION

Peak Oil is a clear and present danger and the HKSAR Government needs to take a proactive approach to risk management.

We believe that the government needs to assign, with high priority, some kind of task force or organization to study the implications of Peak Oil in greater detail and coordinate the initiatives that we have identified above. This is not an issue that can be resolved in the short-term – it requires a level of long term planning, coordination and investment that only the HKSAR government can lead.

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