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Peak Oil & the Impending Oil Crunch

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- Peak Oil Theory
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- The Oil Crunch
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Peak Oil

- Eleven years into the 21st century, the world remains heavily dependent on the fuel that powered the last 100 years: crude oil.

- Concern about the depletion of conventional global oil reserves seems to have intensified for several reasons, including technological improvements in geological data gathering and analysis, the increasingly sparse reserves discovered by new drilling, question marks over the real size of global proven reserves and concerns that much of the world's conventional oil especially in the Middle East, is coming from old and over-exploited mega-fields that are becoming less productive. There is no risk that we are running out of oil but chances of being able to match the projected growth in demand over the medium term with a rise in production is being seriously questioned.

- The peak oil theory explains how the rising oil prices will continue to impact on the global economy & global security all through the 21st century.

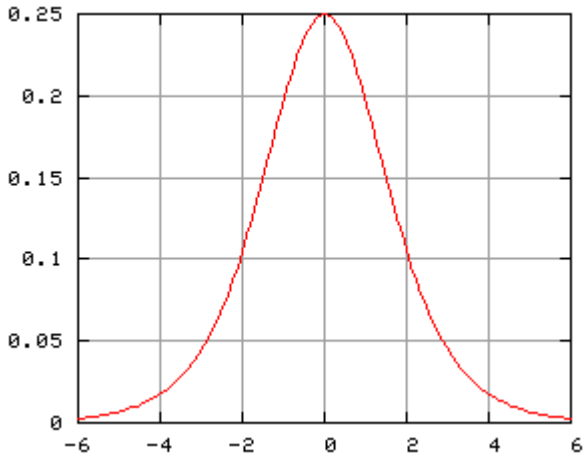
The Peak Oil Theory

- Peak oil theory, also known as the Hubbert peak theory after the American Geologist H King Hubbert, concerns the long-term rate of extraction and depletion in conventional oil and other fossil fuels.

- It states that any finite resource such as crude oil will have a beginning, middle and an end of production, and at some point it will peak. Oil production typically follows a bell-shaped curve when charted on a graph with the peak of production occurring when approximately half of the oil has been extracted. With some exceptions, this holds true for a single well, a whole field, an entire region, and presumably the world (see Figure 1).

- Peak Oil does not mean 'running out of oil', but 'running out of cheap oil'. There is a big difference between oil supplies not running out, and supply meeting demand.

Figure 1
Peak Oil Theory – The Hubbert Curve



So When Will Oil Peak Globally?

- A great battle is raging today about when will global conventional oil production peak and what will happen when it does. In one camp are the “optimists” who tell us that 2 trillion barrels of oil or more remain to be exploited in oil reserves and future discoveries. In the other camp are the “realists” who reckon that 1 trillion barrels of oil, or less, are left.

- The difference between 1 and 2 trillion barrels is seismic. If 2 trillion barrels of oil or more remain, then the peak lies far away in the 2020s and we have enough time to bring in alternatives to oil. If only 1 trillion barrels remain, however, the peak is already upon us and there probably isn’t even enough time to make a sustainable transition to alternatives.

- Many experts think the peak in global oil production has already been reached in 2006, others think it will come between 2010 and 2020. My own research, however, indicates that the peak may have already been reached in 2004 if we factor in what I describe as “OPEC’s inflated proven oil reserves”. My research indicates that OPEC’s proven oil reserves are overstated by some 300 billion barrels (bb).

The Peak & Depletion of Conventional Crude Oil

- Eight of the top oil producers in the world have already peaked: USA peaked in 1971, Canada in 1973, Iran in 1974, Indonesia 1977, Russia in 1987, UK in 1999, Norway in 2001 and Mexico in 2002 while China and even Saudi Arabia are about to peak (see Table 1).

- The only one among the top producers that has clear capability to increase production is Iraq once stability is restored to the country.

Table 1
The Peak & Depletion of Conventional Crude Oil

Country	Date of Peak Discovery	Date of Peak Production	% Discovered	% Depleted	Ultimate Production (bb)
Canada	1950s	1973	95	76	25
Iran	1960s	1974	94	76	130
Indonesia	1950s	1977	93	65	31
Mexico	1950s	2002	94	55	55
Norway	1970s	2001	93	48	33
Russia	1940s	1987	94	61	200
UK	1970s	1999	94	63	32
USA	1930s	1971	98	88	195
The World	1962	2006	94	49	2100

Sources: Association for the Study of Peak Oil's (ASPO) websit www.peakoil.net / The Energyfiles Ltd / Chevron / Petroleum Review.

Depletion of the World's Biggest Oilfields

Also three of the world's largest oilfields have already peaked:

1- Kuwait's Burgan oilfield, the world's second largest, peaked in 2005.
2- Mexico's giant Cantarell peaked in 2006.
3- Saudi Arabia's Ghawar, the world's largest oilfield, peaked in 2006 and is now declining a rate of 8% per year.

OPEC’s Inflated Proven Reserves?

- Many experts have questioned the exact size of OPEC’s reserves and also those of major Gulf oil producer’: Saudi Arabia, Iran & Kuwait (see Table 2).

Table 2
OPEC Proven Oil Reserves

Country	Proven Reserves Claim	Experts Estimates
OPEC	1029 bb	< 500 bb
Saudi Arabia	264 bb	90 bb –148 bb
Iran	138 bb	30 bb - 36 bb
Kuwait	99 bb	24 bb

Source: Petroleum Intelligence Weekly (PIW) / Research by Dr Mamdouh G Salameh on OPEC reserves / Research by Iranian experts on Iran's reserves / BP Statistical Review of World Energy, June 2010.

Table 3
Ultimate Global Conventional Oil Reserves & Depletion Rate (end of 2010)

Volume		Description
Ultimate Reserves (bb)	2,100	Amount of production when production ceases.
Produced so far (bb)	1,176	Until the end of 2010.
Yet-to-produce (bb)	924	Ultimate reserves less produced.
Discovered so far (bb)	1,984	Produced plus remaining reserves.
Yet-to-find (bb)	116	Ultimate reserves less discovered.
Discovery rate (bb/y)	6	Annual additions from new fields
Depletion rate (%)	3	Annual production as % of the yet-to-produce

Sources: USGS / BP Statistical Review of World Energy, June 2010 / IHS Energy Group, World Petroleum Trends (WPT).

Characteristics of a Peak in Oil Production

- A peak in oil production would manifest itself by:

  1- Rapidly escalating prices
  2- A slowdown in conventional oil production
  3- A growing supply deficit
  4- A declining discovery rate of new oil
  5- A declining energy return on investment (EROI) ratio.

- All these characteristics exist today.

A slowdown in conventional oil production

Table 4
Current & Projected Global Oil Demand & Supply, 2009-2030

	2009	**2010**	**2011**	**2015**	**2020**	**2025**	**2030**
Demand	84.08	86.40	87.80	90.40	100.00	112.35	117.40
Supply	79.95	81.32	81.25	81.20	81.10	80.50	80.00
Supply / Demand Deficit	- 4.13*	- 5.08*	- 6.55	- 9.20	- 18.90	- 31.85	- 37.40

Sources: US Department of Energy's International Energy Outlook, 2010 / IEA, World Energy Outlook, 2010 / BP Statistical Review of World Energy, June 2010 / OPEC Monthly Oil Market Report, March 2011 / The US Joint Operating Environment (JOE) – 2010 / Author's projections.

* Deficit is offset by OPEC's production cuts.

Declining Oil Discovery Rate

Table 5
Global Crude Oil Reserve Additions, 1992-2009
(bb)

Year	Added Reserves	Total Production	As % of Total Production
1992-2009	92.09	493.05	19
Annual Average	5.42	29.00	19

Sources: IHS Energy Group's Data / BP Statistical Review of World Energy, 1993-2010.

Declining Energy Return on Investment (EROI) Ratio

- When oil production first began in the mid-nineteenth century, the largest oilfields recovered 50 barrels of oil for every barrel used in the extraction, transportation and refining giving it an EROI ratio of 50:1.

- This ratio has now declined to 5:1 and, in some cases, to 1:1.

Tight Global Oil Production Capacity

Table 6
Capacity Addition & Capacity Erosion, 2006-2011
(mbd)

	2006	2007	2008	2009	2010	2011	2012
Net new capacity	1.037	1.300	1.456	5.722*	3.157**	1.189	-

Sources: Petroleum Review, (various issues 2006-2010).

* Includes 4.1 mbd of production cut by OPEC in October 2008 because of the recession.

** Includes 1.968 mbd of OPEC's production cuts.

Table 7
Unconventional Oil Reserves
(bb)

Canada Tar sand oil	Venezuela Extra-heavy oil	Oil shale	Worldwide Total
173	270	160	603

Sources: BP Statistical Review of World Energy, June 2010 / US Department of Energy (DOE).

Can Unconventional Energy Resources Bridge the Energy Gap?

Table 8
Current & Projected Contribution of Unconventional Oil to Global Oil Demand, 2009-2030
(mbd)

	2009	2010	2011	2015	2020	2025	2030
Demand	84.08	86.40	87.80	90.40	107.00	112.35	117.40
Supply	79.95	81.32	81.25	81.20	81.10	80.50	80.00
Of which							
Unconventional*	1.55	1.55	1.55	1.93	3.05	3.40	3.75
As a % of global Demand	2	2	2	2	3	3	3

Sources: IEA Energy Outlook, 2010 / BP Statistical Review of World Energy, June 2010 / OPEC Monthly Oil Market Report, March 2011 / The US Joint Operating Environment (JOE) – 2010 / Author's projections.

*Excludes biofuels.

Renewable Energy Potential

Table 9
Primary Energy Consumption, 2009-2050
(mtoe)

	2009	2025	2050
Primary Energy	11164	16194	19679
Oil	3882	5135	5288
Natural gas	2653	5119	6927
Coal	3278	3526	2748
Nuclear	611	1061	1937
Hydro	668	314	299
Renewables	72	1039	2480
As a % of total	1%	6%	13%

Sources: Shell International, Scenarios to 2050 / BP Statistical Review of World Energy, June 2010 / IEA, World Energy Outlook 2010.

The Impacts & Trends in the Global Economy

- Rise of many emerging economies and the shifting of global economic power balance from the West to the emerging countries and the oil-exporting countries.

- Currently the West plus Japan account for 52% of the global GDP. However, by 2015 the emerging economies and the developing world are projected to account for 50% of the global GDP.

- The overall transfers from oil consumers to oil producers in 2008 were estimated at $1.3 trillion, or 3% of world GDP.

- The Arab Gulf Sovereign Wealth Funds (SWFs) are equally growing in importance globally. They control assets estimated at $1777bn (see Table 10).

Table 10
Estimates of Assets Under Management for Arab Gulf SWFs

Country	Name of Fund	Assets (US$ bn, end of 2008)
UAE	Abu Dhabi Investment Authority	875
Saudi Arabia	Saudi Arabian Monetary Authority	433
Kuwait	Future Generation Fund	213
Dubai	Investment Corporation of Dubai	82
Libya	Oil Reserve Fund	65
Qatar	Qatar Investment Authority	60
Algeria	Revenue Regulation Fund	47
Oman	State General Reserve Fund	2
Total		1777

Source: IMF, Sovereign Wealth Funds: a work agenda / Sovereign Wealth Fund Institute (Jan. 2009).

An Asian Oil Demand Shock?

- While we recognize the risks associated with a supply shock in the oil patch, the world should be just as concerned about the demand shock evolving from Asia. At the moment, Asia's energy resources are grossly inadequate.

- In 2010 the Asia-Pacific region's dependence on oil imports amounted to 70%. This is projected to rise to 77% in 2015 and 86% by 2025 (see Table 11).

- It is against this background that the concept of peak oil becomes more worrisome. High oil prices might not simply be a cyclical phenomenon brought about by peak demand in this 7-year-old global economic recovery. Instead, high oil prices might be an early indication of a supply-demand imbalance that can't be reconciled by still higher prices. In this case, a more comprehensive oil shock surely awaits.

Table 11
Current & Projected Crude Oil Demand, Supply & Imports
in the Asia-Pacific Region (2008-2025)
(mbd)

	2008	**2009**	**2010**	**2015**	**2020**	**2025**	**% of change (2008-2025)**
Production	8.18	8.04	7.88	6.94	6.00	5.29	- 35%
Consumption	25.66	26.00	26.68	30.18	34.15	38.63	+ 51%
Net imports	17.48	17.96	18.80	23.24	28.15	33.34	+ 91%
As a % of Consumption	68	69	70	77	82	86	

Sources: BP Statistical Review of World Energy, June 2010/ Author's projections.

The Interplay between Oil Peak & Geopolitics

- As the world's number one consumer, the United States will have much to say about how the crisis plays out. The geopolitics of American oil dependency sees three key trends in US energy behaviour: more imports, increasingly unstable and unfriendly suppliers and rising competition for diminishing supplies.

- Despite efforts to diversify the US energy mix, the United States is still heavily dependent on oil imports and this dependency can only deepen in the future (see Table 12).

- The bottom line is that a rising competition for diminishing oil supplies could lead to a deadly confrontation between the world's military powers.

Table 12
US Current & Projected Crude Oil Production, Consumption & Imports (2008-2025)
(mbd)

	2008	2009	2010	2015	2020	2025	% change 2008-2025
Crude production	6.73	7.20	7.05	5.79	5.24	4.73	- 30%
Consumption	19.50	18.69	19.06	21.00	23.19	25.60	+ 31%
Net imports	12.77	11.49	12.01	15.21	17.95	20.87	+ 63%
As a % of Consumption	65	61	63	72	77	82	

Sources: US Energy Information Administration (EIA) / BP Statistical Review of World Energy, June 2010 / Author's projections.

The China Factor

- China's spectacular economic growth has significantly altered its position in the global oil market. In 2010, China accounted for more than 11% of global oil consumption compared to 5% in 1996, whilst its share of global production only amounted to 4.5% (see Table 13)

- To sustain its spectacular economic growth, China is racing to secure Middle East deals, putting it on a possible collision course with US interests in the World's most volatile region.

- China is now the biggest importer of Saudi oil, the second-biggest of Iranian oil, and the largest player in the Iraqi oil game. China is putting a lot of money on the bet that having ownership of oilfields is a better guarantee of supply than buying oil on the open market.

Table 13
China's Oil Production, Consumption & Net Imports, 2006-2030
(mbd)

	2006	2007	2008	2009	2010	2020	2030	% change 1993-2030
Production	3.68	3.74	3.90	3.79	3.68	2.88	2.44	- 34%
Consumption	7.41	7.77	8.09	8.63	9.49	14.24	21.36	+ 187%
Net imports	3.73	4.03	4.19	4.84	5.81	11.36	18.92	+ 407%
Imports as % Of demand	50	52	52	56	61	80	89	

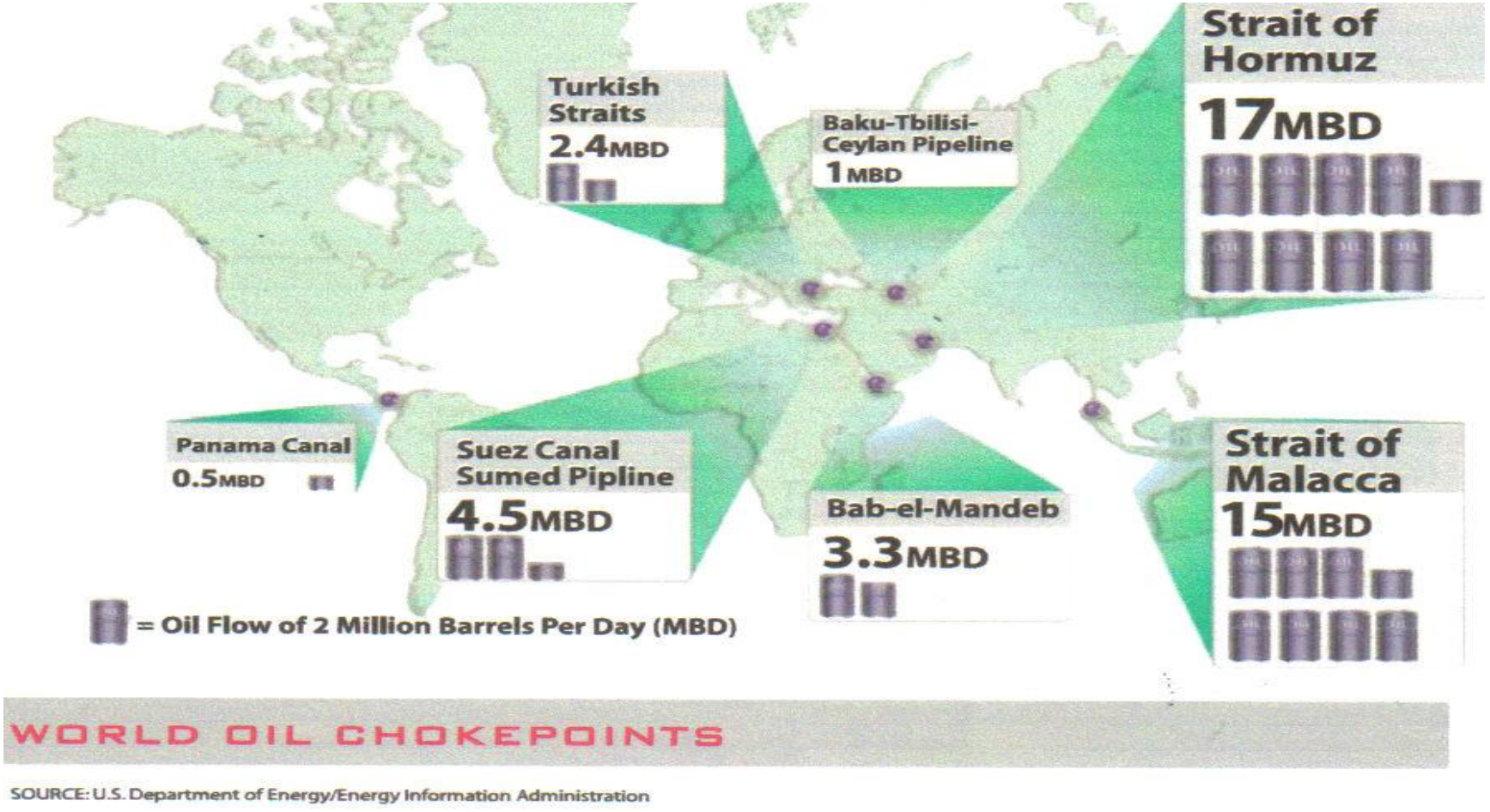
Sources: BP Statistical Review of World Energy, June 2010 / International Energy Agency (IEA) / Author's projections.

China’s Oil Security: A Serious Concern

- China’s growing dependence on oil imports has created an increasing sense of ‘energy insecurity’ among Chinese leaders. They worry about the US naval presence near the Strait of Hormuz, through which 17 million barrels of Middle East oil pass every day and the Malacca Strait, through which 80% of China’s imported oil moves (see Figure 1).

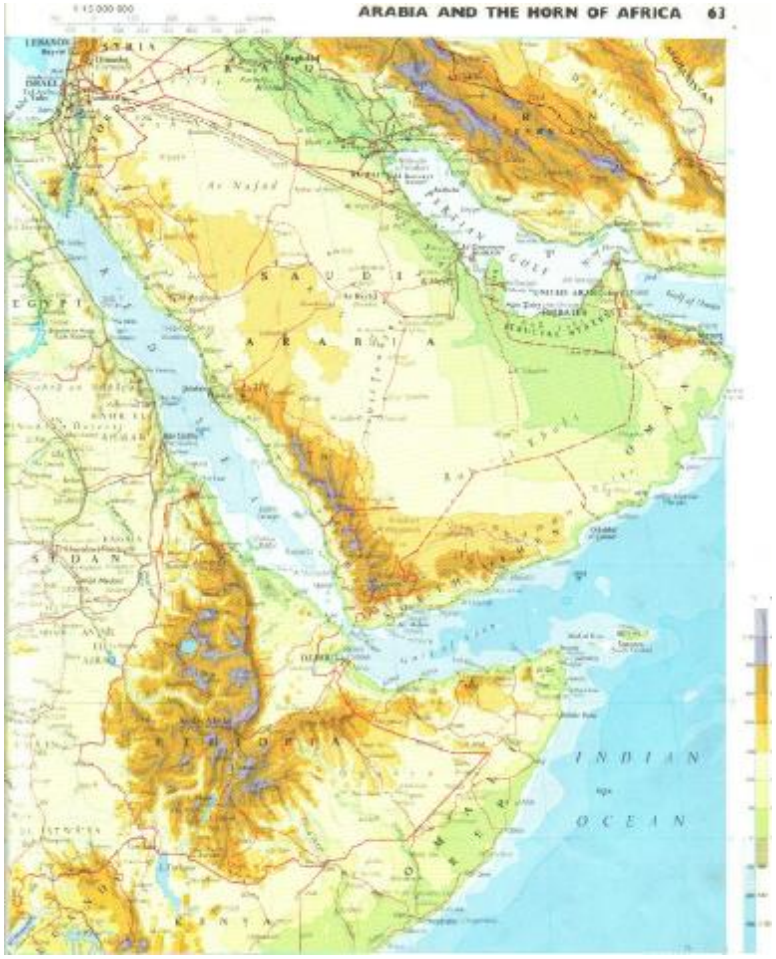
- With the US Navy patrolling the southern end of the Strait and the Indian Navy patrolling the northern end, China feels sandwiched in and strategically vulnerable. The Chinese leaders have often referred to the ‘Malacca dilemma’. ‘Certain powers, ‘they declared, ‘have all along encroached on and tried to control the navigation through the strait’. There is no mistaking whom they mean.

Figure 2
World Oil Chokepoints



SOURCE: U.S. Department of Energy/Energy Information Administration

Figure 3
The Strait of Hormuz



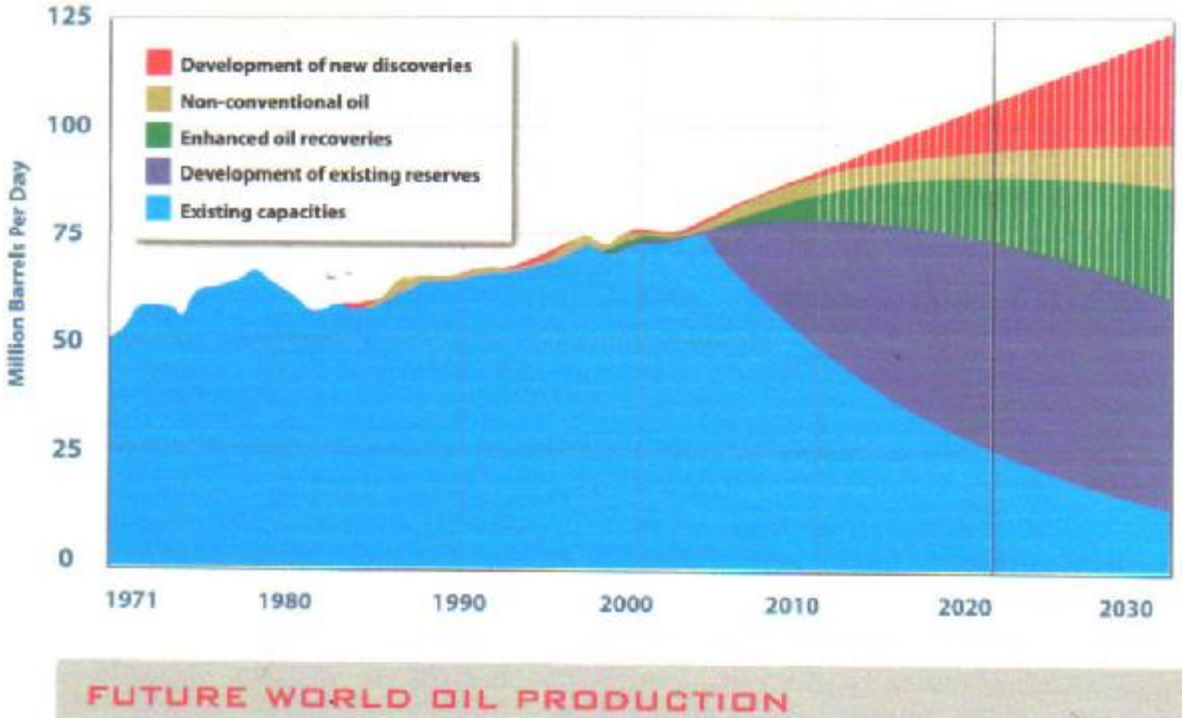
The Oil Crunch

- Global oil demand is projected to rise from 86.40 mbd in 2010 to 118.00 mbd in 2030. To meet this projected demand, even assuming more effective conservation measures, would require the addition of roughly the equivalent of Saudi Arabia's current oil production every seven years.

- It will also require that OPEC raises its oil production from 30 mbd currently to at least 50 mbd. However, OPEC may either be unable to raise its production to that level or may have a vested interest in restricting production increases, both to conserve finite resources and to keep prices high.

- Assuming the most optimistic scenario for improved oil production through enhanced recovery means, the development of unconventional oil and new discoveries, oil will be hard pressed to meet the projected future demand of 118 mbd by 2030 (see Figure 4).

Figure 4
Future Oil Production



Oil Crunch (continued)

- By 2030 the world will require a production of 118 mbd, but oil producers may be able to produce only 100 mbd. By 2012, oil production surplus capacity could entirely disappear if the global economy continues to grow. And by 2015 the shortfall in oil output could reach nearly 10 mbd causing an oil crunch which will be reflected in higher oil prices matching if not exceeding the price levels reached in July 2008, namely $147/barrel (see Table 14).

Table 14
Current & Projected Global Oil Demand & Supply, 2009-2030
(mbd)

	2009	**2010**	**2011**	**2015**	**2020**	**2025**	**2030**
Demand	84.08	86.40	87.80	90.40	100.00	112.35	117.40
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* Deficit is offset by OPEC's production cuts.

Oil Crunch (continued)

- A severe oil crunch could, therefore, be in the offing by 2015 or thereabouts. Even with massive investments in expanding production & refining capacities starting now, it may be too late to avert a severe oil crunch.

- While it is difficult to predict what economic, political and strategic effects such a crunch might produce, it surely would, at best, lead to periods of harsh economic adjustment and, at worst, to conflict and even war should one of the major oil-consuming nations choose to intervene forcefully.

- The war on Iraq was a foretaste of what's to come. That war was instrumental in precipitating the global banking crisis and the recent world recession (see Table 15).

The 21st Century's First Oil War

Table 15
The Global Macroeconomic Costs of the War on Iraq, 2003-2008
($ bn)

Description	USA	UK	Iraq	Global Economy
Oil price impact	2454			7479*
Budgetary costs	2232	31		
Macroeconomic costs	1963	9		
Loss of oil export revenue			171	
Total Costs	6649	40	171	7479

Sources: Dr Mamdouh Salameh's own research / Data from Prof. Joseph Stiglitz's book, "The Three Trillion Dollar War".

* Excluding the United States.

Can the World Be Weaned off Oil?

- The answer to this question is that it can only be done if we endeavour to change our way of life, easy said than done. But the dire alternative will eventually force us to change the way we live and seek alternative energy sources.

- Energy efficiency could be a first step. Automakers, for instance, could increase fuel mileage from the current 30 mpg to 80 mpg at little additional cost. This could have an immediate impact on global oil demand.

- Another option is the electric car. However, an age under electric cars has to be coupled with a shift to solar, wind, nuclear and other sources of renewable energy for electricity generation.

- Hydrogen is also a feasible source of energy for transport. We are 15 to 20 years away from using hydrogen fuel cells as a substitute to oil. Whatever the world decides eventually, it will have to be a concerted effort by governments, manufacturers and even oil producers.

Conclusions

- Peak oil is not only a reality but is already impacting on oil prices, the world economy and the global energy security. Moreover, the days of inexpensive, convenient and abundant energy sources are virtually over.

- An analysis of the global oil market fundamentals indicates that a severe oil crunch could be in the offing probably by 2015 or thereabouts. Even with massive investments in expanding production & refining capacities starting now, it may be too late to avert a severe oil crunch.

- Such a crunch could, at best, lead to periods of harsh economic adjustments in the global economy and, at worst, to conflict and even war should one of the major oil consumer nations choose to intervene forcefully.

- However, I will end my talk with an optimistic note. The impending oil crunch could accelerate global efforts to develop renewable energy resources and also alternatives to oil, particularly in the transport sector.

Thank you for attention

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