PRICE SIGNALS AND GLOBAL ENERGY TRANSITION

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Summary

Most economic policy makers think that cheap oil and energy underpin economic growth. Very large amounts of fossil energy are certainly vital for any modern economy, whether the OECD bloc's service oriented economy, or the fast industrialising economies of the Asian Tigers in the 1975-85 period, or China and India, and several other large population industrialising countries today. The absence of any 'alternate model' for economic development ensures there is continued and strong demand growth for fossil energy, worldwide. Upward potential for personal consumption of fossil fuels is essentially unlimited in this context.

The role of oil and energy price rises in increasing or decreasing economic growth, changing the type of economic growth that takes place, and either increasing or decreasing oil and energy demand growth rates is not well understood. However, and depending on the policy and fiscal context it can be stated that oil price rises to high levels (probably up to $75-per-barrel) almost certainly increase overall or global economic growth rates, and therefore increase oil and energy demand growth rates. Only extreme oil and energy prices, or extreme interest rates and very deflationary economic policies can 'abort' this process or mechanism.

Since about 1994-96 world energy and oil demand growth rates have increased to a large extent. This 'demand shock' is due to a number of economic, energy-economic, social and technological reasons, and in the absence of grave economic recession higher demand growth rates are likely to continue. Current 'trend growth rates' for world energy and world oil demand are about 2.25% for oil and about 2.5%-3% for energy on an annual basis, with major regional variations.

The 'cheap oil interval' of about 1986-99 was an anomaly from many perspectives and for many reasons. One key reason is physical depletion, which is however rejected or ignored by most governments and institutions as a price setting factor for oil and for natural gas. Concerning oil, and more important than physical depletion in the very short run (next 3 - 5 years) is the question of available production capacity, producer country stability, and pricing policy decisions of the OPEC. After 2008 the world oil market may enter a situation of structural supply deficit. Before that period demand growth, and loss of capacity through accidents, strike action, natural disasters, OPEC export limitations, and civil war or sabotage in exporter countries will likely produce major price 'spikes'.

Because of depletion, but in addition because of environment and climate limits, energy transition away from fossil fuels must and will start within no more than 10 years. Price signals, in the existing economic system and framework, are needed if this is to start, and to build from the immediate near term. Existing and developing frameworks provide by the Kyoto Treaty offer some potential for adaptation and direction to the task and goals of energy transition.

Oil prices and economic growth

The US economy attained it highest-ever postwar growth of real GDP, achieving what today would be the unthinkable and also impossible rate of 7.5%, in the Reagan re-election year of 1984. At the time, in dollars of 2003 corrected for inflation and purchasing power parity, the oil price range for daily traded volume crudes was $52-$65/barrel. (See Table 1 at end of article). Despite this simple fact of economic history, Cheap Oil is still regarded by uninformed opinion, and most government agencies charged with economic management as a passport to economic growth.

Oil prices as high as $60/barrel would not harm the world economy today. They would almost certainly entrain increased growth at the 'composite' world economy level within a few months.

Conversely, the setting of extreme interest rates would result in massive economic damage. There would be certain collapse of world stock markets, runaway 'domino effect' bankruptcy of many major finance sector corporations, mass layoffs and unemployment, and grave problems for financing the *structural* trade deficits of especially the US and UK. The US, also facing an all-time record deficit of its public finances (at least $455 Bn in 2003) and around $5 - $6 Bn per month costs from its 'regime changing' experiment in Iraq would expose itself to the risk of runaway flight from the dollar as the interest rate weapon produced stock market and economic rout in its wake. The declining *petromoney* status of the GB pound would unlikely shield the UK economy from the sequels of using the interest rate 'weapon' as a blunt tool of energy policy, to force down oil demand. All European Union countries, and Japan would also face severe national budget financing difficulties, as tax revenues collapsed and spending to limit economic damage, including unemployment compensation and bailouts for large companies spiraled up as the crisis deepened. Financing increased state spending through borrowing would then *lock on* the upward spiral in interest rates, and itself intensify recession while maintaining inflationary pressures.(1).

Higher and much less volatile oil and energy prices underlying serious and committed energy conservation, transition to renewable energy and restructuring for a low energy economy, habitat and society are the real long-term solutions to emerging supply difficulties which will surely raise prices, but energy transition is discarded or rejected as utopian and unworkable by political decision makers. While claims are made that today's economy is 'less oil dependent than in the 1970s' (2) world oil consumption has risen by about 48% or 20 Million barrels/day (Mbd) since 1983, and by about 17% since 1990. Oil import dependence as a percentage of total consumption continues to rise in a large number of OECD economies, and unless demand is rapidly substituted oil imports will soon show very fast growth (3). Unfortunately, the subject of oil prices is given benign neglect when they fall, and energetic propaganda treatment when they rise. Most economic policy makers believe in a simple slogan: the lowest price is always the best.

In theory the 'price signal' of higher oil and energy prices must be present if a range of goals stretching from reduced greenhouse gas emissions through energy independence to slowing the rate of fossil energy resource depletion are regarded seriously. If they are not, or they are denied as being of any importance this can well explain the basic unpreparedness of large oil and gas consumer countries to accept higher and more stable oil prices. Any large interruption in supplies, of more than 5% or so for under 6 months, or depletion linked failure of world production capacity to match demand and its growth would, as in the past, create an immediate crisis.

This leaves 'demand destruction' as the sole option and real response to any large rise in oil or gas prices, through economy destruction by *the interest rate weapon*. The last time this was done, in 1980-83, oil prices were surely reduced through cutting economic activity in general. Oil prices in today's dollars fell from $100/barrel in late 1979 to around $60/barrel in 1984, but the collateral economic and social damage was awesome. Unlike today, however, the OECD economy started from a position of growth, with balanced budgets in many countries including the USA, in 1979-80. The world economy could and did take the horse medecine of sky-high interest rates without imploding into a sequence like that of 1929-31. There is no certainty or guarantee this would be the case today – no 'soft landing' is currently on offer.

Higher oil prices tend to increase world economic growth

Higher oil prices operate to stimulate first the world economy, outside the OECD countries, and then lead to increased growth inside the OECD. This is through the income or *revenue* effect on oil exporter countries, and then on metals, minerals and agrocommodity exporter countries, most of them Low Income (GNP per capita below $400/year). Almost all such countries have very high marginal propensity to consume. That is any increase in revenues, due to prices of their export products increasing in line with the oil price, is very rapidly spent, on purchasing manufactured goods and services of all kinds. In the 1973-81 period, in which oil price rises before inflation were of 405%, the New Industrial Countries (NICs) of that period – notably Taiwan, South Korea and Singapore – which we can call 'traditional' NICs (see below) experienced very large and rapid increases in demand for their exports. These three countries increased their oil imports in under 8 years through the 1973-81 period, and despite the 405% price rise, by 55% to over 80% in volume terms. See Table 2.

Table 2 Asian Tiger economic demand-driven, close-coupled adjustment to Oil Shock

Oil Consumption Thousand barrels/day

	1975	1976	1977	1978	1979	1980	1981	
Singapore	141	165	165	170	183	181	208	Increase 1975-81 : **47.5%**
South Korea	278	310	371	426	480	475	497	Increase 1975-81 : **78.8%**
Taiwan ROC	214	271	304	353	358	388	359	Increase 1975-81 : **67.8%**

Source// BP Statistical Review of World Energy, various edns

The macroeconomic mechanism of higher revenues completely displacing any 'price elastic' impact from much higher oil prices, working between real resource exporters and the 'traditional' NICs, quickly levers up world economic growth (the very simplest type of Keynesianism, but at the global level), and is easily triggered by rising oil, energy and real resource prices. This flatly contradicts the arguments by certain well-known institutions that higher oil prices 'hurt poorer countries the most' (4). Higher revenue earnings for many low income oil exporter countries may in fact prevent such countries from experiencing conflict leading to stoppages of exports. For the special cases of Iraq and Saudi Arabia higher revenues may be the only effective, short-term way to prevent complete chaos in Iraq, and Saudi Arabia from falling into civil strife, insurrection and takeover by hard-line Islamists.

No immediate and instant recession can occur with oil at $50 or $60 per barrel. Vastly higher oil prices than that would be needed to abort the worldwide mechanism of higher oil, energy and real resource prices driving faster economic growth. Conversely, low oil and energy prices entraining low real resources prices, combined with rising population numbers surely aggravate the 'cycle of poverty' in low income commodity exporter countries. Deprived of sufficient revenues, such countries have become 'basket case' indebted countries, subjected to draconian conditions by the Club of Paris, World Bank and IMF for debt refinancing and restructuring. Constant ethnic and civil war in Africa provides the best and most real example of what happens to countries subjected to so called 'structural adjustment' (5). When or if this concerns oil exporter countries there can be no surprise if this reduces or eliminates exports by the affected countries which, after the 'price taker' stage fall into the bottomless pit of basket case low performer economies. When they fall from that into civil and ethnic war their capacity to supply oil – whether cheap or not - will also take a hit.

Today's 'emerging' New Industrial countries (NICs) include China, India, Pakistan and Brazil. All have either big or immense internal or domestic markets, and large potentials for *military Keynesian* spending, that is safeguarding national economic growth through deficit financed and labor intensive modernization and expansion of their military systems. The relative lack of integration of these *behemoth economies* into the world system, particularly India and Pakistan, also provides them with some cover or shelter from the effects of world recession, when or if the OECD countries tilt to all-out recession. Conversely, whenever any increase in world solvent demand for manufactured goods occurs, these countries will very rapidly increase output. China is now and without question the world's leading industrial power for medium- and low-value consumer manufactured goods and will soon become the world's single biggest industrial economy. Under almost any hypothesis, therefore, fossil energy demand – particularly oil and natural gas – will increase in China and India, and in the other large population NICs. Demand growth can only run at rates at least close to, or usually well above their rate of economic growth. (6)

World oil demand change under regimes of rising prices

Oil remains the economic 'swing fuel' par excellence, and oil price increases – before reaching certain supposedly 'extreme' levels – will always tend to increase or restore economic growth at the world or 'composite' level. In addition *oil shock* or sudden and large price increases, as well as slower acting but large price rises that do not fallback, change the *type* of growth towards more energy-intense industrial and manufactured products, away from more services based, lower energy activities (7). This 'perverse' factor results in increased oil intensity of world economic output and raises the 'oil coefficient' or percentage increase in oil demand for a percentage point growth of the economy (8). This *macroeconomic* change affects all economies, some faster than others, during a certain time period. Wholly unlike the stock of myths, and 'facts' without foundation that circulate inside the oil market trading community these effects can be *measured* and have predictive value (9). In brief, a regime of higher oil and energy prices will tend to lever up world composite or global economic growth rates. This, in turn, produces the 'perverse result' of firm demand for much more costly oil and gas. Whether this is inflationary, or not, will depend not only on how high oil prices rise, but more certainly on the *fiscal and policy environment* in large consumer and importer economies.

World oil demand potential and 'demographic' demand

Insofar as *potential demand* is concerned, any oil supplier (whether OPEC or not) should be joyful, or very concerned for their forward national security when serious analysis is given to real world oil demand structures and growth drivers. These are all, finally, due to demographic and economic growth, to conventional technology used in the economic process, and to the very slow progress in finding real, economic, and effective substitutes for oil, gas or even coal that deliver *more* net energy than they 'cost' to produce. In addition, such is the utility and facility of fossil based liquid hydrocarbon fuels and pipeline gas that sought-after substitutes must be of a type that can be utilised in the economy and society without 'total restructuring' of either the economy or society.

Current oil demand worldwide extends down from 25.6 barrels/capita/year (bpy) for the USA to well below 0.2 bpy in rural areas of low income developing countries (LDCs). The world average, which fell slowly for around 15 years through 1978-93, is about 4.51 bpy. As a pure projection, if the world's current 6.3 Bn population consumed oil at current US per capita rates this would generate a demand of around 445 Million barrels/day (Mbd). At the other extreme, at 0.2 bpy world total oil demand would be telescoped to less than 3.5 Mbd. See Table 3, below. The current, real world average of 4.51 bpy is around one-third the average for European Union countries, more than 4 times that of India, and over 3 times that of China – which will soon become the world's biggest industrial economy. Annual increase of the world's population (which is continuing to fall as a percentage rate, and in absolute numbers) is now running at about 85 Million. At the current world average of 4.51 bpy this itself generates a 'latent' or potential growth in world oil demand of about 1.06 Mbd annual, assuming no change in the energy economy, no fuel substitution, and also no economic growth.

Table 3. **Demographic rate of oil demand, 2002**

Country/Region	bpy	World demand at this rate
USA	25.6	445 Mbd
Italy	12.4	215 Mbd
China	1.45	25 Mbd
Rural areas, LDCs	0.2	3.45 Mbd
Real world	4.51	78 Mbd
World annual population growth 85 Million		Annual 'latent demand' increase 1.06 Mbd

Sources/ Population data from UN Population Information Network, Oil demand BP Amoco Statistical Review of World Energy, 2003

The following points are highly significant:

1 – If world average oil demand per capita in 2003 was the same as in 1979 (about 5.53 bpy with oil prices, in today's dollars at up to $100/barrel), world oil demand today would be at least *17 Mbd higher* than it is. World oil demand in 2003 would run at an average of about 95.4 Mbd. There is no certainty at all that world supply would or could satisfy this demand.

2 – If we take current 'demographic demand' (4.51 bpy) the growth of that demand due to population increase, of about 1.06 Mbd per year, is likely an incompressible minimum except in the event of very severe global economic recession with actual contraction of world oil demand.

3 – Any sustained growth in the world economy, that is recovery from recession in the OECD bloc, and/or continued fast economic growth in China, India, Brazil, Pakistan, Iran, Turkey and other large population 'emerging' New Industrial Countries (NICs), will significantly increase total annual world oil demand growth to far above 1.06 Mbd, perhaps to its double (about 2.1 Mbd). This latter is 2.7% on a 78 Mbd base.

4 – Given that world oil demand has increased about 12 Mbd since 1991, and 'demographic demand' is slowly growing again, it is wholly unrealistic to imagine that cumulative world demand growth will be any *less* than about 12.75 Mbd in the next 12 years. This would only change in the event of long-term and worldwide economic recession, or coordinated and legally binding world action for energy transition.

Demand shock

The BP Amoco Statistical Review of World Energy in its 2003 edition notes what it calls 'surprising growth' of world energy demand since 2001 and 2002 – about 2.6% annual compared with a so-called "10-year trend rate" of 1.4% annual for world energy, and 1.3% annual for world oil demand by volume. These "10-year trend rates" were or are also utilised by many energy companies and institutions, such as the US EIA and OECD IEA. However, such 'long-term trend rates' of demand growth for oil, gas and also coal were in reality already giving way to higher yearly growth rates by about 1995. It is difficult or impossible to identify any price elastic effect or factor in these major changes, and the large increase in annual oil demand growth rates since about 1995 can only be analysed as due to the revenue effect far outweighing the price elastic effect, in global macroeconomic terms. It can be noted that the US EIA and OECD IEA, since 2000, generally refer to a trend rate of world oil demand growth in the range of 1.7% - 1.8% annual.(10).

By comparison, when oil prices are considerably higher than today's current price levels, demand growth rates tend also to be higher. During the 1975-79 period, with oil prices in today's dollars in the $38-$55/bbl range, world oil demand growth easily averaged 4% annual by volume, after a sharp, one-year fall in 1975. This can be compared to the 1999-2003 sequence of world oil demand change, with a sharp fall in the single year of 2001. The fall in demand for 2001 against the previous year (about 1.2%) could be claimed as a 'price elastic' response to tripled prices, around 2 years after the 1998-99 price rise but the likely real causes of this 'pause' in generally increasing demand growth rates were the fall in equity numbers on world stock exchanges triggering an erratic downturn in the world economy. To this can be added energy demand reducing impacts of the September 2001 terrorist attacks on world airlines, travel movements and consumer confidence in the OECD countries.

Current oil demand growth rates in the Asia-Pacific region, since 1992 second only to North America as an oil importer and consumer, are generally in the 5.5%-6.5% annual range for most regional countries including China and India (11), and have tended to *increase* since 1998/1999. Oil and gas import demand of this region is set to grow very rapidly, due also to localized depletion of current production capacity (12). It is therefore easy to suggest the "10-year trend" of 1.4% for commercial energy, and about 1.3% annual growth rates of world oil demand was an aberration. In addition, if oil prices played any role at all in setting this low growth trend, it was through *cheap* oil and gas in the 1986-99 period which tended to reduce solvent international demand through reducing commodity

prices and slowing economic growth rates of lower income countries. This, in turn, reduced annual demand growth rates for commercial energy, and particularly for oil.

Generally lower economic growth rates also applied, even in spectacular fashion, to the OECD countries in the 1985-2000 period. For the G-7 group of leading economies in the OECD bloc, average annual real growth rates fell by about 50% comparing average growth rates in 1989-95 with those for 1968-79, due to numerous reasons (13). This fall in average growth rates inside the OECD also resulted in slowed economic growth and falling oil demand growth rates for the 'traditional' NICs or Asian Tiger economies (see above), generally reducing world or composite oil demand growth rates. Since at latest 1994-96 this overall trend (of about 1.3% annual oil demand growth) has been replaced my a much higher trend, notably due to the 'emerging' NICs with huge populations and immense markets, comprising not only China and India, but also Pakistan, Brazil, and Iran. These emerging economies have generally *energy-intense economic activity.* In addition, the aging and sluggish economies of the OECD are now experiencing major energy-economic change, including the replacement of sometimes very aged energy, economic and social infrastructures, markedly increasing their energy and oil intensity of economic output.

One key example of this concerns the world's largest single oil consumer, the USA, where oil demand through the first 5 months of 2003 increased by about 0.6 Mbd. This is 2.9% growth since December 2002, and a year-on-year growth rate of 2% (14). Combined, notably, with very firm demand growth trends in Asia-Pacific it is most likely that low growth trends for both oil and energy have given way to higher annual growth rates. This is for a large number of reasons, which include energy infrastructure changes in the OECD bloc, and the macroeconomic impacts of the 'emerging' NICs, through their fast industrial and economic growth exerting a 'pull effect' on the sluggish OECD bloc. We should also include the many and significant social, secular and cultural changes occurring within the OECD economies, which though almost unstudied from an energy point of view, almost certainly lead to a composite *increase* of their energy and oil demand.

The fact of *oil demand shock* operating from at latest 1995 can be understood from the simplest and most aggregate figures, such as those shown below (Table 4).

Table 4. **World oil demand change by volume, % change on year before**

1995	1996	1997	1998	1999
1.64%	2.15%	2.61%	0.52%	2.86%
1990	**1991**	**1992**	**1993**	**1994**
1.31%	- 0.19%	0.51%	- 0.04%	2.09%

Source/ BP Amoco Statistical Review of World Energy, various editions. See also Table 1.

Price shock

The first 'shock' is that there is an almost complete lack of price elasticity on a world economic scale in response or reaction to oil prices that, through 1998-1999, increased about 230% (see also below). The argument made by this author of *reverse elasticity* or an increase in demand *when prices rise* is rather well shown by even these very simple aggregates. Taking the 1990-99 period we can also note that almost each time oil prices tended to rise *demand increased* within about 6-12 months. See Table 5, below. This is particularly flagrant for 1999 compared with 1998: after an approximate tripling in terms of peak-trough yearly prices world oil demand *increased* by 2.86% over 1998, its highest rate in nearly a decade! Whenever prices fell during the 1990-99 period, demand growth rates tended to fall. This again proves, if proof is needed, that world oil demand is dependent on global

economy growth and yearly changes in that growth, and to many energy infrastructural, technological, energy economic, social and cultural factors. Annual world oil demand is therefore usually *unrelated and un-linked* to the oil price except when very, very high prices are attained in a very short period of time. Over the short-term, and depending on prices attained, demand will often *increase* as prices rise.

Table 5 **World oil demand and oil price variations 1990-99**

Year	1990	1991	1992	1993	1994
Year min oil price 2003 $/bbl*	20.75 USD/bbl	21.60 USD/bbl	21.50 USD/bbl	17.05 USD/bbl	16.90 USD/bbl
Year max oil price 2003 $/bbl*	39.40 USD/bbl	34.55 USD/bbl	29.60 USD/bbl	26.65 USD/bbl	24.65 USD/bbl
Demand change % on year before	**+ 1.31%**	**- 0.19%**	**+0.51%**	**- 0.04%**	**+2.09%**

Year	1995	1996	1997	1998	1999
Year min oil price 2003 $/bbl*	19.55 USD/bbl	21.05 USD/bbl	20.55 USD/bbl	10.95 USD/bbl	27.70 USD/bbl
Year max oil price 2003 $/bbl*	25.20 USD/bbl	29.55 USD/bbl	28.15 USD/bbl	18.75 USD/bbl	28.95 USD/bbl
Demand change % on year before	**+ 1.64%**	**+2.15%**	**+2.61%**	**+0.52%**	**+2.86%**

Source/ Table 1, below

Why oil prices can only increase

For a number of reasons oil prices are on an erratic but upward trend since their 1998/99 most recent low of around $10/barrel. The most recent 'price shock' sequence can be described from various perspectives, including the following (R Mabro)/

"It is useful to distinguish short-term price fluctuations from episodic movements that sometime characterise certain longer periods of time. The most dramatic episode occurred fairly recently and is still very alive in people's minds: this is the 1998/ early 1999 price collapse followed by rises which took prices to high levels throughout 2000. The WTI price (NYMEX first month futures contract) was at $17.65 per barrel at the beginning of January 1998. It reached a low of $10.80 in late December 1998, but the lowest levels were not hit until early February 1999 when WTI bottomed at $10.26 and Brent at $9.70. After that date the price movement was relentlessly upward with the WTI price ending the year at around $26.50 per barrel and peaking at $34.15 on 7 March 2000. It took 13 months of toil for the market to bring the price down by slightly less than $7.0 (that is by 39%) and then another 13 months of over-excitement to raise it by almost $24.0 (that is by 233%)".(15).

Amusingly enough Mabro and other commentators who characterise price increases as 'over-excitement', and price falls as 'toil for the market', trace the signal for this upward price movement to a late-1997 decision by OPEC to *raise* output quotas by 10%. This in turn isolates a key element of oil market mythology – the fixed belief that OPEC has always got spare capacity, and will always have spare capacity. For OPEC as currently constituted (including Iraq), and for the next 3 – 5 years no reasonable analyst can go above 31 – 32 Million barrels/day (Mbd) of exportable capacity, over and above domestic economy oil consumption needs. Speculation on this export capacity number is of course a prime subject of 'OPEC watching', but many unbiased observers suggest the real maximum export capacity of OPEC today, and for the next 3 – 5 years will have real difficulty exceeding 28 – 30

Mbd.(16). More important, and with very few but key exceptions, exportable surpluses of current OPEC producers can only stagnate or diminish. The 'key exceptions' of course include Saudi Arabia and Iraq (with perhaps Abu Dhabi, Kuwait and possibly Nigeria) in the OPEC group, and essentially the Russian Federation alone in the nonOPEC group of oil producers with large exportable surpluses that can, could or might be increased.

Oil market price setting as Mabro and other commentators point out is through trading *expectations,* not facts. These expectations, in other words market mythology, have or had an underlying belief that there can only be slow, gradual and predictable rises in world oil demand, at the 'old paradigm' rate of about 1.3% per year. In addition, market mythology believes or believed that supply from OPEC and nonOPEC 'players' will always tend to increase faster than oil demand. By consequence, prices 'spike' from time to time, when demand very temporarily outstrips supply, but always return to very opaquely defined 'normal trading levels'. For about 13 years through 1986-99 these were set at 'around $18-per-barrel'. Quite how this price was first arrived at and then fixed is at least as opaque and mysterious as oil prices attaining $100/barrel in dollars of 2003 during the Iranian Revolution, in 1979-80, but may relate to very cheap natural gas prices, operating a downward ratchet effect on oil prices. Cheap oil price theory embodied in the *lucubration* of M A Adelman - that the 'right price' for oil is $2.50-per-barrel in dollars of 1972 – has like Gresham's Law fully displaced any consideration of why prices should rise, on the theory side (17). For a few weeks in late 1998/early 1999 the 'right price' of Adelman was achieved, when prices in current dollars hovered around $10/bbl.

Cheap Oil and the depletion issue

Any reasonably unbiased reader of the Summer 2003 'depletion series' by the US 'Oil & Gas Journal' could quickly conclude that oil and gas depletion, as ever, is a 40-year threat, challenge or opportunity, and therefore a subject for the Keynesian long-term. Extremely large remaining and recoverable oil resources, are claimed to exist in so-far underexplored or even 'ignored' regions like the deep offshore South Atlantic region, in parts of Russia that for various reasons would have been overlooked, and of course in Iraq, of which the 'real reserves' are claimed by some, mostly American writers to be far above 200 Bn barrels. World total endowment would, according to these optimists, be at least 4000 Bn barrels, of which production to date is about 900 Bn barrels.

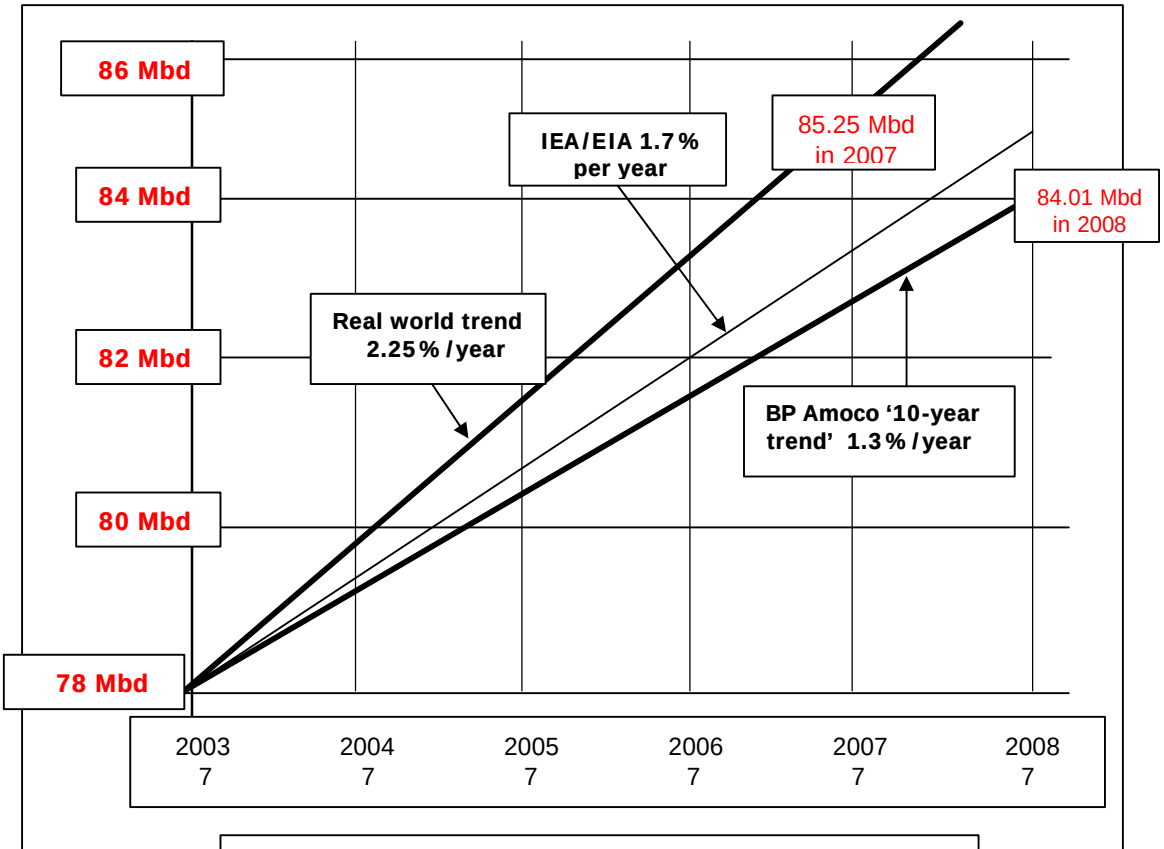
Much less is said about the 'producibility' of these enormous but imaginary reserves, that is the *rate* at which world annual oil production can be increased before some 'hypothetical' maximum is attained, of perhaps 150 Mbd by about 2038 (a 2% annual average growth rate for 34 years would bring world oil demand to 156 Mbd). Even less is said about *oil prices*. For the moment, most contributors to the Oil & Gas Journal's "depletion" series appear to suggest, oil market traders will pursue the 'toil' of talking down oil prices because supply tends to outstrip demand and cheap oil is so good for the economy. A host of 'expert' opinion will always be on tap to opine this is so, latterly using the approximate tripling of oil prices in 1998-1999 as a very retrospective explanation for the 2000-2002 'dotcom-telecom' equity price crash on world stock markets.(18).

The OECD IEA in its monthly oil market assessment 'Oil Market Report' for 11 July 2003 is constrained, by facts, to record that world oil demand on an 'all liquids' base was running at an average of 78.08 Mbd in May-June 2003. Based on data in previous issues of the same 'Oil Market Report' this yields a yearly growth rate of at least 2.25% for Summer 2003 against Summer 2002. Despite this, the IEA confidently forecasts that world oil demand will only grow by 1.28% in 2003-2004, attaining 79.08 Mbd as the rate of average daily demand by Summer 2004. No explanation at all is offered as to why world oil demand growth will now suddenly return to the "long-term trend" growth rate, after its 'surprising' near doubling ! The IEA, in its July 2003 report then goes on to offer the perspective of nonOPEC suppliers increasing their market offer by up to 1.7 Mbd in the next 12 months, leading to OPEC suppliers losing market share for a fifth successive year. The only explanation offered for the 'Baghdad Bounce' in world oil prices is that OPEC has decided not to increase output, and that Iraq's oil output is only making a "slow return" towards prewar levels (19). The now dramatic decline of North Sea oil production, with the UK and Norway losing a total of 0.516 Mbd capacity through June 2002-June 2003, (20), and continuing gradual loss of US production

capacity (a decline of 0.285 Mbd in the same period), while US oil demand has increased at a 24-year record rate of 0.6 Mbd in 12 months, are of course not mentioned by the IEA as factors raising prices.

The work of Deffeyes, Youngquist and the ASPO group (21) on real world oil reserves and production potentials strongly suggests net additions to world production capacity will soon fall to zero as the world arrives at its absolute peak of production. This will, through the deforming lens of the oil market, be tested in real time and its impact will be vastly increased price volatility, followed by price explosion. After this, depending on the immediate economic sequels, some form of world compact to hold oil prices in a new and much higher price band will possibly or probably be arrived at through hastily arranged 'North/South' conferences like those of the 1974-81 period.

Some impression of possible new capacity required through the next 5 years can be obtained by comparing the three major trend rates of world oil demand growth discussed above. These are the actual and current, real world trend of about 2.25% annual (which may well be exceeded in 2003-2004), the lower (1.7% annual) of the two trend rates utilised by the OECD IEA and US EIA, and the '10-year trend' of BP Amoco (1.3%), now 'resuscitated' by the IEA in its forecasts for 2004 oil demand (growth of 1.28% for July 2003- July 2004). The variations, in Mbd values, with a potential for demand attaining about 87.2 Mbd in July 2008 soon become very large. See Figure below.



REAL WORLD DEMAND GROWTH TREND versus TWO SCENARIOS (BP Amoco '10-year trend' and IEA/EIA growth rate trend)

Conclusions

For various economic doctrinal and economic mythical 'reasons' Cheap Oil is seen by the decisionmaking elite in the richer nations as the 'passport to economic growth'. This is a pure fantasy. Only at very high oil prices (probably above $75-$100/barrel) will inflationary and recessionary effects of high energy prices be so strong as to cancel the global economic expansionary impacts of higher revenues for exporters of energy minerals and other energy intense "real resources"

Since about 1995 'demand shock' has begun to operate in the world economy for a number of economic, social and technical reasons, leading to considerably higher underlying growth rates of world oil demand. One counter-intuitive or 'perverse' reason for this shock is *reverse price elasticity* or increasing oil demand with increasing oil prices. Current 'trend growth rates' for world energy and world oil demand are about 2.25% for oil and about 2.5% for energy on an annual basis.

In the case of conventional or classic economic growth, this will be enabled and facilitated at the world or 'composite' level by rising oil prices up to high price levels, probably above $60/barrel in today's dollars. This will serve to underpin, or even increase world demand for fossil energy supplies, indicating that concerted international action is needed to plan for an accelerated arrival of "peak oil", with "peak gas" being possible within 10-12 years after "peak oil".

Because of depletion, but in addition because of environment and climate limits, energy transition away from fossil fuels must and will happen. Price signals, in the existing economic system and framework, are needed if this is to start, and to build from the immediate near term. Existing and developing frameworks provide by the Kyoto Treaty offer some potential for adaptation and direction to the task and goals of energy transition.

REFERENCES

Table 1. 'World oil price and volume demand change' – see next section of this document

1. Discussed in A McKillop 'Is a 1929-style crash likely this October 2003 ?' Posted by sites including Gold-Eagle.com, FiendBear.com and Vheadline.com (July-Aug 2003)

2. US Federal Reserve chairman A Greenspan made this claim with reference to rising US natural gas prices and 'high priced' oil. See for example/ New York Times, June 17, 2003, 'Short Supply of Natural Gas Raises Economic Worries' by Simon Romero

3. For the USA in particular, rising oil import dependence is a highly sensitive subject. In the General Accounting Office report 'Energy Security: Evaluating U.S. Vulnerability to Oil Supply Disruptions and Options for Mitigating Their Effects' (Chapter Report, 12/12/1996, GAO/RCED-97-6) the report noted: 'The GAO found that: the U.S. economy realizes hundreds of billions of dollars in benefits annually by using relatively low cost imported oil rather than relying on more expensive domestic sources of energy; by comparison, oil shocks impose large but infrequent economic costs that, when annualized, are estimated to cost the U.S. economy tens of billions of dollars per year...'
No mention of course was made in this report to such a thing as depletion. For EU states dependent on oil and gas from the North Sea there is very clear evidence of increasing depletion, meaning increased dependence, as for the USA, on oil from the Middle East, Russia, Central Asia and Africa. See/ 'The Impact of Declining Major North Sea Oil Fields Upon Norwegian and United Kingdom Oil Production', Roger D. Blanchard, Department of Chemistry, Northern Kentucky University, Highland Heights, KY 41099-1905, USA (periodically updated).

4. The OECD-IEA Web site posts the following 'information' regarding the claimed effects of higher oil prices on low income countries/ 'High oil prices hurt poor countries more than rich' – 'IEA Underlines Developing Nations Dilemma' (IEA Web site – posted since 2000). This site claims the following: 'High oil prices affect all oil-importing countries but they hurt developing countries more than others. Developing countries suffer more from an oil price hike, as they are more reliant on their energy-intensive manufacturing sectors to spur economic growth. There are often no alternatives to oil. In developing countries an increase in the oil import bill, as a result of a price hike, can lead to a destabilising deterioration in the trade balance and feed inflation'.

5. See A McKillop, 'Dark Continent – Black Gold', posted by Newsbase.com (Afroil) August 2003

6. For 2003 to date, Chinese oil import demand growth remains in the 25%-30% per year region. 'China's oil imports have jumped 29.8 percent to 50.6 million tonnes in just the year to date'. Source: 'Asia starts to gasp for energy', by John Berthelsen, Atimes.com/atimes/Asian_Economy/EH21Dk01.html, August 2003. See also References 11 and 12.

7. The energy-intensity, and especially oil-intensity of world economic output is claimed to have fallen by as much as 15%-20% over 1980-2000 (see 'World Energy Outlook', OECD-IEA, Paris, various editions). This analysis focuses OECD economies in particular, and does not closely analyse regional, national and sectoral variations in energy and oil-intensity of output under regimes of price change. This study is needed, notably to trace the global macroeconomic impacts of higher oil and energy prices, and forecast demand through 2003-08.

8. The calculation of 'oil coefficients of economic growth' is particularly difficult under conditions of falling demand for any reason (very high prices, embargo/rationing, economic recession, etc). See A McKillop, 'Improving the quality of oil demand forecasts', Oil & Arab Cooperation Quarterly, OAPEC, Kuwait, Vol 16, Issue 59, 1990

9. As (8) above.

10. EIA and IEA publications (eg 'World Energy Outlook') utilise composite annual growth rates of world oil demand of 1.7%-1.8% for projecting world demand at around 115 Mbd by 2020. Addressing the May 2002 G-8 energy ministers summit conference in Chicago with the theme 'Preparing for Oil Shocks', US Energy Secretary Abraham projected world oil demand as attaining 120 Mbd by 2020. The difference between a 1.7% and 1.8% annual rate is over 15 Mbd through 17 years.

11. The relation of very strong oil and energy demand growth in Asia-Pacific to growing oil import dependence of the US is discussed in eg.: M G Salameh, 'Quest for Middle East oil – the US versus the Asia-Pacific region', in: Energy Policy, vol 31, 1085-1091, Elsevier Press, 2003

12. Concerning natural gas demand growth rates in Asia, note these forecasts for 2003 against 2002: 'Individual growth forecasts for some of the major gas consuming countries are India 19.1%, China 13.6%, Taiwan 9.1% and South Korea 7%'. 'The Importance of Gas', Editorial, Khin Bo, PetroMin & Hydrocarbon Asia, May/June 2003 (www.Safan.com).

13. Through the long period 1969-2003 the sharpest falls in average annual economic growth rates for OECD countries took place after 1985. Discussed for example in: A Jolley, CSES Working Paper N°5, 'A New Era of Economic Growth', CSES, Melbourne University, Australia, 1996. Average annual growth rates for the G-7 countries fell from 3.2% in 1968-79, to 1.4% in 1988-95.

14. David Bird, 'Energy Matters', Petroleumworld.com, 5 June 2003. US oil demand in May 2003 averaged 20.08 Mbd compared with 19.48 Mbd in May 2002. Growth at 2.9% for the first 5 months of 2003 was the highest since the late 1970s.

15. Robert Mabro, 'Does Oil Price Volatility Matter?", Oxford International Energy Studies - OIES Monthly Comment, June 2001

16. Periodically covered by Reuter's survey of oil market analysts, including Matthew Robinson, 'Shrinking Capacity Threatens OPEC Oil Market Rescue', Reuters, Caracas, 18/10/2002. Also discussed by Seppo Korpela, 'The Prediction of World Peak Oil Production', in A McKillop, editor, 'The Final Energy Crisis', Pluto Press, London, forthcoming (2003).

17. Adelman's 'right price' for oil at $2.50/bbl in dollars of 1972, is lengthily defended by Adelman in various works such as M A Adelman, 'The World Petroleum Market', Johns Hopkins Press, USA, various editions, and discussed with reference to 'dematerialisatin' of the economy in: A McKillop, 'On decoupling', International Journal of Energy Research, Vol 14, n° 1, J Wiley, January 1990.

18. For example L Meyer, 'Why such a sharp slowdown ?', Remarks by (Federal Reserve) Governor Laurence H. Meyer before the New York Association for Business Economics and The Downtown Economists, New York, 6 June 2001. Meyer claimed, in his speech, that 'sharp rises in oil and natural gas prices intensified the fast economic slowdown and slow crash of equity prices.

19. As a sure sign of increasing oil prices, the Wall Street Journal of 29 July 2003 carried an editorial with the title 'OPEC – One Purely Evil Cartel'. In this vituperative editorial, it was claimed that OPEC states are a 'gang of price-fixing oil-rich thug regimes (who) meet to reinforce assorted terrorist-sponsoring tyrants at high cost to world consumers'.

20. OECD IEA 'Oil Market Report', 11 July 2003.

21. See Korpela, reference (16) above, and Web sites such as Peakoil.net.

22. Media reports in July-August 2003 and messages posted to Energyresources forum, Yahoo !

Table 1 **WORLD ANNUAL OIL PRICE AND VOLUME CHANGES 1971-2003**

Year average Oil supply World - All liquids '000 barrels / day		% volume change on yr before	Oil price Year min current dollars	Oil price Year max Current dollars	Maximum oil price PPP adjusted 2003 dollars	Minimum oil price PPP adjusted 2003 dollars	Deflator*	Deflator/ California Energy Commission Delphi IX Oil price forecast Survey State Govt, Sacramento, 1997 1996 = 100 1996-2003 Forecast average 2.9% - 3.4%/year inflation
1971	50,785	4.45						
1972	52,540	3.45	$1.84/bbl	$3.70/bbl	$15.50/bbl	$7.75/bbl	29.36	
1973	58,505	11.35	$2.35/bbl	$3.75/bbl	$14.80/bbl	$9.30/bbl	31.21	PPP adjustment 2003/1973 = x 3.95
1974	58,610	0.18	$11.60/bbl	$15.50/bbl	$56.15/bbl	$42.05/bbl	33.94	
1975	55,690	-4.98	$11.95/bbl	$12.80/bbl	$42.60/bbl	$39.75/bbl	37.2	
1976	60,075	7.87	$11.85/bbl	$12.15/bbl	$38.05/bbl	$37.10/bbl	39.53	
1977	63,000	4.87	$11.50/bbl	$12.90/bbl	$37.75/bbl	$33.65/bbl	42.23	
1978	63,125	0.19	$12.20/bbl	$14.25/bbl	$38.75/bbl	$33.15/bbl	45.56	
1979	65,975	4.51	$21.50/bbl	$41.50/bbl	$103.50/bbl	$53.60/bbl	49.54	
1980	63,135	-4.22	$28.50/bbl	$34.95/bbl	$79.65/bbl	$64.95/bbl	54.2	
1981	59,745	-5.37	$31.10/bbl	$41.25/bbl	$84.95/bbl	$64.10/bbl	59.6	PPP adjustment 2003/1981 = x 2.06
1982	58,005	-2.92	$28.50/bbl	$34.75/bbl	$67.80/bbl	$55.60/bbl	63.31	
1983	58,040	0.06	$27.45/bbl	$31.50/bbl	$59.05/bbl	$51.45/bbl	65.88	
1984	58,650	1.05	$28.60/bbl	$36.50/bbl	$65.25/bbl	$51.15/bbl	68.82	
1985	58,150	-0.86	$26.15/bbl	$30.05/bbl	$52.05/bbl	$45.30/bbl	71.32	
1986	60,655	4.31	$11.40/bbl	$19.35/bbl	$32.65/bbl	$19.25/bbl	73.25	
1987	61,305	1.07	$12.50/bbl	$17.75/bbl	$29.00/bbl	$20.35/bbl	75.58	
1988	63,690	3.89	$10.45/bbl	$14.30/bbl	$22.50/bbl	$16.45/bbl	78.49	
1989	65,875	3.43	$14.65/bbl	$21.20/bbl	$31.90/bbl	$22.05/bbl	82.03	
1990	66,745	1.31	$14.40/bbl	$27.30/bbl	$39.40/bbl	$20.75/bbl	85.59	
1991	66,615	-0.19	$15.65/bbl	$25.05/bbl	$34.55/bbl	$21.60/bbl	88.89	PPP adjustment 2003/1991 = x 1.38
1992	66,950	0.51	$15.90/bbl	$21.90/bbl	$29.60/bbl	$21.50/bbl	91.38	
1993	66,700	-0.04	$12.95/bbl	$20.25/bbl	$26.65/bbl	$17.05/bbl	93.37	

1994	68,100	2.09	$13.05/bbl	$19.05/bbl	$24.65/bbl	$16.90/bbl	95.34	
1995	69,215	1.64	$15.45/bbl	$19.90/bbl	$25.20/bbl	$19.55/bbl	97.6	
1996	70,705	2.15	$17.05/bbl	$23.95/bbl	$29.55/bbl	$21.05/bbl	100	
1997	72,550	2.61	$17.15/bbl	$23.50/bbl	$28.15/bbl	$20.55/bbl	103.2	
1998	72,920	0.51	$9.70/bbl	$16.60/bbl	$18.75/bbl	$10.95/bbl	107.9	
1999	75,005	2.86	$24.90/bbl	$26.05/bbl	$28.95/bbl	$27.70/bbl	111	
2000	76,905	2.53	$22.95/bbl	$34.25/bbl	$36.40/bbl	$24.40/bbl	114.3	
2001	75,990	-1.19	$17.60/bbl	$29.55/bbl	$31.05/bbl	$18.50/bbl	117.6	
2002	76,100	0.14	$15.75/bbl	$29.70/bbl	$30.70/bbl	$16.25/bbl	120	
2003	*77,500*	*1.84*	*Estimate 1*	*$40*	*$40*	*$25*	*123.5*	PPP adjustment 2003/2002 = x 1.029
2003	*78,400*	*3.02*	*Estimate 2*	*$55*	*$55*	*$25*	*123.5*	

OIL PRICES/

'Oil economists handbook' Vols 1 & 2, G Jenkins, Elsevier Applied Science, various editions ; OPEC Bulletin ; Platts Oilgram Price Report

Prices are for selected volume crudes including Saudi light, Nigerian, Norwegian, US WTI, Kuwaiti and other crudes

YEAR AVERAGE OIL SUPPLY/

BP Amoco statistical review ; US EIA ; World Energy Statistics and Balances, OECD-IEA, various editions

1972-73 data is surely in error (11.3% apparent increase, one year)

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