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UBS Equity Derivatives Macro Sales Ideas / Sales Thoughts – (By Andrew Lees 44 207 568 4350)

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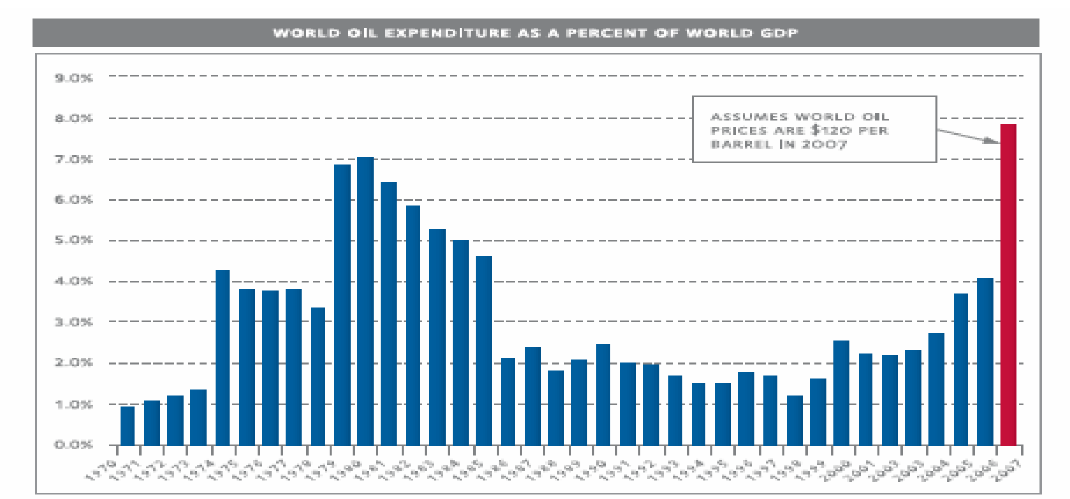
Beyond Peak Capital (Part 2) - The Cost of Fossil Fuel Depletion

Introduction

In February I issued a report, “Beyond Peak Capital – What does Peak Energy mean?” suggesting that the pain of peak fossil fuel energy would fall initially on the highly energy inefficient emerging markets, particularly Asia. High wages are built on high productivity, but this truism was overturned in the 1990’s and the first 3 or 4 years of this century as oil was almost given away. High wage / high productivity economies such as Japan’s were undermined by low wage / low productivity countries such as China. That process is now reversing. The low wage / low productivity business model simply cannot compete with oil prices nearing 10% of global GDP (USD150bbl).



The consequent unwind of globalisation as the West takes production back home, will necessarily lead to stagflation. Some clients and The Peterson Institute for International Economics went one stage further, saying that the politics of food and energy security would speed up this process. Whilst the present credit crunch has complicated matters for the Central Banks, this should eventually be made easier by the geographical division between the stagnation and the inflation; the emerging market growth and export of disinflation over the last 15 years should reverse and become emerging market stagnation and the export of inflation. Western wages should actually start to rise, making our debt mountain more manageable. The scale of Asia’s FX reserves would initially act as a cushion in delaying this transfer of wealth back to the West, but with China requiring more than 10 times the energy per unit of GDP than Japan, this can only ever be a very temporary reprieve.

In the process of presenting this report over the last 6 months, I have realised that this process is only the start of a much bigger picture that is set to unfold over the next few years. In this note, I want to

highlight what I believe is the final outcome from peak fossil fuel, and then work out the likely path of how we get there. Let me say at this stage, I do believe that we will find an alternative to fossil fuels, but I don't think anyone has any real comprehension as yet of just how expensive it will be to achieve.

This is not a bearish report; it is a prudent report. It is far better to raise the questions, have a discussion and make logical choices one way or another, rather than simply not confronting the possibility. Simply saying that "something will come along; it always does" is right, it will. This benchmarking attitude however does not make money. It causes stock markets to follow a hyperbolic discount function (page 25), only reflecting these kind of stories when it is too late. If you can think about these long-term themes in advance, and work out where the end result is going to be, then I think it enables you to understand what is going on and position yourself before we get into the hyperbolic zone, and make money rather than lose it on these big moves.

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3. **The cost of the Switch over - Low Density Solar** asks what the scale of costs we are talking about.
4. **Nuclear Energy – High density but high lead time** questions whether nuclear fission can be brought to the market quick enough to offset the decline in fossil fuel. It also looks briefly at nuclear fusion and the miniscule budget it has compared with that required to develop fission 65 years earlier.
5. **Who Writes the Cheque?** Suggests that we will all bear the cost through a major change in our living standards, but highlights at the same time that GDP may in fact rise.
6. **How do we get there? Why some countries are energy inefficient** explains why some countries will be less able to foot the bill than others.
7. **The sliding Thermodynamic Equilibrium** looks at why the cost of adopting the new energy system will be felt more aggressively by the energy inefficient economies; what this will mean to their economies and how this process will unfold.
8. **The Next Domino to Fall** highlights that the outsourcing and globalisation of the last 20 years will start to unwind, and how this will continue to result in rising inflation.
9. **The Developed Economies** looks at the impact on the wealthy economies; the impact on debt and asset prices, and which economies are best positioned to bear the costs of the switchover.
10. **Oil Exporters** asks whether increased demand from the oil exporters can offset the contraction in demand from Asia.
11. **Industrial Metals** looks at the demand expansion from building out the new energy system.

12. **Jimmy Carter rides again** highlights that despite every U.S. President since 1974 emphasising the importance of energy independence, the public will not vote in the strong leadership that is necessary until we get near crisis point.

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Long Cycle Energy

Most people are familiar with the Peak Oil debate;

1. Conventional oil production peaked in May 2005.
2. Overall production seems to have peaked in 2006, falling by 0.2% last year (BP World Energy Review).
3. The net energy available from the oil that is produced is falling due to the declining EROIE. The EROIE rate will always fall with field age and field size.
4. Exports of oil are collapsing. Exports from the world's top 5 exporting countries fell 4.5% in 2007 after a 3.4% fall in 2006. Demand growth has come primarily from the Middle East and North Africa itself, and then from China.

5. Peak discovery was in 1965
6. Production has exceeded discoveries every year since 1984, by an ever growing margin.
7. 50% of all stated reserves have been derived from upward revisions to existing OPEC fields rather than new discoveries, raising questions over their validity.
8. More than 50% of all the oil ever produced has been consumed in the last 25 years.
9. Technology that has enabled faster recovery rates has also meant much faster decay rates than a normal curve would suggest, such that for example most of North Sea fields have seen decline rates of 40 – 80% in the 10 years past peak production. Mexico's Cantrell field has seen production fall 24% in the last 12 months alone.

10. Saudi's well productivity has fallen by 25% since 2005 despite production being down <10%. Leaked reports suggest its giant Ghawar field (the world's largest field) will see production fall by 17% between 2009 & 2013 according to a leaked Saudi report – (http://energybulletin.net/node/45940).
11. The discovery of Brazil's Tupi oil field was announced on 4th October 2006 at between 5 and 8bn barrels. An optimistic assessment would suggest the whole complex could contain as much as 50bn barrels. An EROIE of no more than 5, reduces the net available barrels to just 40bn. From the date of announcement, the global economy would have consumed more than 40bn barrels by Christmas 2007. Where is the next big find?

12. Rather perversely, if the inefficient energy consuming countries like China and India manage to become more productive, then they will be able to demand higher wages and therefore increase their per capita energy consumption.

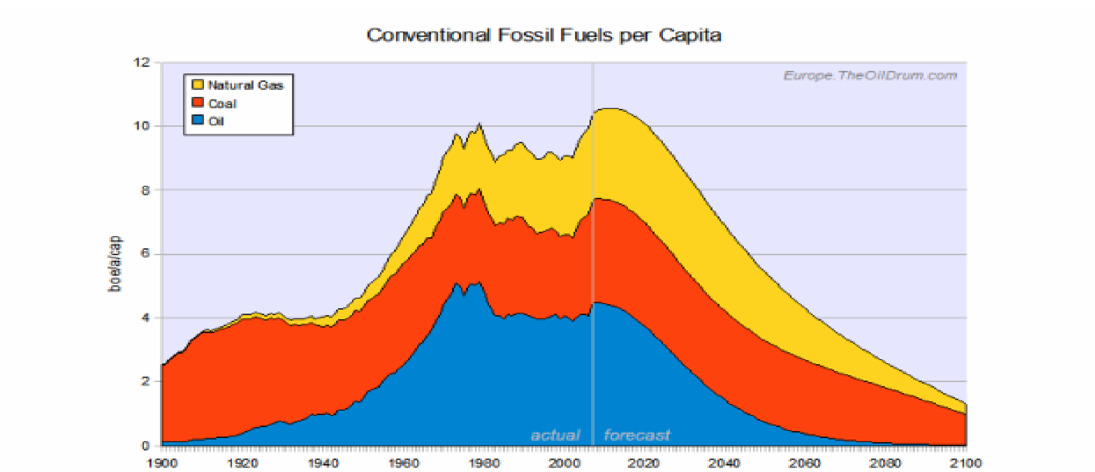
Coal and gas production face similar problems;

North America (inclusive of Mexico) has already gone beyond peak gas production, and a linear decay pattern on the North American gas EROIE rate (energy return on invested energy) suggests that its gas reserves will be completely exhausted within the next 5 or so years. Western Europe went beyond peak production last year, and the big Russian fields Yamburg, Urengoy and Medvezhye which have provided the bulk of Russian production and exports to Western Europe, are also in decline. This is no secret and the data has been published. In 2006 Russia exported 115bcm of gas. New pipelines will provide 88bcm of export infrastructure, but will this will simply take old gas via a new route. The UK government is basing its assumption on Russian exports increasing to 300bcm by 2020, however modelling the decline rate of existing Russian gas fields and new developments shows no increase. Russia consumes over 2/3rds of its own gas production. Flat production, coupled with 2% pa rising domestic demand, will swallow all exports by 2020. Even in the Middle East, a lack of investment means that the countries that make up the Gulf Cooperation Council (Saudi Arabia, Kuwait, Qatar, Bahrain, Oman and the United Arab Emirates) will have a 7trn cubic feet shortfall by 2015 (equivalent to 41% of the UK's entire remaining proven reserves), resulting in big shortfalls in power production. Whilst the shortfall could be offset with oil, that would require a redirection of production from the export market, resulting in an even bigger shortfall in exports than are presently envisaged. This problem is resulting in plans to build nuclear power plants to compensate.

In terms of coal, the picture is no different. Whilst volumes of U.S. coal production are still rising, the energy content peaked in 1998. The U.S. is a net exporter, but these exports are expected to slow, possibly fairly rapidly given the inventory draw down at U.S. utilities in Q1. Even if U.S. production hadn't peaked, it would not be able to make up for the shortfall from China, which presently accounts for over 40% (U.S. 20%) of global production but is expected to see a 40% decline in output over the next 20 years. Europe is already an importer of coal from Africa. India is an importer of 6% of its hard coal needs, and this requirement is expected to rise to 28% by 2030. India's rising demand has partly been supplied by Africa, squeezing European supplies.

On the 6th July 2008 China turned off 2.5% of its power generation capacity due to coal shortages. Like the States, inventories of coal at Chinese power utilities are collapsing, forcing the government to delay imposing royalties on coal production for fear of negatively affecting supply. The coal shortages (and gas shortages in Latin America) are having to be made up with diesel generators.

Another factor to consider is that the global population is still expanding, and therefore even flat energy production would mean a per-capita decline. The below curve, known as an Olduvai curve, shows energy consumption per capita based off an assumed peak of oil in 2011, a peak in gas in 2030 and a plateau on coal production from 2020 – 2040. Despite these more optimistic scenarios, energy per capita peaks in 2011 along with oil.



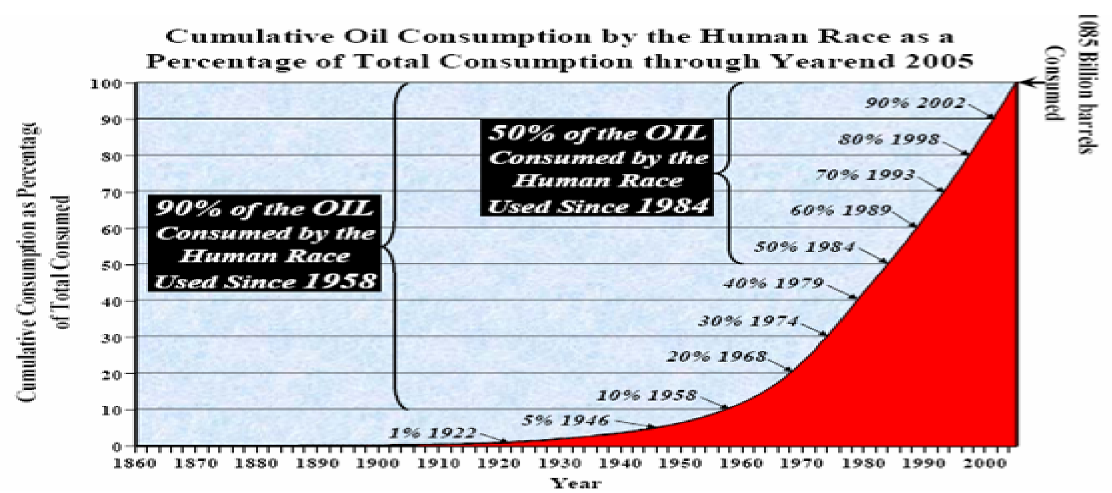
Forecast for Conventional Fossil Fuels per Capita.
Sources: UN for Population model, Jean Laherrère [pdf!] for Natural Gas, Energy Watch Group for Coal and The Oil Drum - Khebab for Oil. Click for large version.

Slow and Fast Cycle Energy

Fossil fuel is effectively fossilised solar power. Lets call that the “long” cycle as it takes millions of years to produce. There are however two other cycles where we use solar energy, the “slow” and “fast” cycles. The fast cycle is direct use of solar power for such things as growing grains, and for the energy required to drive the water cycle – (effectively to desalinate sea water and then transport the water via precipitation inland). The slow cycle involves the storage of these “fast” cycle energies in terms of aquifers and icebergs that lock the rain water away for later use, or that lock decaying plant matter away in terms of top soil, processes that can take several thousand years. Not only are certain parts of the world (predominantly Asia) now consuming way in excess of the energy that can be provided by the “fast” cycle just to survive, but they have now almost completely exhausted the energy stored away from the “slow” cycle in terms of aquifer and top-soil depletion. We are increasingly reliant on stored solar energy from the “long” cycle (fossil fuels) just to feed and water ourselves. The so-called Green Revolution was in-fact the force feeding of grains with “long” cycle energy. Surface water now supplies less than 60% of the water used in irrigation globally, relying instead on energy intensive pumping of aquifers. Crop production now consumes as much fossil fuel energy as the calorific energy we eat, ie we are eating fossil fuels – (As of 1994, the U.S. was consuming more than 400 gallons (over 8 barrels) of oil equivalent to feed every citizen according to the book Eating Fossil Fuels by Dave Allen Pfeiffer). The exhaustion of “slow” and “fast” cycle energy is primarily focussed in Asia.

If we are consuming energy beyond the “fast” cycle, have almost exhausted the “slow” cycle, and have now consumed more than 50% of “long” cycle fossil fuels, then either the remaining “long” cycle reserves will be consumed much more quickly, or we will face a dramatic collapse in energy consumption per capita, ie demand destruction on a scale never seen before.

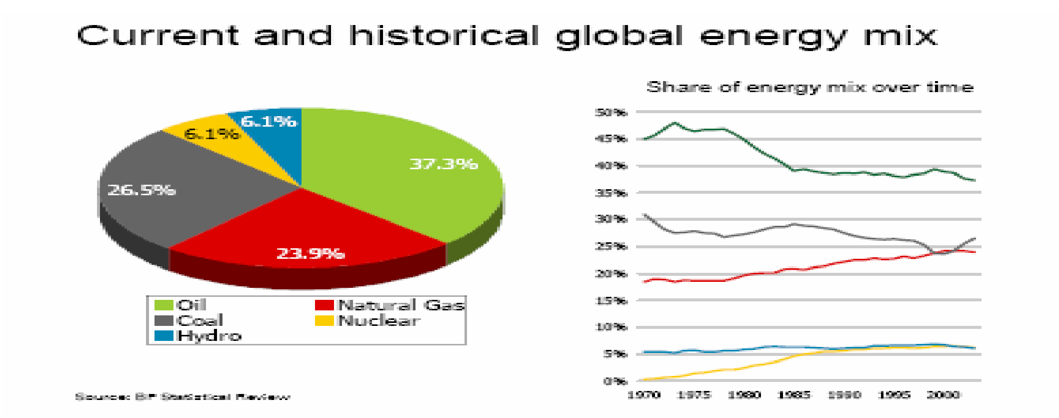
Over the last 25 years, we have consumed more than 50% of all the oil ever used in the history of the human population. At the same time we have been depleting our “short” cycle energy reserves of topsoil and underground aquifers, making us increasingly reliant on our remaining “long” cycle energy just to feed and water ourselves. The call on “long” cycle energy consumption will continue to accelerate. It will not take another 25 years for us to deplete 50% of our remaining oil reserves. It will be a much faster decay than a normal curve would suggest.



The Cost of the Switch-Over – Low Energy Density Solar

U.S. Presidential Candidate Barack Obama has said that if he becomes President, he will invest USD150bn over the next 10 years in Alternative Energy programs. According to the United Nations Environment Programme, globally we invested USD150bn in renewables and other forms of low-carbon energy technologies last year – (USD330bn over the last 3 years), and yet when I look at the June 2008 BP Statistical Review of World Energy, solar and wind power don't even have a visible market share, only justifying the following footnote; "Renewables still make a minor contribution, although their rate of growth exceeds traditional energy sources albeit from a low base". Less than 0.02% of U.S. electricity came from photovoltaic cells last year. More than half of the world's installed solar capacity is within Germany, and even that only equates to ½% of Germany's electricity (not even energy) supply. Simmons & Company estimate that a 25% pa growth rate will mean that by 2020 solar power still provides less than 1% of world electricity demand. The EIA says that by 2030 the U.S. will be getting 5bn kwh pa from solar, less than 1.5% of what it estimates will be coming from coal.

The U.N. says that renewable sources account for nearly 2% of all energy sources, but that is predominantly biofuels which for the reasons on "short" and "fast" cycle depletion mentioned earlier, are not renewable. We have spent USD330bn over the last 3 years on renewables, presumably giving a cumulative spend over the last 5 – 10 years in the order of USD1/2trn, and yet we are still not even getting 1% of energy from these alternative sources (ex bio-fuels). A very simple estimate would therefore suggest that we are talking of at least USD50trn of investment required to replace fossil fuels. Perhaps coincidentally, this would concur with the IEA estimates (USD45trn) of the money needed to be spent just to slow the release of carbon emissions, which is just a corollary of this switch of energy sources. These figures however significantly underestimate the expenditure necessary to fully replicate our present fuel needs with alternative energy sources as the figures above all relate to "installed capacity" rather than actual production. The typical wind turbine has a capacity factor of just 20 – 40% of stated installed capacity.



At the moment peak energy and alternative energies are being viewed in isolation from one another. Analysts are not taking account of the incremental fossil fuel demand needed to build out this new alternative platform.

Whilst the new energy platform is likely to have numerous different energy sources, the sheer scale of energy required means that the two main routes open to us will be solar power (i.e. photovoltaic cells) and nuclear.

Contrary to popular opinion, there has not been much improvement in solar power efficiency since the 1950's when solar cells were first built. Efficiency improvements have been in the production process rather than in the actual conversion of solar energy. The ratio of electric power to the light incident on the cell is governed by laws of physics, which give a theoretical maximum of about 26% for single spectrum cells. Solar cells are effectively just LED's run in reverse. Just as an LED will only emit one colour of visible light when exposed to an electric charge depending on the material used in the semiconductor, so a solar cell will only collect energy from one particular part of the light spectrum depending on the material used. Most cells are based on Silicon which only reacts with a limited part of the light spectrum, hence the efficiency limit of 26%. The efficiency of these cells is about 22%.

More complex solar cells that effectively sandwich together semiconductors made of silicon, gallium arsenide, zinc manganese and other materials, do give access to a greater proportion of the spectrum, however these only give about 40% efficiency and are extremely costly to produce, limiting their use at the moment to spaceflight applications where outside the Earth's atmosphere the solar density is about 8 times that on the planet's surface. (In the 1970's and again now, NASA and others have studied the prospects of putting solar arrays into space and then beaming this higher energy content down to Earth either by microwaves or via lasers, however the cost is seen as multiples higher than Earth based solutions, so I think we will leave that to science fiction for the moment).

A common misconception seems to be the assumption that Moore's Law can be applied to photovoltaic cells. This is not the case; the laws of thermodynamics are not so generous. As an aside, it should also be noted that Moore's Law states that the processing power of new semiconductors doubles every 18 months, not that its processing power doubles per unit of energy applied. Google has even warned that its energy bill will soon cost more than its server bill.

Solar power's dependence on daylight would mean having far more solar capture capacity during the day time as it would be needed to power high capacity batteries (or to produce hydrogen) to cover our energy needs during the evening and night. Alternatively, super conductivity cabling would mean that we could follow the Sun around the Earth (I should probably say the Earth around the Sun), however that would still need sufficient capacity to be built in Australia to power not only Australia but Britain as well – (at the moment the best conductivity cables still leak 3 – 5% energy every 1000km). Either way we are effectively talking of doubling up the solar collective capacity to compensate for the energy we use outside of daylight hours. Then there is the fact that we would also need sufficient capacity not only to meet our present energy needs, but also to build replacement solar cells when the existing ones come to the end of their useful life; based on the cells not reaching energy breakeven for 5 years and probably having a useful life of no more than 15 – 20 years, we are probably talking about an additional 33% - 50% capacity. Then finally the additional cost of upgrading the grid capacity as we replace our oil-based transport system with one based on electricity in one form or another.

Most of the energy required to create a solar cell is consumed in the manufacture of the raw silicon itself which requires temperatures in excess of 2000 degrees Celsius, and then upgrading it to the necessary quality. At the moment the industry is using scraps left over from the computer chip industry, but if solar power is to expand greatly then other dedicated sources of silicon must be generated, with presently unknown effects on the energy cost, ie it is not just a case of the energy cost to build the silicon, but also the energy cost to build the silicon plants in the first place.

Based off a simple energy breakeven, and assuming efficiency gains make up for all these additional costs, the energy cost of building out this new alternative energy system is going to be a minimum of 5 years worth of our existing fossil fuel production. **Whilst that is undoubtedly a huge expense, realistically it would be an incredibly cheap investment if we could genuinely build a platform that could produce as much energy annually as we presently consume, on an initial energy outlay of just 5 years worth of fossil fuels.** That would be a far better return than almost anything else I can think of.

If fossil fuel production was falling at 5% pa (aggressive scenario for illustrative purposes), then based off the 5 years required to get energy balance, that would require us to invest 25% of a single year's fossil fuel production just to make sufficient solar cells to make up for this annual shortfall. Obviously after a period of years the additional solar energy would start to kick in, but you can see below that even after 20 years the *rest of the economy* has still not returned to energy parity with year 1, losing slightly more than an accumulated 3 years worth of GDP. In fact under this basis, the energy available to the rest of the economy would not reach 100% of year one's level until year 37, however in those additional 17 years the additional loss of energy to the rest of the economy is only 46.7%, ie just under ½ a year's worth of GDP spread over the full 17 years. The scale of fossil fuel depletion will ultimately determine the maximum period over which the pain can be spread, however government policy will determine the different resource allocations between investing in the new energy platform, and household spending. (Note, we cannot simply divert expenditure from the oil industry into the alternative industry as the rate at production declines would accelerate dramatically, eg since 2005 Saudi's well productivity has fallen 25% and therefore production has had to be made up by further investment. If anything, expenditure on the oil industry is set to accelerate – (the IEA believes USD22trn will need to be invested between now and 2030) - to fight the natural decay rate).

Year	AVAILABLE FOSSIL FUEL ASSUMING 5% PA DECAY	FOSSIL FUEL INVESTED IN SOLAR	NET FOSSIL FUEL AVAILABLE FOR REST OF ECONOMY	ENERGY FROM SOLAR CELLS	AVAILABLE ENERGY FOR REST OF ECONOMY	RATE OF GROWTH OF ENERGY FOR REST OF ECONOMY	LOSS OF ENERGY / GDP REST OF ECONOMY
1	100.0	25.0	75.0	0.0	75.0	-25.0%	25.0
2	95.0	25.0	70.0	5.0	75.0	0.0%	25.0
3	90.3	23.8	66.5	10.0	76.5	2.0%	23.5
4	85.7	22.6	63.2	14.8	77.9	1.9%	22.1
5	81.5	21.4	60.0	19.3	79.3	1.7%	20.7
6	77.4	20.4	57.0	23.5	80.6	1.6%	19.4
7	73.5	19.3	54.2	27.6	81.8	1.5%	18.2
8	69.8	18.4	51.5	31.5	82.9	1.4%	17.1
9	66.3	17.5	48.9	35.2	84.0	1.3%	16.0
10	63.0	16.6	46.4	38.7	85.1	1.2%	14.9
11	59.9	15.8	44.1	42.0	86.1	1.2%	13.9
12	56.9	15.0	41.9	45.1	87.0	1.1%	13.0
13	54.0	14.2	39.8	48.1	87.9	1.0%	12.1
14	51.3	13.5	37.8	51.0	88.8	1.0%	11.2
15	48.8	12.8	35.9	53.7	89.6	0.9%	10.4
16	46.3	12.2	34.1	56.2	90.4	0.9%	9.6
17	44.0	11.6	32.4	58.7	91.1	0.8%	8.9
18	41.8	11.0	30.8	61.0	91.8	0.8%	8.2
19	39.7	10.5	29.3	63.2	92.5	0.7%	7.5
20	37.7	9.9	27.8	65.3	93.1	0.7%	6.9
						TOTAL	303.6

As you can see from my simple modelling above, there would be an initial whack to the economy, and then a gradual build on growth from lower level. **This is not an actual loss to GDP but rather a switch of GDP from consumer goods to energy capturing goods, presumably in the public sector**. Scaling in this resource switch could smooth the process, but whichever way there is a huge cumulative hit to our standard of living that must be taken. The scale is not unprecedented. The Manhattan Project (designing and building its nuclear bombs in WWII) cost the U.S. 0.25% GDP annually for 5 years. The NASA budget peaked at 0.72% of U.S. GDP in 1966, the Vietnam War peaked at 9% GDP, the Korean War at 14% GDP and World War II at 38% GDP. I would say that this is going to be a have an annual cost similar to the peak expenditure on the Vietnam War, but lasting for 10 to 20 years. Ofcourse we would get used to the lower disposable income so after the first few years it wouldn't be an issue. The real problem would be financing today's debts with this much lower disposable income. Financing for the present economy would be crowded out by financing for the alternative energy grid. Asset prices would be destroyed (at least in real terms), putting the entire banking system under huge stress, and lifting the cost of capital.

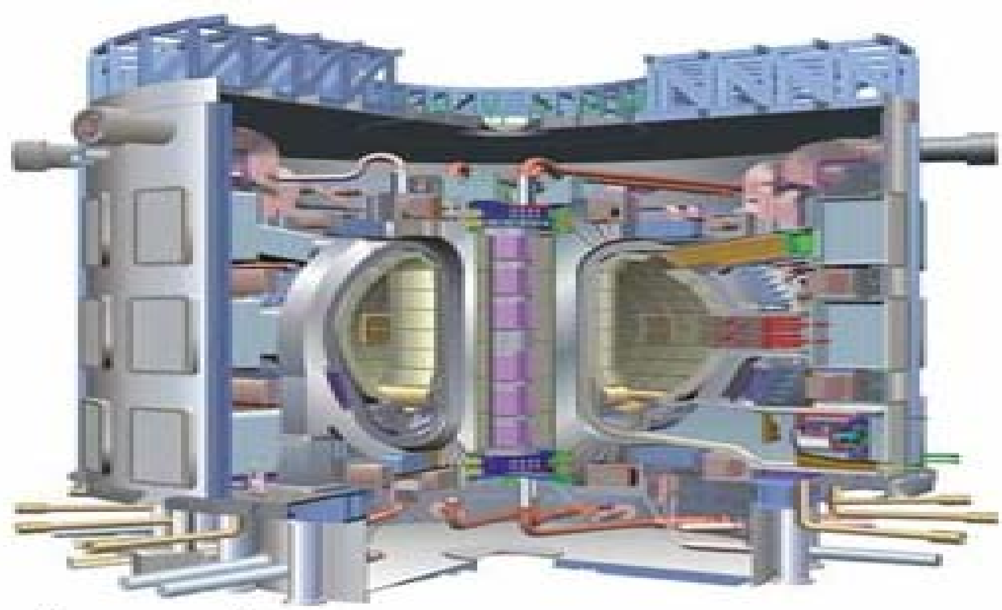
Whilst this may sound an incredibly negative story, I believe I am putting the positive spin on the true depth of the problem. My figures only look at replacing the “long” cycle fossil fuels, and ignore the greater call that will be placed on this once our “short” cycle energy is exhausted, ie once the aquifers and top soil are exhausted and we have to turn to desalination and ever greater fertilizer use .

A recent example of this kind of transfer tax would be the German Re-Unification or Solidarity Tax. Initially that was 7.5% of the income tax bill, ie if income tax was 30% of earnings, this would be an additional 2.25% (7.5% of 30%). The tax was then later scaled back to its present rate of 5.5%. Whilst the rate is significantly less than I envisage for the alternative energy tax, it has still caused a lot of resentment in West Germany. Realistically however, whilst it might have caused resentment, the scale of the pain has been fairly easily absorbed, again giving me belief that a scaled in tax transfer of 3 or 4 times that can be achieved.

Nuclear Energy - High Density, but Long Lead-Time.

Solar power has a very low energy density – (at least on the Earth’s surface) - hence the long period before energy payback. Nuclear Fission will have a higher energy density, but I think is less feasible as a replacement to fossil fuels, at least in the short term. As of 2005, no nuclear plant had been ordered in the U.S.A. without subsequent cancellation for over 20 years. It is estimated that we would require 10,000 new single Gigawatt plants (the largest practical nuclear plant) to balance our present energy needs. We simply do not have the skill-set to build that quantity of plants to the required safety standards, in the required time space. It is just unrealistic. It is also estimated that the World’s supply of Uranium 235- (the Isotope used for nuclear power) - would only be sufficient to power these plants for 10 – 15 years, although this can be extended by using the power from a breeder reactor to enrich Uranium 238 (more available than U235, but cannot be used directly to make nuclear power) into Plutonium 239 which can then be used as an energy source as well as in nuclear weapons. Such breeder reactors would increase the availability of fuel for the reactors 5 fold. The U.S. does not have any breeder reactor programs, although Japan, Russia and India do. Realistically however, nuclear fission could not be rolled out quickly enough and even if it could, the available fuel will mean it can only ever be a bridge to the next fuel source. Fission has a higher energy density than solar, but given the lead time to educate people, and then to actually build-out the system, you are probably talking a slower energy breakeven time to begin with. It is worth noting here that it has historically taken us around 25 years after commercial introduction for a primary energy source to obtain a 1% global market share. Whilst nuclear fission is not a new energy source, I think for practical purposes it is.

Nuclear Fusion seems to be our only real long-term option, although we have still not managed to create a self-sustaining cycle. Despite various suggestions over the years of successful “cold fusion” experiments, the results have always been suspect and none of these have ever been able to be repeated. Most of the focus continues to be trying to replicate the sun with hydrogen or deuterium atoms. Fusion reactions have to be contained. In the Sun, gravity performs this containment. On Earth, the energy would melt any material, so a virtual container has to be created with a magnetic field, known as a Tokomak field. This is itself created within a vacuum to keep the high temperatures away from the material walls. The magnetic field allows a “neutral beam injection”, and then sudden compression of the gas (plasma compression) to the necessary density and temperature, to create the reaction. All experiments so far have used more energy to create and contain any reaction than they have managed to produce, even for a nano-second, with the best results so far limited to a 50% recovery rate according to David Goodstein’s book Out of Gas. The International Thermonuclear Experimental Reactor, a collaboration between Japan, the EU, Russia, China, South Korea and the States, hopes to achieve energy breakeven within the next decade and demonstrate the technical feasibility. The project is costing EUR10bn, however this pales into insignificance even against the Manhattan Project mentioned earlier (1.25% of U.S. GDP or USD180bn in today's money) and certainly against the costs of not finding an energy source.



The ITER device

Who Writes the Cheque?

Huge increases in spending on alternative energies are required, but I'm not sure a free-market economy can make such an investment. If oil prices go up, then alternative energy prices will also go up. We need to break this link to drive investment. We also need a mechanism to reduce our consumption of consumer goods fairly comprehensively, and to redirect that spending into building out this alternative energy system. Higher oil prices simply transfer wealth to the Middle East. We need to destroy demand rather than transfer it.

We need to create a false market. Some kind of tax has to be put on the consumption – (NOT production) of fossil fuels (either directly or indirectly), and the proceeds of that strictly invested in alternative energy. Rather than transferring our wealth to the Middle East, we need to be investing some of it in our alternative energy system. Unless the Middle East is kind enough to run a huge current account surplus with us for the foreseeable future – (their demographic trends would suggest not) – then we will have to bear the demand destruction ourselves. Japanese industry was built on this kind of "window guidance" with the government using the banking system to allocate resources via preferential lending rates to build up specific industries. The targeted industry would then be allowed to operate as a monopoly or cartel so that it could develop super-normal profits which would then position it in a great position for the global market. In the States and Europe - (particularly the U.K.) - I think the only way to get the necessary re-allocation of resources is via government direction in terms of fiscal policy.

Historically, this kind of comprehensive demand destruction and redirection of resources has happened in war time. In his 1942 State of the Union address, Roosevelt famously said “Let no man say it cannot be done”. In 1942 the sale and production of cars and trucks for private use was banned. Residential and highway construction was halted. Driving for pleasure was banned. **This wholesale switch of production to military equipment resulted in the greatest expansion of industrial output in America’s history**. Perhaps a modern day equivalent of switching IT, electronics hardware and software, and mobile phone companies etc to wholesale solar production could achieve a similar result. Given that the alternative energy systems have such a long energy breakeven time, their cost will always rise with the cost of the fossil fuels needed to manufacture them, some kind of tax will be necessary to encourage this switch; perhaps a high consumption tax on consumer electronics which the government could then use to subsidise alternative power production.

It should be remembered that this will probably not result in a fall in GDP, but instead a change in the makeup of that GDP from consumer discretionary goods to solar cells or their equivalent. In 1942 the U.S. recorded its fastest ever expansion of industrial output according to the book “Plan B”. Why not the same again? Certainly expenditure on the alternative energy system will crowd out most other expenditure, but overall the economy should expand. Indeed if, on the table above, you add up the columns fossil fuel invested in solar together with the energy available for the rest of the economy, you will see that there is no initial hit and it continually rises.

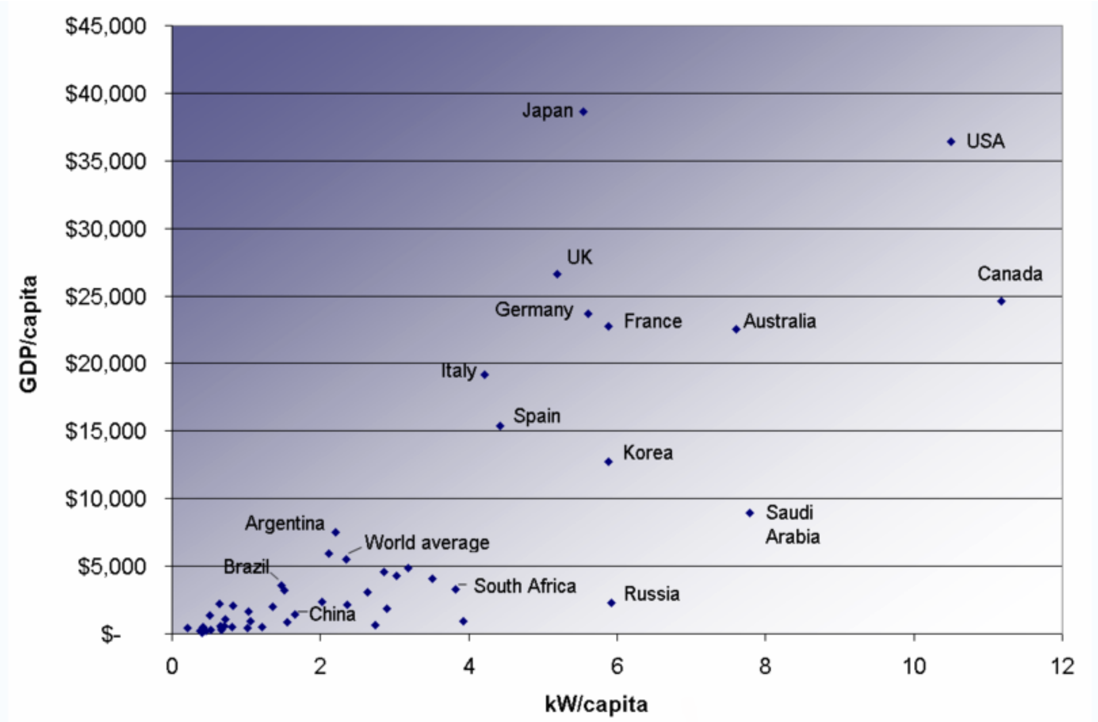
Unfortunately, “political leaders don’t lead, they follow”. History tells us that the only way we will vote in a politician that is willing to impose such pain on us is if we are desperate. Think of the pain the U.K. felt right the way through the 1970’s - (3 day week, IMF bailout and then the Winter of Discontent) – before the electorate was willing to elect a prime minister who was prepared to take action. The accumulated pain to force this move will come from further rises in energy prices, and the associated rises in food and manufacturing prices as their supply curves follow the energy supply curve to the left.

If you take WWII as an example of government direction of capital, U.S. tax receipts soared from 7% GDP in 1941 to 21% at the end of the war. Treasury Bill rates were fixed at 3/8% for the duration of the war, which supported demand for War Bonds from banks. It also strangled corporate profit by controlling prices and hiking the corporate tax rate. Policy effectively directed every part of the economy’s output to the war effort. Similar policies will need to happen now. This is simply to highlight that resources can be mobilised although as I said earlier, I don’t think the scale of the resource allocation that needs to happen this time is anywhere near the scale of WWII, and it can be spread over a longer period of time. It will be painful, but it can be done.

Just like they say the first step to recovery for an alcoholic is to admit he has a problem, it is the same here. Those people that give themselves comfort by sticking their head in the sand and denying any problem are making the solution worse. Once we accept the problem, we can achieve a reasonably painless recovery. The question is how we get acceptance of the story and therefore get a solution.

How Do We Get There? Why some countries are energy inefficient.

It’s all very well saying that energy prices need to rise further to inflict the necessary pain to force action, but this is not going to be evenly distributed. It is also not going to be as affordable for one country as it is for another. World expenditure on energy as a percentage of GDP is higher now than in the 1970’s or 1980’s, but oil prices are only back to their long term average against income in the States (page 21). Energy efficiency will determine the allocation of resources. Political interference may slow and interrupt this process, but it will not stop it. The former Soviet Union for example found that despite all its best efforts, its inefficient industry could not support the high cost of domestic oil production, eventually needing the world economy to drive the necessary investment in its oil industry, and effectively subsidise the rest of the Russian economy.



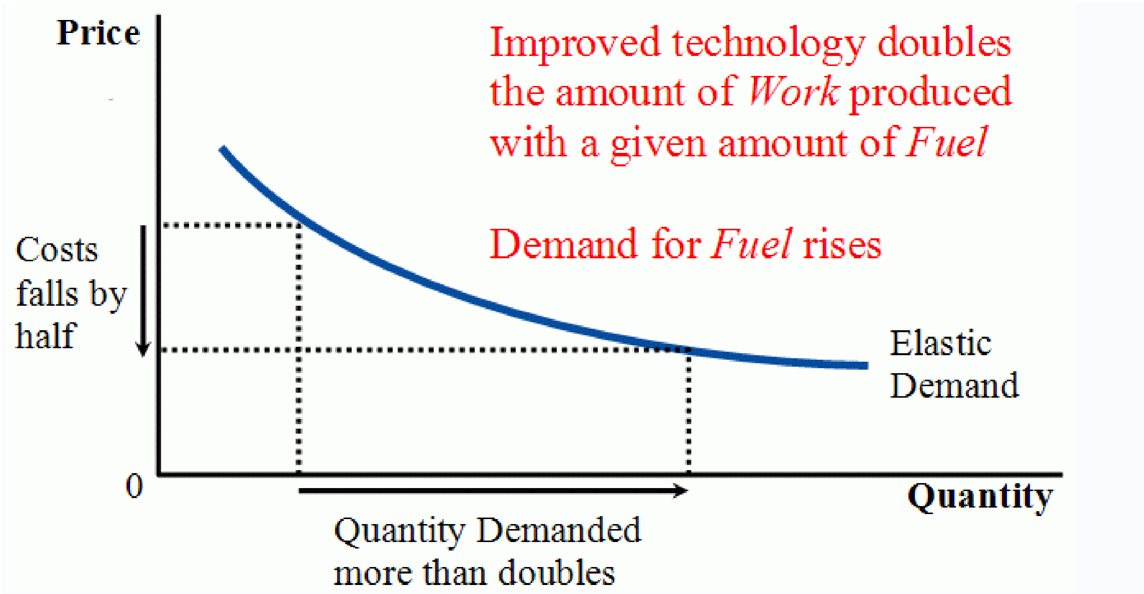
Whilst the oil exporting nations such as Saudi Arabia and Russia are extremely energy inefficient, the market will not initially be allocating resources away from these countries. Instead it will be weighing up the efficiency of the energy importing nations. The question is why is somewhere like China so energy inefficient? There is a common misconception that its inefficiency is simply due to the concentration of heavy industry. This is not the case. Data farms (server centres) in the West can consume more energy than aluminium smelters for example, and the growth of these remains extremely robust. There are other reasons explaining the inefficiency of China's industry. Sixty percent of its cement industry for example is still using technology that Europe last used 200 years ago. On the face of it, this means that there is ample scope for China to increase industrial efficiency, or there would be if there wasn't an energy problem. Moving up the efficiency ladder – (lifting the "thermodynamic equilibrium") - requires additional energy rather like a motorbike going around a "wall of death" at a funfair, so efficiency gains are unlikely. In fact if there is an energy shortfall, then like the wall of death motorcycle falling to a lower level, so a complex society would see its productivity fall. North Korea, Cuba and I guess South Africa are all examples of this, although at different stages of thermodynamic unwind.

This misses the point however. China's real efficiency problem is a definitional thing. It is not so much that it is energy inefficient, but rather that it is "long" cycle energy inefficient. The reason is that it is consuming way in excess – (estimates put Beijing and the surrounding area at 75% in excess) – of the "fast" cycle energy provided by the sun on a daily basis, and has almost completely exhausted its "slow" cycle energy (top soil, aquifers and forests), to try and compensate. As a result it has had to increasingly rely on "long" cycle energy to make up for these shortfalls. Because "slow" and "fast" cycle energy are not accounted for correctly, but "long" cycle energy is, as the first two become increasingly exhausted, China will become even more energy inefficient. When economists talk about China exporting its savings in terms of its trade surplus, they are mistaken; China is not exporting its savings. It is exporting its capital in terms of embedded energy reserves.

China uses about 85 times as much fertilizer – (energy) - per unit of GDP than does the U.S.A. (China uses 3.5 times the fertilizer per acre than the U.S. does to achieve just 95% of the yield. It has 4.4 times the population and its GDP is less than 20% of the U.S. GDP). In terms of energy used for pumping water, whilst I don't know the exact figures, it will be comparable to India which uses more than 1/3rd of its annual energy consumption simply to pump water from aquifers for irrigation – (http://developmentfirst.org/india/report/chapter7.pdf). The water shortfall, beyond sustainable levels, in Beijing and the surrounding area is estimated at around 45bn cubic metres a year, the equivalent of twice the storage capacity of the 600 kilometre reservoir behind the Three Gorges Dam. At some stage in the next few years, China will have to desalinate this quantity of water annually. When you adjust for the fact that these countries still have a vastly larger percentage of their population still living on the land, then you can start to understand why China for example uses more than 10 times as much energy per unit of GDP than does Japan.

Another explanation for China's inefficiency is the factor proportions theory of comparative costs. Productivity is to a greater or lesser extent determined by the capital / labour ratio. Despite all its efforts, China's capital / labour ratio remains low for the very simple reason that the industrial workforce remains a small percentage of the overall population, ie the denominator is inclusive of the huge workforce employed in the countryside that is barely self-sufficient. Even within industry, the high growth of capital is matched with the addition of about 10m new workers each year keeping the capital / labour ratio under pressure. But this process is coming to an end. China's productivity gains were within the agricultural industry after the 1978 land reforms that outlawed the collective farming, creating the surplus of labour. That surplus is now close to being fully employed, and indeed due to demographics, the industrial workforce is expected to fall by about 80m people over the next 15 years. Worse still, the almost absolute exhaustion of soil and water is resulting in rural wages rising relative to industrial wages, which will gradually act to tax workers away from industry and back to the land. China's so-called economic miracle has simply been a factor mobilisation story and not driven by productivity.

China is expected to overtake the U.S. in terms of energy consumption in 2010 according to the IEA. At the moment its energy consumption is growing about 5% pa faster than GDP, making its energy demands on the rest of the world increasingly difficult to meet. If however we ignored everything above and said that China would become more efficient, then we are still left with the same problem. As China becomes more efficient, its wages would rise, and with that its energy consumption per capita would rise. Asia ex-Japan's annual purchase of cars is now greater than the U.S. If China's nominal GDP continues to grow at the present percentage pace, then an ever increasing number of workers will move into the threshold of being able to afford to buy a car each year. This is the Jevons' Paradox. Increased efficiency of energy usage results in increased consumption of energy – (The efficiency gain causes a decrease in the effective price of that resource when measured in terms of the work it can achieve. As something becomes cheaper, the demand for it rises).

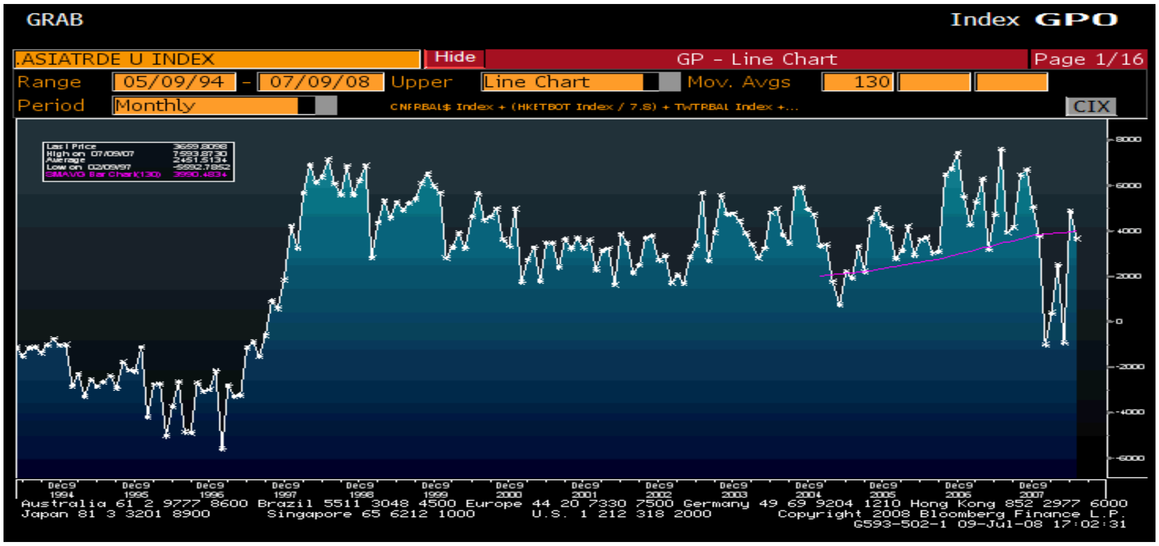


Whether China's growth continues to be driven by factor mobilisation or whether it starts to become driven by efficiency gains, either way its energy demand will grow. Without more energy supply, this would mean that somewhere else will lose out.

Asia's Thermodynamic Equilibrium to move to a lower plane

As energy prices have soared, so the terms of trade have movied dramatically against a lot of Asia, turning trade surpluses into deficits. Price controls and subsidies are being used to try and offset this effective "tax" hike, however all this is doing is undermining profits and therefore investment, in favour of consumption. Rather than boosting efficiency via capital investment, they are effectively undermining investment. The Indonesian President has warned that if oil prices average USD140bbl this year then oil and electricity subsidies will cost IDR295trn (USD31.9bn), the equivalent of 56% of all its FX reserves. Moodys has warned that the Philippines is now more at risk than Indonesia as record food and energy prices threaten budget targets and cause currencies to decline. Foreign debt comprises 41% of both countries' debt, although that is still relatively irrelevant at USD21bn (Philippines) and USD9bn (Indonesia).

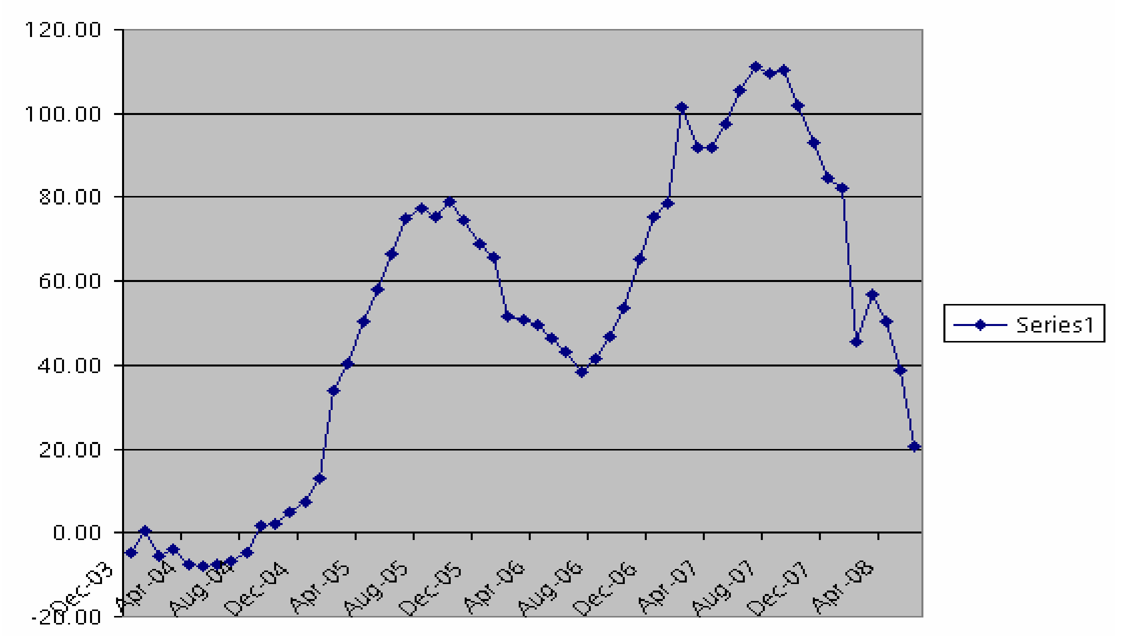
Trade surpluses are disappearing quickly. In fact if you take Asia ex Japan as a whole (China, Hong Kong, Taiwan, Korea, India, Indonesia, Philippines and Thailand), trade temporarily fell into deficit earlier this year as the chart below shows, although subsequently rebounded. FX reserves have started to fall in certain countries, and there has been FX intervention to support currencies by a few others, particularly South Korea. It is expected that this month (July 2008) that Oil Exporters holdings of U.S. Treasuries will exceed Japan's holdings of Treasuries for the first time, highlighting that there is a transfer of wealth happening from Asian manufacturers to the oil exporting countries. In fact it is not just a transfer from Asia to the Middle East, but a general loss of competitiveness. The U.S.A.'s trade deficit has improved by USD7.2bn from the lows in October 2005, but over the same period, its oil deficit is likely to have expanded by USD38.25bn simply due to the price appreciation – (USD145bbl vs USD62bbl). This would imply that its non-oil trade deficit has improved by a massive USD45.45bn. Some of that improvement is in manufacturing and some in grains. The U.S. still does have a huge trade deficit, but that deficit is increasingly with the oil exporters rather than Asia where it can now compete. (It is worth highlighting here that the U.S. thermodynamic equilibrium has fallen in recent years. In 1990 for example, the average age of the vehicle fleet was just 6.5 years old. In 2005 it was up to 9 years old. The older the car becomes, the less efficient it becomes, however at the same stage, turning over the fleet less frequently saves more energy).



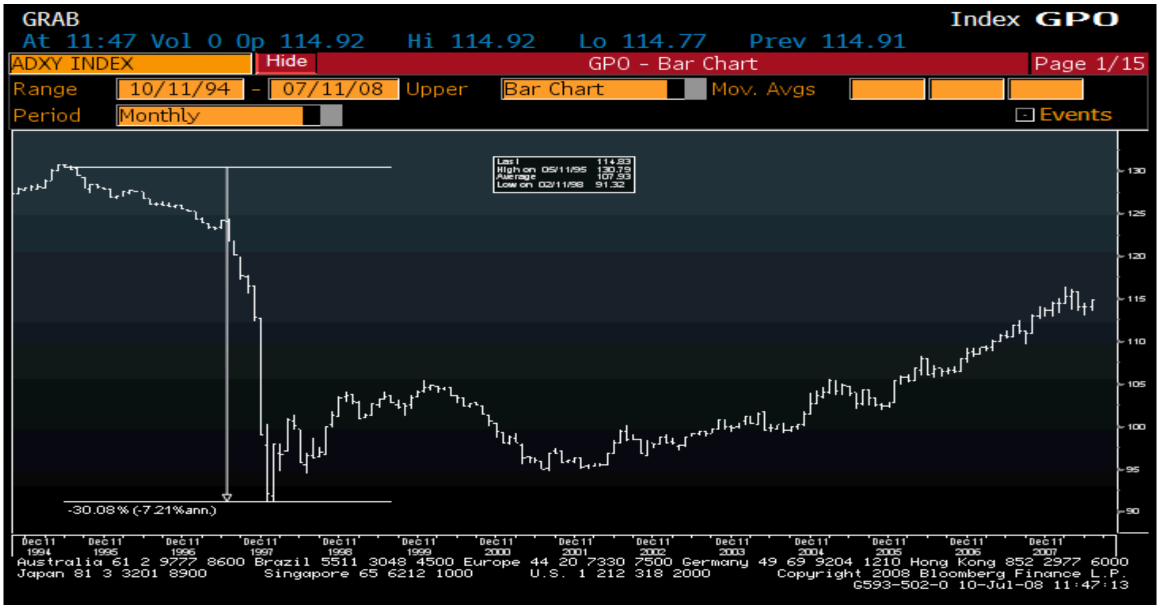
As Asia's trade surplus does turn into deficit, its FX reserves will act as a cushion. I believe however that we have been fed a bit of a red-herring as far as the reserves go. The cumulative total of Asia's trade surplus since it became positive in September 1997 is just USD518bn. I would suggest that the balance of its FX reserves are in-fact just recycled FDI and other investment flows, ie a call that the West has on Asia. Net FX reserves of USD518bn is undoubtedly a huge cushion, but it is not of the order of magnitude that people think. It would only cover 10m bpd of oil at USD140bbl for just 1 year. In the 12 months to June, South Korea and China imported an average of 5.9m bpd (data not available for the rest of Asia) with an average price of USD102bbl. When you consider that Fitch has recently warned that Western Banks have USD2.6trn of exposure to the emerging markets (it did not state what proportion is to Asia, but I would suggest a large proportion), the risks of weak bank balance sheets forcing this to be liquidated are very real. The best indicator of any stress on the servicing of this debt will presumably be emerging market corporate profits.

The below chart shows that if you subtract South Korea's external debt from its foreign exchange reserves, then it actually has a shortfall of just over USD154bn. The cumulative USD184bn of FX reserves built from 1997 to January 2006 has been completely wiped out just over 2 years. If foreigners wanted to withdraw funds en-masse, Korea would not have sufficient reserves to be able to absorb the selling.

In case you think that China is immune to this, the below chart shows that whilst its trade surplus – (this is the rolling 12 month surplus) – is still growing, it is growing at an increasingly slow pace; last year by just USD20bn. Unless the trade surplus averages USD18bn over the next 3 months, this chart will fall below the zero line. On the 8th July 2008 Hong Kong's Small and Medium Sized Enterprises Association warned that "almost 1/3rd of the 70,000 Hong Kong invested factories in China's Pearl Delta may close or move out this year as higher costs and cuts to export incentives bite", a theme we are hearing increasingly often.



Just 11 years on, a repeat of the 1997 style Asian financial crisis now looks likely with international banks having up to USD2.6trn of exposure at risk. Whilst we all remember the final 30% collapse at the end of 1997, the Asian dollar index (ADXY) was rolling over for 2 years beforehand. A similar build-up of pressure seems likely. What may be slightly different however is that unless energy prices collapse, I don't think a 30% cut in Asia's relative wages would be sufficient to offset its energy inefficiencies. If it were, oil demand would not fall. The demand destruction this time has to be more permanent.



Understanding why China is energy inefficient helps to explain some of the problems it may encounter. Its low wage model means that China has little discretionary spending beyond food and shelter, and therefore little margin to absorb a redirection of energy use. Chinese coal production is expected to fall 40% over the next 20 years, meaning that energy imports will have to soar for China's energy consumption just to stand still. Domestic coal is priced at about USD100 a ton below landed coal prices. Paying international prices for that 40% fall would cost the economy an additional USD100bn a year. Given that increasing amounts of the energy is used just for food production, discretionary spending will be completely destroyed. If China has to import energy just to produce food, then it will have no ability to invest in alternative energy. The States on the other hand, which has GDP per capita about 8 times as big as China, has plenty of scope (admittedly painful) to redirect some of its consumption to alternative energy.

China is a factor mobilisation story rather than a productivity story. This is visible in all of the data, with growth being explained absolutely by the scale of the workforce and the scale of the capital being employed. The model of low productivity / low wages is completely dependant on high energy input. The collapse of this model will result in extremely high inflation in Asia. **The savings ratio will collapse as people try to maintain their present consumption rates, undermining investment and adding to the scale of the inflationary problem**. Over the longer term, the rising dependency ratio – (it is set to soar from 16% now to 50% by 2040) - will mean the savings ratio is decimated, which will in turn mean the capital / labour ratio plunges. Standard & Poors has made similar long term warnings about Korea. China's economic miracle has been a simple re-run of the Soviet story of the 1950's and 1960's, the consequences of which will essentially be the same. The pain is likely to continue to be centred in food and energy prices as China increasingly has to turn to imports just to stand still, with the rest of the economy gradually seeing investment crowded out by the subsidising of the food and energy consumption. Until the demand has been broken, the terms of trade are going to continue to move against the manufacturing countries, with food and energy prices making new highs, further undermining Asia's competitiveness. Whilst this process happens, the demand destruction will continue to be focussed initially on the OECD countries as it has been in recent months, but then the destruction of Asian demand will be much more aggressive when it is finally realised. So far the pain has been in the long duration assets such as equities, but as the overall trade position starts to go negative, the pain will become more inclusive of the shorter duration assets such as the currency.

Higher manufacturing prices will not suddenly make Asia competitive again, and so will not give them the ability to import energy.

The Next Domino to Fall.

The Peterson Institute for International Economics warned recently (13th June 2008) that the liberalisation of global trade has come to a "screeching halt….It'll take years to rebuild the foundations of free trade policy". The Institute suggested the reasons were political, based off the need to protect food security, local jobs and the environment. That may have been the case, and indeed U.S. Presidential candidate Barak Obama is talking about restructuring trade deals in favour of the U.S.A. to support domestic jobs, but the fact is that the production is coming back home anyway.

On the 17th June 2008, the WSJ carried a 2 page article highlighting that "the rising cost of shipping everything from industrial pump parts to lawn mower batteries or living room sofas is forcing some U.S. manufacturers to bring production back to North America and freeze plans to send even more work overseas". It talked of production being taken back from China and being re-established in places like Kentucky. The article talked about the transport costs rising, but also said that wage growth and the stronger currency, meant that China is no longer a cheap place to produce goods. "I believe a decent amount of production could come back to the States within 5 years, not everything….But it won't be because of transport costs – it'll be because other production costs have gone up and companies have realized they can have better control over their production when its closer to home".

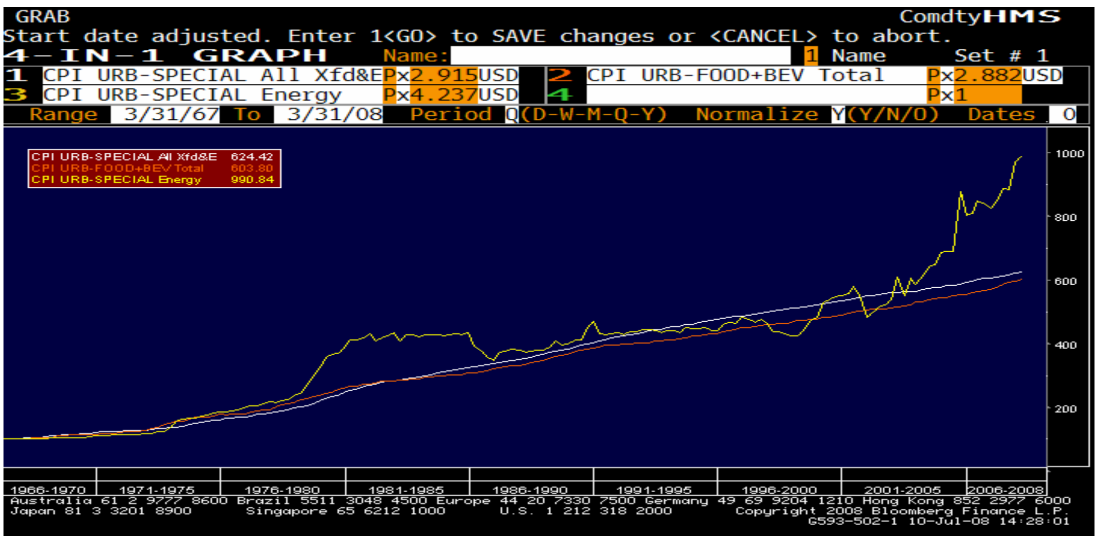
The shift started when oil was about USD100bbl, but now with it at USD130bbl and Asia simply energy inefficient, it has become "even more serious" to bring production back home. Outsourcing is still happening, but it is being scaled down aggressively; a North Carolina Furniture company that had planned to outsource 40% of its production to China by year end has now stopped that in its tracks with less than 20% having been outsourced. This particular factory still estimates that it saves 7 to 8% by outsourcing, but that is less than half of the saving of a year ago, and a lot lower than it had been previously. When the saving is down to 15%, it makes it much harder to justify the outsourcing particularly given that the extended transport time of about 12 weeks means you can't work on a just-in-time basis, which is particularly important now the U.S. economy is slowing

The higher costs are particularly problematic for lower-value goods. China's "freight sensitive" exports to the U.S. are now falling for the first time in more than a decade. Factories that were closed in the U.S. are now being told to "reactivate everything". China's energy inefficiency simply means it won't be able to compete with energy prices where they are, particularly when it has to turn to energy imports rather than relying on domestically produced coal. With wages in China now rising close to 25% a year in dollar terms, the vaunted "China price" for a growing list of goods, particularly low tech products, is no longer such a bargain". Given the scale of investment in recent years, foreign companies are "desperately" looking for ways to control costs, but are likely to end up having to close down plant. Shipping costs also means that replacing expensive Chinese labour with machinery in China also makes no sense.

There is also the question of high transport costs undermining the business model of producing different components in different places and then assembling them in one location. **The economics of the free trade**

doctrine of comparative advantage will start to unwind. The “assembled by” China stamp will no longer stand up as the costs of transporting products from the rest of Asia for assembly within the Middle Kingdom will make this business model obsolete. Just as the public may be talking about food miles, businesses must surely be talking about component miles.

Globalisation is coming to a halt. Politics may be speeding up the process, but economics is the real driver. Manufacturing capacity has to gradually be eroded. **Government policies aimed at subsidising consumption will mean that the demand destruction happens by a slowdown in capital spending**. Nevertheless reduced energy supply means that producer input prices will continue to rise relative to output prices; the pain will fall squarely on profit margins and employment. The capital to labour ratio (or at least available labour) will fall, resulting in stagflation. Whilst it is true to say that individual manufacturing prices will always fall relative to energy prices as manufacturing productivity is only limited by our imagination and ingenuity, the Jevons Paradox will mean that we will always demand more of these manufactured goods, and therefore the manufacturing and energy CPI will always go up in tandem in the long term. My view however is that CPI will turn upwards, but it will continually lag the energy prices because the consumer demand destruction is being delayed by this cross-subsidy of consumption from investment.



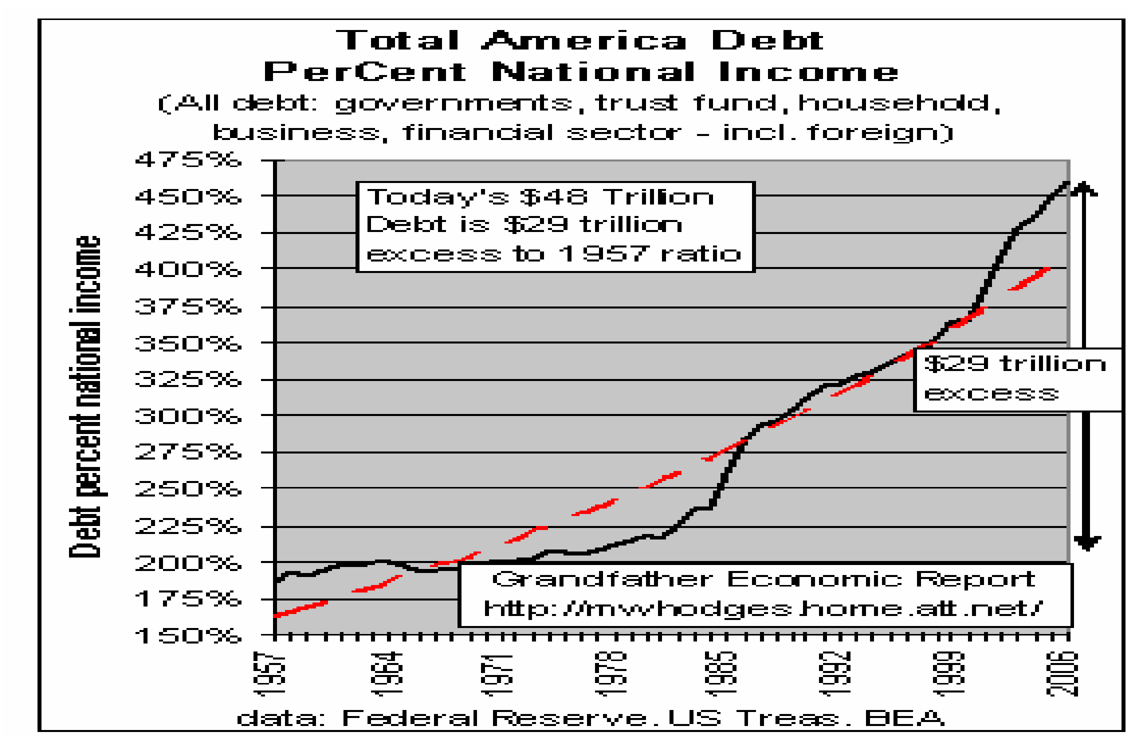
The Developed Economies.

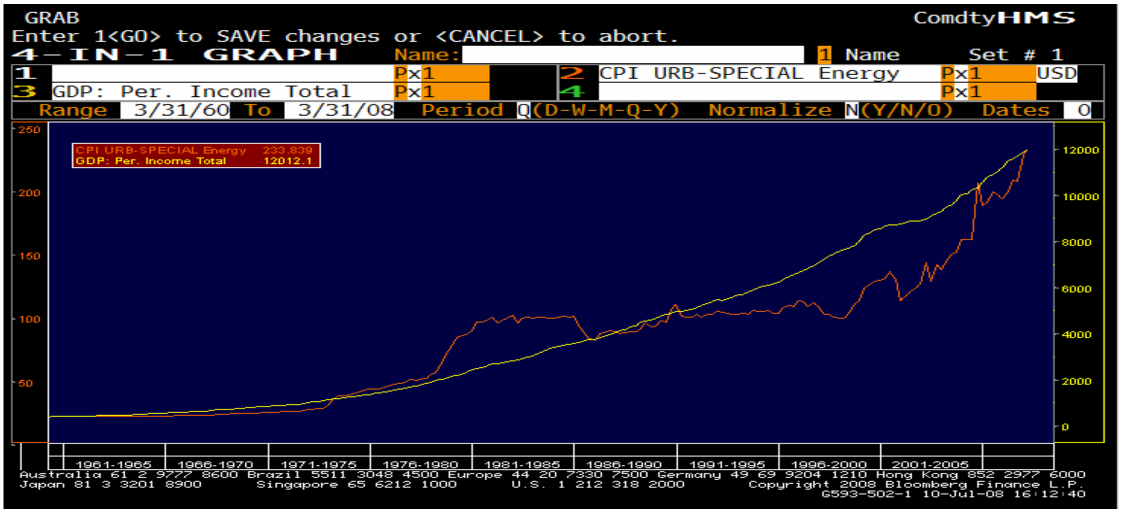
U.S. production is clearly being priced back into world output. The FT (16th July 2008) reports that U.S. exports have been growing close to 20% this year, offsetting the credit crunch. The U.S. is even able to export steel profitably. There is no doubt that production is coming back home. This process will create inflationary pressures within the U.S. It is a structural change. At the same stage however, the U.S. is fighting a credit crunch and asset price deflation.

Total U.S. Debt: GDP is around 500%. This is unsustainable. The banking system is going to remain under huge pressure. Asset prices will continue to fall. But, we are not under the Gold Standard. The Fed will continue to offset this asset price driven credit contraction with cheap money. U.S. stored wealth will both be inflated and deflated away at the same stage. Asset prices will fall (deflation), but so too will the currency (imported inflation). Effectively the value placed on the U.S. machine (whether assets or earnings) is falling. This is driving a fall in U.S. real wages when priced in non-dollar currencies and therefore lifting U.S. competitiveness. To quote a client, the “lender of recent years will now subsidise the borrower”

Unfortunately the U.S. is walking down the productivity spiral. Its capital:labour ratio is falling – (Bernanke has been warning for some time about the magnitude of the slowdown in capital spending) - although it still remains extremely high by most standards. The U.S. is simply bringing production back home by lowering the denominator side of the equation. Over time this will rebuild its savings ratio, allowing down-payments to be made on mortgages and more importantly allowing it to resume investment. In the meantime, the U.S. is likely to face the twin forces of asset price deflation but rising CPI as the falling dollar redirects its domestic production away from home consumption and towards exports.

The chart directly below the total Debt:GDP chart, shows U.S. energy CPI against U.S. earnings. Earnings in this sense includes income from investments rather than just wages. Comparing the two charts, when oil prices are high relative to earnings, debt growth slows. When oil prices are low, debt soars. The reason is simply that when oil prices are low, cheap labour from the emerging markets makes the U.S. high wage / high productivity model uncompetitive. Manufacturing production shifts abroad and U.S. real wages fall as they have been. To compensate, the U.S. household takes on more debt, the corollary of which is higher investment earnings. This will now reverse.





In the 1970's and early 1980's when oil prices were high, the U.S. was able to offset its trade deficit in oil with grain. Unfortunately the U.S. imports of energy have grown relative to its exports of grain, although this is likely to narrow over the next two years as China is expected to dramatically increase its reliance on grain imports. Everything would suggest therefore that the U.S. savings ratio will gradually start to rise. It will be vital to direct those increased savings into alternative energy.

Germany and Japan have big positive savings ratios. Germany has the largest trade surplus in the world at USD279bn in the 12 months to May according to The Economist Magazine. Japan's trade surplus has been demoted to 5th biggest at USD99.7bn, behind China, Russia and Saudi Arabia. Japan is by far the most energy efficient country in the world, so it seems very logical to assume that just as it has lost some of its manufacturing dominance to China and the rest of Asia over the last 20 years, so it will be the biggest beneficiary of that unwinding. Of the manufacturing economies, Germany, France and Italy are the next most competitive followed shortly thereafter by the USA and Spain, but of these only Germany has a trade surplus. Italy and France's trade deficits are relatively insignificant and therefore can be reversed very easily as we have described, although Spain's is a very big problem.

Nuclear and renewable energy combined represents 16% and 17% respectively of Germany & Japan's primary energy source against 14% in the U.S. and a miserable 11% in the U.K. Given their competitive position, and their trade surpluses, Germany and Japan should be able to afford the necessary investment in alternative energy without having too much effect on their living standards. France gets 40% of its energy from nuclear and renewable energy, and given its surplus in "short" and "fast" cycle energy it will continue to be able to be very fossil fuel efficient, putting France and Germany combined in a very good position. In terms of the best place to park your money, my guess is Norway as it will not only benefit from the strong oil prices whilst it remains a producer, but it already gets 60% of its own power consumption from renewables, putting it in a leading position. Sweden also gets the majority of its energy from nuclear and alternative energy. (I have not looked at the age and state of repair of these nuclear energy power stations). Overall, Europe (ex U.K.) looks very well positioned to be able to afford the upgrade to the new energy grid, however the stresses on Spain are likely to intensify; Germany and France are not going to be wanting to continue to support Spain's 9.5% current account deficit, and the only way that Spain can adjust that now is through real wage cuts given that it has no currency flexibility. (It should be noted that Norway has started to see a small fall in oil exports over the last few years. It has also warned that its production has plateaued, and has started lowering its estimate for output in 4 years time as maturing oil fields decline).

Primary Energy Mix in Germany in 2005 (%)	
Petroleum	36
Natural Gas	22.7
Coal	12.9
Nuclear	12.5
Lignite	11.2
Renewable Energies	4.6
Others	0.1

Renewable Energy mix in Germany in 2005 (%	
Wind	42.6
Water	34.6
Biogenic Solid Fuels	7.6
Biogas	5.1
Landfill Gas	3.5
Biogenic Share of Waste	3.3
Photovoltaic	1.6
Sewage Gas	1.4
Biogenic Liquid Fuels	0.2
Geothermal	0.0003

	Fossil	Nuclear	Renewables	Other
Iceland	28	0	73	0
Norway	37	0	60	0
Sweden	37	37	26	0
France	52	40	6	2
Finland	59	16	23	2
Switzerland	63	24	13	0
Canada	67	7	25	0
Slovenia	69	19	11	1
New Zealand	71	0	29	0
Bulgaria	71	22	5	2
Belgium	75	22	2	1
Austria	77	0	21	2
Spain	82	12	6	0
Portugal	83	0	15	2
Japan	83	12	5	0
Germany	84	12	4	0
Denmark	85	0	14	1
USA	86	8	6	0
Estonia	87	0	10	3
UK	89	9	2	0
Italy	90	0	7	3
Luxembourg	92	0	2	6
Greece	94	0	5	1
Netherlands	94	1	3	2
Poland	95	0	5	0
Australia	97	0	3	0
Ireland	97	0	2	1

Other positives in the States and Europe are the relatively high unemployment rates. If this wasteful resource can be employed in building out this alternative energy system, then at least there would not need to be a labour transfer as well as energy transfer. The U.S. old age dependency ratio is set to rise, but not as bad as Germany and Japan's, and certainly not as bad as China's. The U.S. also has huge inefficiencies in its healthcare system that, if squeezed out, could free up a huge amount of capital. At the moment its healthcare system consumes 16% of GDP and is growing at 6.4% pa vs Europe's supposedly superior system which consumes half as much per capita. There are also huge amounts of man-hours wasted in the U.S. in traffic jams etc due to underinvestment, which Germany and Japan do not suffer from. To improve these efficiencies however will take further investment. It will happen. It has to happen, but it is going to be painful in the meantime. The U.S.A.'s one savings-grace is its grain surplus, accounting for 44% of world grain exports. The U.S. is depleting its "short" cycle energy to provide this surplus, but the depletion is only in water resources and on nowhere near the same scale as Asia. Heavy investment in no-till farming has stopped the U.S. top soil erosion.

Different mandates and philosophies at the central banks will also impact resource allocation. The Fed has the dual mandate of inflation and growth whereas the ECB has a strict inflation target. ECB policy will help drive the process of repatriating production (insourcing?) via pressure on wages whilst the Fed will achieve the same thing via a weaker dollar.

Oil Exporters.

World oil exports showed a small fall between 2000 & 2005. They then started to accelerate with net exports from the top 5 exporters falling by 3.3% in 2006 and 4.4% in 2007. Between 2000 & 2005 the top 5 exporters (Saudi Arabia, Russia, Norway, Iran and the UAE) saw domestic oil consumption rise by 3.7% pa, accelerating to 5.3% in 2006 although it slowed back to 2.4% last year. Total Middle Eastern consumption grew by 4.26% in 2007 and North African demand by 4.6%, taking their combined consumption nearly 20% above China's.

Saudi Arabia is now the world's biggest oil consumer per capita, at more than 32 barrels a year, 28% higher than the U.S. The result is that 22% of Saudi production now stays at home, compared with under 16% just 7 years ago. Forecasts from the U.S. Energy Department and the International Energy Agency say that by 2020, Saudi Arabia will be consuming more than 1/3rd of all its production. Rising domestic demand with fairly stagnant production growth starts to lead to export declines, but when production starts declining, the fall in exports can be very severe. Between 2005 & 2006 U.K. and Indonesian oil production fell by 3.9% and 7.8% respectively, leaving exports to fall by 28.9% and 55.7%. Over the next 5 years, 4% pa domestic demand growth and 2% pa production decline is expected to reduce Russian exports by 50%.

World oil production is concentrating in fewer hands. At the moment the Rest of the World (World minus OPEC and the former Soviet Union) - accounts for about 13.7% of world reserves, but has to squeeze out of them 41% of world production. Overall the Rest of the World production peaked in 2003, and excluding the tar sands, the decline rate is expected to be a massive 7% pa. Any offsetting RoW production has to come from ultra-deep fields which have very low EROIE rates and consequently higher costs of production. This concentration of production in fewer hands is being accelerated with Gazprom trying to buy control of gas supplies (and other resources) from North Africa and Central Asia to form an "energy triangle" and effectively control the world price, and therefore continue to rebuild its political influence.

As we have discussed, global manufacturing prices will rise despite demand destruction and demand transfer, but oil prices will rise even further, continuing to transfer wealth to the oil exporters. Currency realignments will become more pressing, but the question is against what?

The WSJ (Monday 21st July) led with an article suggesting that within the Middle East itself, America's political influence is waning. On the same day, The BBC news (Hard Talk) highlighted that Iran is now becoming the political force in the region, exerting perhaps more influence over Iraq, than does the States. There is a dramatic shift in the balance of power away from Washington's interests. Regional talks have supplanted U.S. led negotiations. In May Qatar successfully pushed a peace deal in Lebanon that saw Iranian backed Hezbollah gain extensive new political powers. Last month Egypt brokered a peace deal between Israel and Hamas. Turkey is mediating reconciliation between Israel and Syria. "Through the negotiations, say diplomats and analysts, Israel and Arab governments are positioning themselves for a drastic shift in American foreign policy, no matter who wins November elections". As wealth transfers from Asian manufacturers to Middle Eastern and Russian oil exporters, so the world political landscape will also move that way.

Industrial Metals

Low energy prices drove the transfer of wealth to Asia, lifting wages and driving the demand for industrial metals and food. According to Goldmans (FT July 16th), about 70m people a year are entering the middle class wealth group each year as defined by incomes of between USD6,000 and USD30,000. Clearly if this continues as they suggest and the so-called BRICs continue expanding, then demand for industrial metals will continue to grow, underpinning prices. What happens however under the scenario of peak energy that I am suggesting?

First of all, the main input to mining ore bodies is energy. If energy prices are going to continue to rise, then input costs will rise. My mining colleague will say however that if we are going to be demanding less ore, then we can concentrate our efforts on higher grade mines, in which case less energy will be needed. This is however preconditioned on the idea that there will be demand destruction. Hopefully I have convinced you that there will not be demand destruction, but rather a major transfer of demand from consumer goods to alternative energy goods. I would reiterate that following such a switch in 1942, the U.S. economy achieved its greatest expansion of industrial production of all time. Demand destruction from China and India will be huge, but I think this will be more than offset by the demand growth from the West.

It should also be noted that if we were to build out photovoltaic cells for example on any proper scale, this could result in major material shortages. For example gallium arsenide is the material of choice for doping material to apply to silicon. The principle source is from aluminium mining and purification. But if the industry were to increase by a factor of 10, other sources would have to be found, and presumably its cost would increase dramatically. Likewise if we are to attempt to replace liquid fuels with electricity, an enormously greater amount of copper will be needed. If you think about upgrading the West's electricity power lines to support even a 10% increase in load factor (probably more likely to be 30 – 50%), this would dwarf the shortfall from China.

Middle East and North African oil demand growth has exceeded that of China's, and their absolute demand is bigger still. Add in Russia, and the demand growth is huge. It seems logical to assume that as China's and India's FX reserves are gradually transferred to these oil exporting countries, that their construction boom will continue apace. This demand growth will also help to offset some of the lost demand from Asia for industrial metals etc.

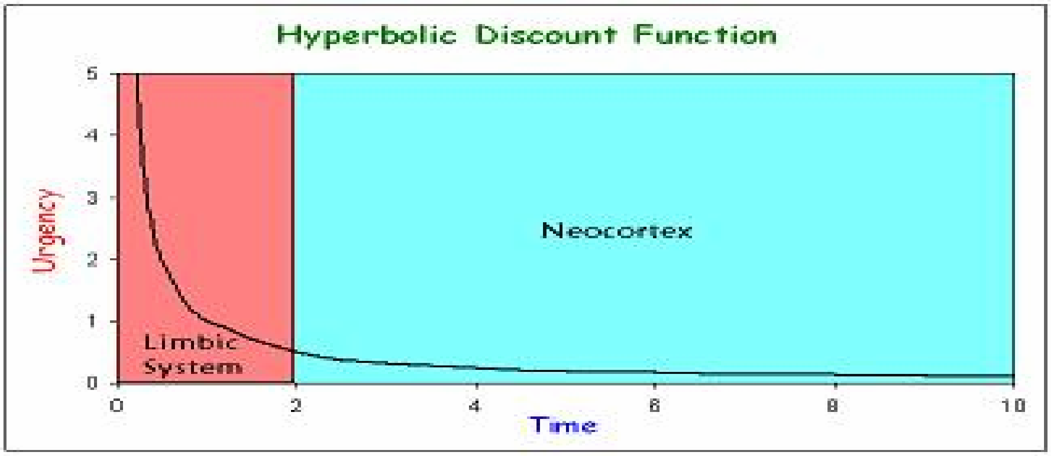
I would therefore continue to remain long the industrial metals and the relevant emerging markets, although I think all of these assets should be held through long dated options as the risks of short term pullbacks are going to be huge. I would also stress that as we make this spending transfer, the individual resources that make up the new spending may well be different to the ones behind China's boom. Be very selective in your choice of resources.

(I should highlight here that my partner in crime John Clemmow, whose view I respect immensely, disagrees with this view, believing that the demand destruction from Asia will be too big for prices not to fall. John would remain long the agricultural plays which I would concur with, although again we have a slight difference of opinion. I believe that if their demand for industrial metals falls, so too will their demand for food imports, although lagged by a year or two. Whilst China may need to import food, if it can't afford it, no one is going to give it away, particularly in an environment where our own consumption is being squeezed).

Jimmy Carter rides again

Every president since 1974 has emphasised the importance of energy independence, but none of them have had the public support to do anything about it. On July 15th 1979, at the height of the Iranian oil crisis when energy prices were a record percentage of U.S. income, U.S. President Jimmy Carter gave his famous "Crisis of Confidence" speech in which he outlined a program for achieving energy independence. "On the battlefield of energy we can win for our nation a new confidence, and we can seize control again of our common destiny". Four months later Mr Carter was voted out of office.

It is clear that to get the necessary policy response discussed earlier, we need to see much more pain first. The hyperbolic discount function illustrates that whilst the financial markets might discount assets and liabilities at a steady interest rate, the human mind uses a hyperbolic discount function. We are able to bury our heads in the sand and convince ourselves that everything will be alright despite all the evidence to the contrary. It is not until it becomes irrefutable that we will give politicians the power to take the necessary action. Even assuming an optimistic scenario of peak oil production not being until 2020 (USGS), we should be investing far more heavily in energy replacement than we are now. By 2020 it would be too late. The market will demand a solution faster than politicians are able to provide it. That means oil prices will be forced up a lot further and more wealth will be transferred to the Middle East and away from the dollar.



http://www.paulchefurka.ca/Hyperbolic%20Discount%20Functions.html

http://repositories.cdlib.org/cgi/viewcontent.cgi?article=1086&context=are_ucb (formal descriptions)

"Socialism collapsed because it did not allow the market to tell the economic truth. Capitalism may collapse because it does not allow the market to tell the ecological truth" according to Oystein Dahle, Vice President of Exxon Norway. I am not suggesting that capitalism breaks down, however I am suggesting that because of its failure to price externalities - (I am not referring to global warming, but to the cost of replacing the energy we are using) – it will feel like capitalism is breaking down. Earlier I drew up a table highlighting a scenario of how much GDP we would initially lose if we were to offset a 5% pa energy shortfall with investment in solar power. I suggested that we would need to take an initial GDP hit of 25%, and could then start to recover from there. The question is whether that hit is driven by government policy redirecting production from present consumption to building out the new energy grid – (the most palatable way, but unlikely to happen), or whether it happens due to economic collapse in which government tries to offset rising unemployment with fiscal stimulus, building the modern equivalent of the Hoover Dam.

It should be noted that whilst the U.S. appears to be in a worse position to make the transfer than does Europe, the U.S. political system has historically has been much more willing to implement bold policies than has Europe's more consensual approach.

The IEA's July report asserted that high oil prices are justified by the fundamentals. "Often it is a case of political expediency to find a scapegoat for higher prices rather than undertake serious analysis or perhaps confront difficult decisions". Of 16m bpd of new OPEC supply over the next 5 years, 14.8m bpd will go to making up the shortfall from collapsing North Sea and Mexican fields. It said that the pace of depletion of existing fields has been brushed under the carpet by politicians, but cannot be ignored any longer. It warned that Saudi Arabia is having bigger problems than it is willing to admit, even suggesting that Saudi's claims to maintain production should be met with scepticism.

As I said earlier, the first step to recovery for an alcoholic is supposedly the admission that he has a problem. The same is the case here. Once our leaders declare that we have a problem and that we are in effect facing a state of emergency, then we will all crowd around our TVs and wait to be told what to do. The sooner we admit we have a problem, the sooner we will get a solution, and the cheaper it will be. Having compared the solution to the measures taken in a war, the actual recognition of the problem will be similar. Again if you look at WWII as an example, despite all the obvious indicators of the scale of German arms build-up, neither Britain nor the U.S. started to arm themselves until they were already effectively in war, perfect examples of the "hyperbolic discount factor". The question therefore is what will be the trigger point that forces the State of Emergency speech. It is only over the last 18 months that the IEA has gone from saying there is no problem, to saying that there wouldn't be a problem if we scaled up investment dramatically, to now warning that there is a major problem. My guess is that it won't take long for government to go through similar recognition. The likely trigger in my opinion is the shift from higher food and energy prices to physical shortages. Initially these shortages will be caused by truckers or dockworkers (1973 halt of grain exports from the U.S. was caused by longshoreman refusing to export U.S. grains abroad when U.S. supplies were so low that prices were soaring) that will be met initially by some temporary relief from the government (perhaps the release of strategic reserves) and plenty of aggressive condemnation of OPEC, but then over the following 6 to 12 months as problems get worse, the light bulb will start to go on.

Whilst the spotlight is on China's coal shortages, a recent article on the Energy Bulletin – (http://energybulletin.net/node/45942) – highlights that there is a growing number of states worldwide that now experiencing power shortages. Several now appear on the path to an energy shortage induced economic and perhaps political collapse in the foreseeable future. The most obvious places at the moment are Pakistan and Bangladesh. Both are nations with populations in excess of 150m that are ensnared by devastating power shortages that have destroyed their export industries. Both are facing water and agricultural problems that threaten their food supplies. Liquid fuels are running short and reductions in exports threaten their ability to import oil and natural gas. Saudi Arabia is already forgiving Pakistan USD6bn of their annual oil import bill. Worsening blackouts, the liquid fuel shortages and the food situation is likely to lead to serious political instability before the year is out. Of the major economies, whilst China has problems, India is in a far worse situation. Its nuclear power plants are failing and hydro power is drying up. Over 85% of India's oil must be imported, which is having a heavy toll on the state budget. Blackouts and liquid fuel shortages are now a daily occurrence. There is no end in sight, and the blackouts mean the ability to afford fuel is falling. It is becoming a vicious circle. (India uses over 1/3rd of its energy purely to pump water out of aquifers and to irrigate land). A number of important mineral producing countries in Africa and Latin America have reduced mineral production because of power shortages, including South Africa, Chile and Zambia. This is going to continue to drive prices higher in the West and make life very difficult indeed in the emerging markets. It seems therefore that the hyperbolic discount function is getting very close, at least within the emerging markets.

I will undoubtedly be accused of being bearish writing such a report. At the moment, this story probably has even less support than when we were going on about the Asian "Noddyomics" that led to the 1997 financial crisis, the complete irrationality of the Internet Bubble, or the scale of U.S. debt growth over the last 5 years or so. Excuses for high oil prices have been made all the way up. Do you remember when people said there was no way they would go through USD30bbl, and certainly not USD40bbl? The excuses have changed as each argument was eventually debunked. This maybe a medium to long term theme, but it is these trends that we should position for; a gradual shift of manufacturing production from energy inefficient consumers to the efficient consumers, a continual transfer of wealth to the energy exporters, and a gradual shift of spending from consumer discretionary spending to these alternative energy trades.

SPECIFIC TRADES.

1. Be long the energy rich economies such as Norway, Sweden and Canada vs the energy short economies like China and India.
2. Be long energy efficient manufacturing economies like Japan, Germany and the U.S.A. against short the energy inefficient economies such as China and South Korea.

3. Continue to be long the Euro and Yen against the dollar, although keep an eye out for any out performance of agricultural prices relative to energy prices that would favour the dollar. Also keep monitoring the political development. A strong government policy will be matched with a strong currency.

4. Be short credit in all forms. Anticipated default rates will soar.
5. Expect government and utility issuance to crowd out other issuance, further lifting the real cost of capital. Expect swap spreads to continue to widen.
6. Whilst banks may appear to offer value given their share price collapse, expect significant pressure on their assets to continue to squeeze equity capital very heavily.
7. Easy money to facilitate this will continue to lift gold prices.
8. The re-composition of CPI baskets due to the redirection of demand will interfere with inflation trades, but I would still buy inflation caps and bet on asset price deflation.
9. Expect equities not only to be de-rated but for nominal falls. (Keep an eye on the Karachi stock index as a leading indicator of just what sort of damage may be inflicted on other emerging markets).

10. Along with major changes in trade positions, expect a handover of FX reserves from Asia to OPEC and Russia. Higher energy prices will mean that the FX reserves continue to increase, but their investment policy is likely to be different to Asia's. As my colleagues in FX keep saying, follow the money.
11. Within the energy sphere, I would continue to be long both oil and gas, although I would personally only hold them via long dated options as pull backs are likely to be extremely aggressive. My favourite is Natural gas where energy for energy, it is trading at about 50% of the level it should trade compared with oil. The gradual shift of the U.S. supplies to LNG will help this process to happen as international oil and gas prices are much more inline with each other.

12. In terms of transfer of consumption, we don't as yet know which alternative energy we will invest in. If it is solar, then my guess is that whilst a lot of the tech companies will be the big beneficiaries even though their traditional markets will be decimated. In terms of demand destruction, I think it will be in oil use of all sorts, so big tax hikes on driving and on flying..
13. Power utilities will be used as the investor in the new power system, so will be allowed to continue making a profit.

Thanks for taking the time to read this. A peak in fossil fuels and its subsequent exhaustion is certain. The timing difference between the optimists and the pessimists is now so small as to be irrelevant. The question therefore is what does this mean, and how do we get there. Hopefully this note goes someway at least to raising a few of the questions and suggesting some of the paths the global economy will take to get there.