



## **...To Grandmother's House We Go: Peak Oil Is Here**

Posted by [Prof. Goose](#) on September 26, 2007 - 10:00am

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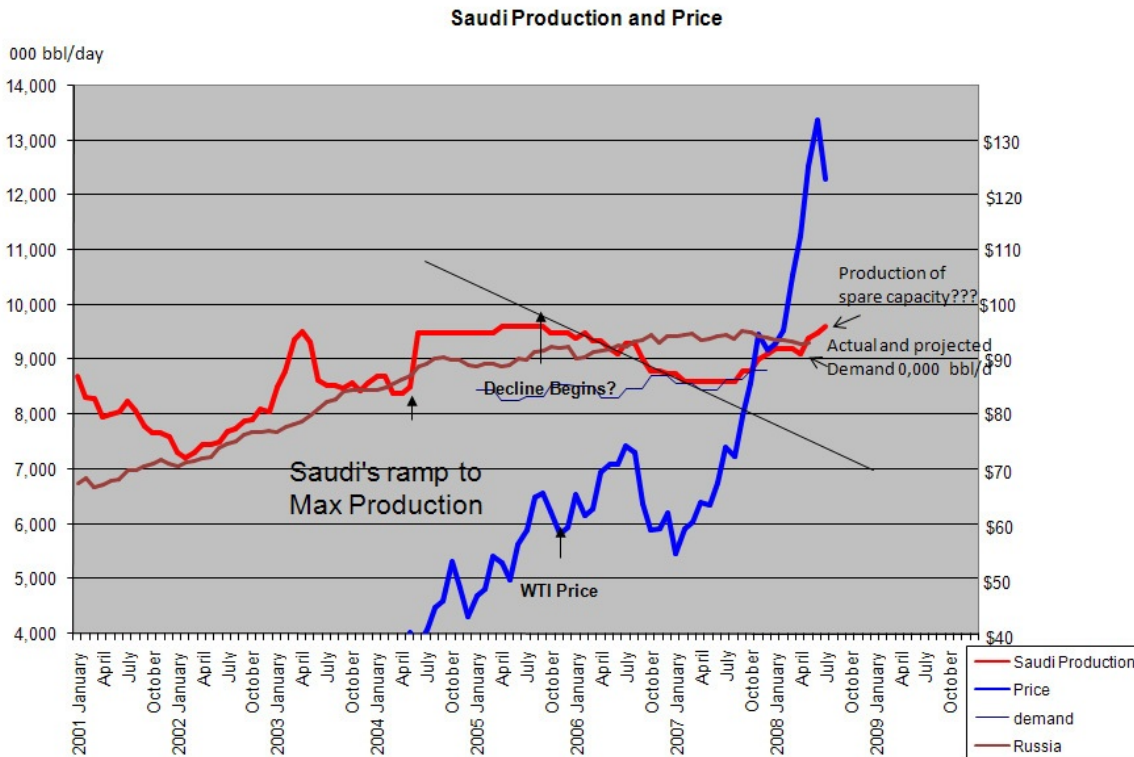
I have intentionally paraphrased this wonderful Christmas song because it has much to say about the future after peak oil which I am now ready to say has already happened. As energy declines, we will indeed go to our grandmother's house--one without electricity and running water, sewer or septic and deep, mechanically pumped water wells. At least that was MY grandmother's house. She lived on the Kansas prairies of the 1890s. In the 1960s I asked my grandmother what the greatest invention of her life had been. She said electricity because before they had lights, everyone went to bed shortly after sun down because it was simply too dark to do to much. There was no air conditioning, so the summers were very hot. In the winter, trips to the outhouse were cold (and brutally awakening if during the middle of the night). While she had wood where she lived, about 100 miles west of her home, people had to burn dung as is done in Tibet today. See the picture below of the dung plastered against the house. When one wants to cook, one retrieves a patty.

Without cheap energy, we go back to my grandmother's house or one quite like it...



Yes, folks, peak oil is here, that thing that politicians don't speak of; that event which cornucopians (those who believe that we will not run out of energy) believe is a fraud or misunderstanding is here. The cornucopians believe we are wrong because many have predicted that we would run out of energy before and have been wrong. What they lacked was the 20-20 that hindsight gives one. Today, we can see the peak behind us.

First, how do we recognize when peak oil is about to happen or has happened? The first thing is that it always comes with a gradual decline in production. Steep changes in production curves are due to political or economic decisions. Let's look at Saudi production from 2001 to the present. *(NB: Click all graphics throughout this post to expand them to full size.)*



The first thing we notice is that it is declining from January 2001 to January 2002. That is the recession resulting from the collapse of the tech stock bubble, causing a worldwide reduction in oil demand. The world then began to recover. In January, 2003 political events in Venezuela shut in that country's oil. We find this

"January 12, 2003: OPEC held its 123rd meeting to review oil markets in Vienna, Austria. OPEC decided to raise its production quotas from 23 million barrels per day to 24.5 million barrels per day, effective February 1, 2003, in order to ensure adequate supplies of crude in response to the oil supply shortfall in Venezuela" <http://www.eia.doe.gov/cabs/opec.html>

This was a short-lived, very steep increase in production, followed a couple of months later by a nearly equivalent sharp drop in production. This is not a sign of peak oil; it is a sign of political manipulation of production. The next thing we notice is the sharp rise in production in April, 2004. This was due to the rise of price above \$40/bbl, a level which OPEC had previously thought would cause a recession. They opened the taps to try to damp down the price. What they didn't count on was that China's and India's consumption had taken off like a rocket because of their economic growth. The price continued to rise, showing that scarcity of oil had come.

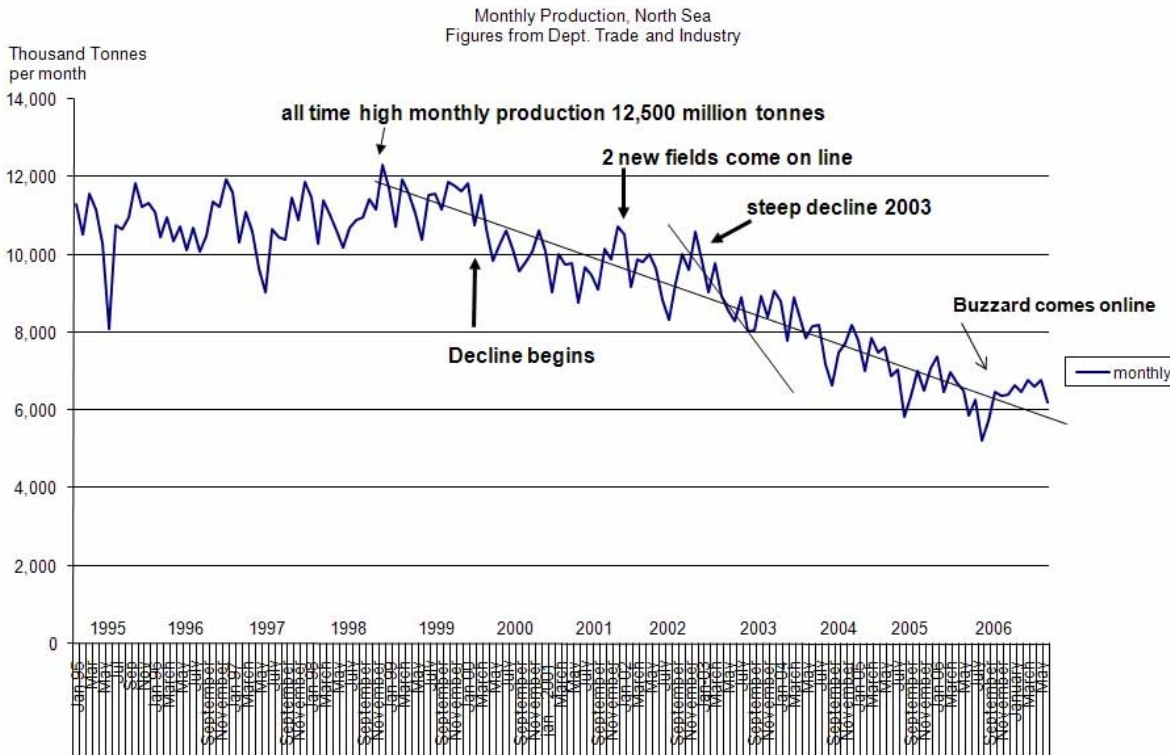
After a year and a half of all out production, we see the first signs of decline, normal natural decline in the Saudi production. The plateau of production is followed by a gradual decline in output. One might be tempted to say that the decline in production was due to declining prices, but this isn't true for the period from Oct. 2005 until July 2006. The price rose but the production declined. The gradualistic tail on Saudi production is what an oil field decline looks like.

Just as I was finishing writing this page, I saw this report.

Nicosia, Sept 8: Saudi Aramco in its Annual Review 2006 said that last year the company's crude oil production declined by 1.7 percent, while exports declined by 3.1 percent, compared with the previous year.

Crude oil production in 2006 averaged 8.9 million barrels of oil a day (b/d) and exports 6.9 million b/d. (<http://www.dailyindia.com/show/172345.php/Saudi-Aramco-reports-oil-outpu...> ) To me, the interesting thing about this is that with a 3.1 decrease in exports, this means that there is a reduction of 266,000 barrels per day available to the rest of the world. Production doesn't really matter to the rest of the world. Only exports matter. If the Saudi's used all of their oil, there would be nothing left for us to use. This data confirms that their exports are decreasing faster than their production is decreasing.

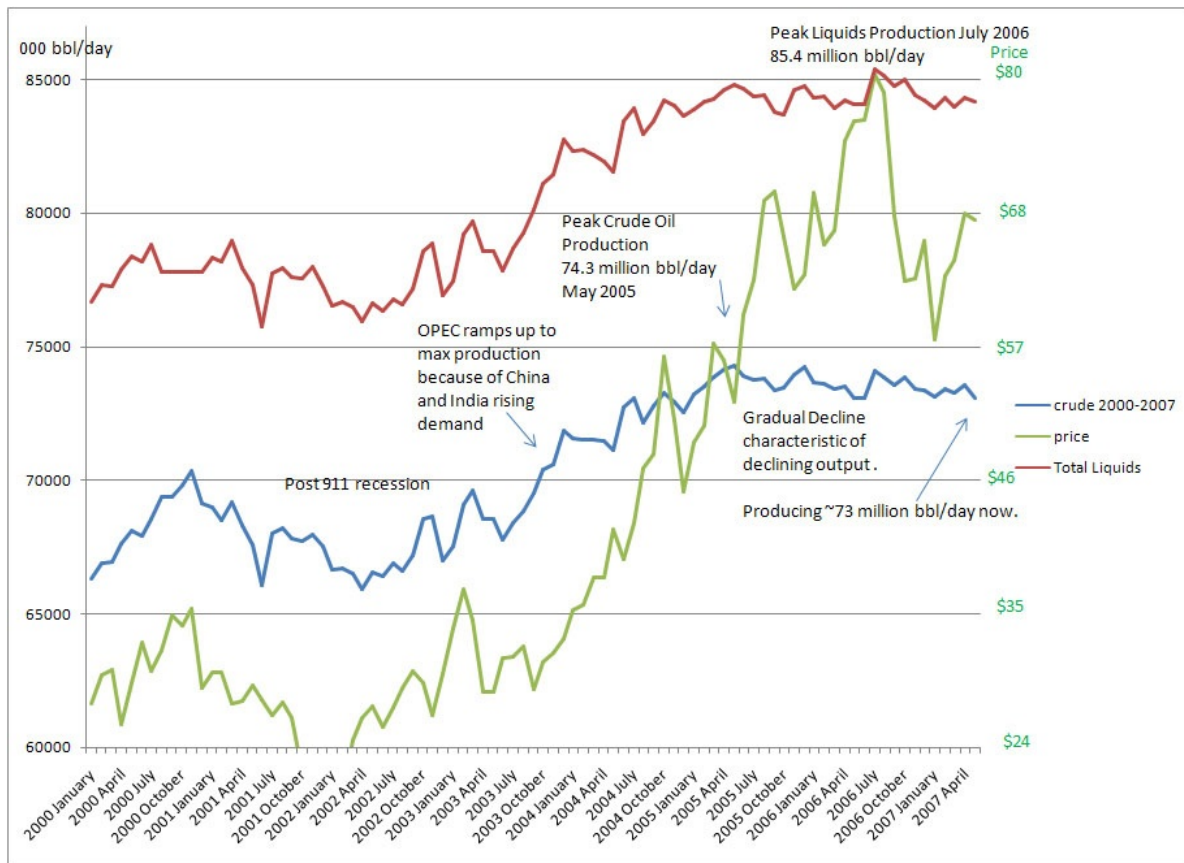
Let's take another example, the United Kingdom.



From 1995 until 1999, the UK production was a plateau. But in mid-1999, the monthly production began to gradually decline. I moved to the UK in August 2001, looked at the curves and told a colleague and fine geologist, Steve Daines, that the UK had peaked production. He disagreed. We made a bet for a lunch that at the end of 2000, the UK would produce no more than 130,000 tonnes of oil. I took below that figure, he took above. Instead of a lunch, he and his wife had me and my wife over for a wonderful Malaysian dinner cooked by his beautiful Malay wife. We ate that meal with gusto along with a Turkish couple, that they knew. The sad thing was that the UK production decline has continued even into this year. When I left the UK, I told one young geologist that if she wanted to have a career in the oil business, she was going to have to leave the UK. While that day hasn't come for her yet, it will. No one will pay geologists to manage fields that aren't producing. The above curve is what peak oil looks like for a country--a plateau followed by a gradual decline that is inexorable.

Now that we know what peak oil looks like, let's look at the current global production of both black oil (crude) and Total Liquids (crude plus condensate--a liquid that comes out of natural gas wells which is usually clear).





What we see here is that following the post-911 recession, there is the ramp up of production to supply the increasing demand from China and India. By late 2004, the rate of increase in world crude production (blue curve) slowed, reaching a peak of 74.3 million barrels per day in May 2004, marked by an arrow. The trend from that time has been down, gradually I would admit, but down none the less.

So, why do I call this the peak of world crude production? Isn't it possible that new production will come on line and lift that number above the 74.3 million bbl/day? Possible, barely, probable, no. Why? All the world's biggest fields are in decline, and they produce a large percentage of the world's oil. We saw Saudi Arabia's production, and that represents 10% of world oil. So, we know that 10% of the world's oil is in decline. But the Saudi's are the second largest producer. Russia, the largest producer of oil, is, at best, flat in production now. The U.S. is the third largest producer of oil (something that surprises everyone) and we have been declining in oil production for 30 years. These three countries account for 28% of the world's production, all in decline.

Mexico has the 3rd largest oil field and that one field represents 2/3 of its crude production. It is in decline, plummeting 20% last year. The UK, Norway, Indonesia, Oman and China are all in production declines. The only places on earth that are undergoing significant increases in crude production are Angola, Kazakhstan and Brazil. Kazakhstan will always be limited to the size of the pipeline it has available. Pipelines have fixed capacity.

Given all this, it is hard to see how the future is going to bring forth vast new quantities of daily production.

Another objection: Above I said that peak oil was a plateau followed by a decline. Could we be in the plateau of world production? Yes, that is certainly possible but for the reasons I list above, the

current levels of production simply can't be maintained. Annually, the world loses 5 million bbl/day of productive capacity. The curve above shows that we are not adding to world productivity rates even 5 million bbl/day per year of productive capacity since 2005, which would have kept us absolutely flat.

Now, one other thing makes me think that this is the peak of world crude production. The price response in relation to the supply. Usually if price is going to bring forth new supplies from OPEC (who supposedly has all these vast untapped oil fields just waiting to be turned on), it would happen in sharp steps. The Saudi's have not increased production since late 2004 or early 2005. Yet, because the price has gone up from that time, if they had the oil, they could have made lots and lots of money. But they don't seem to be able to take additional advantage of the oil price. In spite of high prices, indeed, increasing prices, no one on earth seems to have the excess capacity sell more oil into this rising price environment. Given the past history of cheating on the part of the OPEC members, the lack of new supplies coming to market must say something important about its availability

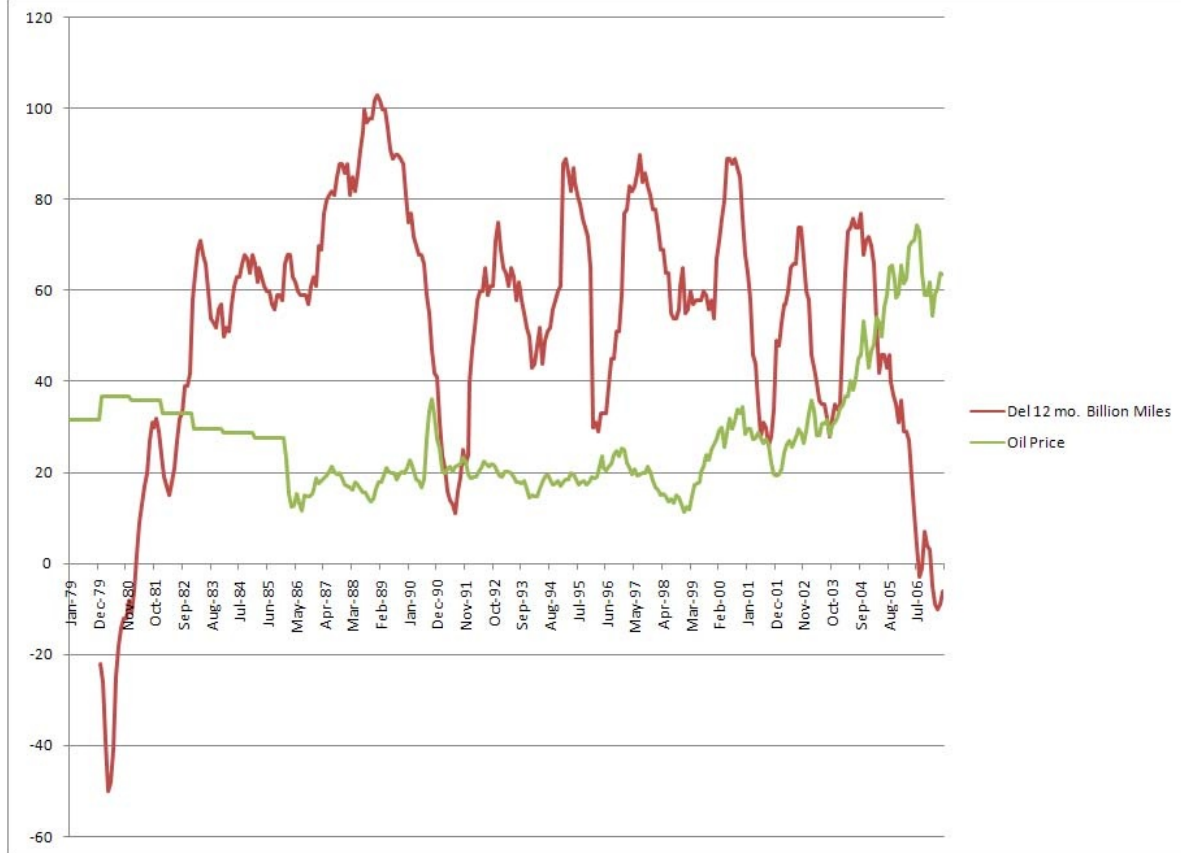
Another interesting feature is the total liquids curve (the red curve). This is both black oil plus the clear condensate from natural gas wells. This curve also seems to have peaked, but peaked a year later, in July 2006. Thus, we are 2 years out from peak crude oil, but only one year out from a probable peak liquids.

What are the implications?

The most important thing we need to know is the rate of decline, which of course, we don't know and won't know for a while. We can delimit it a bit. a 1 million bbl/day decline from May 2005 until May 2007 represents approximately a .75% decline per year. Hardly something to worry about right? The first year of UK decline was only about .5%. The second year of decline was 9%, but then, the UK is a much smaller place than the world, so it is unrealistic to expect the world to follow precisely the UK pattern of decline. We can expect the world crude production to decline much faster in the next few years than it is right now. How fast remains to be seen, but even a 5% decline will mean that in 10 years we will be producing only 60% of what we do today! Instead of having 85 million barrels per day of total liquids, we would only have access to 50 million barrels per day.

Driving

Clearly that kind of restriction in oil supply means that either mass transit must come to America as it is in China, or we must only go to work 3 days per week. In 10 years, having only 60% of the oil we have today means 40% less driving for everyone. Going to work only 3 days per week, would mean the destruction of the economy. Most jobs can't be handled across the internet. How does one do the job of grocery store stocker by telecommuting? Even today though, the relatively mild oil prices we have experienced have altered the driving habits of the American public. I sent this chart to a friend last summer. The chart shows the change in mileage driven on US highways from last year. If we drive more this year than last year, the number will be positive; if we drive less, then the number is negative. As you can see, the response to the rise in the price of oil (green curve) has been that for the first time in 27 years Americans are driving less than the previous year. The last time this happened was during the Iranian hostage crisis!



Expect more of this in the future.

Another implication is that automakers shouldn't make gas guzzlers. Those old enough to remember the Iranian hostage crisis, when everyone had to take turns getting gasoline on alternate days, knows a bit of what it will feel like. Back then, people stopped buying big cars. The V8 went out of style in the 1970s; it was too expensive. I expect the Hummer will meet a similar fate.

Suburban sprawl won't work

American cities will need to restructure to be more like European cities, where one can walk to the stores. In Aberdeen, Scotland, most Aberdonians shopped daily because they had tiny refrigerators. But that didn't matter, if they forgot something, they could walk to the store in about the same time it takes me to drive to the store here.

Flying

Flying will become like it was when I was a child--the province of the rich. I did not get on a commercial jet until I was 25 years old. My children grew up with flying and have seen far more of the world than I have at an equivalent age. But, as oil prices rise, fuel costs will bury many airlines. As far as I know, I own no airline stocks either directly or indirectly through mutual funds. They are not going to have a growing clientele as energy costs go up. We have already seen one of the impacts of the energy costs to this sector. Years ago, I was speaking with my wife's brother-in-law who used to work with Boeing. Boeing had made the choice to go energy efficient with their planes, while Airbus had decided to go BIG. I told my wife's brother-in-law that Boeing had made the correct choice. This is from a Business Week web site:

"Instead, the show could highlight a growing list of woes at the company, based in Toulouse,

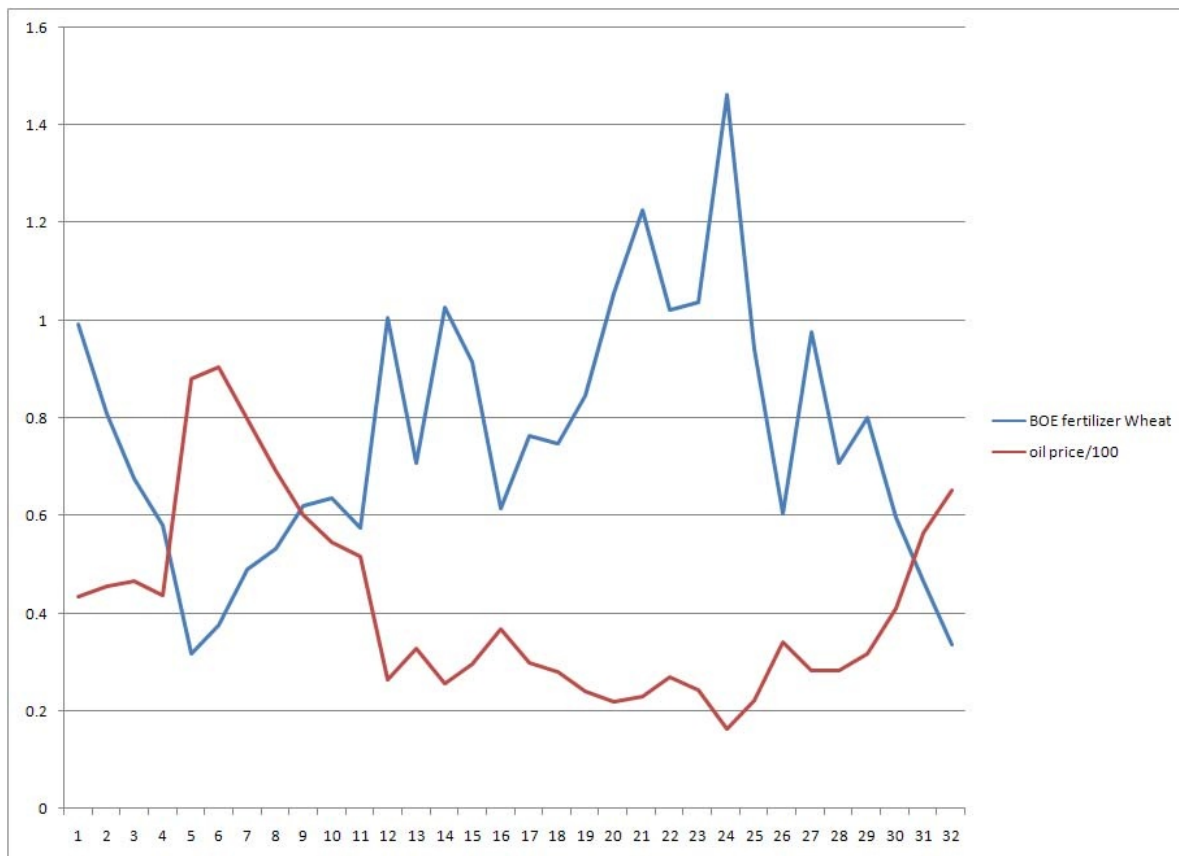
France. On June 1, Airbus acknowledged that the first deliveries of the A380 will be delayed up to six months, from mid-2006 until early 2007, due to unspecified production difficulties. Then Emirates airlines, which had been expected to announce a big order for the A350 at the air show, said it was not ready to make a decision. Airbus sales chief John J. Leahy, who said earlier that he might announce more than 100 orders for the A350 in Paris, now says big orders could come "a week or two after."

Has Airbus lost its mojo? The past few months have been rough. Boeing, after trailing Airbus on orders for the past three years, has racked up 255 orders as of the end of May, compared with only 196 for Airbus. Even more worrisome, Boeing's new 787, which boasts better fuel efficiency thanks to lightweight composite materials and next-generation engine design, is proving a hit with airlines. They have placed orders and commitments for 266 of the jets, while Airbus has yet to announce a major deal for the competing A350. Meanwhile, the A380's order book has been stuck at 154 since last year." Why Airbus is Losing Altitude," June 20, 2005, [http://www.businessweek.com/magazine/content/05\\_25/b3938069\\_mz054.htm](http://www.businessweek.com/magazine/content/05_25/b3938069_mz054.htm)

And a more recent news source notes that Boeing has won 706 orders for its Dreamliner while Airbuss has only 154 for the A350. Energy is king in the airline industry, even if a government run airplane manufacturer thinks they can change the laws, both of the land and of physics.

## Food

One percent of world energy use goes to fertilizers. High energy prices will affect fertilizer use. Indeed, we can see that now. This is a plot of inflation adjusted oil price divided by 100 (so it will fit on the same chart) with the barrels of oil equivalent energy of fertilizer applied per acre of wheat. One can see that when oil prices are high, fertilizer use is low; and vice versa.





Few city people know that an acre of wheat has 1.3 million wheat plants--a density hard to achieve if one is throwing seed by hand. Corn is sown at 30,000 plants per acre. Such densities require mechanical sowers. To sow corn at these densities by hand would require 42 hours (5 seconds per seed). This kind of puts into perspective the utility of energy for our tractors. If the price of oil goes up, there will be fewer bushels per acre because of the combined effects of less mechanization and less fertilizer. Now clearly for a while efficiencies will help. People will figure out how to apply fertilizer more effectively; but eventually not having fertilizer will come into play.

I am fond of citing a little known fact I got from a Walter Youngquist article. Mechanization allows a farmer to spend 4 hours per acre and produce 160 bushels of corn per acre. Back in the 19th century, it was 500 hours per acre and 30 bushels of corn per acre. This of course brings an interesting conundrum to those expecting corn-based ethanol to fuel the world. Without petroleum-based fertilizers, there won't be enough corn to feed us much less fuel the world. A five fold drop in corn yields would leave many in the world starving.

It is unlikely that we will be able to have air-shipped strawberries from Argentina in the winter, so food will once again become seasonal, like it was in my childhood before globalization.

## Water

Water and food are entirely linked. Without water, many crops won't grow, but we also need water to drink. A few weeks back the Wall Street Journal gave a couple of interesting facts about farming in India.

"Since the 1990s, India has been a major net exporter of rice, shipping nearly 4.5 million tons last year.

"But annual yield increases began to slow over the past decade. Farmers cranked up fertilizer and water use, draining the water table. Many began planting two crops a year, taxing the soil. Punjabi area officials discouraged farmers from planting two crops and in some places outlawed it, but many farmers ignored them."

"I'm doing mischief against the government,' concedes Kanwar Singh, a second rice crop recently on a stretch of flooded land near the northern India city of Karnal. He says he now has to pump water from 300 feet below the surface, compared with 70 feet 10 years ago." 'In a year or two, maybe it will be finished,' he says." Patrick Barta, "Feeding Billions, A Grain at a Time," Wall Street Journal, Saturday/Sunday July 28-29, 2007, p. A10

and

"Lakhbir Singh, 35, this year planted aerobic rice for the first time. He says his costs have tripled over the past decade. His well was about 60 feet deep 10 years ago; now, it's down to 450 feet, and he has to use a special submersible engine to help haul the water to surface. The health of his soil has deteriorated, so he's using more fertilizer." Patrick Barta, "Feeding Billions, A Grain at a Time," Wall Street Journal, Saturday/Sunday July 28-29, 2007, p.A10

One simply MUST have energy to pull that water up from depths of 300 to 450 feet. Without it, there will be no water. Which raises the question, what will these poor guys do when the electricity isn't there to run their pumps?

But this isn't a problem for poor Indian farmers. When the electricity is off, the water pumps, which pump water out of deep wells will not be running. That means that agricultural irrigation

will be interrupted. That means that city water supplies won't flow either. Both wells and surface water systems require electricity to move the water from source to your favorite drinking fountain.

## Energy source

Another implication is that coal will have to play a larger role in the US energy budget over the near term. We can use coal to make diesel, electricity and thus mitigate, for a while, the coming problems. Coal can be used to manufacture fertilizer and avoid the problems (for a while) cited immediately above. We will use coal or our economy will not function. We will simply have to lose our aversion to coal and the CO<sub>2</sub> it produces. I have asked many greens this question: If it comes to a choice between your child freezing in the dark or burning coal, which would you choose. I have yet find one so pure to their principles that they tell me they would let their kid freeze in the dark of a winter night. They all will burn coal to keep warm. Having lived in a society (China) where coal is the major source of energy, the smog is almost unbearable. There were days I could taste the sulfur in my mouth as I walked to work in Beijing. But we are no different than they. Their choice is also one of burn oil or have no heat in the winter or cooked food. The only alternative would be to chop down all the trees (which has almost been done in wide areas of China).

Yesterday there was an article in the Wall Street Journal talking about the coming electricity problems for Texas. Due to the success of the Greens at stopping TXU from building coal-fired power plants, in 3-4 years, Texas will probably start having similar problems to those California is having. California, and now Texas, stupidly decided that we would rather freeze in the dark rather than burn coal. We get 60% of our electricity from fossil fuels, coal, oil and natural gas! The decisions we make today will have immense impacts on your ability to go to work (how is your computer going to function without electricity? Do you really want to be able to drink water from the fountain on your 27th story office? Won't you just love walking those 27 stories each morning to get to work, which will put you in great shape if you don't have a heart attack during that first month of climbing). I suppose deodorant sales will increase in such a situation.

## Conclusion

I will finish with personal story from my life overseas. When I lived in the UK, I saw what happens when the oil is shut off. In Sept 2000, the lorry drivers blockaded the refineries. My wife and I were brand new in the UK and driving back from a play in Aberdeen one night, we saw huge lines at the petrol stations. We wondered what was going on, but we drove on home not wanting to be in such long lines anyway. Unfortunately, those people in line, knew that the refineries had been blockaded, I didn't. By the time we realized it, the petrol was gone. That led to many interesting experiences. In one week, the food on the store shelves was gone. By two weeks, police and fire and ambulance were having trouble responding. Farmers were about to have to slaughter chickens because they couldn't get feed after only 2.5 weeks. Construction sites shut down. I learned through that experience that a society has about 3 weeks after the oil is shut off. Food ceases to move into the cities.

How can economic growth continue if each day into the future we have less energy than we had the day before??? This is a historic moment in human history. For the first time in 10,000 years, we have less energy than we had yesterday. And that will continue into the foreseeable future.



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