The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

An Economist response, or is it a techie Sunday?

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Topic: Supply/Production
Tags: depletion, economist, production, saudi arabia [list all tags]

Oh, dear it looks as though I have to disagree with an economist again. But this time it is the magazine rather than an individual. As has been pointed out, and to an extent discussed in recent comments thanks to which I was able to read the initial article, the Economist came out with an article this past week that suggested that the current problems with the supply of oil are not really serious, or long-term.

There are several ways to address the issues of the article (you will have to wait a bit for discussion of the author's book since I only ordered it on Friday), but it appears to me that a primary criticism has to lie in the misunderstanding that the author appears to have about the role of technology and the slow speed with which things happen. I am not going to argue the point that there is still a lot of oil lying around. Yes there is, and even when we have depleted a field, we are leaving perhaps 60% or more of the original oil in place. And yes, given enough money and time we can even get that oil out.

Nor am I going to argue, at present about the longer-term existence of large volumes of oil. Rather, I would argue that the problem that we have is of getting an adequate supply of oil, each year, to meet the demand that there will be for the oil in that year. Under the current methods of production, and against an increasing level of demand it is becoming more difficult to produce enough oil to meet that demand. There are two major reasons for this, neither of which is properly recognized in the Economist article.

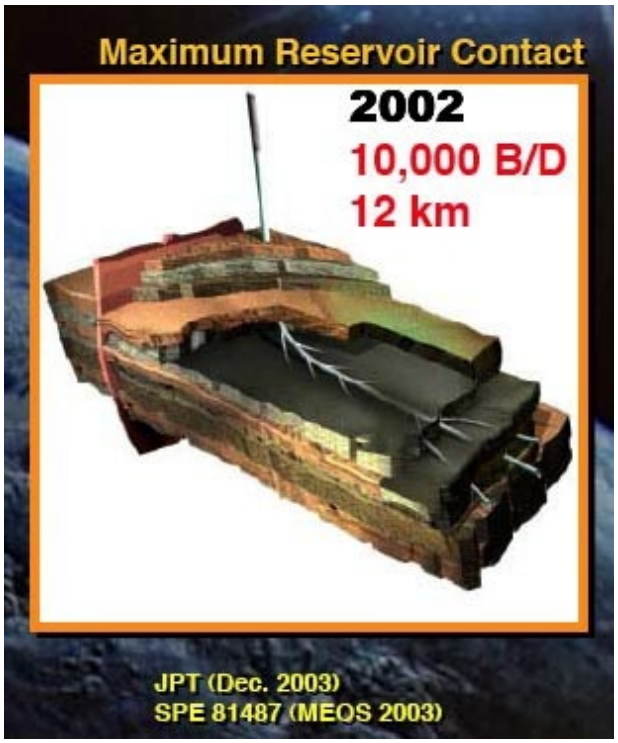
The first, and most critical issue, is the one that we call depletion. When an oilwell is first put into production, the oil flows into the well due to the pressure difference between the fluid in the rock, and the fluid in the well. If there is no difference in pressure, then no oil flows, (see Newton) and the greater the difference in pressure, then the higher the oil flow rate. As the oil flows out of the well, however, it reduces the pressure in the fluid. (Simple, crude experiment - get a bottle of soda water, shake it up and stand it in the sink. Open the top. The gas pressure will drive some of the water out of the bottle, but after a short while the pressures are equal and more than half the water is still in the bottle.)

This basic knowledge has been around for a long time, and it has been recognized that it gets harder to get the oil out, and that it flows more slowly, as the volume of oil that is left in the rock around the well goes down. (And generally a single well can only, realistically drain the rock out to a certain distance from its location). Historically that number has been considered to that the well will deplete (or reduce production) by about 5% every year, from its peak level.

But this has recently changed, and the change has both merits that the Economist understands, and pitfalls that they don't appear to have heard of. The change comes about with the increasing practice of pumping water into the ground under the oil layer, so that as the oil flows out, water is

pumped in to replace it, and the driving pressure remains the same. This extends the life that the well has at the higher pumping rate, but it has two downsides. The first is that it is very hard to control how the water flows up through the rock toward the well. And if the well is in the wrong geological conditions, then the water can get to the well before all the oil is removed, and production is lost.

To solve this problem, and also to increase flow rate, there has been a move towards a second innovation, where the oilwells, that used to be vertical, now curve over and run horizontally along and through the oil-bearing rock. They can also now be built so that instead of just a single well bore running through the rock, the drill is backed and re-run so that the well has a number of small offshoots from the main well as it goes through the rock. This is known as maximum reservoir contact or "bottle-brush" drilling. If can increase the volume flow from an individual well from a few hundred barrels a day to up to 10,000 bd.



I borrowed this slide from one of Matt Simmons presentations.

Unfortunately it is not increasing the actual oil volume in the ground, nor in many cases, is in giving much more total volume of oil from the field than might have been obtained conventionally (Matt Simmons would argue that it might give less). Thus the first effect is that it shortens the life of the field. The second, and this has only been appreciated in the past decade, is that it also means that when the oil now starts to deplete, it drops at a much faster rate. Examples from Oman and the North Sea have shown that the number is now in the range around 15% rather than 5%, and thus fields that were expected to retain a long life in decline are now showing that instead it will be brutally short.

The second critical issue that the Economist is not able to properly understand relates to the historic nature of oilfield discovery and development. Generally the larger fields in a region are found first. They are also, obviously, usually the first to be developed and produced, and as they deplete, the production moves on to exploit the next largest (of which there are more) and as these deplete so smaller fields are exploited, of which a greater number must be found and produced to maintain or increase overall production each year.

It is only when these two critical factors are considered that the underlying weakness of the current world oil situation can be understood. The Saudi Oil Ministry has admitted to a depletion rate of around 800,000 bd/year, Iran to about 400,000 b/d, to name but two.

If you are going to match that depletion and increase production you have to drill more oil wells. And this is where the second catch comes in, because the new wells will not, in general, be as productive as the old ones, so you have to drill more of them. So now some of us start doing mathematics and multiplying number of rigs x wells per rig x production per well and getting numbers for the new production, to match both depletion and increase, that a country can achieve in a year. We also look at the volumes of new production that are planned by the companies (and Chris Skrebowski's list is looking to be more comprehensive now than that of CERA). Bear in mind that horizontal wells take longer to drill than verticals, so you can't get as many of them in a year, and if you are drilling with water injection then you have to drill the water injection holes as well. And also (and this is where the USGS may have slipped a bit) as fields age, so the success rate in finding new fields goes down, and a greater number of wells have to be drilled to give the same number that find a productive volume. This is why a number of us at this site have an interest in exactly how many rigs are really out there producing. For example the new development at Kurais, which will produce 1.2 mbd has been projected to need 400 wells (at 3,000 bd/well), and at 6 wells/rig/year this will take 20 rigs three and a half years.

Having said all that as background, it is not unreasonable to assume a number for the depletion of existing wells that lies around 5%, but for which there are legitimate reasons to argue could also be around 8% (As Schlumberger, for example, has suggested). At the lower level world production from existing wells is falling at around 4.2 mbd/year; at 8% it is falling at 6.7 mbd/year. Thus, over the next 5 years, just to sustain production, we have to find between 21 and 33 mbd of oil. When CERA says that we are going to find 15 mbd in that time frame, you can understand why the question of the depletion rates that are assumed become of critical concern. And since this is going to cause some debate, let me give one of those quiet coughs, and point out that those who say that depletion rates have been overestimated were those who were also saying that the UK would be self-sufficient in oil and gas until 2010. (And that North Slope depletion had stopped). The recent comment that Saudi Arabia tries to hold depletion to 2% through increased in-field drilling and new discoveries is not exactly a boost of confidence to that argument.

Unfortunately the article also has no apparent understanding of how long it takes to develop a field. Nor of some of the geo-political problems that have been covered in posts and comments at this site. The comment

> It is true that the big firms are struggling to replace reserves. But that does not mean the world is running out of oil, just that they do not have access to the vast deposits of cheap and easy oil that are left in Russia and members of the Organisation of Petroleum Exporting Countries (OPEC). And as the great fields of the North Sea and Alaska mature, non-OPEC oil production will probably peak by 2010 or 2015. That is soon--but it says nothing of what really matters, which is the global picture.

This does not recognize the dramatic drops in production that have already occurred in both the North Sea and North Slope, and implies you should believe that they are still at peak levels, it also seems to suggest that there are great gains in production to the world to be expected of Russia and the Middle East. As has been noted in several posts and comments here, those statements cannot be justified by the facts.

Thus when the article goes on to

> For one thing, the nightmare scenario of Ghawar suddenly peaking is not as grim as it first seems. When it peaks, the whole "super-giant" will not drop from 5m bpd to zero, because it is actually a network of inter-linked fields, some old and some newer. Experts say a decline would probably be gentler and prolonged. That would allow, indeed encourage, the Saudis to develop new fields to replace lost output. Saudi Arabia's oil minister, Ali Naimi, points to an unexplored area on the Iraqi-Saudi border the size of California, and argues that such untapped resources could add 200 billion barrels to his country's tally.

it fails to recognize that some parts of Ghawar have peaked some years ago, as has overall production from the field. Further that the concern is that, with increasing numbers of wells in the field being "bottle brush", that when the decline comes it will, in fact, be the same 15% or more that we are now also anticipating for Cantarell, and that we see in the North Sea and saw in Yibal. The length of time that it will take to develop new fields is finite, and that is the critical value of the CERA and Skrebowski lists, because in the immediate short term these are the only new projects that can be anticipated within this decade. Even if 200 billion were found on the border (and if you look at a map there are known fields up there already) it will still take years to develop and bring them into production.

This is already getting way too long but let me throw you a few more bones, and then I'll quit.

> The notion of a sharp global peak in production does not withstand scrutiny, either. CERA's Peter Jackson points out that the price signals that would surely foreshadow any "peak" would encourage efficiency, promote new oil discoveries and speed investments in alternatives to oil. That, he reckons, means the metaphor of a peak is misleading: "The right picture is of an undulating plateau."

Nope, no price signals around here that I can see! How about you? Seen much increase in efficiency so far? Me neither!

> . Kenneth Rogoff, a Harvard professor and the former chief economist of the IMF, thinks concerns about peak oil are greatly overblown: "The oil market is highly developed, with worldwide trading and long-dated futures going out five to seven years. As oil production slows, prices will rise up and down the futures curve, stimulating new technology and conservation. We might be running low on $20 oil, but for $60 we have adequate oil supplies for decades to come."

Hmm, wonder who is going to be developing that technology - can't be DOE they are cutting budgets, can't be those who know what they're doing, they are all either getting rich or retiring, and the world-wide shortage of engineers that is developing means that the new crop will likely go to production rather than research.

But the main hope that he throws to us is alternate fuels.

> Despite today's obsession with the idea of "peak oil", what really matters to the world economy is not when conventional oil production peaks, but whether we have enough

> affordable and convenient fuel from any source to power our current fleet of cars, buses and aeroplanes. With that in mind, the global oil industry is on the verge of a dramatic transformation from a risky exploration business into a technology-intensive manufacturing business. And the product that big oil companies will soon be manufacturing, argues Shell's Mr Van der Veer, is "greener fossil fuels".

After all

> But if the peak were to come after 2020 or 2030, as the International Energy Agency and other mainstream forecasters predict, then the rising tide of alternative fuels will help transform it into a plateau and ease the transition to life after oil.

Wonder if he has any clue as to how much agribusiness will be required to replace 15 mbd of oil? Many of the techniques he mentions at the end will help towards a reduction in the size of the problem we are starting to face. Unfortunately the Kern River produces only 570,000 bd of oil, and now needs 33,000 wells to do this (with annual drilling of new wells at levels of up to 2,000 per year.