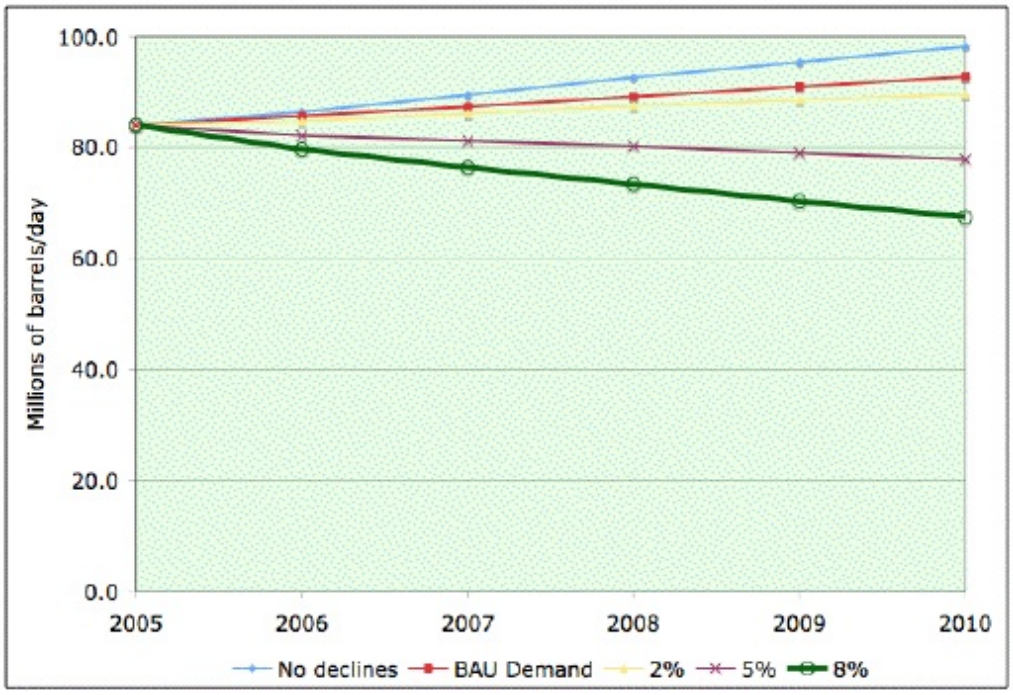
The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Exxon, and the Implications of 8%

Posted by Stuart Staniford on November 17, 2005 - 3:44am
Topic: Supply/Production
Tags: decline rate, gas prices, hubbert peak, oil prices, peak oil [list all tags]

Most of us thinking about peak oil have been aware for some time that the central uncertainty is the decline rate on fields in production (FIP). This dramatically affects when one believes peak will be, and seems to be the main difference between more pessimistic projections such as Chris Skrebowski's , and CERA's. It's also critically important in assessing the economic impact, since the faster total production declines, the harder it will be for the economy to adjust, and as we go further and further past peak, the fewer new projects there will be to add to the declining bulk of production.

In the past, peak oil projections have used fairly low decline rates for FIP - 3%-6%. There are now several pieces of evidence that the FIP decline rate might be more like 8%. Adding that to Chris Skrebowski's list of new projects makes for a very rough ride:



Production projection with 2005 ODAC Megaprojects plus various average decline rates of existing fields and the supply required to maintain "business as usual".

As noted at the recent ASPO-USA conference, Andrew Gould, the CEO of big oil services firm Schlumberger, has been saying for a few months that:

> ...the industry is dealing with a phenomenon that is exaggerated by the lack of investment over the past 18 years. This phenomenon is the decline rate for the older reservoirs that form the backbone of the world's oil production, both in and out of OPEC. An accurate average decline rate is hard to estimate, but an overall figure of 8% is not an unreasonable assumption. The maintenance required to slow the rate of decline, and increase the overall recovery, is a key element of the supply picture going forward.

He also notes what has been extensively discussed here at TOD:

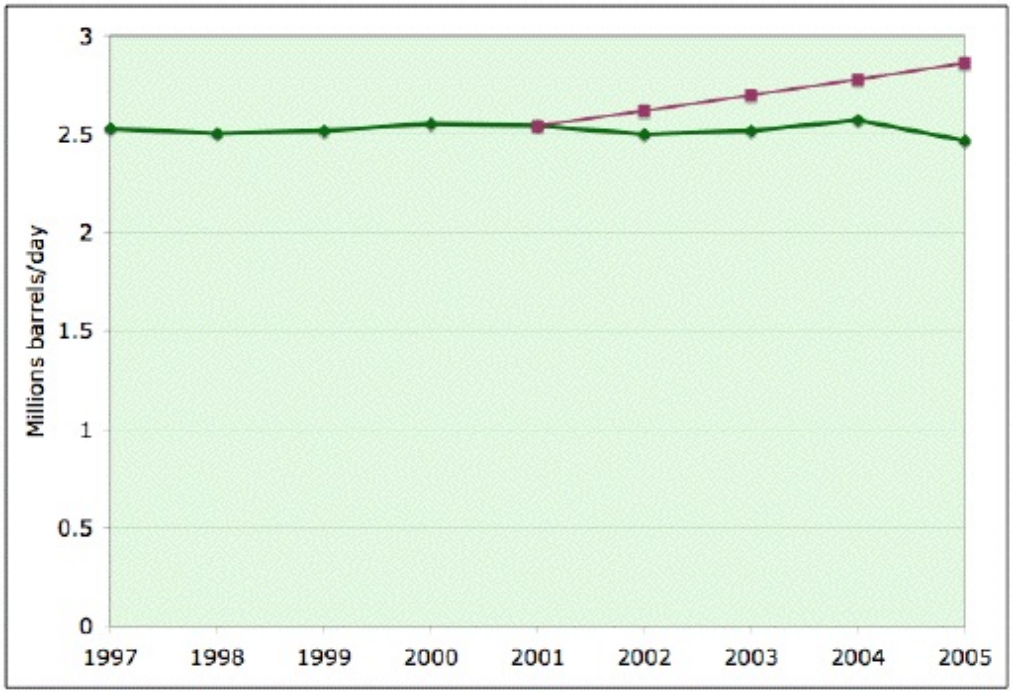
> Finally, the oil service industry is not in particularly good shape to meet the needs of a rapid worldwide ramp up in activity. A lot of the rig fleet, and much of the equipment are old. Very little spare capacity exists. This combination will compromise the service response, but the most disturbing shortage by far is the lack of specialized E&P professionals. A lot of skilled people have either been laid off, or have retired from the industry in the last 18 years. This shortage is as acute on the service side as it is on that of the operators. Training their replacements takes time, and there is already a great deal of evidence to suggest that the industry is fighting over the core of professionals that remain.

It's also been noted by the EIA that Saudi fields are declining by 5%-12%, and that Iran's fields are declining by 8%-13%. So OPEC countries appear to generally fit what Andrew Gould is talking about.

Today, I got email from Kyle Swanson, a Professor of Mathematics and Atmospheric Sciences at the University of Wisconsin-Milwaukee. Kyle looked into what would happen if one did a MegaProjects style analysis on Exxon circa 2001. (Exxon being the most optimistic of the big oil companies - eg. the one not yet running ad campaigns asking the public for help in producing enough oil). Kyle's conclusion:

> Looking over Exxon's annual reports for the past 5 years, I think that a reasonable case can be made that Exxon's internal liquid decline rate is actually about 10%.

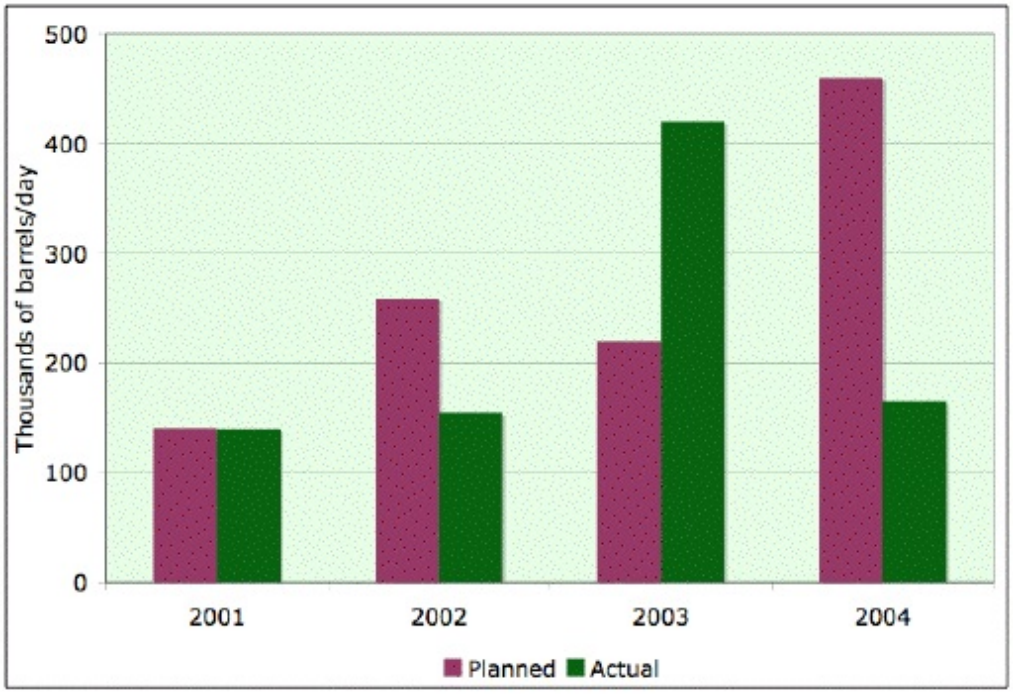
I didn't quite do it the same way as Kyle, but I come out in the same ballpark. Let's replicate and extend his analysis graphically so that we can see exactly what's going on. Here's Exxon's oil production (including NGL and tar sands), over the last five years from their annual reports:



Recent Total Exxon Liquids Production (dark green) with 2001 projection (purple).

The 2005 number is actually the 2nd quarter, taken from Petroleum Review. As you can see, the dark green line is basically flat, with very slight fluctuations. They certainly haven't been growing production in any significant way. However, if we follow Kyle's advice and take a look at their 2001 annual report, we see that they certainly thought they would - they estimated that they would grow at 3% annually through 2007. That's the purple line.

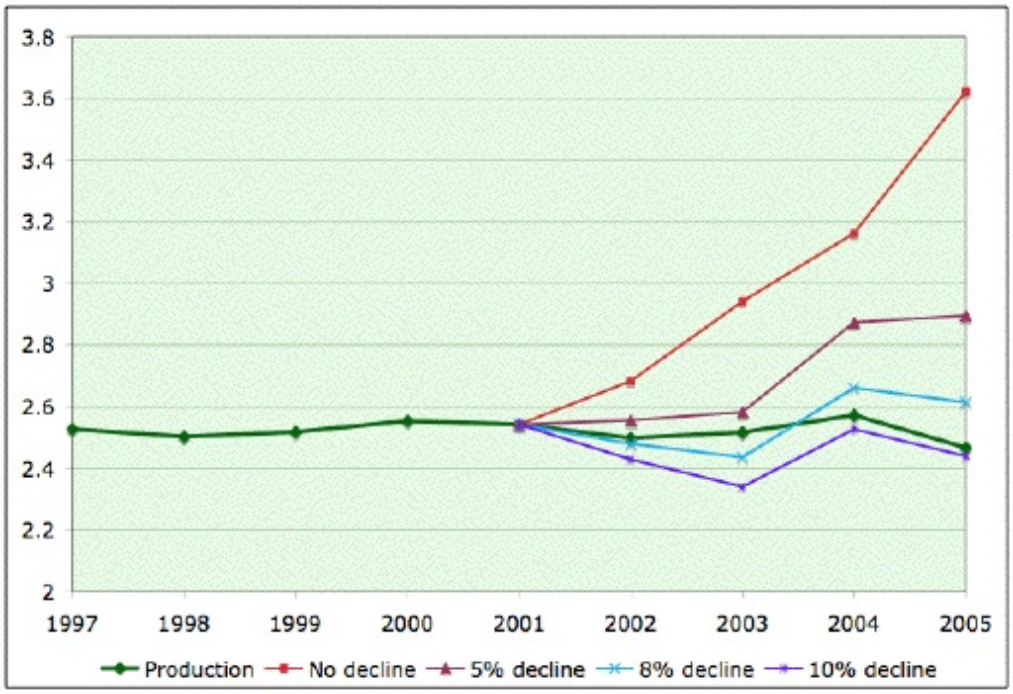
Now, let's take a look at how they expected to do that. A complete list of projects is on page 32. The planned (as of 2001) capacity additions reaching first oil in each year, are shown, along with what actually happened:



Exxon planned and actual additions to capacity reaching first oil in each year.

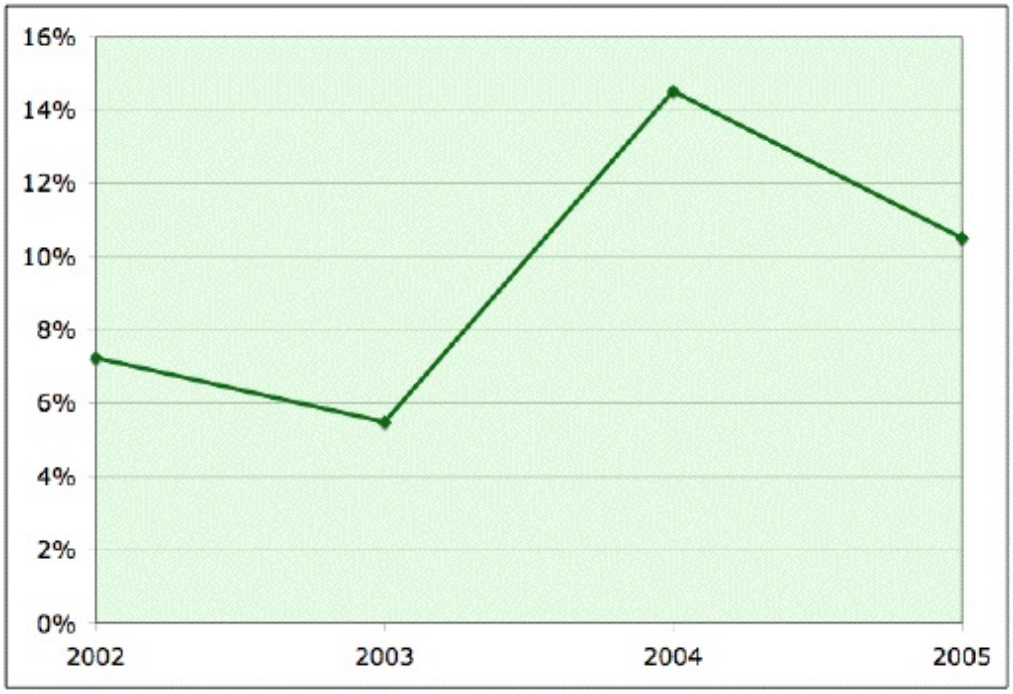
You can see there's a certain tendency for things to get delayed (as in 2002), and then catch up (as in 2003, where they actually got a little ahead of schedule). The dip in early 2005 production is probably accounted for by the large fraction of new capacity for 2004 that got delayed.

Now, given all this, we can compute a decline rate for FIP from subtracting out the new projects. However, there's one tricky point here. As I have noted in the past, a project which hits first oil in year X, probably doesn't hit peak production until some time in year X+1, and year X+2 might well be the first year to see peak production for the entire year. So assuming a new project in 2001 creates it's peak capacity for all of 2001 creates a significant error. As a rough approximation, I'm going to treat all these projects as though they add nothing in the first year, but the full capacity in the following year. With that assumption, we can make the following picture:



Exxon production together with production computed from various constant decline rates plus actual new projects that reached first oil the prior year. Y-axis is millions of barrels per day, and is not zero-scaled.

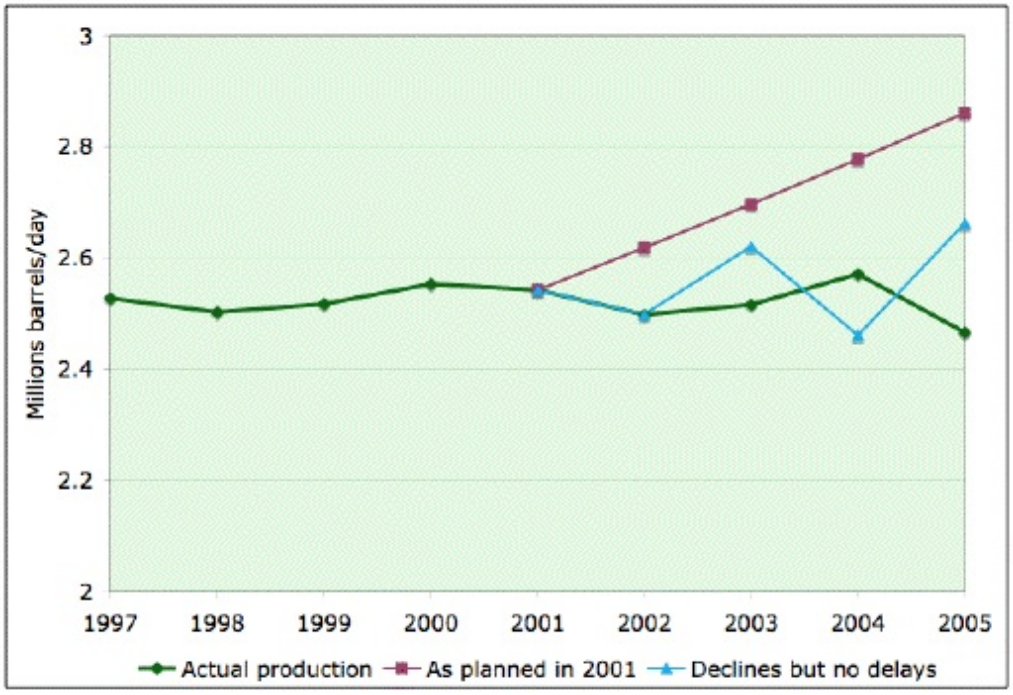
Clearly, if there had been no decline in FIP, Exxon would be in seventh heaven, with production up 1mbpd over the last four years, instead of down slightly. That's the power of depletion. Also clearly, a model of constant depletion rate plus new project peak capacity cannot perfectly account for the data. The 8% and 10% curves mostly bracket the actual line, but not perfectly. In fact, if we work the other way and ask what non-constant decline rate would have been required to exactly fit the actual production, we get this:



Exxon estimated annual decline rate in fields in production.

Now, the exact numbers shouldn't be taken too literally here. Remember we have this slightly crude model for the onset of new production in there and the 2005 number is only half way through the year - it could decline more, or some more of the delayed projects might come on and push production up (and thus the decline rate down). My average of these decline rates is 9.4%, not too different than Kyle's 10%. However, clearly the extrapolation of a curve this bumpy by it's average taken as a constant has to be viewed with a little caution.

Before we leave Exxon, one last graph. Let's look at what would have happened to production if they'd had the exact same declines, but all projects had come on exactly as planned in 2001. That would be the middle blue curve here (more-or-less between what they hoped for, and what actually happened).



Exxon production, production goals in 2001, and the prodution they would have achieved with no new project delays, but otherwise identical decline rates. Note that the graph is not zero-scaled.

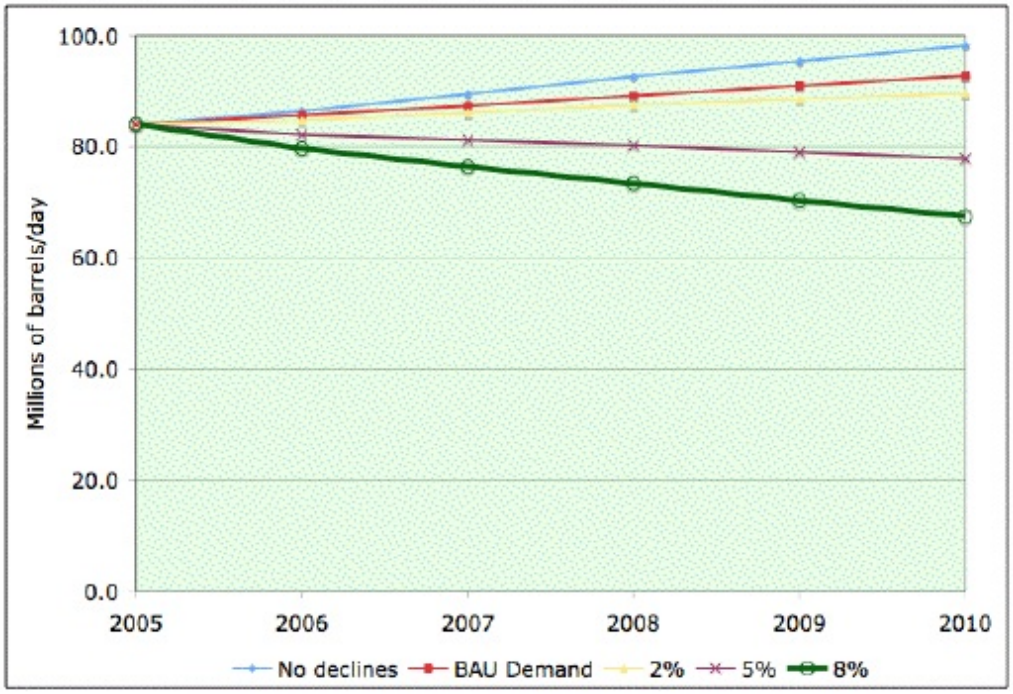
Clearly, the bulk of Exxon's failure to grow their supply as they hoped does not come from project delays, but rather than from somewhat underestimating the decline rate in their existing fields. Indeed, for the last eight years, **all** of the very considerable new capacity that Exxon has bought on at great expense and enormous trouble has only gone to offset declines. They have not managed to grow their production or market share one iota. So when Exxon CEO Lee Raymond says

> When oil's at $60 a barrel, at least $20 of that is speculative and not supported by the fundamentals.

one has to wonder why he feels so confident when his own company is running with Alice and the Red Queen: going hard at it just to stay in the same place.

At any rate, all of this evidence - Saudia Arabia, Iran, Exxon, is reasonably consistent with Ray Gould's 8% number. What does that mean?

Well, if we take Chris Skrebowski's list of projects, this years production of around 84mbpd, and add various decline rates, we get this picture.



Production projection with ODAC Megaprojects plus various average decline rates of existing fields and the supply required to maintain "business as usual".

The 8% line is the big green one at the bottom. It seems to me there are only about three possibilities here:

1. Chris Skrebowski has missed most of the volume of new projects in his analysis.
2. Andrew Gould is smoking dope, Exxon, Iran, and Saudi Arabia are an anomalously bad piece of the production mix, and the average decline rate is really much lower.
3. Life is about to get less fun, pretty quickly.

As those of you following my analysis of the relationship between miles travelled and GDP know, I'm pretty convinced the US economy can't save very much absolute oil usage without economic growth being hurt - we can only make the economy less oil intensive at 3%-4% annually, and the historical GDP growth will completely offset that. Developing countries can probably go a little quicker because, as Henry Groppe has alerted us there's about 20mbpd of heat/power usage in those countries which can be substituted by other fuels. But don't forget China just built a freeway system, and India is in the middle of doing the same thing. They will probably do their best to actually drive on their new roads, which will limit their ability to do all the oil saving for us.

I think we'd better focus on figuring out whether there's any possibility of 1) or 2) being correct.