The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

The End of Exploration?

Posted by Dave Cohen on January 11, 2006 - 12:27am
Topic: Geology/Exploration
Tags: ihs energy, ngl, oil discoveries [list all tags]

There's been some discussion lately about reserve additions due to new discoveries and the trends there. This topic came up in some comments on Stuart's Predicting US Production with Gaussians--for example here). WebHubbleTelescope over at Mobjectivist has done a couple posts lately on this topic. In Monte Carlo Discoveries, he comes to a rather important conclusion.

> The main thing to note relates to the essential noise characteristic in the system [discovery curves]. The fluctuation excursions fairly well match that of the real data (see the first diagram at the top of this post), with the occasional Ghawar super-giant showing up in the simulations, at about the rate expected for a log-normal distribution. But the truly significant observation relates to the disappearance of the noise on the downslope, in particular look at the noise after about 1980.
>
> Remember what I said initially about noise telling us something? The fact that the noise starts to disappear should make us worry. That noise-free downslope tells us that we have pretty effectively mined the giants and super-giants out there and that oil exploration has resorted to back-up strategies and a second pass over already explored territory or to more difficult regions that have a tighter distribution of field sizes.

I'll leave the heavy duty mathematics & modelling to Stuart, WHT, Khebab and others to argue over. This includes the mysterious assumption first used by M. King Hubbert that

> The discovery curve mirrors approximately the production curve with a lag that varies from country to country. The US-48, for example, had a lag of 41 years whilst the UK North Sea production, with its urgency and technological basis had a lag of 25 years. The World's lag is estimated to be 36 years.

noted at (among other places) Wolf At The Door. Here instead I will check in with the *real world data* over the last twenty years and particularly since 1994 using a favorite source, presentations from IHS Energy, to see what's been happening lately on the tail end of the discoveries curve. I feel it's always a good idea to remain a part of the *reality-based community*, so let's look at some data and look closely at what the recent trends are. Do they confirm the modelling?

We are all familiar with graphs like this one re-produced by Robert Hirsch in The Inevitable Peaking of World Oil Production (pdf, October 2005).

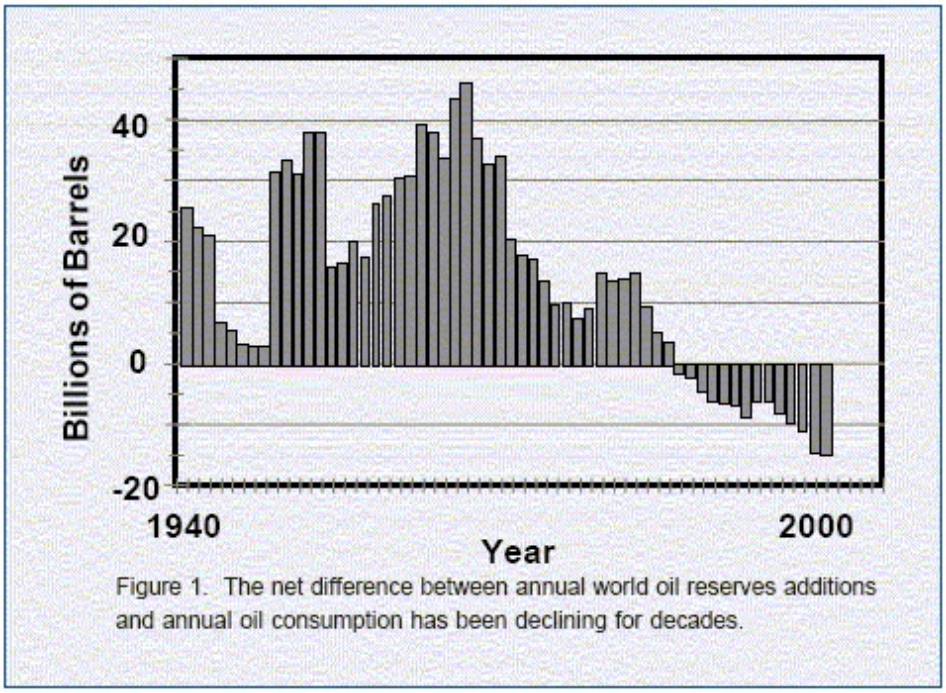
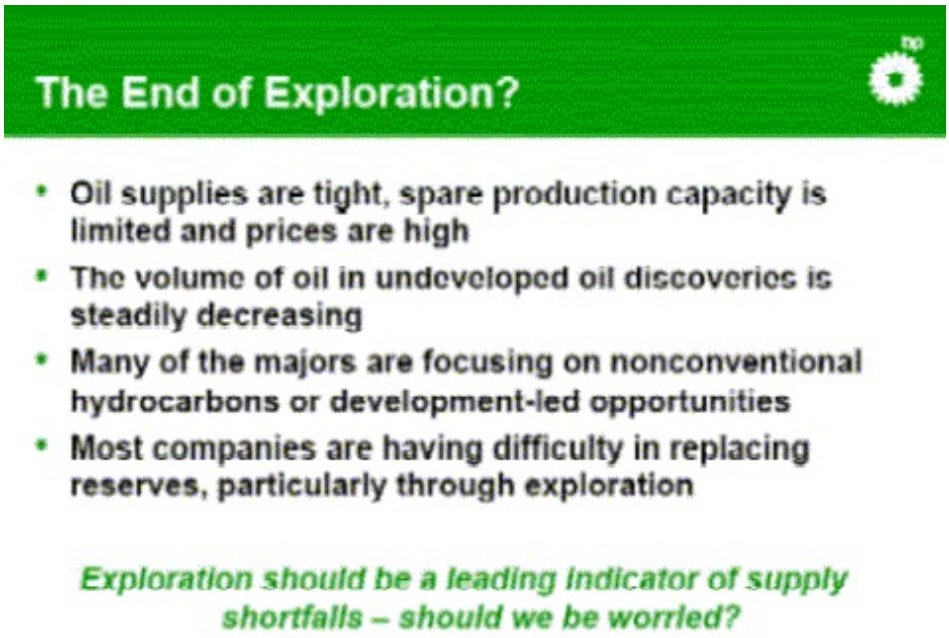
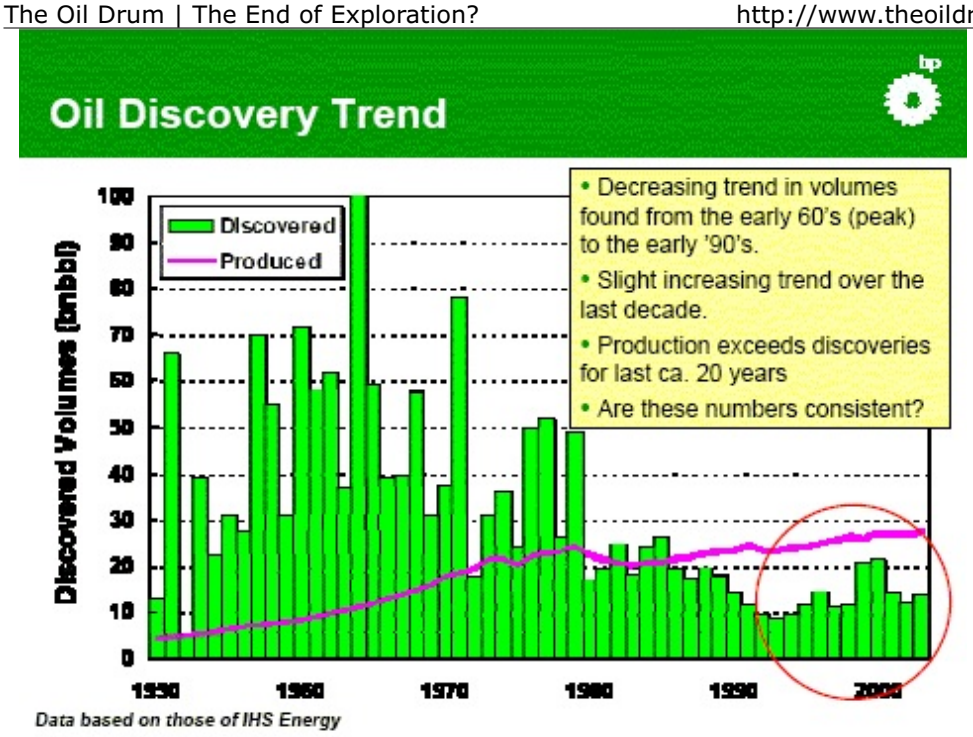


Figure 1. The net difference between annual world oil reserves additions and annual oil consumption has been declining for decades.

Perhaps it will not surprise you too much that this IHS Energy presentation The Future of Global Hydrocarbon Exploration by Francis Harper, BP plc (APPEX, March 2005) asks the pertinent questions and shows the same thing as Hirsch, et. al. (slides 1 & 2)

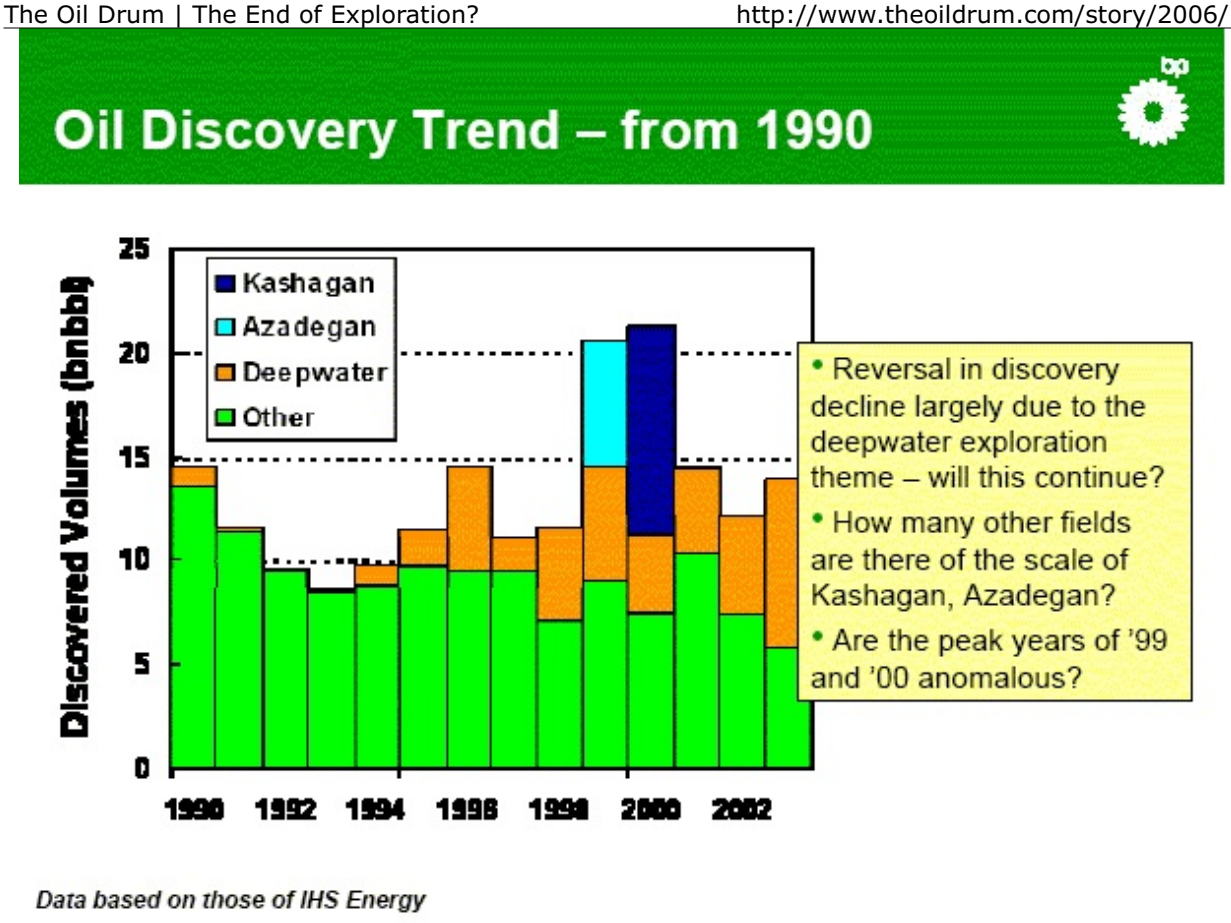




Here's a quote from an abstract from IHS Energy data analyst Sandy Rushworth entitled The Challenging Role for Giant Fields: Can We Expect Giant Fields to Meet Increasing Oil Demand Trends? This is for an upcoming conference AAPG Annual Convention, April 9-12, 2006.

> For almost 20 years new oil discoveries have failed to replace production. Correspondingly, the number of large and giant (> 500 MMboe) discoveries have declined and average discovery size has decreased while demand has continued to increase. These contrary trends raise concerns about industry's ability to meet global energy needs. For the balance of this decade, nevertheless, projected liquids capacity growth is expected to exceed demand.
>
> The objective of this paper is to frame the critical role of giant fields in meeting the global oil future. Since 1994 giant fields represent only 2% of the [total # of] discoveries but almost half of the resources added. But 144 Bbo [Gb] of liquids discoveries since 1994 replaced only about 61% of the consumption.

It seems that IHS Energy, ASPO, TOD and many others are asking exactly the same questions. Only 61% of consumption was replaced over a 10 year period--assuming the figure includes 2004. Now, let's take a closer look at the circled area in the *Oil Discovery Trend* graphic above from the Harper presentation.



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The important question comes up: *Are the peak years of '99 and '00 [due to Kashagan and Azadegan] anomalous*? By using the precise method of eyeballing this graph, we see that since 1994 there have been about 134 Gb discovered with the two megafields comprising about 41 Gb of reserves, 30% of the total. [Editor's Note: 1) this is all liquids including Natural Gas Liquids (NGLs) and Condensates and 2) all references to *reserves* should be considered with Bubba's post and comments about reserve estimates in mind.] Using IHS Energy's estimate of 144 Gb since 1994, that makes 2004 discoveries about 10 Gb.

So, what can we conclude from this data? I'll make some observations and include my own opinions.

- Excluding Kashagan and Azadegan, discoveries since 1990 never exceed 15 Gb with steady but flat volumes found due to deepwater reservoirs.
- The two big fields are actually *noise* in the data trend and are anomalous.
- IHS Energy estimates are for all liquids (boe), not crude oil of whatever grade. If you look around at some of the other presentations there, you will see that NGLs and condensates represent the large majority of new discoveries.
- If you don't think any big mega or giant discoveries are right around the corner--as I don't--then the rate of consumption replaced by discoveries--61% in the last 10 years--can only down year-on-year.
- The idea that the discovery process is *stochastic* at this point in time is almost certainly wrong and disregards history. The world is well-explored and the bigger fields are found first because petroleum geology is an empirical science with many years of experience behind it. These experts have known for some time now where to look. On occasion, mostly due to lack of political access or effective technology, prospective areas have been left

unexplored. Now, new *plays* are running out. This point (link from WHT)

> "Pearson's r" [statistical validity] test found no correlation between oil discoveries from one year to the next, i.e. discoveries appear to be random. But there is > 99% confidence that annual oil production is not a random process. (It looks like a bell-curve, not very noisy.)

is correct. Even if some new megafields are found, they will be few and far between.

- Modelling by Stuart, WHT, Khebab and others is essentially capturing the trends accurately and predicting the future with some confidence.

As Harper asks, *Exploration should be a leading indicator of supply shortfalls –should we be worried*? Many of us would say *hell, yes*. There's always the Arctic, a few more deepwater finds and a bunch of smaller or *super* deepwater finds which may not be economical to produce unless oil prices are much, much higher.

On the other hand, you can always throw in those non-conventional sources (oil sands) or hope for some Gas-to-Liquids (GTL) or political stability with increased production from the Middle East and the rest. This all makes the numbers come out right as the ever-optimistic Sandy Rushworth of IHS Energy does (link above)

> Field growth, mostly in giant historic fields and increased recoveries in Canadian and Venezuelan oil sands, though, added about 190 Bbo of additional resource - more than replacing consumption. The combination of recent giant discoveries and reserve growth from historic giants will drive the projected liquids production growth through this decade. Other factors are critical to sustain future production growth. One is access to enormous Middle East resources with potential for more than 250 Bbo in giant fields. Another is technology. A five percent increase in recovery factor could add about 220 Bbo from western hemisphere oil sands. Proposed GTL technologies, mostly targeting fallow giant gas resources in the Middle East and Asia, could add 1.5 MMb/d of liquids production by 2020. Giant hydrocarbon accumulations will continue to dominate future liquids supplies.

Is it *The End of Exploration*? Not quite yet but we may be closer than you think. We shall see.