The Oil Drum: Europe
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

A Primer on Reserve Growth - part 3 of 3 - Revisited

Posted by Rembrandt on November 2, 2010 - 10:20am in The Oil Drum: Europe
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This post was originally written by Rembrandt in 2006.

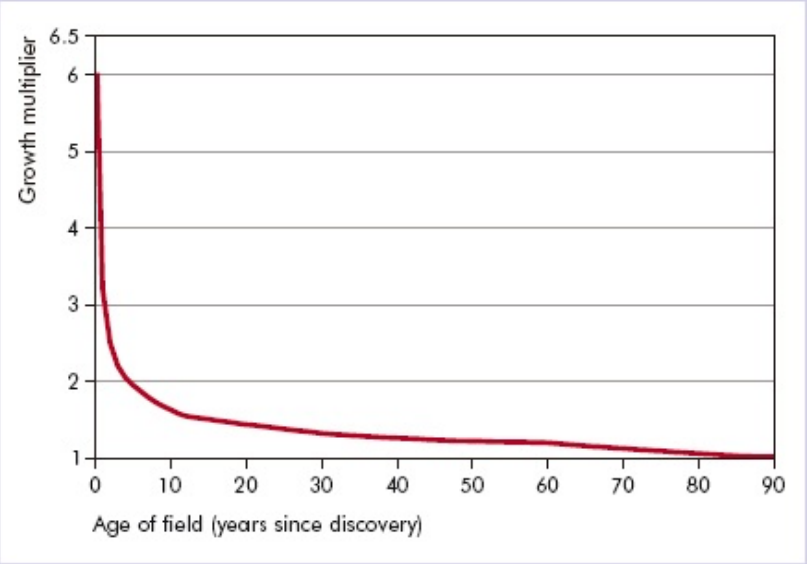
Will 730 billion barrels be added to the reserve pool from reserve growth between 1996 and 2025 as estimated by the United States Geological Survey?

This post is the third part in a three piece series about the phenomenon of reserve growth in found oil fields. Insight in future reserve growth, often attributed to technological advancement, is crucial in determining the peak of conventional oil production. Parts 1 and 2 can be found here and here.

What we learned in part 2 of this series is that the data with respect to reserve growth is utterly confusing. Nonetheless, we need an answer to the question what the future perspectives are for reserve growth in order to; 1) improve forecasting the peak in conventional oil production; 2) Increase the understanding of the future role of technology in the oil industry.

The United States Geological Survey has so far been the only institute which has published an estimate for future reserve growth. In their World Petroleum Assessment from the year 2000 they estimated that reserves would grow with 730 billion barrels between 1996 and 2025.(612 billion barrels for conventional oil, 118 billion barrels for Natural Gas Liquids). By estimating past reserve growth in the US lower 48 a reserve growth algorithm was established. This algorithm of which the curve is shown below was then applied to the entire world. Delivering an estimate of 730 billion barrels.

***Figure 2.18** • USGS reserve growth function*



The curve has been calibrated from historical oil and gas reserves data from the United States lower 48 states.

Reproduced from USGS.

Chart 1 - Source: USGS, Verma

The problem with this method is the way how crude oil reserves are reported in the US which has been described in detail in part 2. Because of the practice of reporting only proven reserves, the amount of reserve growth is very high in the US when compared to other regions. In addition several heavy/extra heavy oil fields such as the kern river oil field are included in the assessment, which showed huge reserve growth due to the advancement in steam technology necessary to dilute the oil to produce it in the middle of the 20th century. It is erroneous to apply reserve growth in such heavy/extra heavy oil fields with medium and light crude oil fields. Thirdly applying onshore reserve growth to offshore and deepsea fields is certainly not an approach that gives a correct estimate. Based on these three issues, the figures presented by the USGS do not seem to have much value. The method used likely provides figures too inacurrate to be relied upon.

However, the USGS authors (Albrandt et al) have acknowledge a part of the problems outlined:

> "There are several reasons why a reserve-growth function that is based on historical trends for oil and gas fields in the Lower 48 states could Overestimate world potential reserve growth:
>
> Engineering criteria for reporting reserves of world oil and gas fields might, in general, be less restrictive than those for the United States, tending to increase known reserves and decrease the potential for reserve growth.
>
> Reported reserves might be deliberatly overstated in some countries, reducing the potential for future reserve growth.
>
> Large world oil and gas fields might tend to have more substantial development than U.S. fields prior to release of initial field-size estimates, leading to more accurate initial reserves estimates and reducing the potential for future reserve growth.(USGS WPA 2000, chapter AR)"

To see if these critical remarks on their study held any value the authors of the USGS study attempted to apply their function for reserve growth, as shown in graph 1, to other oil producing regions in the world. Several latter publications were published with respect to reserve growth in Volga-Ural (Verma et al., 2000), West Siberian Basin (Verma and Ulmishek 2003), the North Sea (Klett and Guatier 2003, 2005), the Middle East (Verma et al., 2004) and Canada (Beliveau, 2003; Verma and Henry, 2004). Their conclusion was that the reserve growth curve is indeed applicable to the entire world, given reserve growth patterns observed in these other regions. The one about Russia has been described in detail in part 2. These publications do not shed much light on the issue however as shown in part 2. Reserve growth varies in every region in the world. Applying a strict curve from one region towards others does not make much sense to me in the light of the highly chaotic variance in data. I therefore disagree that such a conclusion can be made, the USGS authors could be right, but they could also very well be wrong.

The International Energy Agency seems to disagree with this cautious vision on estimating reserve growth. In their recent resources to reserves report they noted the following about the USGS method and the criticism it received from ASPO:

> "It should be noted that some authors (ASPO) argue that the "reserve growth" phenomenon is an artefact of very conservative United States reporting on proven reserves, which should not be applied worldwide, particularly in OPEC countries where some observers claim that published proven reserves numbers are suspicious (Simmons 2005). However, further studies by USGS geologists have pointed to reserve growth observed also in large fields outside the United States, at a rate consistent with the assumption of the 2000 Assessment (Klett 2003)." (IEA Resources to Reserves, 2006)

There is only one way to give a reasonable answer to what future path there is for reserve growth. The USGS takes the estimates from the IHS energy database (formerly petroconsultants) as a starting point. The updates in the IHS energy database therefore give excellent means for reviewing the forecast from the USGS. By looking at every change in the past decades in the IHS Energy database (formerly Petroconsultants) in meticulous detail an accurate answer can be found. Only then we will know what exactly bas happened in the past decades with oil reserves (proven and probable). There is only one problem, access to the database costs approximately 1 million dollars a year, a bit too expensive for a voluntary weblog. So the best we can do at the moment is by looking at the bigger trends that are available in public domain data.

In a publication from August 2005 in AAPG Bulletin (An evaluation of the USGS WPA 2000) the authors (Albrandt et al) conclude that approximately 28% percent or 171 billion barrels of the forecasted 612 billion barrels for conventional oil had been added to the reserve pool between 1996 and 2003.

In a presentation from 2004 one of the UGSS study authors (Klett) showed a graph depicting reserve growth in giant oil fields between 1981 and 1996 and 1996 and 2003:

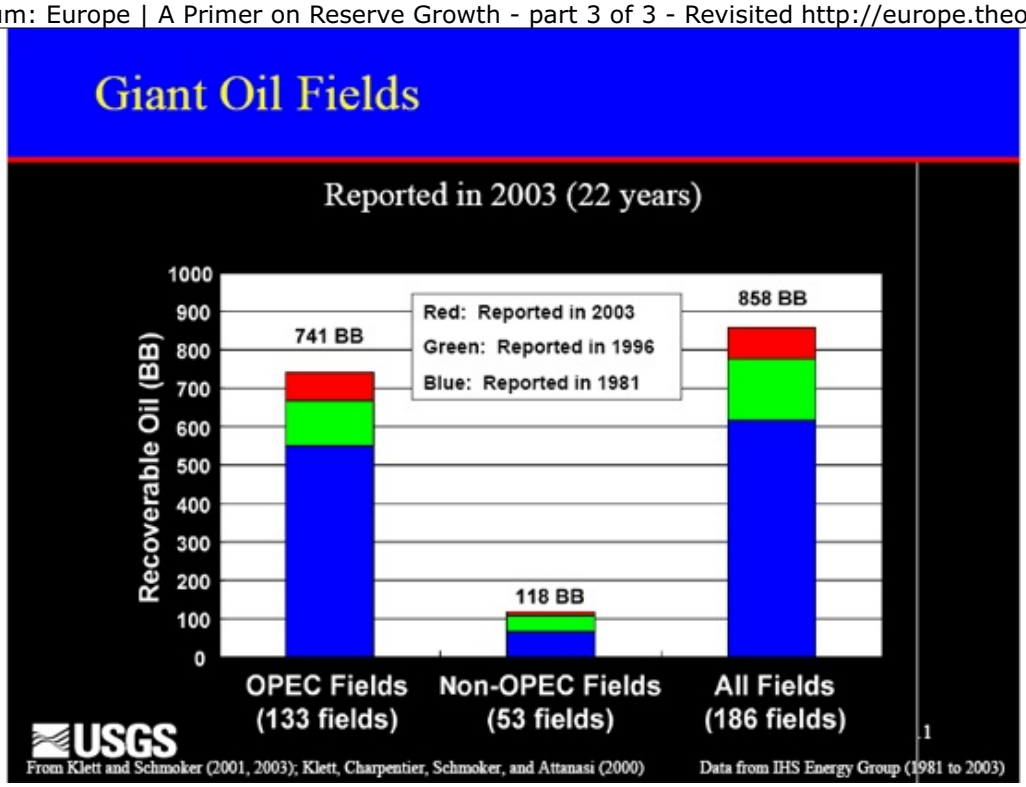


Chart 2 - Source: USGS, Klett

It is important to note that the largest part of the change occured in giant oil fields operated by the OPEC cartel. The USGS notes that 73 of the 171 billion barrels of reserve growth came from giant fields in OPEC countries. From a chart in a paper by Ahlbrandt (USGS WPA 2000 main author) in the "book Oil in the 21st century" the division between the 171 billion barrels figure for reserve growth between 1996 and 2003 can be estimated (approximates):

83 billion barrels (Middle East and North Africa)
36 billion barrels (Central and South America)
18 billion barrels (Former Soviet Union)
13 billion barrels (Sub Saharan Africa)
12 billion barrels (North America)
5 billion barrels (Europe)
3 billion barrels (Asia Pacific)
1 billion barrels (South Asia)

The reserve growth phenomenon is also tracked by IHS Energy, whom present a much larger number than the USGS with respect to reserve growth in the period between 1995 and 2003 (457 billion barrels). The large variance in figures presented is to say the least, puzzling. The most likely explanation is a difference in definitions. The USGS could for instance only have include additional proven reserves while IHS Energy included proven + probable reserves. Nonetheless they both agree that the largest part of reserve growth between 1995 and 2003 was observed in the Middle East:

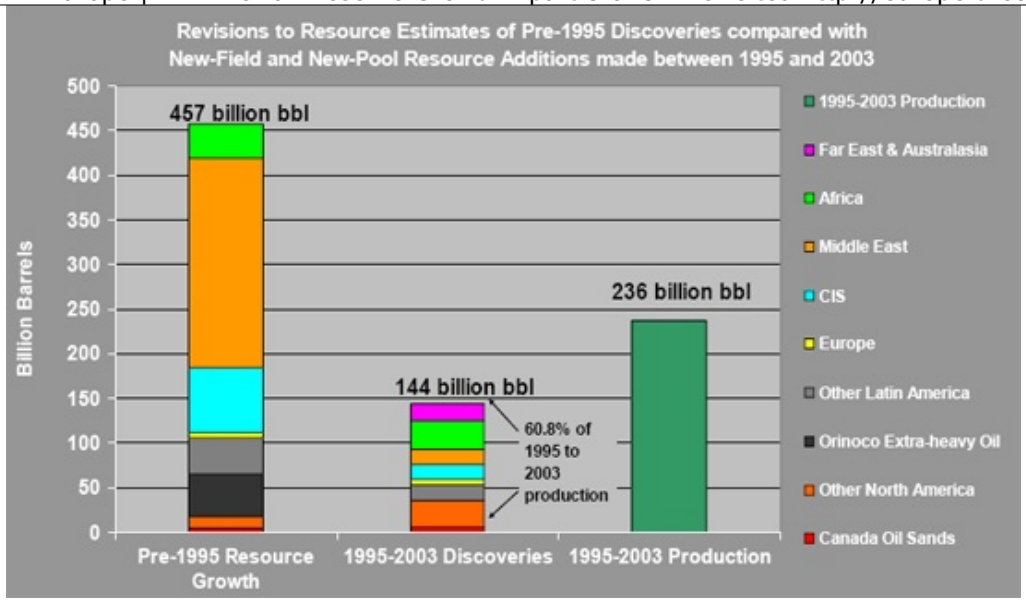


Chart 3 - Source: IHS Energy

In the period between 1995 and 2003 nearly 250 billion barrels were added to fields in the Middle East in the IHS Energy database. In this period almost no conventional oil was discovered in the same region. Given the secrecy of Middle East reserve forecasts, it is questionable that these reserve additions are real. In addition Jean Laherrère notes that in 2004 another large reserve increase occured in the Middle East in the IHS Energy database. (Laherrère, 2006, pag. 19).

The effect of reserve growth on reserve estimates over time is shown very clearly in a graph from Francis Harper from BP:

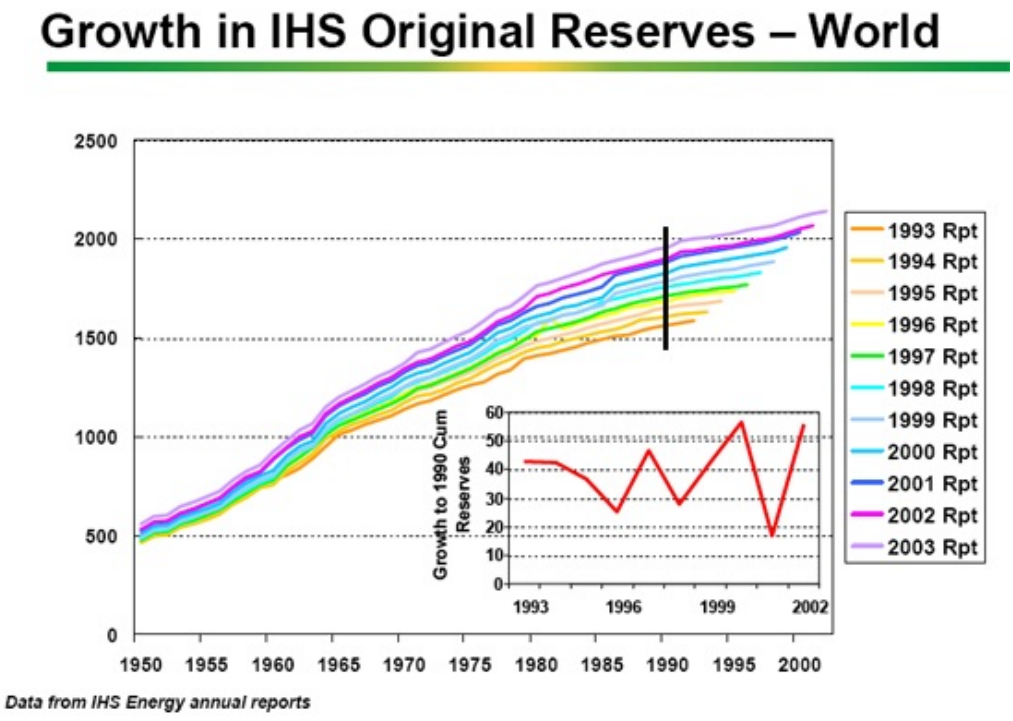


Chart 4 - Source: Francis Harper, BP, reserve growth in this chart is not backdated to original discovery as is common practice in reserve estimates made by ASPO.

Since I have no additional information with respect to the value noted by the USGS on reserve growth (171 billion barrels), we take a further look at the changes stated by IHS Energy (457 billion barrels)The difference between the USGS figure from the IHS database and the figure from IHS Energy is explained in a presentation by Peter Stark (Vice President IHS Energy):

Chart 5 - Source: IHS Energy

The revisions that IHS made shown in the chart above explain the largest part of the reserve growth phenomenon. 96 billion barrels can be discounted because of missing data. An additional 52 billion barrels can be discounted because of changes in the rules. That leaves 309 billion barrels of reserve growth in the period between 1995 and 2003. Of these possibly 120 billion barrels according to IHS are due to underestimates in the Middle East. The question that remains is where the remaining 190 billion barrels of reserve growth as noted by IHS energy comes from. The largest part of this increase comes from the Middle East, given the increase in reserves from pre-1995 discoveries of approximately 250 billion barrels between 1995 and 2030.

So basically we are left with two choices:

1)If we think that the 190 billion barrels can be attributed to genuine reserve growth, the USGS estimate of an addition of 730 billion barrels from reserve growth between 1995 and 2025 is on track so far. This does not necessarily mean that reserve growth will continue or discontinue to happen in the future as it did in the past.

2)If we think that the 190 billion barrels are not caused by reserve growth but mainly by political overstated reserves in the Middle East, then we can throw the USGS estimate in the garbage can. Reserve growth will be far lower then now accounted for and forecasting publications that rely on the USGS estimate are too optimistic (IEA and EIA forecasts).

As to the lastest figures from IHS, 2005 was a very bad year for reserve growth. Only 8 billion barrels were added from pre-2005 discoveries in the IHS Energy database in 2005. Production in 2005 was larger then reserve growth and discoveries combined in the IHS Energy database, leading to a net decline in reserves:

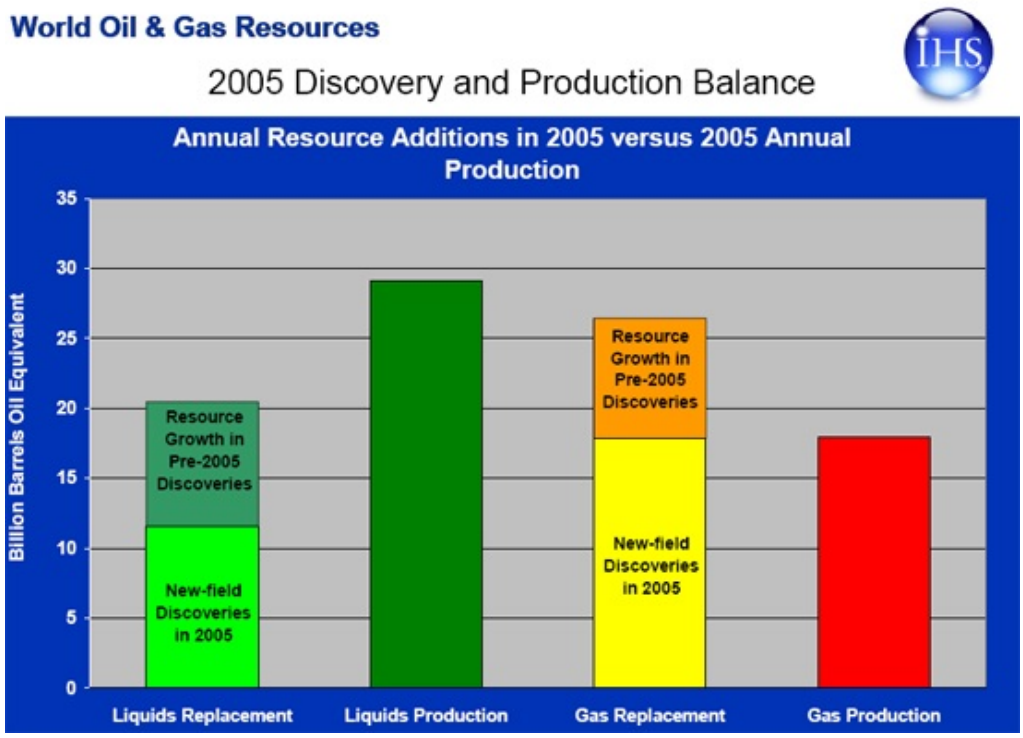


Chart 6 - Source: IHS Energy

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