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DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

The 2008 IEA WEO - Oil Reserves and Resources

Posted by Phil Hart on November 20, 2008 - 11:28am in The Oil Drum: Australia/New Zealand
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True to their word, the 2008 World Energy Outlook represents a significant development by the International Energy Agency (IEA) in the philosophy and methodology of their oil supply forecasts. The report attempts a bottom-up model of the world's oil production potential and even revises down estimates previously taken at face value from the United States Geological Survey (USGS). The tone of the report has also changed dramatically, with an urgent call for investment in additional oil projects to avoid production shortfalls by 2015.

Despite those significant changes, the report still relies on inflated estimates of reserves from OPEC countries, overplays the contribution of reserves growth due to technology and predicts the reversal of a decades long trend of declining oil discoveries. These are the real factors that will send oil production into decline, but at least now we have some numbers we can discuss and analyze instead of a decade of blind faith in oil market economics.

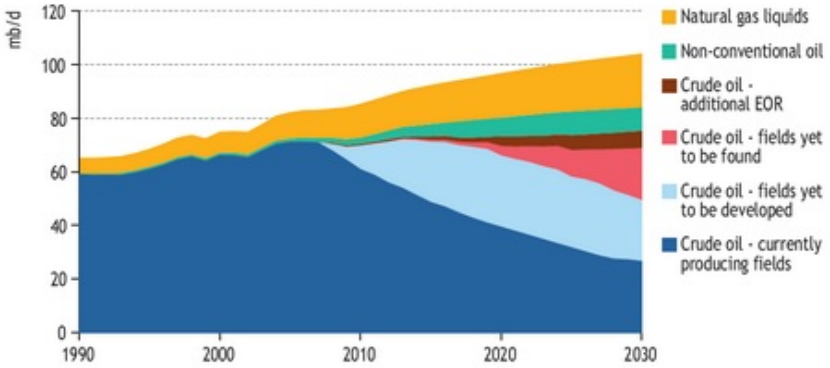
IEA 2008 World Energy Outlook Ultimately Recoverable Resources Conventional Oil and NGLs (billion barrels)	
Cumulative Production	1,128
Remaining Reserves	1,241
Reserves Growth	402
Undiscovered Resource	805
World URR	3,577

This article is part of a series of posts on the IEA 2008 World Energy Outlook, which includes other articles on issues more closely related to production. In this post, I review the IEA figures for conventional oil reserves and future resources, including natural gas liquids (NGLs). The chart above shows that the IEA's estimate for these resources amounts to 3,577 billion barrels, or approximately 3.6 trillion barrels. I will show that a better estimate is 2.5 trillion barrels, a reduction of 1.1 trillion barrels.

Resources relate to the total amount of oil and NGLs that can ultimately be produced, rather than the amount of production in any given year. However, even with 3.6 trillion barrels of resources, the IEA just barely manage to show oil production increasing to 2030 at an anemic annual rate of two hundred thousand barrels per day. According to the IEA:

> Worldwide production of conventional crude oil alone increases only modestly from 70.2 mb/d to 75.2 mb/d over the period. *(Page 250)*

Figure 11.1 • World oil production by source in the Reference Scenario



With 1.1 trillion barrels less resources, the result is likely to be much lower.

The first item on my initial slide (repeated below) is cumulative production - the amount of oil extracted to date. This is the only figure about which there is little to dispute. In the remainder of this article I will reassess the IEA's other figures for (1) Remaining Reserves, (2) Reserves Growth and (3) Undiscovered Resources.

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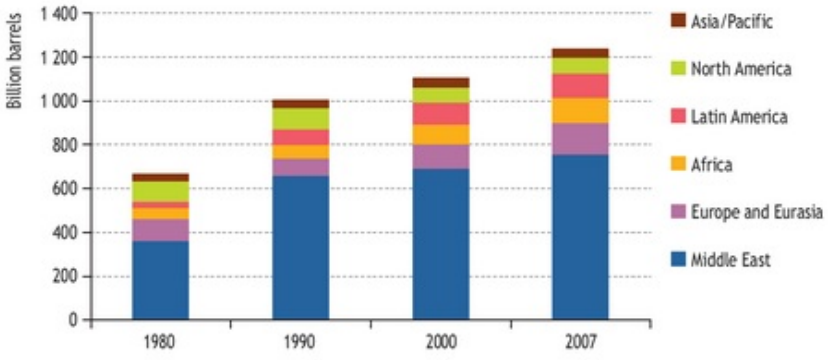
Remaining Reserves

Companies producing oil make estimates of the amount of their 'proven' reserves remaining. These are generally published in financial statements, and are a matter of public record.

Figure 9.3 • Proven remaining oil reserves by region, 1980-2007 (end-year)



Source: BP (2008).

Despite the vagaries of financial reporting standards for oil reserves (which the IEA report comments extensively on), the estimates for reserves in Non-OPEC countries can be taken as a reasonable estimate. OPEC reserves on the other hand are the "toxic low-doc mortgage backed investments" of the oil world. At issue particularly are the large fraction of world reserves reported by National Oil Companies in the Middle East. The reserves of these companies are not audited, which the IEA recognises in the following statement:

> Auditing reserves and publishing the results are far from universal practice. Many oil companies, including international oil companies, use external auditors and publish the results, but most National Oil Companies do not. *(Page 199)*

OPEC Reserves (Paper Barrels)

There are strong reasons to believe that OPEC reserves, particularly for Middle Eastern countries, are considerably overstated.

Stated Oil Reserves in Selected OPEC Countries

	UAE	Iran	Iraq	Kuwait	Saudi Arabia	Venezuela	Neutral Zone
1983	32.3	55.3	65.0	67.0	168.8	25.9	5.7
1984	32.5	58.9	65.0	92.7	171.7	28.0	5.6
1985	33.0	59.0	65.0	92.5	171.5	54.5	5.4
1986	97.2	92.9	72.0	94.5	169.7	55.5	5.4
1987	98.1	92.9	100.0	94.5	169.6	58.1	5.3
1988	98.1	92.9	100.0	94.5	255.0	58.5	5.2
1989	98.1	92.9	100.0	97.1	260.1	59.0	5.2
1990	98.1	92.9	100.0	97.0	260.3	60.1	5.0
1991	98.1	92.9	100.0	96.5	260.9	62.6	5.0
1992	98.1	92.9	100.0	96.5	251.2	63.3	5.0
1993	98.1	92.9	100.0	96.5	261.4	64.4	5.0
1994	98.1	94.3	100.0	96.5	261.4	64.9	5.0
1995	98.1	93.7	100.0	96.5	261.5	66.3	5.0
1996	97.8	92.6	112.0	96.5	261.4	72.7	5.0
2005	**97.8**	**136.3**	**115.0**	**101.5**	**264.2**	**80.0**	**5.0**

Source: OPEC 2006 Annual Report

When Kuwait raised its stated reserves in 1984 from 67 to 92.7 billion barrels, it had the effect of increasing their production quota at a time of low oil prices, thereby increasing their revenue at the expense of other OPEC members. Not surprisingly, the next year Venezuela doubled its

reserve estimate. The United Arab Emirates, who previously had 33 billion barrels of oil, must have found an additional 60 billion barrels in a cellar cupboard which they subsequently put on the books in 1986.

Saddam Hussein in Iraq kept things simple with a revision to a clean 100.0 billion barrels in 1987. He then, like many of the others, reported exactly the same figure for a decade. Only by the late 1990's, when that reporting game became patently absurd, did they start reporting minor increases to make the figures look more sensible.

This is nonsense and the IEA even recognises it as such:

> According to BP, which compiles published official figures, proven reserves worldwide have almost doubled since 1980 (Figure 9.3). Most of the changes result from increases in official figures from OPEC countries, mainly in the Middle East, as a result of large upward revisions in 1986-1987. **They were driven by negotiations at that time over production quotas and have little to do with the discovery of new reserves or physical appraisal works on discovered fields.** The official reserves of OPEC countries have hardly changed since then, despite ongoing production. *(Page 202)*

That is the first and last time the IEA report refers to this fundamental problem with stated OPEC oil reserves.

While $100,000 will buy you access to industry databases with information about oil fields throughout the rest of the world, the information relating to OPEC countries is not much better than guesswork. This year, however, the IEA paid to access such a commercial database from IHS: *"a leading global source of critical information and insight, dedicated to providing the most complete and trusted data and expertise"*.

The IHS data for OECD countries is perhaps the best available, but because accurate reserve estimates for OPEC countries are closely guarded state secrets, their figures relating to OPEC oil fields are less accurate. Why have we become addicted to oil without demanding adequate disclosure from the countries holding the largest share of such an important commodity for the world economy?

While the reported figures are poor, we do have other sources of information about OPEC oil resources. International oil companies, including those based in the United States, operated in the Middle East for several decades before ownership was transferred to state-run National Oil Companies.

International Oil Companies in the Middle East

Oil exploration in the Middle East goes back a century or more and activity accelerated after the Second World War. Western oil companies were heavily involved in oil exploration and production for more than two decades, enough time to build up a considerable knowledge of the giant fields and remaining exploration potential, prior to nationalisation in the late 1970s and early 1980s.

Since then, a myth has developed (in their own interest) that if only a western oil company could get back in there and drill more exploration wells then more oil would be found. The reality is that these are mature oil provinces that are quite thoroughly explored. The reason the industry made early discoveries there is because the majority of oil in the Middle East lies at shallow depths in large and easily identified structures. Future discoveries will be limited to smaller structures, or drilling into deeper formations which are more likely to contain gas than oil.

Exploration statistics in Saudi Arabia tell the story another way. 80% of Saudi Arabia's oil resources were discovered by the first 20 new field wildcat exploration wells between 1935 and 1965. The last 20 wildcat exploration wells have only found 1% of the resources (Laherrere, 2006). The reason exploration drilling has reduced is because there is not much more to be found: drilling wells cannot find oil that is not there.

One man who has first hand experience of reserves accounting in the Middle East is Jeremy Gilbert, who provided this quote:

Jeremy Gilbert, former BP Chief Petroleum Engineer

There were people from the International Oil Companies still working with virtually all the OPEC country National Oil Companies in the late 1970s. From talking to a cross-section of them we can be sure that the numbers quoted for OPEC reserves in the early 1980s (before the revisions) were reasonable.

I was more or less responsible for the Iran reserves compilation in 1977 and 1978 and I worked in Abu Dhabi and Kuwait in the early 1970s: I am quite confident that the numbers shown for these countries in the early 1980s are good; they are possibly a little conservative, because there was some reluctance by the western International Oil Companies to make big capital investments in improved secondary/tertiary recovery which might have led to slightly higher numbers, say 5% more at most.

Since we know from service company and other sources that there were no multi-billion barrel discoveries in these countries in the mid 1980s there can be no technical basis on which reserve estimates could have later increased as reported by the individual National Oil Companies.

It is probable that the archives of BP, Shell, ExxonMobil etc., contain reports from the period which would confirm all of this. These companies provided technical-expert teams which regularly reviewed field performance data and reserves estimates with the technical staff of the operating companies during the 1970s.

Jeremy Gilbert's quote indicates that the reserves stated in 1983 were relatively accurate, but that there is little justification for the big increases countries reported in the following years.

The International Oil Companies (such as BP, ExxonMobil, Shell and Total) are running out of good options elsewhere, so it is natural that they now want a piece of the action where most of the remaining resources are. This is the reason for their public agenda pushing for greater access to Middle Eastern resources. The problem is that their argument that the Middle East needs them is wearing thin. The International Oil Companies sold many of their specialist capabilities to oilfield service companies (such as Schlumberger, Halliburton and Transocean) long ago. Those service companies now operate in the Middle East just as they do anywhere else, as subcontractors to the National Oil Companies.

Despite their desperation, the International Oil Companies have very little to offer, and the IEA has accepted as much:

Higher oil prices and a growing conviction among political leaders that national

> companies serve the nation's interests better than private and foreign oil companies have boosted the confidence and aspirations of national companies, some of them rivaling the international companies in technical capability and efficiency. *(Page 333)*
>
> National companies are becoming more technically proficient and better able to handle the challenging new developments with the help of the oilfield-service companies. *(Page 334)*

Saudi Aramco in particular could lay claim to being one of the most capable oil companies, and it is successfully executing some of the largest ever oil field megaprojects. That said, its disclosure standards do leave a lot to be desired.

Kuwait Comes Clean, UAE Downgraded

> Kuwait oil reserves only half official estimate
> **19th January, 2006**
>
> "Petroleum Intelligence Weekly learns from sources that Kuwait's actual oil reserves, which are officially stated at around 99 billion barrels, or close to 10 percent of the global total, are a good deal lower, according to internal Kuwaiti records," the weekly PIW reported on Friday. It said that according to data circulated in Kuwait Oil Co (KOC), the upstream arm of state Kuwait Petroleum Corp, Kuwait's remaining proven and non-proven oil reserves are about 48 billion barrels.

In a previous IEA report, World Energy Trends 2005 – Middle East and North Africa, the IEA have themselves downgraded reserves estimates for Kuwait and the United Arab Emirates. Kuwait was estimated to have 'proven plus probable' reserves of 54.9 billion barrels (slightly higher but similar to the leaked figure above) while the UAE was estimated to have 55.1 billion barrels.

These two revisions alone represent a reserves downgrade of almost 90 billion barrels. Yet there is no evidence that the IEA has used these lower figures in their 2008 World Energy Outlook. They have instead reverted to their reliance on OPEC and IHS.

Assessment of Saudi Arabia's Giant Oil Fields

While Saudi Aramco and the NOCs of other OPEC countries publish many technical papers, they consistently remove references to particular fields or locations to deter others from drawing conclusions about their overall reserves. However in May 2007, after months of painstaking forensic work piecing together charts and information from dozens of technical papers, Stuart Staniford and Euan Mearns prepared separate assessments of Ghawar, the world's largest oil field in Saudi Arabia.

Subsequently, JoulesBurn used satellite observations of drilling rig locations around Ghawar to provide independent confirmation for the findings and predictions from Stuart and Euan's investigations. (JoulesBurn has also already provided his more detailed critique of the IEA 2008 Saudi Arabia analysis).

Taken together, these two pieces of research above constitute an unprecedented challenge to the integrity of the IHS oil database, the blind acceptance of stated OPEC reserves by the IEA and the idea that the Middle East can easily meet the expanding future oil production needs of the

world.

For comparison, the IEA published their estimate of Ghawar's size, based presumably on the IHS database:

> All of the 20 largest producing fields are super-giants, of which Ghawar, with 140 billion barrels of initial reserves, is by far the largest. *(Page 226)*

The conclusion of Stuart Staniford's analysis was that the Ghawar field had initial reserves of 96 billion barrels (+/- 15 billion). In this one giant field alone, we therefore have 40 billion barrels of overstated oil reserves. The IHS data for OPEC fields and the IEA's reliance on it must be called into question.

Counting the Paper Barrels

The "quota wars" in 1984-1988 led to total upward revisions of 284 billion barrels. OPEC oil production since 1985 has been more than 170 billion barrels but this has not been subtracted from reserves estimates either. Adding these two figures gives a total of 454 billion barrels, although some allowance must be made for the real discoveries and field development work that has been made since then.

In a May 2008 article Oil Reserves: Where Ghawar goes, the rest of OPEC follows, I combined Stuart's work on Ghawar, Euan's additional analysis of the Abqaiq field, a 1979 report to a US Senate Subcommittee on "The Future of Saudi Arabian Oil Production" and the IEA revisions for Kuwait and UAE (above) to estimate that OPEC oil reserves in total are overstated by some 340 billion barrels.

With such secrecy around the real figures comes enormous uncertainty. However, a conclusion that OPEC oil reserves are overstated by between 250 and 450 billion barrels is robust.

Reserves Growth

The second figure that needs revision is that for "Reserves Growth", which the IEA sees as playing a very important role:

> A growing share of the additions to reserves has been coming from revisions to estimates of the reserves in fields already in production or undergoing appraisal (reserves growth) rather than from new discoveries. (Page 203)

The IEA also discusses the different factors that can lead to reserves growth:

> - Geological factors: The delineation of additional reserves through new seismic acquisition, appraisal drilling or the identification (using well-bore measurements),

of reservoirs that had been previously bypassed.
- Technological factors: An increase in the share of oil in place that can be recovered through the application of new technologies, such as increased reservoir contact, improved secondary recovery and enhanced oil recovery.
- Definitional factors: Economic, logistical and political/regulatory/fiscal changes in the operating environment. *(Page 210)*

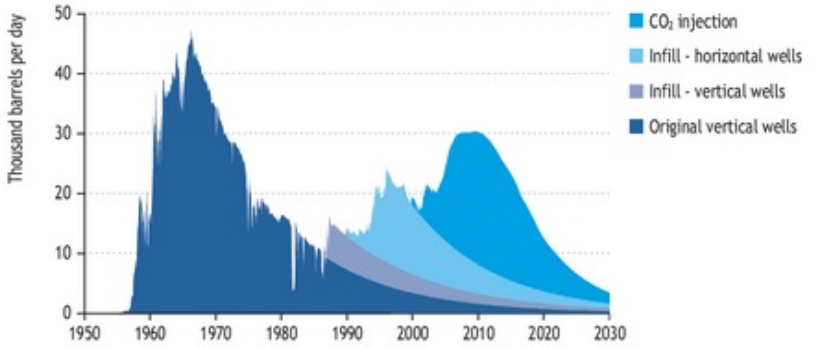
Geological factors can be summarised as increasing the estimate of the Oil Initially In Place in the reservoir (OIIP) or the recovery factor (ie. how much of the oil in place can be produced). At the time of discovery of a new oil field, there is large uncertainty in these estimates, but this reduces after a field has been producing for several years.

The technologies that most significantly increase recovery of oil from existing fields, particular secondary and tertiary recovery, have been standard industry practice for many decades. While there are further developments to be made, the largest and easiest gains have already been achieved. External factors such as high oil prices have not been as constant, but are the least significant of the three. An ageing workforce and other capacity constraints also limit the speed with which other measures can be implemented. The nature of the game is that these gains will be extracted slowly over a long period of time.

Reserves Growth Case Studies

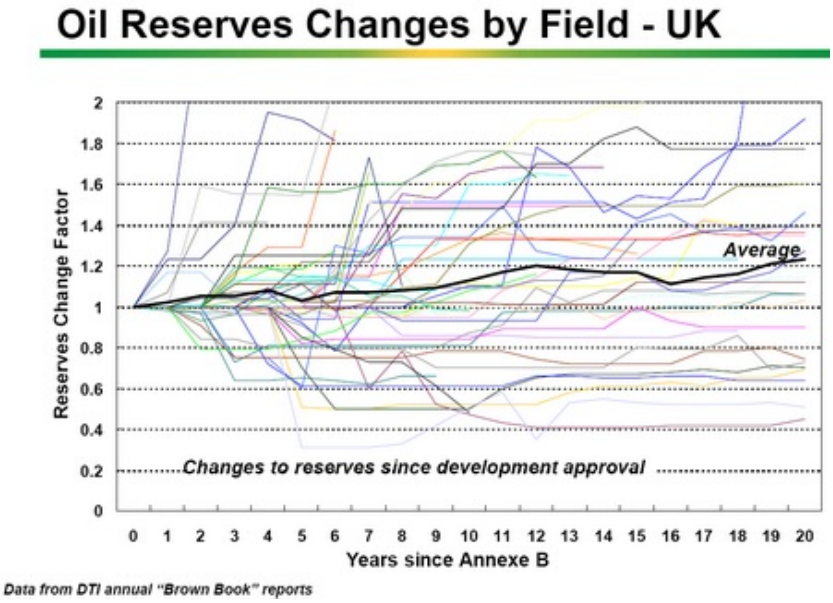
There are a handful of celebrity oil fields that show a remarkable increase in reserves as a result of additional development work. The World Energy Outlook featured one of these, the Weyburn field in Canada:

Figure 9.8 • A case study of oil reserves growth: the impact of technology on oil production from the Weyburn field in Canada



Source: PTRC Weyburn-Midale website (www.ptrc.ca).

But cherry-picking one example is not very helpful. The chart below shows the reserves estimates for a number of UK North Sea fields, demonstrating just how volatile and uncertain reserves estimates are.

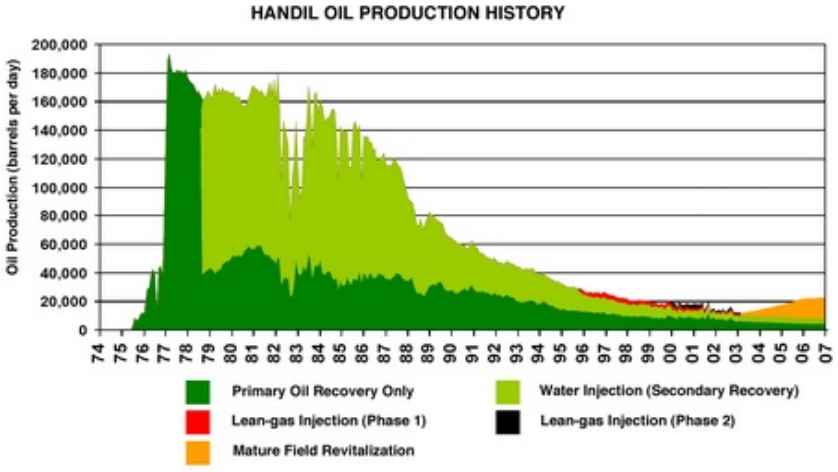


Source: Harper (BP), ASPO Berlin, May 2004

There is a great deal of uncertainty with early estimates of an oil field's reserves but an oil company's best estimate of 'proven plus probable' reserves is just as likely to go down as up. Increases in reserves due to application of new technology or changing economic assumptions are small compared to the total variability.

From the above chart, it would be easy to pick one field with a dramatic story of reserves growth, but the average is one of only slow growth over an extended period of time. So it is inappropriate for the IEA to talk about the returns due to Enhanced Recovery using CO_2 in the Weyburn field as though that same experience could be repeated everywhere. Generally such techniques are only economic where standard production practices are not effective due to poor characteristics of the particular oil field.

I n How Technology Increases Oil Production, I analysed a more representative story about TOTAL's giant Handil field in Indonesia:



Adapted from Journal of Production Technology, January 2008

What is simply described as "Mature Field Revitalization" comprises many years of technically challenging study and modeling followed by intensive application in the field. For the engineers and geologists involved this was no doubt rewarding work.

Yet for a substantial investment of time, money and effort in this giant field, we gain just 10,000 barrels per day of oil production towards the end of its field life. Nevertheless, this was the most significant of several case studies featured in the Society of Petroleum Engineers' January 2008 Journal of Production Technology. While there will be isolated fields that perform better, there will be many more where such activity is economically marginal at best.

Why then, has the 'reserves growth' argument become so prominent?

A Happy Marriage: USGS and IHS

In their 2000 study, the United States Geological Survey estimated 730 billion barrels of reserve growth over the thirty year period from 1995-2025. This describes an annual reserves increase of 2.5% which is far greater than oil company's observations of their own fields. The primary reason for this is that the USGS looked at conservative 'proven' reserves rather than the best estimate of 'proven plus probable' reserves.

The story, however, seems to get more interesting. Since 1995, IHS has been revising up their field estimates, especially for giant fields in the Middle East. Former TOTAL petroleum engineer Jean Laherrere has roundly criticised this as "political pollution of technical databases". It has been suggested that these revisions help bring the IHS into favour with the OPEC National Oil Companies, perhaps earning them important new clients.

Curiously, since these type of revisions have been applied over the last decade to the giant OPEC fields (which contain a large fraction of total world oil reserves), it also means that when the USGS go back and look at the IHS data almost a decade after their original study, they find evidence that reserves are growing in line with their predictions - but the data that they are using to reach this conclusion may be almost completely arbitrary!

Taking just one example of these revisions, the recovery factor for Ghawar in 2001 in the IHS database was a reasonable 47%. By 2004 the recovery factor was increased to 60% and in 2006 increased again to an incredible 70% *(Laherrere, Groningen, 2006)*. This compares to a recovery factor of around 55% determined by Stuart and Euan in their forensic study of Ghawar. A 70% recovery factor is unlikely even in the high quality northern sections of this field, but is wildly implausible across the field as a whole.

Re-assessing Reserves Growth

In Shedding Light on the Question of Reserves Growth, I suggested an alternative model for estimating the potential for reserves growth. A summary was also published in the June 2007 Journal of Petroluem Technology in response to an earlier opinion piece from CERA's Peter Jackson.

This model recognises that as fields get older the maturity of their reserves estimate improves and the scope for future reserves growth reduces. This reflects, amongst other factors, the field progressing through different development stages (see the original article for more detail).

Field Category	Maturity of Reserves Estimates	Potential for Reserve Gains	Average Reserve Growth	Cumulative Production & Current Reserves	Potential Reserve Growth
Not yet in production *eg Kashagan*	Very Low	High	35%	100	35
Primary recovery only[a]	Low	High	25%	200	50
Secondary recovery applied[b,c] *eg Ghawar*	High	Moderate	10%	1050	105
Tertiary recovery active *eg Cantarell*	Very High	Limited	5%	200	10
Near or at end of field life *eg Brent, East Texas*	Very High	Limited	5%	400	20
Total				**1950 Gb**	**220 Gb**

The figures in this table are rough estimates at best, but they correctly describe the scale of what reserves growth could achieve. Since 90% of production now comes from fields more than 20 years old, our resource base is very mature. While oil field reserves may have 'grown' 10-20 per cent since the 1980s, we should not expect the next 20 years to deliver the same gain. Discovery of new fields has tapered off to low levels and the easy pickings for increased recovery have already been had.

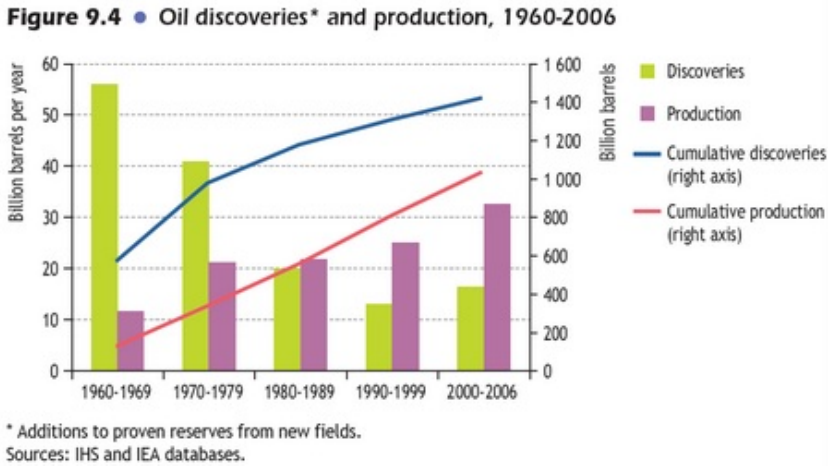
Reserves Growth - Double Trouble

There is also a compound failure in the IEA approach to reserves growth. They are taking an optimistic assessment of how much reserves grow over time, and multiplying it by a clearly inflated figure for OPEC reserves. A moderate reduction in the assessment of reserves growth, multiplied by a figure corrected for OPEC overstatements yields a significantly lower total estimate for reserves growth.

The IEA are to be congratulated for a lower assessment of reserves growth this year (402 billion barrels total) than previous estimates from the USGS (730 billion barrels over 30 years). However, their arguments and the trends in IHS data are misleading and a figure that is lower still, around 200-250 billion barrels, is far more likely.

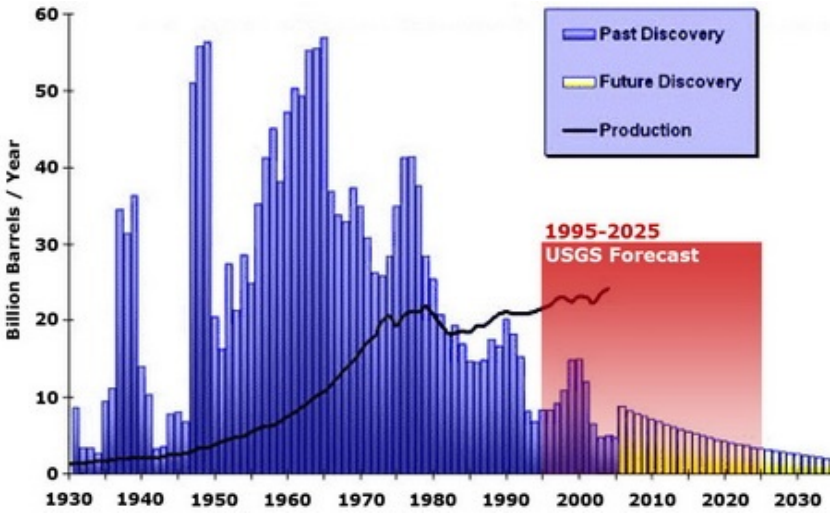
Undiscovered Resources

The third and final figure that needs revision is 'Undiscovered Resources'. The World Energy Outlook provides this graphical summary illustrating that oil discoveries have been declining since the 1960s and that production has exceeded discoveries since the 1980s:



> The volume discovered has fallen well below the volume produced in the last two decades, though the volume of oil found on average since 2000 has exceeded the rate in the 1990's thanks to increased exploration activity (with higher oil prices) and improvements in technology. *(Page 197)*

The following chart tells a similar story but on an annual basis and over a longer time scale.



(Discovery Source Data: Longwell (ExxonMobil), World Energy, Vol 5 No3 2002)

The yellow bars are an extrapolation of the oil discovery trend, which sum to an estimate of around 200 billion barrels remaining to be discovered. In contrast, the red box shows the average amount estimated to be discovered by the USGS each year between 1995 and 2025 (totaling 939 billion barrels). More than ten years into their forecast period it is clearly implausible that their forecast could be met (as Rembrandt has also discussed). The IEA take a figure of 805 billion barrels as the ultimate resource yet-to-be-discovered. That still implies a radical departure from the discovery trend and appears hopelessly optimistic.

It could be argued that exploration in Iraq, extreme Arctic areas and possibly even deepwater offshore Brazil have been constrained by external factors and that discoveries in those regions could therefore represent a break from the prior discovery trend. There is only a limited basis for this claim though.

While the Arctic has some petroleum potential, the alternating presence of ice caps over geological

timescales causes fractures in the underlying layers, making it unlikely that large petroleum accumulations have survived intact. Additionally, the Arctic is more likely to be gas rather than oil-prone. Recent Brazilian finds provide extreme technical challenges and it is not yet clear how much will ever be economic to recover. Discovery potential in Iraq is also highly speculative, although no doubt significant compared to limited potential elsewhere. In short, these provinces could increase future discovery above 200 billion barrels, but more than 300 billion barrels is highly unlikely.

World Oil Resources

Having reassessed the three categories of resources, it is now possible to present a more robust picture of the resources underpinning future production:

Review of 2008 World Energy Outlook
Ultimately Recoverable Resources
Conventional Oil and NGLs (billion barrels)

	IEA 2008 WEO	Downward Adjustment	Revised Estimate
Cumulative Production	1128		
Remaining Reserves	1241	~ 340	900
Reserves Growth	402	~ 180	220
Undiscovered Resource	805	~ 550	250
World URR	3,577	~ 1,070	2,500
% Produced	32%		45%
Remaining Resources	2,449		1,370

Rather than having produced 32% of a 3,577 billion barrel resource, we have more likely consumed 45% of a 2,500 billion barrel resource. The estimate is only slightly higher than recent publications by Laherrere & Wingert and Campbell, who estimate global ultimately recoverable conventional oil resources at 2,250 and 2,270 billion barrels respectively. Note that of the remaining 1,370 billion barrels in the Table above, some 200 billion barrels are Natural Gas Liquids which have only two-thirds the energy content of crude oil and cannot be used by much of the existing transport fleet and infrastructure.

In total, our remaining conventional oil and NGL resources are more likely only 55% of what the IEA concludes in its 2008 outlook. Conventional oil and NGL production in 2030 is therefore likely to be 50-60 million barrels per day, compared to the current level of just over 80 md/d. Even optimistic assessments of the potential for unconventional oil cannot close that gap. Oil production will therefore not be greater than 100 mb/d in 2030 as forecast by the IEA, even though that is a reduction of 10 mb/d from their last World Energy Outlook.

Summary

Previously the IEA has openly assumed that the growing gap between future demand and their forecast for non-OPEC production would be met by OPEC, with no quantification of whether

OPEC resources were available to match that ambitious assumption. That the IEA has now attempted a resource based estimate for both non-OPEC and OPEC regions is a vital albeit obvious and overdue step forward. In another positive move, the IEA has also seen fit to independently revise down the USGS estimates for reserves growth and undiscovered resources.

The most obvious and fundamental flaw in the IEA report is that OPEC reserves have again been taken at face value. The laws of physics do not stop at the Middle East borders and there is not some mythical abundance of oil in OPEC countries. They do have the largest share of remaining resources but they cannot meet our expanding desire for oil forever.

Despite recognising the OPEC reserves issue, the IEA has avoided confronting it. The poor quality of data for these countries has consequential impacts on the assessment of reserves growth and real discovery trends. We cannot have a robust official forecast of future oil supply until we get transparent and audited information concerning oil reserves in OPEC countries.

The IEA has warned that massive levels of investment are required to bring oil resources to market in a timely manner, but the reality is that oil resources are insufficient to meet these forecasts regardless of investment. Oil production will be heading down hill well before 2030, constrained by a fundamental lack of oil resources and not simply a lack of investment.

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