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The US Energy Information Administration's Faulty Peak Oil Analysis

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Introduction

Crude oil provides 35-40% of global primary energy and is a vital driver of economic productivity. The question of when oil supply will reach its global peak is an important and controversial question that is gaining increased attention from a wide array of researchers, commentators and policy makers. Many analysts, including now even the International Energy Agency in its 2010 World Energy Outlook accept the possibility of a near-term peak in global oil supply. The United States Energy Information Administration (EIA) however, based on a report published in 2004, remains optimistic about the future of global oil supply and maintains that global peak oil will not likely occur before 2030. How does the EIA remain optimistic given the growing trend throughout the world towards energy pessimism? This post will explain the methodology that underlies the EIA's optimistic oil supply vision, and will point out two important flaws in this methodology that call their results into question. It will finally replicate the EIA's forecasts using a simple methodological correction and demonstrate the the agency's oil optimism is unfounded.

US EIA methodology and its shortcomings

The EIA uses a variant of the reserves to production ratio (R/P ratio) to predict the global peak in conventional oil. The reserves to production ratio divides proved reserves (R) by that year's rate of oil production (P), and is a ratio commonly used to estimate a resource's static lifetime, or the length of time proved reserves will last assuming a steady production rate. The EIA turns to the R/P ratio rather than use the Hubbert method to predict global peak because the agency believes the Hubbert method yields forecasts that are consistently too early, and because the R/P ratio does a better job of incorporating non-geological factors into a production forecast. The theory behind using the R/P ratio to predict peaks relies on the ratio falling from a higher value early in a region's resource production cycle until it reaches a threshold value at which a production peak emerges. After the production peak the R/P ratio levels off and production rates decline. Figure 1 illustrates this relationship.

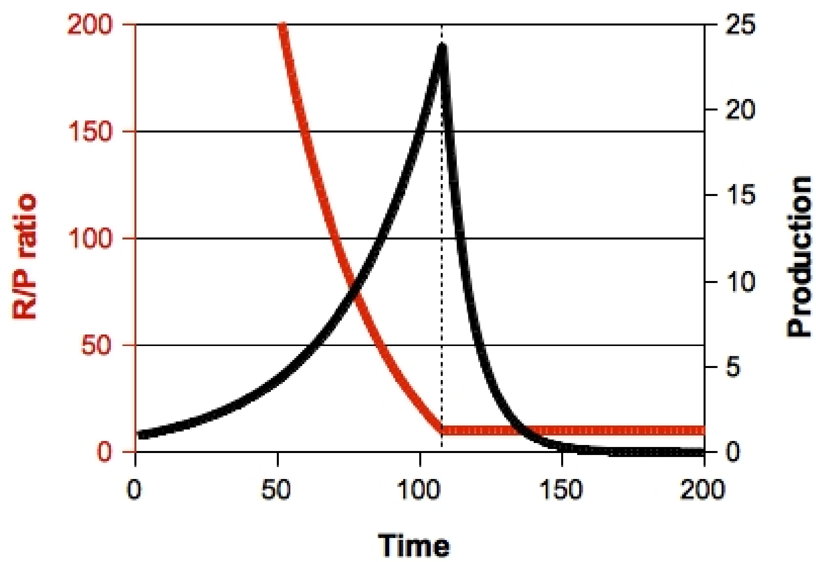

Figure 1. Oil production and the R/P ratio in a theoretical oil province where a production peak is reached at an R/P threshold value of 10

As in Figure 1, the EIA uses in its forecasts a threshold *R/P* value of 10. It derives this value from the United States' oil production, which reached its peak roughly at an *R/P* ratio of 10. The EIA reasons that since the United States represents a mature, prolific, geographically diverse petroleum production region its threshold value of 10 can be generalized to the world as a whole and thus used to predict when a global peak may occur. Global oil production forecasts are calculated for several scenarios based on resource estimates from the United States Geological Survey's most recent [World Petroleum Assessment](), and delivers the optimistic vision of the global oil future shown in Figure 2. The EIA's results are the most optimistic published, and appear to drive the unwillingness of the EIA and the US Department of Energy to take the issue of peak oil seriously.

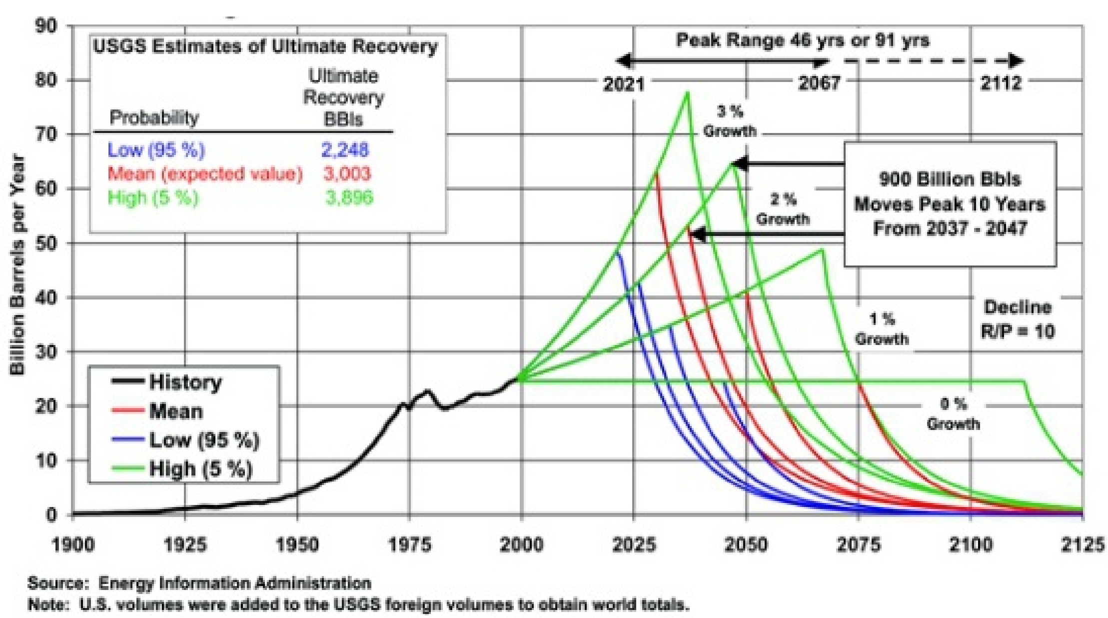

Figure 2. Results of EIA scenario calculations

Two issues cast doubt on the EIA's optimistic analysis. First, the agency calculates the US' threshold value of 10 using proved reserves statistics (R) in the R/P ratio's numerator, but then uses USGS estimates of technically recoverable oil (R') in the ratio's numerator in its scenario calculations. This leads to internal inconsistency between how the R/P ratio threshold value is calculated and then applied in scenario analysis. The difference between proved reserves and remaining technically recoverable oil is substantial, since proved reserves often represent only the portion of technically recoverable oil that has been discovered and documented well enough to meet government reporting requirements. Oftentimes the proportion of a region's technically recoverable oil that can be reported as proved reserves is quite small, sometimes less than 10 percent in regions that have not yet been thoroughly explored or developed. In order to make the EIA's analysis internally consistent, it must either use proved reserves to both calculate the threshold value and in scenario calculations, or it must used estimates of remaining technically recoverable oil. The agency cannot use these disparate estimates interchangably.

Beyond issues of internal inconsistency, the threshold value of 10 that the EIA applies to their global forecasts is questionable. Historical statistics in the United States show that the US R/P ratio was hovering near 10 *for several decades* before US oil production peaked in 1970 (Figure 3). This reality diverges starkly from the theory underlying the use of the R/P ratio as an indicator with which to predict oil production peaks. One can only conclude from this that, at least when formulated using proved reserves in the ratio's numerator, the R/P ratio was not able to predict US peak oil production and shows no promise in predicting global oil production.

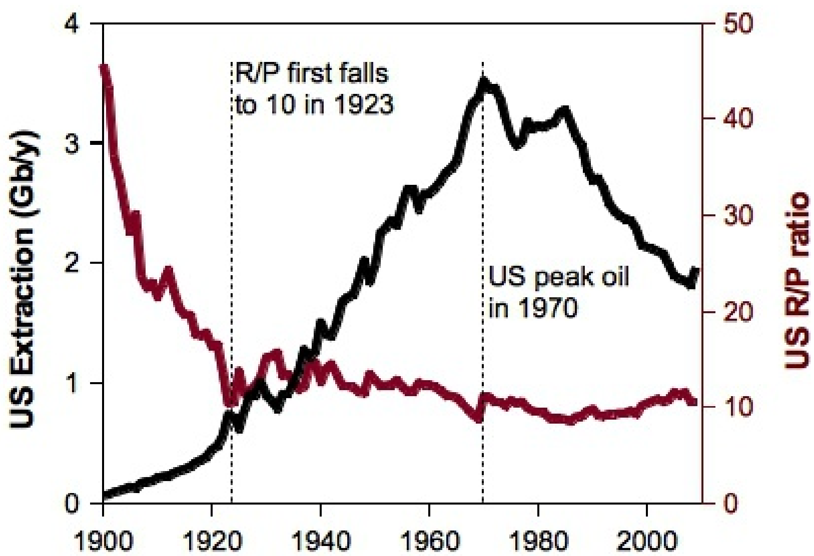

Figure 3. US historical R'/P ratio versus historical oil production (crude + condensate)

Luckily, using remaining technically recoverable oil in the R/P ratio's numerator is easy enough to do, and it solves both of the above problems. Figure 4 illustrates what the new R'/P ratio looks like based on estimates of remaining technically recoverable oil from the USGS and Minerals Management Service. This alternative formulation of the R/P ratio falls until the US peak in 1970, after which it levels off. This mirrors the original theory underlying the use of the R/P ratio (Figure 1) reasonably well, but yields an estimate for the US R'/P threshold value of 87 rather than 10, as the EIA had assumed. Since the R'/P ratio falls over time as oil resources are extracted, this difference becomes extremely important. If one assumes a threshold value far lower than the actual value for the purpose of forecasting, predictions of peak will necessarily be more optimistic than what would actually occur. In other words, the EIA analysis, by virtue of its internal inconsistency in calculating the threshold values used for it scenarios, unwittingly biased its forecasts towards optimism.

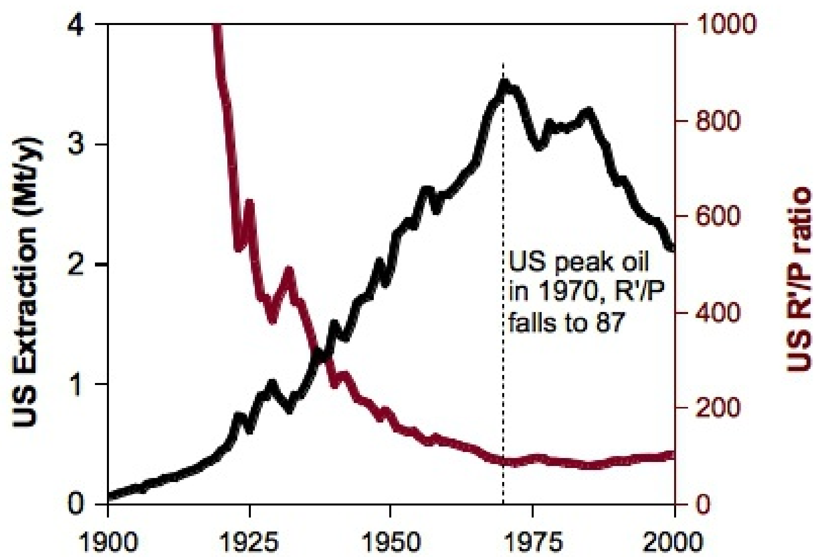

Figure 4. US historical R'/P ratio versus historical oil production (crude + condensate)

Replicating EIA's scenarios with the alternative indicator

To gauge just how overly optimistic EIA's scenarios are, I largely replicate their analysis by calculating the R'/P threshold value for the United States as described above and applying this threshold value to scenarios to calculate when global peak oil may occur. I begin forecasts in 2000 as EIA did, but use actual historical statistics for global annual conventional oil production from 2001-2010 and only use EIA's 0, 1, 2, and 3% growth assumptions thereafter.

In their analysis the EIA ignored the distinction between conventional and unconventional oil, even though the USGS resource estimates they used were explicitly for conventional oil only. This is not a big issue when calculating the R'/P threshold value for the United States since the US' unconventional production is negligible, but unconventional supplies from Canada are significant enough that they need to be accounted for in scenarios attempting to predict the peak of global oil supply. I use statistics from the Canadian Association of Petroleum Producers to estimate the amount of unconventional oil produced from Canada's tar sands and subtract this from global crude oil production statistics to estimate global conventional oil production. Canada's unconventional oil production is not the only unconventional oil produced globally, but it dominates by volume by far. After subtracting Canada's unconventional production, I assume all other sources of unconventional oil are negligible.

The results of this new analysis paint a much less rosy vision of the future of conventional oil than that offered by the EIA. Table 1 shows the EIA's estimates for the year of global peak oil for all scenarios in its original report, and for those same scenarios using the corrected method discussed above. For all scenarios using USGS low estimates of recoverable resources, global R'/P threshold values first fall below the threshold value of 87 in 1979. This prediction is very early. However, the low resource estimate is the lower edge of a 90% confidence interval about the mean so it is far from the most likely resource availability scenario. All mean estimates of resource availability, which are the most likely levels of resource availability according to the USGS, predict a peak in 1999. Only when USGS high resource estimates are used (which are just as unlikely as USGS low resource estimates) does the analysis predict global conventional peaks beyond the present day, but much nearer in time than predicted by EIA in their original analysis.

Table 1. EIA results compared to those from this study. Low and high estimates of conventional oil represent lower and upper edges of a 90% confidence interval around the mean USGS resource estimate.

Scenario	EIA results	Current results
Low (95%), 0% Growth	2045	1979
Low (95%), 1% Growth	2033	1979
Low (95%), 2% Growth	2026	1979
Low (95%), 3% Growth	2021	1979
Mean (50%), 0% Growth	2075	1999
Mean (50%), 1% Growth	2050	1999
Mean (50%), 2% Growth	2037	1999
Mean (50%), 3% Growth	2030	1999
High (5%), 0% Growth	2112	2027
High (5%), 1% Growth	2067	2018
High (5%), 2% Growth	2047	2015
High (5%), 3% Growth	2037	2014

Table 1. EIA results compared to those from this study. Low and high estimates of conventional oil represent lower and upper edges of a 90% confidence interval around the mean USGS resource estimate.

The revised, internally consistent R'/P method, when used with USGS estimates of technically recoverable resources, suggests that a peak in global conventional oil supply should have occurred in 1999 or thereabouts. At present, global conventional oil supply appears to be on a very bumpy plateau with the most recent peak, as recorded by statistics, set back in 2005 or 2006 depending on which agency's annual statistics one adopts. While it remains to be seen whether a new conventional peak will emerge, this paper shows the flaws in the EIA methodology that underlie the agency's optimistic outlook on global oil supply and shows that a corrected application of EIA's approach agrees well with many reports suggesting the likelihood of a near-term or historical peak in global conventional oil.