Response to Leonardo Maugeri's Decline Rate Assumptions in "Oil: The Next Revolution"

Posted by Euan Mearns on July 11, 2012 - 10:55am
Topic: Supply/Production
Tags: bakken, decline rate, depletion rate, harvard, iraq, maugeri, oil production, saudi arabia [list all tags]

This is a guest post by Stephen Sorrell, senior lecturer Science and Technology Policy Research, Sussex Energy Group, and lead author of the UKERC Global Oil Depletion report, and Christophe McGlade, doctoral researcher at the UCL Energy Institute. This post was slightly revised by the authors and updated here on 25/07/2012. Please see paragrapghs 8 and 9 below the fold for the updated text.

*The 76 page Belfer Centre pdf can be downloaded **here**. This critique by Sorrell and McGlade first appeared in the ODAC newsletter **here**.*

Commentary on: Oil: 'The Next Revolution: The Unprecedented Upsurge of Oil Production Capacity and What it Means for the World' - Leonardo Maugeri, Belfer Center for Science and International Affairs, Harvard University

Summary Maugeri's analysis and conclusions are critically dependent upon the decline rates applied to existing and future fields, and yet he does not explicitly say what these decline rates will be. However, Maugeri's assumptions can be derived from his Table 2, which projects gross and net capacity additions over the period to 2020. Doing so suggests he uses an average annual decline rate for all fields of **1.6%** over this period, which is less than half of the IEA and CERA estimates for 2008 (4.1%/year and 4.5%/year respectively). The discrepancy is even greater since the IEA and other analysts project an increase in average decline rates over the 2011-20 period. If we replace Maugeri's 1.6% decline rate assumption with the IEA estimate of 4.1%, the projected loss of production capacity over the period to 2020 increases from 11 mb/d to 26.5 mb/d. In turn, the projected global production capacity in 2020 reduces from 110.6 mb/d to 95.1mb/d (a reduction of 14%). Since average decline rates would be expected to increase over this period, this projection must be considered optimistic.

Maugeri's projections are very sensitive to the assumed rate of decline of production from currently producing fields - and his assumptions appear inconsistent with the available evidence.

A *decline rate* is a measure of how rapidly the rate of production from a field or group of fields is declining, while a *depletion rate* is a measure of how rapidly the remaining recoverable resources in a field or region are being produced (see box below). To avoid confusion, these concepts need to carefully defined and measured. But instead, Maugeri uses the term depletion rate when he means decline rate and fails to provide adequate definitions.

Both the IEA (2008) and CERA (2008) have estimated decline rates from a globally representative sample of post-peak fields, including the majority of the world's giant fields. These studies allow 'global average' decline rates to be estimated. Maugeri claims that the IEA's results conflict with CERA's results, but this is incorrect. As shown in Sorrell *et al* (2011), the IEA and CERA studies use the same data source (the IHS field by field database) and reach broadly the same conclusions. The IEA estimate the production-weighted decline rate of their sample of post-peak fields to be 5.1%/year, while CERA estimate 5.8% a year. A third and comparable study by Hook *et al.* finds 5.5%/year. Allowing for minor differences in samples and definitions, these three estimates may be considered consistent.

The above numbers underestimate the global average decline rate for *all* post-peak fields since the mean size of the sample of fields is greater than that of the global population of fields, and small fields decline faster than large fields. Under the (probably optimistic) assumption that that decline rate for smaller fields is the same as that for the 'large' fields in their sample (10.4%/year), the IEA estimate a production-weighted global average decline rate of 6.7%/year for all post-peak fields.

To estimate the global production capacity that is lost each year, it necessary to estimate the production-weighted aggregate decline rate of *all* fields, including those in build-up and plateau. Using the IEA data, we estimate this figure of ~4.1%/year which is comparable to CERA's estimate of 4.5%/year. This implies that around 3 mb/d of capacity must be added by new investment each year, simply to maintain global production at current levels.

A critical question for supply forecasting is how global average decline rates may be expected to develop in the period to 2030. Most existing fields will enter decline over this period, with a growing proportion of production from younger, smaller, and offshore fields that tend to have higher rates of post-peak decline. The IEA (2008) anticipates the production-weighted global average decline rate of post-peak fields increasing to 8.5%/year by 2030, leading to an estimated loss of 61% of current capacity by that date.

On page 19, Maugeri states that: "….The IEA projected the world oil average decline rate up to 2030 would increase to over 10% by 2010, while IHS-CERA predicted a 4.5% depletion rate". But this sentence is ambiguous, two different terms are being used to mean the same thing and it is not clear how decline rates are being defined. The 10% figure appears to refer to the IEA projection for *natural* decline rates (see box below) for *post-peak* fields in *2030*, while the 4.5% figure refers to a CERA estimate of *overall* decline rate for *all* fields in *2008*. In other words, Maugeri is comparing apples and oranges.

Maugeri does not explicitly state what decline rate assumptions he is using for his study, although he claims (contrary to the above) that there is no evidence for an average decline rate greater than 2-3%. However, Maugeri's assumptions can be derived from his Table 2, which projects gross and net capacity additions over the period to 2020. Subtracting, column 5 from column 4 in this table suggests a projected loss of 11 mb/d of production capacity between 2011 and 2020, owing to the decline of production from post-peak fields. This translates to an average annual decline rate for all fields of **1.4%** over this period, which is less than half of the IEA and CERA estimates for 2008 (4.1%/year and 4.5%/year respectively). The discrepancy is even greater since the IEA and other analysts project an increase in average decline rates over the 2011-20 period.

If we replace Maugeri's 1.4% decline rate assumption with the IEA estimate of 4.1%**,** the projected loss of production capacity over the period to 2020 increases from 11 mb/d to 29.2 mb/d. In turn, the projected global production capacity in 2020 reduces from 110.6 mb/d to 92.4mb/d (a reduction of 16%). Hence, a more realistic decline rate completely eliminates his projected increase. Since average decline rates would be expected to increase over this period, this projection must also be considered optimistic.

The bottom line is that Maugeri has made some very optimistic assumptions about global average decline rates, failed to provide adequate justification for them and misrepresented the estimates made by others. Adopting more realistic estimates would significantly change his results.

Decline rates and depletion rates

The rate of oil production from an oilfield normally rises to a peak or plateau and then declines. The term *decline rate* refers to the percentage annual reduction in the rate of production (in barrels/day) from an individual field or a group of fields. When measuring the average decline rate for a group of fields, it is important to distinguish between the *overall* decline rate which refers to all currently producing fields, including those that have yet to pass their peak, and the *post-peak* decline rate which refers to the subset of fields that are in decline. Some analysts also estimate the *natural* decline rate, which indicates the rate at which production would decline in the absence of any additional capital investment. When estimating the average decline rate for a group of fields, it is common to weight the decline rate of each field by its contribution to the total production from that group, thereby giving a 'production weighted decline rate'. The amount of new capacity that needs to be replaced every year to maintain current levels of production is given by the product of the production-weighted overall decline rate for a region and the initial level of production.

The term *depletion rate* refers to the percentage of recoverable resources (in barrels) in a field or region that are being produced each year. For an individual field, this is defined as the ratio of annual production to some estimate of recoverable resources, where the latter could be proved reserves, proved and probable reserves, the remaining recoverable resources (i.e. allowing for future reserve growth) or the estimated ultimately recoverable resources. Depletion rates can also be estimated at the regional level, although the uncertainty on recoverable resource estimates will necessarily be greater since they must also include undiscovered resources. In all cases, higher estimates of recoverable resources will lead to lower estimates of depletion rates.

References:

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