Reserves Growth and Production Flows

Posted by Dave Cohen on August 30, 2006 - 4:46pm
Topic: Supply/Production
Tags: cges, production flows, reserves growth [list all tags]

[editor's note, by Dave Cohen] HO is out of town on family business so I took this subject up in his absence.

Dr. Leo P. Drollas, Deputy Director and Chief Economist for the Centre for Global Energy Studies has issued a response to Heading Out's Depletion estimates and the CGES. I feel that Drollas' comments deserve a response.

The argument concerns what is termed "reserves growth" which Drollas defines as

> Growing knowledge tends to result in more oil reserves through oilfield extensions and revisions of reserves -- what is commonly known in the industry as `reserves growth' -- as well as through discoveries of new oilfields....
>
> If there are no gross additions to reserves the depletion rate is equal to the world's rate of oil production as a percentage of global proven reserves (2.38% in 2005). However, gross additions have not been zero; indeed, since 1954 they have exceeded the world's production of oil.

The entire comment is below the fold.

[Update by Dave Cohen on 08/30/06 at 4:46 PM EDT] User BluePeter calls our attention to an excellent article by Roger Bentley in this pdf document for those of you who are serious students of reserves growth. Quoting from page 9:

> Overall, the key idea to retain about proved reserves [as used by Dr. Drollas] is that for the majority of countries in the world and, and especially the large producers, the data have no bearing at all on true reserves.
>
> Not surprisingly, the date at which a country goes over its production peak cannot be determined simply form its proved reserves data; additional analysis is needed...

Bentley's well documented views support my point in this piece. Here is Drollas's original comment.

> Response to Heading Out piece posted on Friday, 25th August, 2006

Oil's depletion rate

In a recent piece (25/8/06) the author behind `Heading Out' sought enlightenment on the matter of oil depletion by reading a `report' by the CGES on this subject. Since, by his own admission, the author has remained unenlightened, may we suggest a few reasons why this was so. The CGES piece was not a report but a short proprietary article in our Market Watch series (part of our Global Oil Report), which looks at various topical issues concerning the oil industry. Heading Out contends that the CGES piece `conceals some of the assumptions that it makes, by hiding them within the overbounding simplification of its argument.' The CGES article did not deliberately try to simplify, but attempted instead to make a simple point based on a simple argument. For the benefit of those who have not read the CGES paper, the simple argument we made is as follows.

In any single year the world's oil production rate forms one of the key elements of its depletion rate. Last year, 26.38 billion barrels of crude oil were produced globally (according to the Oil and Gas Journal) yielding a depletion rate of 2.38% on the basis of an average level of proven global crude oil reserves of 1,109 billion barrels in 2005 (again according to the OGJ, but excluding Canada's tar sands reserves). If -- a big `if', by the way -- there are no further additions whatsoever to the world's proven reserves of crude oil, then the world's depletion rate will obviously rise over time from the 2.38% rate of 2006. With no further reserves additions and assuming the same rate of oil production, it is a mere matter of arithmetic to calculate the depletion rate ten years hence (3.1% a year), twenty years hence (4.5% p.a.) and thirty years hence (8.3% a year). However, the world's crude reserves do change over time because companies strive to change them; after all, reserves are the future lifeblood of the industry.

The rate of change of oil reserves is tautologically equal to the rate of gross additions to reserves less the rate of oil production. Gross additions, in turn, comprise new discoveries, oilfield extensions and revisions. It is highly unlikely that during any particular year there will be no gross additions to reserves whatsoever. Discoveries -- small or large -- are being made continuously and with the passage of time and the aid of technology companies get to know more about their oilfields. Growing knowledge tends to result in more oil reserves through oilfield extensions and revisions of reserves -- what is commonly known in the industry as `reserves growth' -- as well as through discoveries of new oilfields.

A case in point is the United States, the world's most mature oil province. At the end of 1973, during the first oil crisis, the US had proven oil reserves of 35 billion barrels, giving it an R/P ratio of 10 years and a depletion rate of 10% a year, provided no new oilfields were discovered thenceforth and no oilfield extensions and revisions were made either. At the end of 2005 the US had proven reserves of 21 billion barrels with an R/P ratio of 11 years, yet had produced in the meantime no less than 86 billion barrels of crude oil! It would be extremely difficult to determine precisely what proportion of the 86 billion barrels actually produced between 1973 and 2005 was due to new discoveries, oilfield extensions or revisions, and in a fundamental sense it is irrelevant because the US enjoyed the benefits of this oil, whatever its source. What really counts is the oil producers' ongoing struggle to replace the oil being produced: whether this is achieved via wildcat wells, or oilfield extensions or reappraisals of existing fields hardly concerns the average consumer filling up his shiny SUV in Los Angeles or his beaten-up truck in Mumbai.

> Having made the theoretical point presented above, the CGES article proceeded to look at the global picture and see whether the world's gross additions to oil reserves since 1954 exceeded or fell short of global production. We did not discuss in our short article individual oilfields, or countries for that matter, for there was only enough space to concern ourselves with the aggregate picture; incidentally, for those interested in individual countries do feel free to contact the CGES. As a matter of historical fact, then, one can assuredly say that since 1954 the world's cumulative gross additions to reserves have exceeded its cumulative oil production. If this had not been the case, the world's proven reserves would not have grown at all -- and surely no one is purporting that! This is not to say that we `don't need to worry', as Heading Out contends we are urging our readers, for the future might be very different from the historical record. There are indeed a number of reasons why we should be fearful, the most important being the lack of opportunities afforded to the international oil companies to `grow' their oil reserves, because they are kept out of the most prospective areas in the world.
>
> To sum up, the author of Heading Out was not enlightened by our article simply because he did not read it carefully enough. The CGES set out to find what is the world's oil depletion rate and to see whether it has changed over time. If there are no gross additions to reserves the depletion rate is equal to the world's rate of oil production as a percentage of global proven reserves (2.38% in 2005). However, gross additions have not been zero; indeed, since 1954 they have exceeded the world's production of oil. As a result, proven global oil reserves have grown since then and expansion rather than depletion has been the norm. Oil reserves may shrink in the future and cause depletion to become a serious worry, but they have not done so both in the more remote and the recent past, and that is as much as we dare say on this subject at present.
>
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A key part of the argument concerns the United States and the view here if that part of the argument is answered, the entire CGES argument is effectively disposed of. So, let's concentrate on this part of Drollas' text.

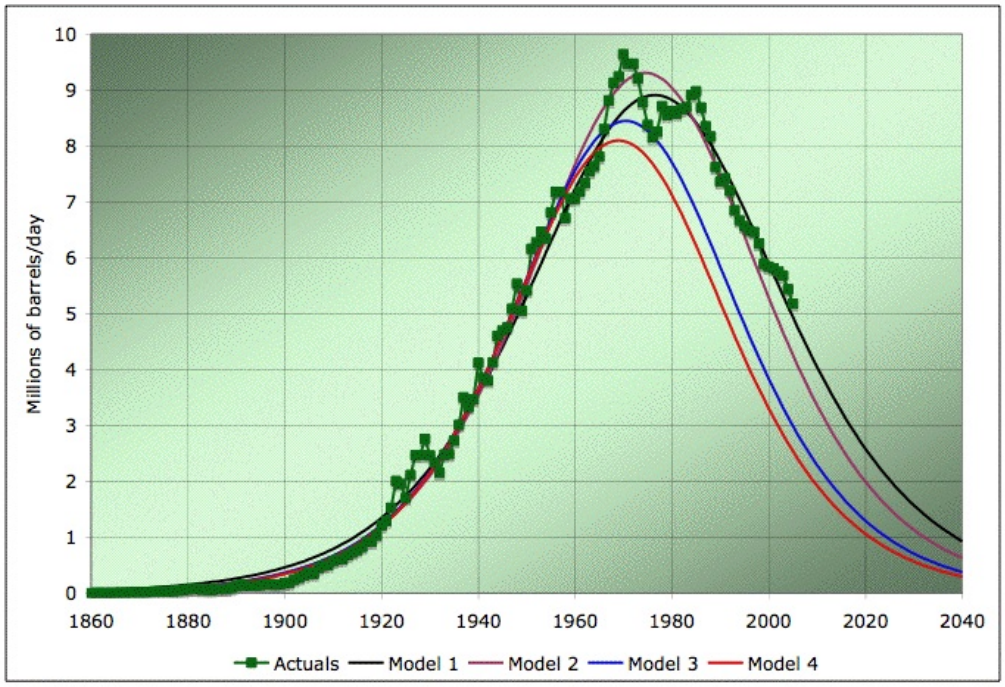
> At the end of 1973, during the first oil crisis, the US had proven oil reserves of 35 billion barrels, giving it an R/P ratio of 10 years and a depletion rate of 10% a year, provided no new oilfields were discovered thenceforth and no oilfield extensions and revisions were made either. At the end of 2005 the US had proven reserves of 21 billion barrels with an R/P ratio of 11 years, yet had produced in the meantime no less than 86 billion barrels of crude oil!

HO states in his post that

> There is still a lot of oil to find, but as fields get smaller, they also produce less individually, so that more must be found, and produced, each year. *That is why I am more concerned with production rates than I am with the amount that will ultimately*

> *be recovered from a reservoir.*

In fact, "reserves growth" is the wrong argument—it is a red herring and a misleading indicator of our true concerns. Let us look at production rates for the United States. There is no better place to start than Stuart Staniford's Four US Linearizations.



EIA Field production of crude, and four Hubbert models based on different linearizations. Source: EIA for the data, models as described in the text.

In this story, Stuart was playing around with various fits based on different historical data sets. Ignore models 2 through 4 and concentrate on model 1 which is "a regression of the data between 1958 (which is the point Deffeyes chooses) and today" *ie*. a complete data set. As you can see, production is well over 9/mbd (million barrels per day) in 1973 but averaged 5.121/mbd in 2005.

What was the "reserves growth" during the period? As Drollas cites, the US started with 35 Gb (billion barrels) in 1973 and produced 86 Gb during the 1973 to end 2005 period. The US has 21 Gb left. So, simple arithmetic says that growth was 72 Gb during the period. Let's take a closer look. From the EIA US Country Brief.

> According to EIA's 2004 Annual Report on U.S. oil and natural gas reserves, the United States had 21.4 billion barrels of proved oil reserves as of December 31, 2004, the eleventh highest in the world. These reserves were concentrated overwhelmingly (over 80 percent) in four states. Texas had 22 percent of total US oil reserves, Louisiana had 20 percent, Alaska 20 percent, and California 18 percent (note: all of these figures include onshore plus Federal and state offshore reserves). U.S. proven oil reserves have declined more than 17 percent since 1990, with the largest single-year decline (1.6 billion barrels) occurring in 1991.

Reserves have declined more than 17% since 1990. In 2001, the EIA said that the US had 21.8 Gb of reserves and that reserves had declined 20% since 1990. Since we have produced about 6.148 Gb in the 2002 to end 2004 period and reserves differ by only 400 million barrels fewer, it

appears that reserves have grown 5.748 Gb since 2001 while production has fallen from 5.746/mbd (2002) to 5.419/mbd (2004, cited above), a percentage drop of approximately 5.7%.

Citing reserves accounting (growth in Gb) and production flows (barrels per day) yields two different results. A final word about R/P ratios. If there is reserves growth that nearly covers production as in the 2002 to end 2004 period in our example just above, the R/P ratio is not a good indicator of what's going on. In 2001, reserves were 21.8 and the R/P ratio was 10.4. However, in 2004, reserves were 21.4 and the R/P ratio was 10.8. Reserves growth occurred, the R/P ratio went up and production dropped 5.7%. What's wrong with this picture?

In summary, this is why some of us regard production data as a more important indicator of problems in the oil supply than reserves accounting. Reserves growth can obscure production declines. Although the world may not have reached peak production yet, it has been in a plateau since the spring of 2004. This is a worrisome trend.

I hope this disposes of the US argument and by extension, the world. As a personal note to Dr. Drollas, Heading Out is a consultant to the energy industry and travels all over the world sharing his expertise on various problems. I am just a journalist writing about energy issues. I have written for various publications but I also know a problem when I see one.

We are all, in our various ways, on the path to *enlightenment*.

Sincerely,

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