The Oil Drum: Europe
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

The Shape of Oil to Come

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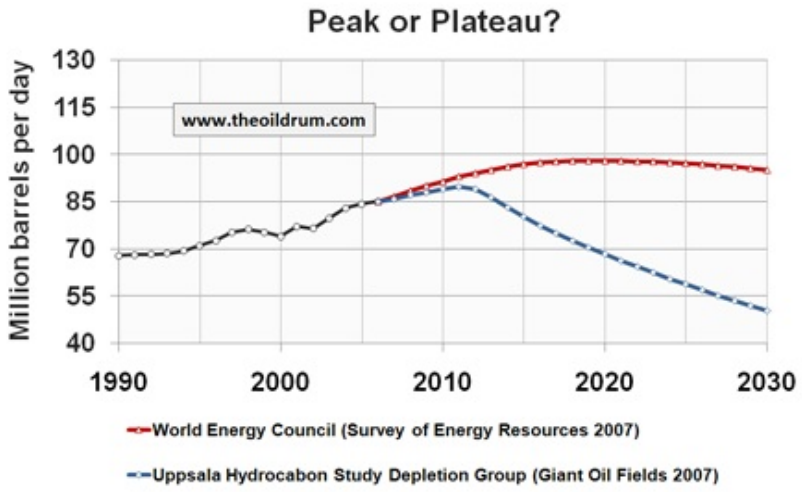
Topic: Supply/Production
Tags: original, peak, plateau, reserves growth, supply [list all tags]

This article is about the way in which oil production is going evolve. Will there be a sharp peak, or a long lasting plateau?



Our future is highly dependent on the way in which worldwide crude oil production is going to decline. If it goes rapidly, declining with a few percent each year or more, than it will be very difficult to complete the energy transition without severe economical consequences. If production stabilizes and plateaus for a decade or longer, after which the period of long decline begins, it would provide much greater means to sustain the present economy. Stability is needed to scale up alternative sources of energy sufficiently to replace crude oil during a transition period of decades.

Within the world of independent forecasters both the peak and the plateau scenario exist. The group of sharp “peakers” are mainly represented by the experts within the Association for the Study of Peak Oil and Gas (ASPO). The best publication out there so far is that of the Uppsala Hydrocarbon Study Group (UHSG), which is led by ASPO President Kjell Aleklett.

In his PhD thesis, Fredrik Robelius has outlined the fate of the Giant oilfields, that drive crude oil production, and came to the conclusion that production will peak between 2008 and 2018, at approximately 90 to 95 million barrels per day. With the more likely scenario stating that the peak is in 2012 after which a sharp decline occurs. By 2030 he suggests production could have declined towards the low point of 50 million barrels per day.

Figure 2 - Fredrik Robelius

The group of "plateau" forecasters are widespread. Coming from a variety of organisations such as the BGR, the World Energy Council and energy consultancy PFC Energy. The analysis of the latter results in maximum production being reached around 2014, at nearly 100 million barrels per day, which would be maintained for a decade after which a slow decline occurs.

The plateau scenario would be far more beneficial for the world because it is not likely that it will lead to widespread liquid fuel shortages. Other liquid sources or equivalent energy sources can in that case fill a large part of the gap between supply and demand that is going to occur. The world could step up the pace significantly for the energy transition to succeed, leading the way for the time when production worldwide is going into actual decline. If this decline would occur immediately after the peak without significant preparation instead of a plateau, a worldwide liquid fuels crisis is inevitable.

Differences come mainly from disagreement related to the role of technological progress on valorising oil reserves into producible reserves.

What drives oil production?

From statistics we know that since the beginning of 2005, crude oil production including unconventional has been on a slightly upsloping plateau (see Oilwatch Monthly). It can be concluded from different reports, that in the the same period of time, 4 to 5 million barrels per day of new production have been added to supply (Skrebowksi, 2006; Koppelaar, 2006; CERA, 2005) . Which implies that present world production is declining at a rate of 4% to 5% annually. When looking at the scheduled new oil fields coming on-stream in the coming years, one can see a continuation of recent supply additions. Approximately 5 million barrels per day will be added each year up to 2010. From this it can be concluded that the present situation – a plateau that started in 2005 - is stable for now as long as no major factors are going to change. This situation is plotted in figure 3 below, where we see production increasing through an up sloping plateau until 2010, continued by a down sloping plateau until 2013 after which the decline sets is. In total this scenario amounts to total present recoverable (proven + probable) reserves of 1220 billion barrels, which is in line with current estimates from the IHS Energy database.

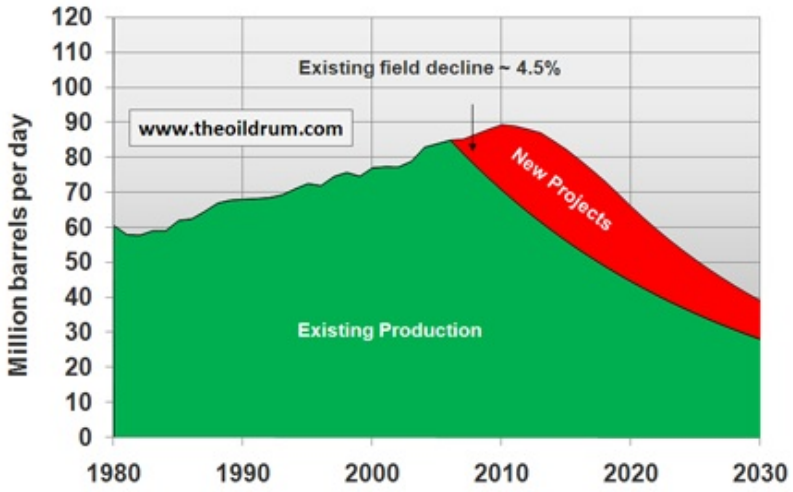


Figure 3 - The base of existing production declining at 4.5% per year in green and my own estimate for new oil field projects currently scheduled in red (from the ASPO-Netherlands projects database)

In relation to the peak or plateau question, this raises two questions. For how long will the oil industry be able to add such a large amount of new production each year? And the second being, is the decline rate of 4% to 5% stable or will it increase or decrease in the future?

The answer on the first question is dependent on two developments, future oil discoveries, and additions from unconventional plays. The answer to the second question is dependent on technological developments that add reserves, keeping the decline rate down, and on the production expectations for the giant oil fields in the world (Robelius, 2007).

From historical data we know that discoveries peaked in the 1960's and have been declining ever since. Presently we are discovering on average one barrel for every three consumed. The continuation of this trend, which is very likely given the lack of new regions that have not yet been explored, would imply a remaining amount of oil yet to be found in the order of 100 to 250 billion barrels. The effect of 170 billion barrels of new discoveries in the coming 15 to 20 years is shown in figure 4 below. This would extend the present plateau until approximately 2017, under the assumption that the present decline rate of 4.5% will remain stable.

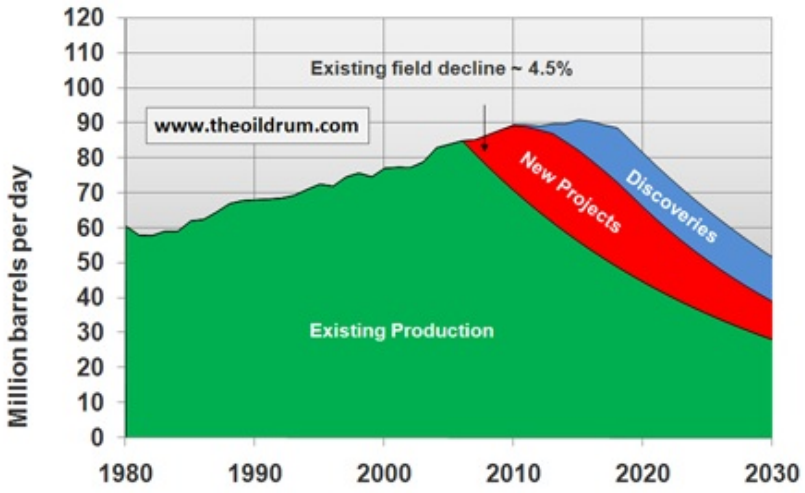


Figure 4 – The effect of 170 billion barrels of discoveries on the shape of oil production, assuming a continuation of the present decline rate of 4.5%.

While discoveries can influence the extension of the plateau, unconventional crude oil is not likely to have such an influence. With unconventional in this article I mean oil sands, oil shale, polar oil and heavy and extra heavy oil. Present scenario's for these sources of unconventional oil estimate a production level between 8 to 12 million barrels per day in 2030 (Campbell, 2006; IEA, 2006). This is too little and too late. The effect of approximately 12 million barrels per day by 2030 of unconventional production is shown in figure 5 below, which only slows the decline setting in 2017 slightly.

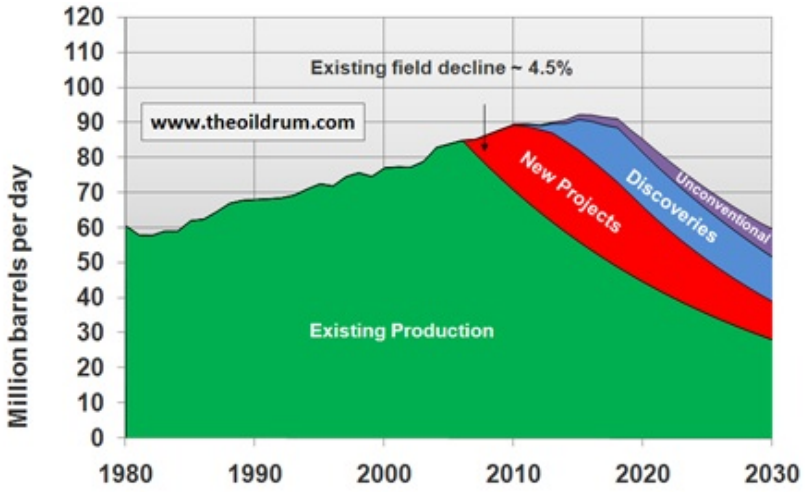


Figure 5 – The effect of 12 million barrels per day of unconventional production by 2030 on the

shape of oil production. The figure of 12 million b/d can be aggregated from 2 million b/d in the existing green production part, 3 million b/d in the red new oil projects part and 7 million b/d in the purple unconventional part.

Will the decline rate continue at 4.5%?

The scenario in figure 5 above, with a plateau extending for a decade, is very dependent on the future evolution of the decline rate. As mentioned before, technological development can add reserves to the present oil fields of the world, so called reserve growth, and thus slow the decline rate significantly. For more details about reserve growth, I wrote a three part series about this topic, published on The Oildrum last year (1), (2),(3). Estimates and opinions on reserve growth differ widely. For the purpose of this scenario exercise, we take the figure of 500 billion barrels presented by Ray Leonard as the consensus conclusion of one of the latest HedBerg Conferences on the future of oil production. More information about this conference can be found in the interview of journalist David Strahan with Ray Leonard about the HedBerg Conference. The figure of the Hedberg conference leads to a recoverable conventional reserves estimate of 1890 billion barrels (1220 billion from present reserves, 170 billion from future discoveries and 500 billion from reserve growth). How likely this amount of reserve growth is going to occur will be discussed later in the discussion at the end. The effect is shown in figure 6 below, where we see that a sum of 500 billion barrels does not lead to an extension of the plateau, but to a much slower decline rate after the slightly higher peak.

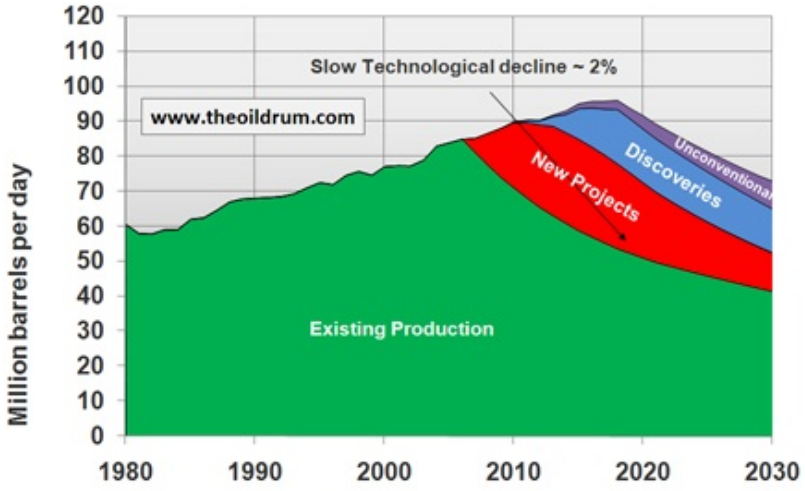


Figure 6 – The effect of 500 billion barrels added from reserve growth on the shape of oil production.

On the other hand, there is also a significant downward potential because of the giant and super giant oilfields which dominate production. In his PhD thesis, Fredrik Robelius did a splendid job on analysis the largest oil fields in the world. A set of 507 giant and supergiant fields, contain around half of the words presently expected oil reserves that are going to be produced, according to the IHS Energy database. Their share of present total production is 48%, or in production terms, 40 million barrels per day. From his model, Robelius expects that these fields are the main driving force behind the shape of oil production yet to come. When this group of fields, that has been on a plateau since the '80s, starts to decline, world production will go with them. In figure 7 below the low standard case from Robelius is shown, assumptions behind this scenario can be found in his PhD. thesis on page 126 and 127, such as the expectation that the ultimate production of the supergiant Ghawar will be 105 billion barrels.

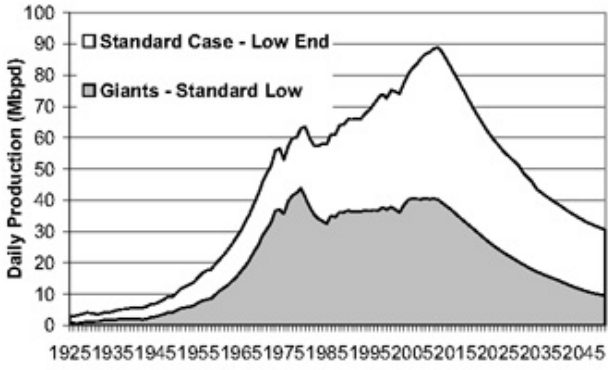


Figure 7 – The effect of the decline in the giant oil fields on world oil production- taken from the giant oil fields of the world, Fredrik Robelius, 2007, Uppsala University

Next to the decline in production from the super giant oilfields, which is bound to increase decline rates, deepwater production will also have a significant influence. Deepwater fields have a rapid upslope, a short peak and a rapid downslope, because that is the most economical way to produce the oil from deepwater fields. In total, deepwater production is expected to ramp up to 9 to 12 million barrels per day at the beginning of the next decade, after which a annual decline of 10%-15% sets in (Campbell 2006, Robelius 2007).

A scenario of what could happen to the shape of oil production because of these downward potentials is shown in figure 8 below. Here we see production increasing to a peak in 2010, after which the decline sets in which increases rapidly at the end of the next decade. Leading to a recoverable conventional reserves estimate of 1170 billion barrels (1000 billion from present reserves and 170 billion from future discoveries).

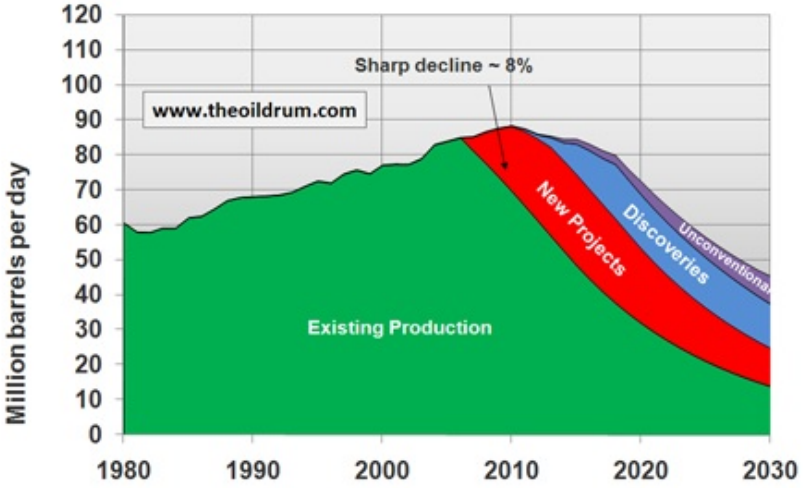


Figure 8 – The effect of an increase in the decline rate of present production towards 8% on the shape of world oil production.

Conclusions

1)If the global decline rate of existing production of 4.5% continues, oil production is likely to plateau at a level of 90 million barrels per day around 2010 until the end of the next decade, after which a moderate to sharp decline sets in.

2)If the global decline rate of existing production of 4.5% slows down to 2%, thanks to the addition of 500 billion barrels due to reserve growth, production will likely increase with some bumps towards 95 million barrels per day at the end of the next decade, after which a slow to moderate decline sets in.

3)If the global decline rate of existing production of 4.5% increases to 8%, due to the effect that the end of the era of giant oil fields and declining deepwater production has, production will likely peak around 2010 at 88 million barrels per day, declining slightly to 80 million barrels per day at the end of the next decade, after which a sharp decline sets in.

Discussion

The discussion on peak oil has progressed significantly since the article on the end of cheap oil was published in Scientific American (Campbell & Lahérrere, 1998). Presently there is a converging agreement that we are going to enter a period in which supply can no longer meet demand, giving way to sustained high oil prices. Either because of the expectation of a long production plateau for one to several decades, or a peak after which a sharp decline sets in. My scenario exercise supports mainly the view of a peak with a sharp decline. The conditions in which a plateau can occur for more than a decade are an unlikely amount of reserve growth, significantly above 500 billion barrels, and/or much higher unconventional production increases.

As to what is the most likely scenario, I expect that the increase towards a higher decline rate, as shown in figure 8, is going to occur. The reasoning behind this is a combination of developments, 1) The end of the era of giant oil fields, where there was a sustained base of production of 40 million b/d, which is going to fall away, 2) The end of a sharp increase in production thanks to deepwater, which is going to go away with an equally sharp decrease, 3) The fact that the world has produced more reserves in the past three years than have been added from discoveries and reserve growth (Robelius, 2007; J.S. Herold, 2007), 4) The effect of above ground factors on production, which will lead to higher declines, because from 2009/2010 onwards there will be a significant gap between personnel supply and demand (CERA, 2007), there is a problem to scale up sufficient oil rigs for exploration and production (Simmons 2006), unrest and geopolitics are delaying new oil fields developments, and keeping production down in several countries such as Iraq, Venezuela and Nigeria, which is not likely to change for the better in the future.

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