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TOTAL's view on future oil production

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Since 2006, the international oil company TOTAL has consistently voiced warnings about the future inability of the oil industry to meet continued oil demand growth. In 2006, then CEO Thierry Desmarest stated that maximum oil production lies between 100 to 110 million b/d, reached potentially by 2020. Only a year later the new CEO Christophe de Margerie announced that it would be difficult for the industry to produce beyond 100 million b/d, a message that became and remained 95 million b/d in subsequent years (1), (2), (3), (4). To better understand how TOTAL arrives at this view, the organizers of the 9th international ASPO conference asked the company to give a presentation on why they expect a plateau in production around 95 million b/d. In this post I give a summary of that presentation, given by Pierre Mauriaud, TOTAL Exploration Training and Technical Image Manager (PDF of presentation) (watch presentation VIDEO).

In the first part of his presentation, Pierre Mauriaud described a number of graphs and trends well known to those who study Peak Oil. These included the discovery trends outlining peak discovery in the 1960s, changes in OPEC oil reserves in the 1980s, and the Hubbert curve that shifted due to the 1973 and 1979 oil shock. He made the important statement that TOTAL does not trust any published numbers, but works on the basis of their own geological data to estimate resources, reserves, and production potentials depending on the geology of the basin.

The modelling of tens of thousands of oil fields

Pierre Mauriaud told the audience about their internal team that for a number of years has carried out an analysis on all oil fields in the world, to assess what is geologically possible to produce. Their geological model is probably fairly complex, and was not shared in detail, but an illustration was given via a simplified version. Mauriaud gave the distinction between North Sea Clastic and Middle East Carbonate reservoirs. The main difference is the behavior of water and oil in the sedimentary rock at a pore level. In a clastic reservoir only oil will be produced in the early lifetime of the well. The produced water content will begin to increase when around 20% to 30% of the ultimate oil reserves are produced, shown in figure 1 for an unnamed clastic oil field in the North Sea.

Figure 1 - Production profile of a North Sea Clastic Oil Field. Source: Pierre Mauriaud, TOTAL (click for large version)

Together with the increase in water content of production in a clastic reservoir, overall oil production begins to decline, a process which can be postponed only marginally according to Mauriaud.

> "After 20 or 30% of production in the field you get more and more water, whatever you do. There are a lot of little things you can do to improve it, but on the long term you cannot produce more. There are extremely good reservoirs in the north sea where you can produce up to 50%, but normally the average world you cannot get more than 35-37% of oil because you get more and more water. And that is the case for all clastic reservoirs such as in the north Sea and deep offshore fields."

The oil to water content of production is highly different for a carbonate reservoir, where the oil "sticks" to the rock and water is also initially found between the pores. Mauriaud told the audience that when a reservoir is in this case produced too quickly much more water is produced and the oil recovery factor declines. The reason is that the oil can become immobilized once the water front has gone past the pores. In general water production along with the oil in these reservoirs comes very quickly already at the beginning of production, shown in figure 2 for an unnamed Carbonate oil field in the Middle East.

Figure 2 - Production profile of a Middle East Carbonate Oil Field. Source: Pierre Mauriaud, TOTAL (click for large version)

By doing the exercise above in a more detailed manner for various different basins TOTAL found a clear pattern in that all fields begin their decline around 25% to 30% of the oil originally in place (OIIP).

> "Whatever the size of the field, you can put Ghawar the biggest field in the world and a very small one together, there is some physical law that after a recovery of about 25% - 30% of the Oil Originally In Place (OIIP) in the reservoir oil production will begin to decrease."

In performing their analysis, TOTAL created their own view on how future oil production in different regions will develop. Mauriaud mentioned in his presentation that once the geological decline begins it is inevitable, except for a few small upward bumps which do not change the decline trend much (shown in figure 3 in the case of the UK). Also, he made the prediction that the decline in Russian oil production will begin once about 60% of all potential to produce reserves are produced, implying that Russia will peak around 2014.

Figure 3 - Production expectation for Russia. Source: Pierre Mauriaud, TOTAL (click for large version)

The key message behind TOTAL's Peak Oil Expectation.

Just like in past public statements by TOTAL, Pierre Mauriaud mentioned that their key message is not one of a lack of resources. According to the company there are plenty of resources left, including conventional oil. The problem lies in turning these into reserves due to the need for advanced technology, large scale investments, and a lack of resource accessibility of international oil majors.

> "When I was thinking about the highly technical and huge investments needed, it is sure that the time of cheap oil is finished and has been for some time. It is something which is absolutely obvious, and the low-cost cheap oil is only remaining in OPEC countries in the Middle East...there are all these more technical oils such as deepwater, extra heavy oil, arctic oil, which can be produced but only when the price is right, and which depends on the law of offer, supply and demand, due to which oil demand is very important"

To underline this view, he presented a highly interesting graph depicted in figure 4 with data on TOTAL's expectation for production costs of different types of oil, denoted in the break even oil price in 2010 at an Internal Rate of Return (IRR) above 10%. The more technical projects, including enhanced oil recovery and extra heavy oil, require an oil price range between 60 to 90 dollars to give a decent return.

Figure 4 - Break even oil price range in 2010 required to produce a certain type of oil. Includes all sources of oil. Source: Pierre Mauriaud, TOTAL (click for large version)

The cost, lead times, and probably other factors such as unavailability of production inputs like water not mentioned in the presentation, leads TOTAL to believe that it will be difficult to meet demand in the future. Although not explicitly stated by Mauriaud, but mentioned in earlier interviews, TOTAL does not see the international oil majors able to sufficiently increase production by the more complex technical projects. The new detail beyond previous statement's from Mauriaud's presentation is the relative quantification given of which regions will be the major producer in the future, as shown in the chart *"oil production by 2020-2030 around 95 million barrels per day"*, shown in figure 4. This chart shows the relative decline and increase in several world regions, without any quantified number to really know what is going on. From this we can learn that TOTAL sees oil production as stagnating and declining in all regions except for the Middle East. The Americas (Canada and Venezuela) will be able to increase Heavy Oil production significantly, but that is not going to be enough to compensate for mature conventional oil production in the OECD, at least if the bars in the graph are scaled similarly as one would logically expect. Based on this, it can be inferred from the chart that TOTAL expects 45% to 50% of the 95 million b/d will come from the Middle-East in 2030.

Figure 5 - Total's expectation for oil production in 2030. Source: Pierre Mauriaud, TOTAL (click for large version)

A stable plateau, or large shocks and deviations?

The 95 million barrels per day production level stated by TOTAL is based on a geological comprehension of what is possible, but does not incorporate political changes at a national level nor economic changes in the world economy as also explicitly mentioned by Mauriaud:

> "What we will produce is around 95 million b/d mostly in the Middle-East, it will not be flat, no way, just think about what is now happening in the Middle East, between Yemen, Egypt, just think a minute what happens if this happens in Saudi Arabia...that could be going back and forth...basically linked to how the oil is produced the Middle-East produces very slowly and they have good reserves [I think he means large here or good reservoirs]."

To summarize, according to TOTAL the world can likely not produce over 95 million barrels per

day due to constraints in producing more technically challenging oil fields such as deepwater, heavy oil, and fields located in the arctic. Furthermore, such a production level is only possible if the countries in the Middle-East, especially Saudi-Arabia, Iran, and Iraq, will be able and willing to increase their production.

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