PEAK OIL: THE END OF THE MODELING PHASE

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1. *Introduction*

Modeling for 'Peak Oil' began seriously in the mid-1990s as the question of worldwide oil production reaching a maximum became a matter of widespread concern in some petroleum circles and academic centers. Among a score of other models, the 'World Oil Production Capacity' [WOCAP] model was developed over the years 1997-2000 [1]. And, even in those early days, the model --- based on 'Ultimate Recoverable Reserves' [URR] of 1,900 billion barrels estimated by Dr. Colin Campbell --- did point towards a 'Peak' within the first decade of the 21st century.

2. *The WOCAP model*

Further design developments and dozens of simulations over the years 2001-2003 resulted in WOCAP's final 'Base Case' scenario that predicted a 'Peak' of 81-82 million barrels per day [mb/d] over the years 2006-2007 (see Figure 1).

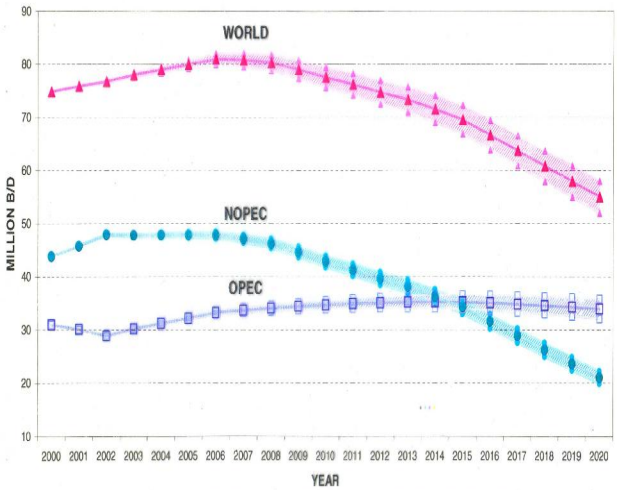

Figure 1. GRAPHICAL REPRESENTATION OF CRUDE OIL PRODUCTION IN OPEC, NON-OPEC (NOPEC) AND WORLD ACHIEVED BY SIMULATING 'WOCAP' MODEL OVER 2003-2020, WITH RESPECTIVE ERROR MARGINS ADDED IN.

Thereafter, global production would enter a decline; at first, with a benign gradient, which would get gradually steeper, leading to a 2020 production level of some 55 mb/d (give or take 3 mb/d). In 2003, however, many of the other models did show 'Peaks' well after 2010 and the idea of an early 'Peak' in the first decade of the century was widely regarded as 'highly pessimistic' and 'rather improbable'.

Then, in 2004, Prof. Renato Guseo of the University of Padova entered the world of 'Peak' modeling with his 'Generalized Bass Model' [GBM] based on the 'Diffusion Method' [2] and making use of the powerful 'Non-Linear Least Squares' algorithm. The major results obtained by the GBM were for a 'Peak Oil' in 2007 (see Figure 2) and a 2020 production of 55 mb/d.

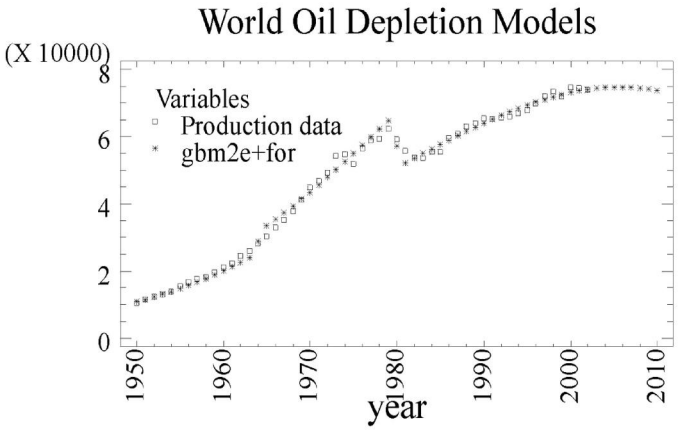

Fig. 2. World Oil Depletion: a zoom on GBM after 1950 with two exponential shocks.

Now, two very different models --- WOCAP and GBM --- had arrived at the very same conclusion, and that could not be pure coincidence. To the contrary, it was a proof (if proof need be) that the 'Peak' was for either 2006 or 2007. In addition, the similar 2020 production level of some 55 mb/d not only confirmed the models' parallelism but also came to stand as the best prediction available presently worldwide for future oil output.

Having seen the results of Prof. Guseo's GBM model, it became clear that the modeling phase of 'Peak Oil' had come to an abrupt close and that henceforward 'Peak Modeling' should be shelved once and for all. Some experts still seem unconvinced as they continue to compare and weigh results generated by all types of available models --- as, for example, 'The Oil Drum' [3] and 'TrendLines' [4] websites. A comparison is available in ref. [6] while a comparison from The Oil Drum is shown in Figure 3.

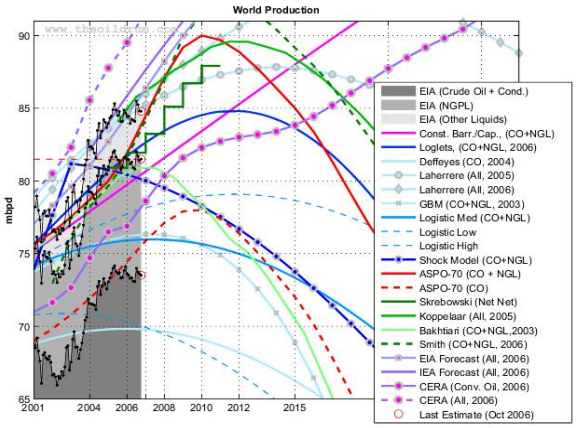

Figure 3

4. "Bottom up" analysis

Despite the good agreement of the historical data and the models, a clear-cut confirmation of 'Peak Oil' was still called for and the best method at hand seemed to be a 'bottom up' analysis. Thus, for every given year, the output of fresh oilfields and field expansions coming on-stream would be added up, and compared with global depletion of all the producing oilfields.

In order to assess 'negative' depletions, the world was subdivided into two regions: OPEC (11 members) and Non-OPEC (11 regions), and each of these subdivisions assayed for both onshore and offshore depletions; yielding a grand total of forty-four 'negative' rates. As for the 'positive' inputs, all fresh oilfields (both for 'Conventional' and 'Non-Conventional' [5]), field expansions and also Secondary Recovery projects (EORs) were taken into considerations and duly added up. This exercise was initially carried out for the four years 2006-07-08-09. And for all these years, 'negatives' came to surpass 'positives' by a margin that left little doubt over the imminent decline of global crude oil production.

For example, in the case for 2006, the 44 depletion rates yielded a cumulative of roughly 3.5 mb/d (give or take an error margin of 10%) and the fresh inputs amounted to a maximum production of 2.5 mb/d --- coming from 25 fresh or expanded oilfields, and three Canadian 'tar sands' projects. Therefore, the conclusion was drawn that for 2006, overall oil production should be in decline --- especially bearing in mind that the 'negatives' will occur come what may, but the 'positives' depend on the upstream developments being completed on schedule.

Crude oil production statistics should always be weighed for their true worth with utmost care, as they usually reflect official data --- which are subject to being influenced by a number of factors independent from the oil industry itself. As Dr. Campbell uses to say: "All data are wrong; the question is: by how much?".

Nevertheless, even official data can sometimes be indicative of a general trend. For example, oil production figures issued by the 'International Energy Agency' [IEA] and the US 'Energy Information Administration' [EIA] over the last two years both report a rather flat output for the past eight quarters (see Table 1 below for actual daily averages). This trend is unprecedented in oil industry history and does seem to strongly indicate that the global oil supply has entered a protracted stagnation period that can only open up on some kind of decline. Furthermore, a graphical representation of '12-month moving averages' for global 'all-liquids' output is available in ref [6]. The following graph shows a comparison of results from several models and the experimental data.

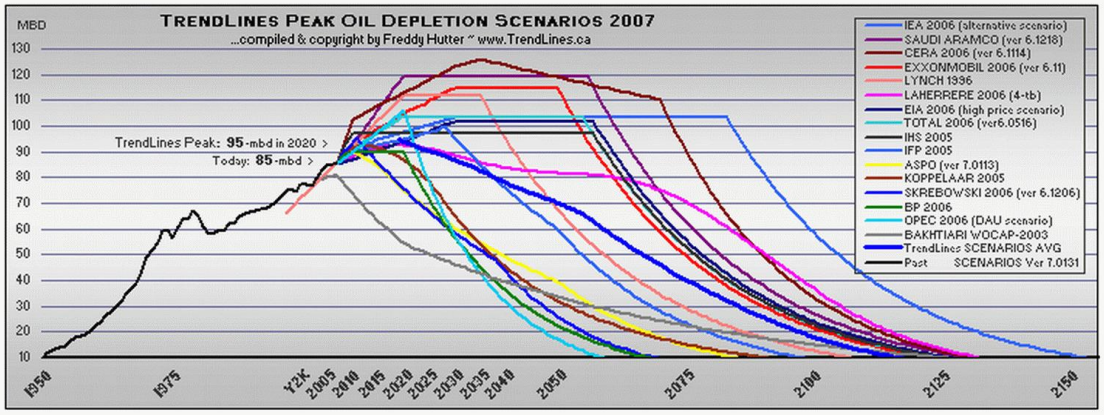

Table 1. Total World Supply of 'Hydrocarbon Liquids' as reported by the EIA in its 'World Oil Balance' for 2005-2006 [7].

Year / Quarter		*Total World Supply [daily average in mb/d]*
2005	*Q1*	*84.24*
	Q2	*85.03*
	Q3	*84.45*
	Q4	*84.54*
2006	*Q1*	*84.25*
	Q2	*84.17*
	Q3	*85.18*
	Q4	*84.74*

N.B. The discrepancy between the EIA daily averages and the WOCAP 'Peak' at between 81-82 mb/d is due to different definitions of 'liquid hydrocarbons' --- but it is here of secondary importance because the emphasis is on the output's apparent stagnation (neatly mirroring the flatness observed at the simulated WOCAP 'Peak').

4. Conclusion

The similarity of the results obtained by two very different models --- the WOCAP and the GBM --- should help bring 'Peak Oil' modeling to a close, as according to these models the peak of global oil production has now been reached. Furthermore, the two models' similar forecast for a global oil supply of 55 mb/d by 2020 can now be considered as being the most accurate and reliable forecast for the future production of the international oil industry.

REFERENCES

[1] See: 'December 2003: The World Oil Production Capacity Model' at the website www.samsambakhtiari.com

[2] Prof. Renato Guseo et al., 'World Oil Depletion Models', 'XLII Riunione Scientifica' SIS, at Bari, June 9-11, 2004.

[3] 'The Oil Drum' website is at www.theoildrum.com

[4] 'TrendLines' website at www.trendlines.ca

[5] As per definitions established by Dr. Colin Campbell, 'Conventional Oil' is defined as the common crude oils with API degrees between 20 and 50; whereas 'Non-Conventional Oil' mainly covers four major categories:
(1) Extra Heavy oils (tar sands, oil shales, Orinoco heavy oil, etc…);
(2) Deepwater oil;
(3) Polar oil;
(4) Gasplant NGL.

[6] See the website www.energikrise.com for the source of the graph --- which is based on data taken from the 'International Petroleum Monthly'.

[7] See in website www.eia.doe.gov and the section 'World Oil Balance' spanning 2002-2006.