The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

# Peak Oil Update - July 2009: Production Forecasts and EIA Oil Production Numbers

Posted by Sam Foucher on July 7, 2009 - 10:05am
Topic: Supply/Production
Tags: ali morteza samsam bakhtiari, bp, chris skrebowski, eia, logistic, loglets, m. king hubbert, oil, original, rembrandt koppelaar, robelius, update [list all tags]

An update on the latest production numbers from the EIA along with graphs/charts of different oil production forecasts.
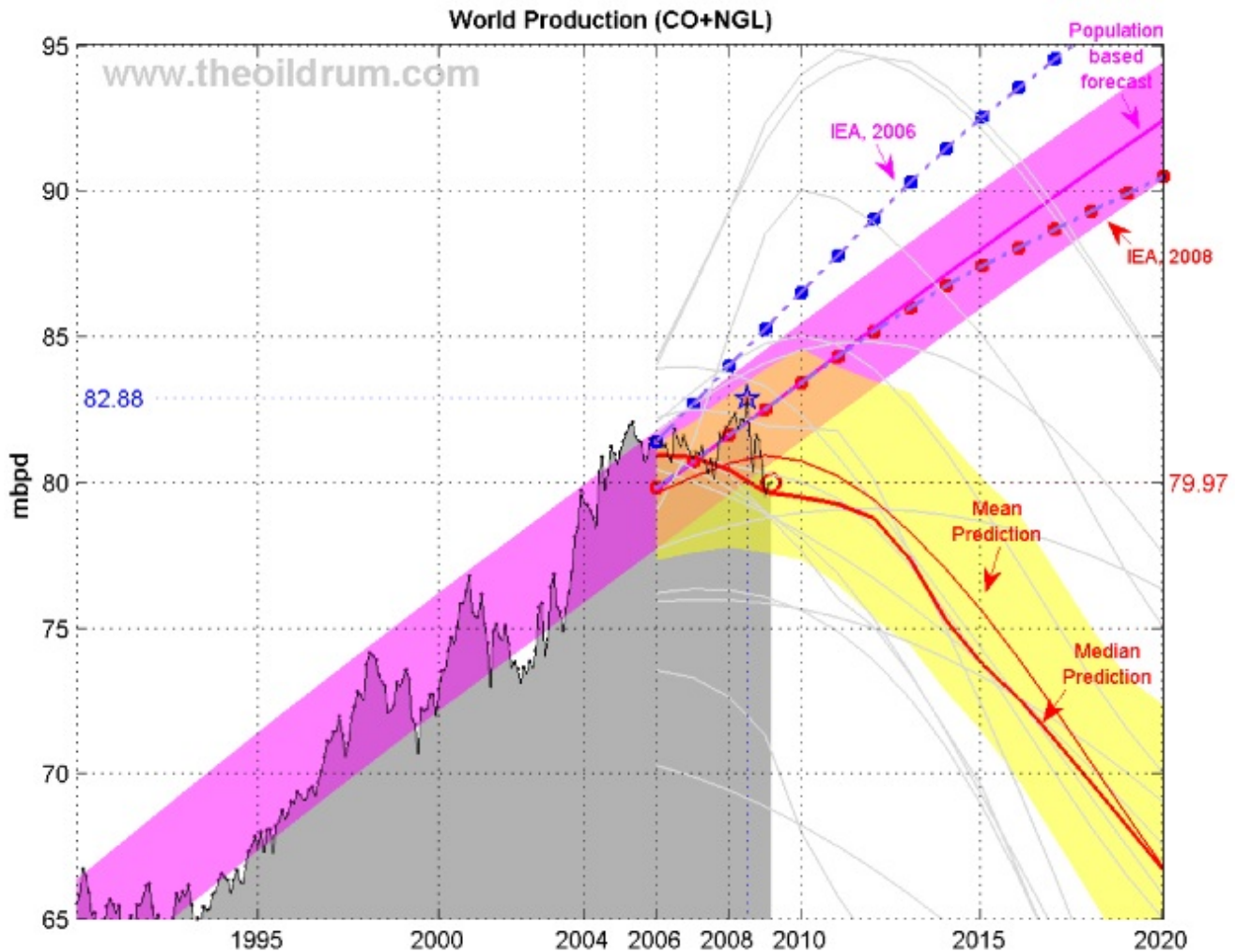
World oil production (EIA Monthly) for crude oil + NGL. The median forecast is calculated from 15 models that are predicting a peak before 2020 (Bakhtiari, Smith, Staniford, Loglets, Shock model, GBM, ASPO-[70,58,45], Robelius Low/High, HSM,Duncan&Youngquist). 95% of the predictions sees a production peak between 2008 and 2010 at 77.5 - 85.0 mbpd (The 95% forecast variability area in yellow is computed using a bootstrap technique). The magenta area is the 95% confidence interval for the population-based model. Click to Enlarge.

Notations:

- *mbpd= Million of barrels per day*
- *Gb= Billion of barrels (10^9)*
- *Tb= Trillion of barrels (10^{12})*
- *NGPL= Natural Gas Plant Liquids*
- *CO= Crude Oil + lease condensate*
- *NGL= Natural Gas Liquids (lease condensate + NGPL)*
- *URR= Ultimate Recoverable Resource*

EIA Last Update (March)

Data sources for the production numbers:

- Production data from BP Statistical Review of World Energy (Crude oil + NGL).
- EIA data (monthly and annual productions up to March 2009) for crude oil and lease condensate (noted CO) on which I added the NGPL production (noted CO+NGL).

The all liquid peak is now July 2008 at 86.65 mbpd, the year to date average production value in 2009 (3 months) is down from 2008 for all the categories. The peak date for Crude Oil + Cond. is also July 2008 at 74.80 mbpd (see Table I below).
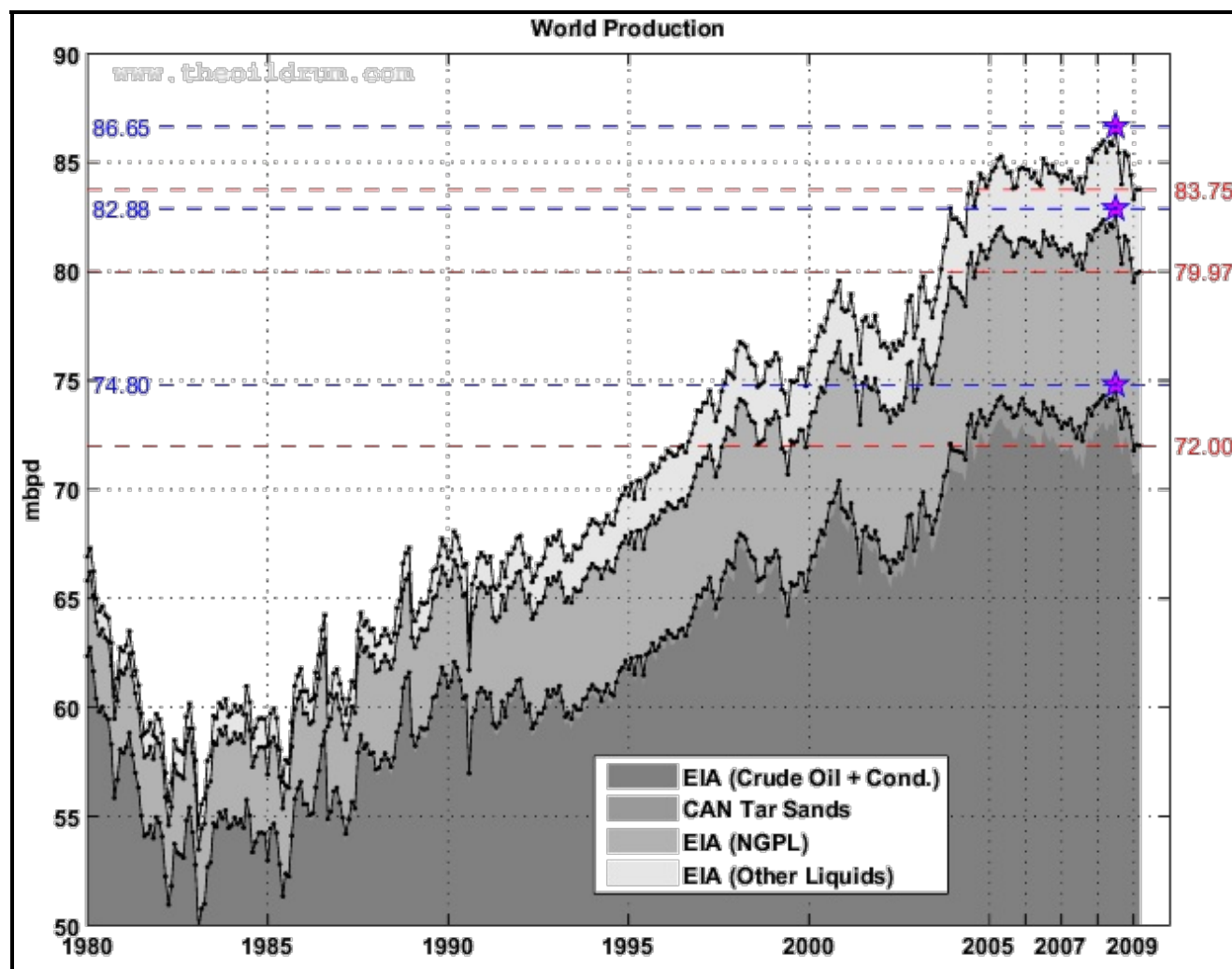
Fig 1.- World production (EIA data). Blue lines and pentagrams are indicating monthly maximum. Monthly data for CO from the EIA. Annual data for NGPL and Other Liquids from 1980 to 2001 have been upsampled to get monthly estimates.

Category	MAR 2009	MAR 2008	MAR 2007	12 MA[1]	2009 (3 Months)	2008 (3 Months)	2007 (3 Months)	Share	Peak Date	Peak Value
All Liquids	83.75	85.98	84.25	84.93	83.60	85.48	84.42	100.00%	2008-07	86.65
Crude Oil + NGL	79.97	82.35	80.92	81.14	79.79	81.73	80.96	95.49%	2008-07	82.88
Other Liquids	3.78	3.63	3.33	3.79	3.81	3.75	3.45	4.51%	2008-11	3.89
NGPL	7.97	8.06	7.95	7.89	7.86	7.93	7.96	9.52%	2008-07	8.08
Crude Oil + Condensate	72.00	74.29	72.97	73.25	71.93	73.80	73.01	85.97%	2008-07	74.80
Canadian Tar Sands	1.26	1.19	1.26	1.22	1.24	1.20	1.19	1.50%	2007-08	1.35

Table I - Production estimate (in millions of barrels per day (mbpd)) up to March 2009 taken from the EIA website (International Petroleum Monthly). [1]Average on the last 12 months. Canadian tar sands production numbers are from the NEB and includes updagraded and non-upgraded bitumen.

Business as Usual

- EIA's International Energy Outlook 2006, reference case (Table E4, World Oil Production by Region and Country, Reference Case).
- IEA total liquid demand forecast for 2006 and 2007 (Table1.xls).
- IEA World Energy Outlook 2008, see post here for details.
- IEA World Energy Outlook 2006 : forecasts for All liquids, CO+NGL and Crude Oil (Table 3.2, p. 94).
- IEA World Energy Outlook 2005 : forecast for All liquids (Table 3.5).
- IEA World Energy Outlook 2004 : forecast for All liquids (Table 2.4).
- A simple demographic model based on the observation that the oil produced per capita has been roughly constant for the last 26 years around 4.4496 barrels/capita/year (Crude Oil + NGL). The world population forecast employed is the UN 2004 Revision Population Database (medium variant).
- CERA forecasts for conventional oil (Crude Oil + Condensate?) and all liquids, believed to be productive capacities (i.e. actual production + spare capacity). The numbers have been derived from Figure 1 in Dave's response to CERA.
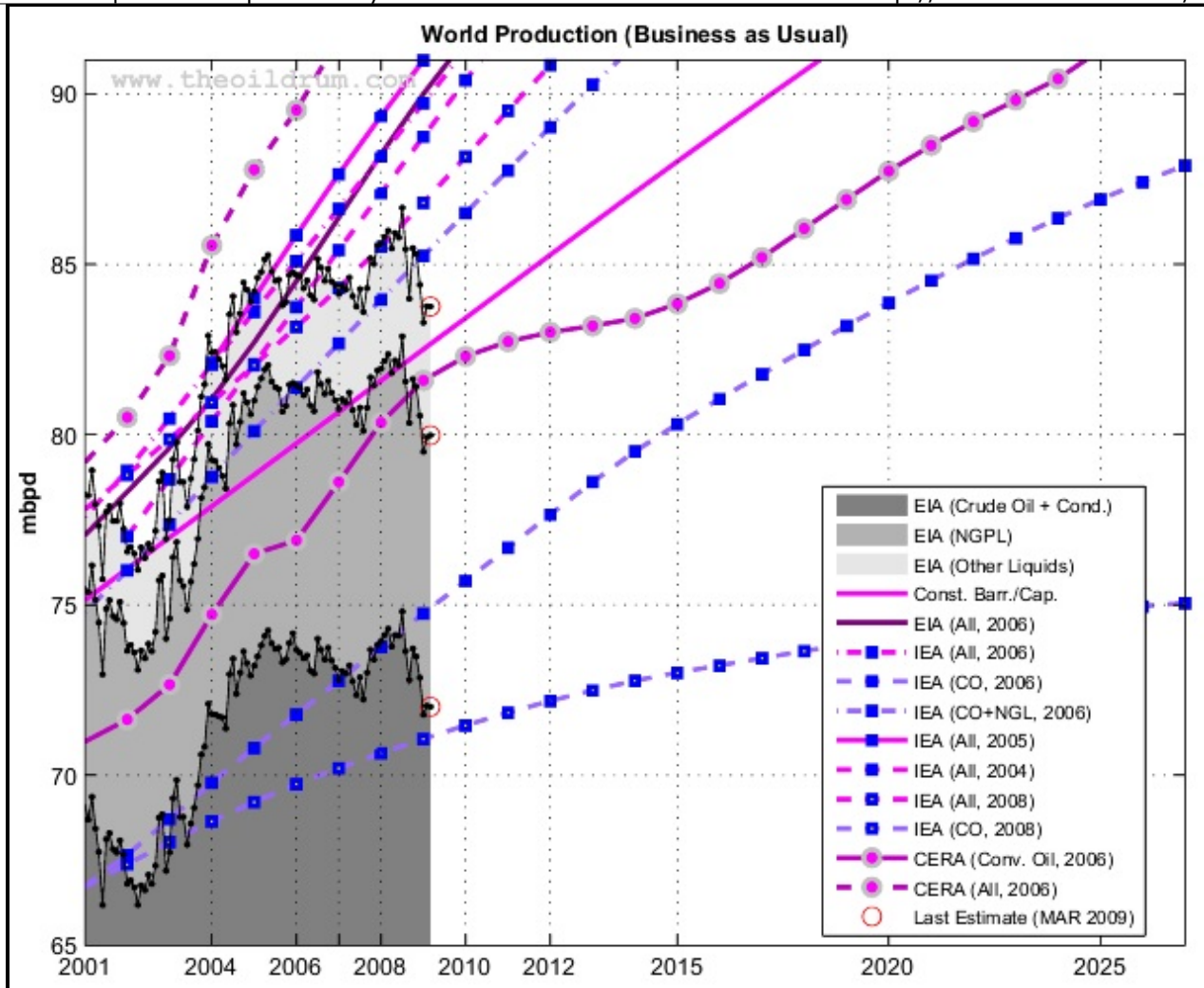
Fig 4.- Production forecasts assuming no visible peak.

PeakOilers: Bottom-Up Analysis

- Chris Skrebowski's megaprojects database (see discussion here).
- The ASPO forecast from April newsletter (#76): I took the production numbers for 2000, 2005, 2010, 2015 and 2050 and then interpolated the data (spline) for the missing years. I added the previous forecast issued one year and two years ago (newsletter #58 and #46 respectively).
- Rembrandt H. E. M. Koppelaar (Oil Supply Analysis 2006 - 2007): *"Between 2006 and 2010 nearly 25 mbpd of new production is expected to come on-stream leading to a production (all liquids) level of 93-94 mbpd (91 mbpd for CO+NGL) in 2010 with the incorporation of a decline rate of 4% over present day production"*.
- Koppelaar Oil Production Outlook 2005-2040 - Foundation Peak Oil Netherlands (November 2005 Edition).
- The WOCAP model from Samsam Bakhtiari (2003). The forecast is for crude oil plus NGL.
- Forecast by Michael Smith (was at the Energy Institute, now works for EnergyFiles) for CO+NGL, the data have been taken from this chart in this presentation (The Future for Global Oil Supply (1641Kb), November 2006.).
- PhD thesis of Frederik Robelius (2007): *Giant Oil Fields - The Highway to Oil: Giant Oil Fields and their Importance for Future Oil Production.* The forecasts (low and high) are derived from this chart.

- Forecast by TOD's contributor Ace, details can be found in this post.
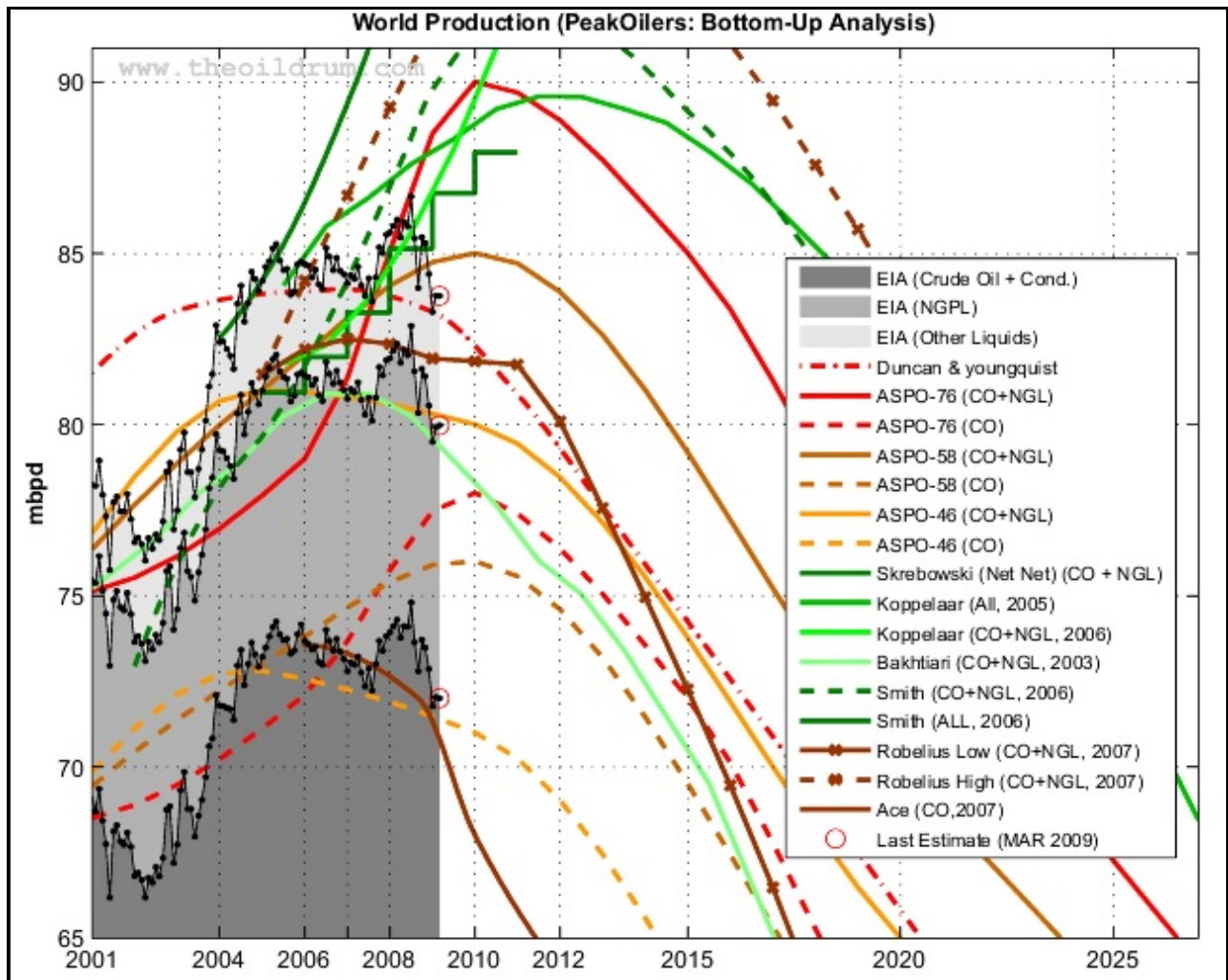- The forecast by Duncan and Youngquist made in 1999, see also this post by Euan Mearns.

Fig 5.- Forecasts by PeakOilers based on bottom-up methodologies.

PeakOilers: Curve Fitting

The following results are based on a linear or non-linear fit of a parametric curve (most often a Logistic curve) directly on the observed production profile:

- Professor Kenneth S. Deffeyes forecast (Beyond Oil: The View From Hubbert's Peak): Logistic curve fit applied on crude oil only (plus condensate and probably excluding tar sand production) with URR= 2013 Gb and peak date around November 24th, 2005.
- Jean Lahèrrere (2005): Peak oil and other peaks, presentation to the CERN meeting, 2005.
- Jean Lahèrrere (2006): When will oil production decline significantly? European Geosciences Union, Vienna, 2006.
- Logistic curves derived from the application of Hubbert Linearization technique by Stuart Staniford (see this post for details).
- Results of the Loglet analysis.
- The Generalized Bass Model (GBM) proposed by Prof. Renato Guseo, I used his most recent paper (GUSEO, R. et al. (2006). World Oil Depletion Models: Price Effects Compared

with Strategic or Technological Interventions ; Technological Forecasting and Social Change, (in press).). The GBM is a beautiful model that has been applied in finance and marketing science (see here for some background). The estimation in Guseo's article was based on BP data from 2004 (CO+NGL).

- The so-called shock model proposed by TOD's poster WebHubbleTelescope . You can find a description of his approach on his blog here as well as a review on TOD. The current estimate was done in 2005 based on BP's data (CO+NGL).

- The Hybrid Shock Model is a variant of the shock model described here. The forecast is based on EIA data (up to 2006) for crude oil + condensate, the ASPO backdated disovery curve and assumes no reserve growth and declining new discoveries.
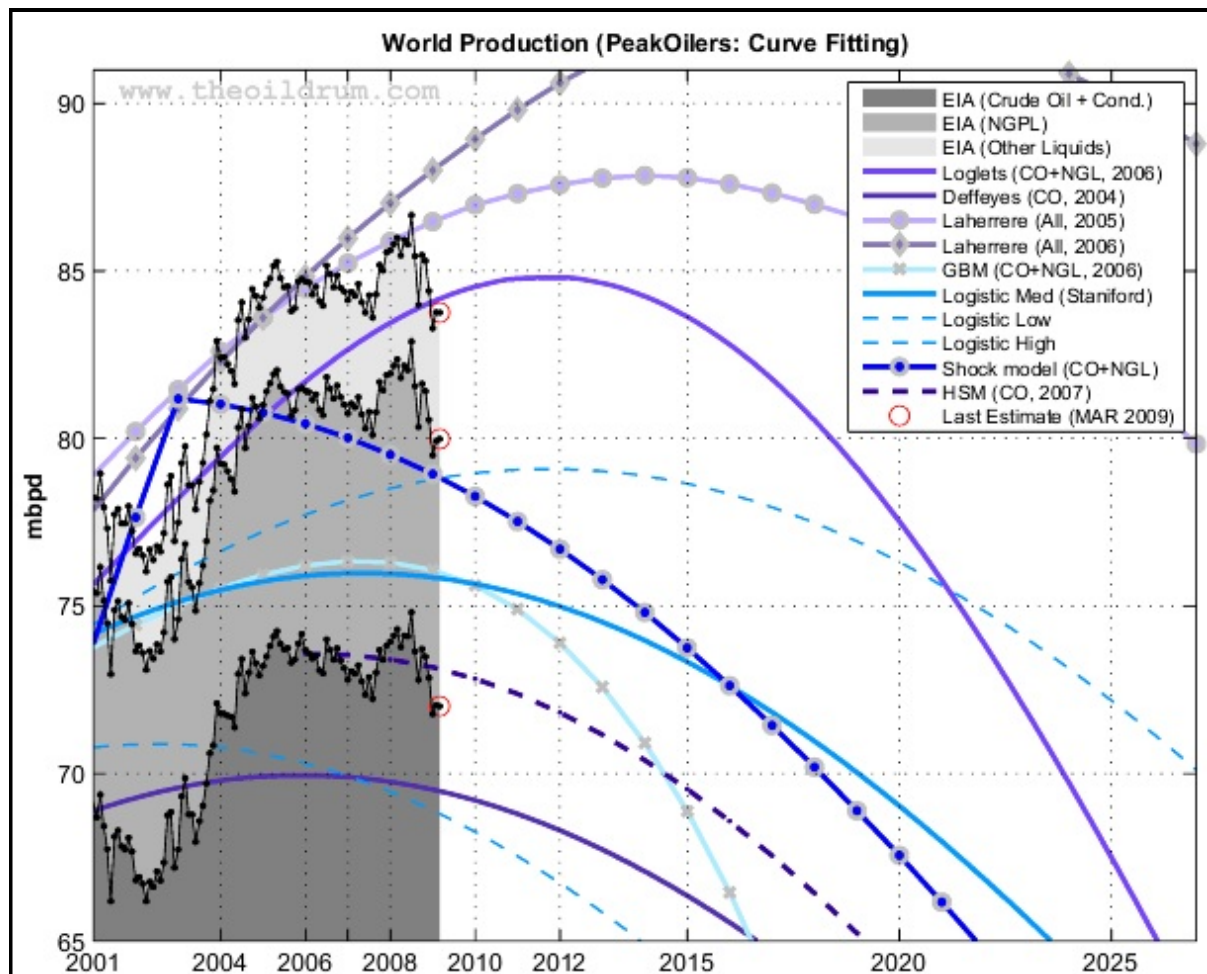

Fig 6.- Forecasts by PeakOilers using curve fitting methodologies.

Forecast Performance

It is difficult to compare forecasts because they deal with different liquid category and have different baseline. The forecasts were evaluated using the Mean Asolute Scaled Error (MASE) proposed by Hyndman and Koehler [1]. A good forecast will have a MASE value less than 1 (i.e. better performance than a simple naive forecast). We can notice than some MASE curves are decreasing with time indicating that their predicted values are getting more accurate further in time.
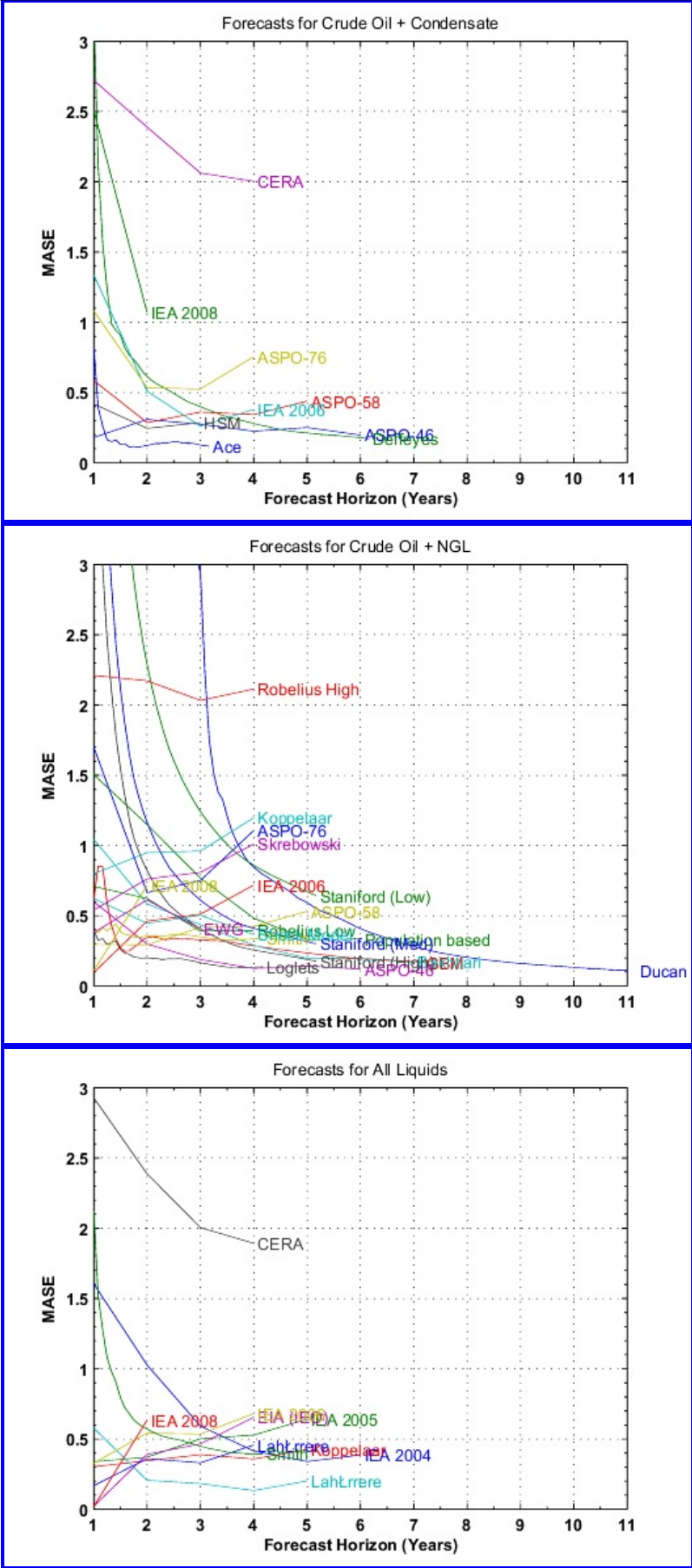
Fig. 7. - MASE values as a function of the forecast horizon.

Forecast	Date	2006	2008	2009	2010	2015	MASE[2]	Peak Date	Peak Value
All Liquids									
Observed (All Liquids)		*84.54*	*85.48*	*83.60*	*NA*	*NA*		*2008-07*	*86.65*
IEA (WEO)	2004	83.74	87.08	88.74	90.40	98.69	0.39	2030	121.30
IEA (WEO)	2005	85.85	89.35	90.98	92.50	99.11	0.64	2030	115.40
Koppelaar	2005	85.78	87.60	88.33	89.21	87.98	0.42	2011	89.58
Lahèrrere	2005	84.47	85.87	86.46	86.96	87.77	**0.20**	2014	87.84
EIA (IEO)	2006	84.50	88.23	90.00	91.60	98.30	0.65	2030	118.00
IEA (WEO)	2006	85.10	88.17	89.73	91.30	99.30	0.68	2030	116.30
CERA[1]	2006	89.52	93.75	95.34	97.24	104.54	1.89	2035	130.00
Lahèrrere	2006	84.82	87.02	87.99	88.93	92.27	0.46	2018	92.99
Smith	2006	87.77	94.38	96.98	98.94	98.56	0.39	2012-05	99.83
IEA (WEO)	2008	83.15	85.51	86.80	88.15	94.40	0.63	2030	106.40
Crude Oil + NGL									
Observed (EIA)		*81.25*	*81.73*	*79.79*	*NA*	*NA*		*2008-07*	*82.88*
Duncan & Youngquist	1999	83.93	83.55	82.90	81.65	73.47	**0.11**	2007-01	83.95
Population based	2004	79.73	81.58	82.50	83.42	88.01	0.33	2050	110.64
GBM	2003	76.27	76.20	75.87	75.30	67.79	0.17	2007-05	76.34
Bakhtiari	2003	80.89	80.24	78.94	77.64	69.51	0.17	2006	80.89
ASPO-46	2004	80.95	80.59	80.31	80.00	73.77	0.12	2005	81.00
ASPO-58	2005	82.03	84.05	84.74	85.00	79.18	0.53	2010	85.00
Staniford (High)	2005	77.92	78.63	78.86	79.01	78.51	0.18	2011-10	79.08
Staniford (Med)	2005	75.94	75.91	75.76	75.52	73.00	0.30	2007-05	75.98
Staniford (Low)	2005	70.13	69.20	68.60	67.92	63.40	0.64	2002-07	70.88
IEA (WEO)	2006	81.38	83.96	85.24	86.50	92.50	0.72	2030	104.90
Koppelaar	2006	82.31	85.60	88.03	91.00	NA	1.20	2010	91.00
Skrebowski	2006	81.97	85.14	86.76	87.95	NA	1.01	2010	87.95
Smith	2006	82.81	88.27	90.58	91.95	88.60	0.34	2011-02	92.31
Loglets	2006	82.14	83.74	84.29	84.65	83.26	0.14	2012-01	84.80
ASPO-76	2006	79.00	85.06	88.49	90.00	85.00	1.11	2010	90.00
Robelius Low	2006	82.19	82.35	81.92	81.84	72.26	0.39	2007	82.50
Robelius High	2006	84.19	89.27	91.65	93.40	92.40	2.11	2012	94.54
Shock Model	2006	80.43	79.51	78.93	78.27	73.74	0.37	2003	81.17
EWG	2007	81.00	79.79	79.00	78.06	69.21	0.41	2005	81.39
IEA (WEO)	2008	79.80	81.59	82.49	83.40	87.40	0.71	2030	95.00

Crude Oil + Lease Condensate									
Observed (EIA)		73.46	73.80	71.93	NA	NA		2008-07	74.80
ASPO-46	2004	72.56	71.89	71.47	71.00	63.55	0.20	2005	72.80
Deffeyes	2004	69.92	69.64	69.37	69.01	65.98	**0.17**	2005-12	69.94
ASPO-58	2005	73.80	75.39	75.89	76.00	69.50	0.44	2010	76.00
IEA (WEO)	2006	71.78	73.76	74.74	75.70	80.30	0.38	2030	89.10
CERA[1]	2006	76.89	80.35	81.58	82.29	83.83	2.00	2038	97.58
ASPO-76	2006	72.10	75.74	77.47	78.00	72.00	0.75	2010	78.00
HSM	2007	73.56	73.40	73.16	72.82	69.53	0.28	2006	73.56
Ace	2007	73.48	72.18	69.77	66.96	58.47	0.12	2006-01	73.55
IEA (WEO)	2008	69.73	70.64	71.06	71.46	73.00	1.07	2030	75.20

Table II. Summary of all the forecasts (figures are in mbpd) as well as the last EIA estimates.[1] Productive capacities. [2] MASE value for March 2009, the value in bold indicates the best forecast (i.e. the oldest with the lowest error).

Are We There Yet?

We can consider two competitive models for the crude oil + NGL production:

1. M_0: The oil production will continue to grow with the world population at a constant rate of 4.3 barrels per capita.
2. M_1: The production will fall according to the average peak oil forecast.

These two models are represented as a magenta and a yellow area on the top figure of this post. According to the M_0 model, the current fall in production levels for March 2009 is 0.004 significant. However lower deviations were observed in the late 90s and in 2001 (there were previously 16 months with larger deviations since 1990). The likelihood ratio between the two models has significantly increased above 3 indicating than the M_1 model is more stronly supported by the recent production levels than the M_0 model which was not the case before 2009.
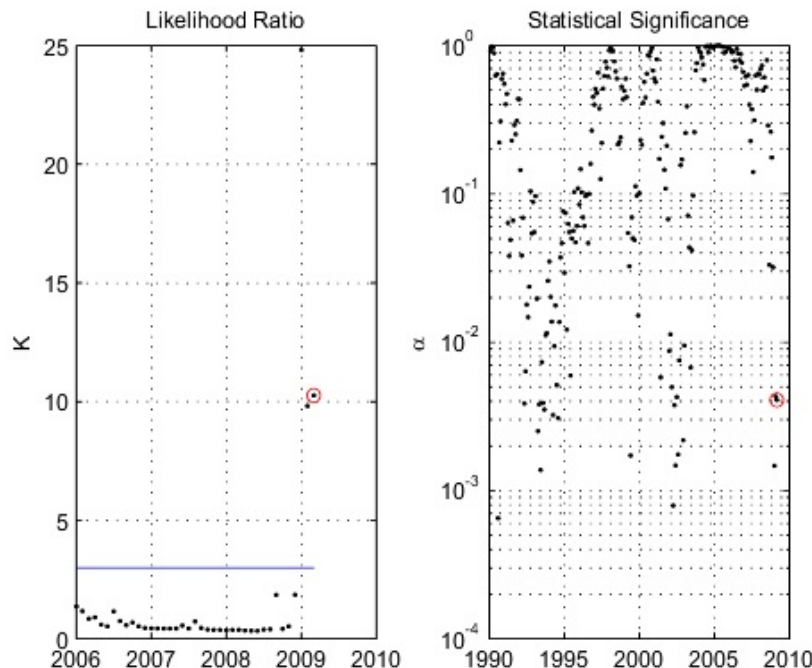
Fig. 8 - Likelihood ratio (M1/M0) at the left and Statistical significance of observed production levels according to M0 (the red circle is March 2009).

Previous Update:

[August 2008](#)

[1] Rob J. Hyndman, Anne B. Koehler, Another look at measures of forecast accuracy, International Journal of Forecasting, Volume 22, Issue 4, October-December 2006, Pages 679-688. pdf available [here](#).

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