GLOBAL OIL DEPLETION – METHODOLOGIES AND RESULTS

R. W. Bentley

c/o Department of Cybernetics,
University of Reading,
Reading, RG6 6AY, UK.
r.w.bentley@reading.ac.uk
http://www.oildepletion.org

I. INTRODUCTION

This paper describes methodologies used by a variety of individuals and organisations to predict future world production of oil and gas.

The models fall into three broad groups based on how the authors see future oil production:

Group 1 calculations indicate that global oil production will reach a resource-limited maximum sometime between the years 1996 and 2020, and thereafter decline. Some of these calculations relate to conventional oil only, others to both conventional and non-conventional oil.

Group 2 forecasts terminate in 2020 or 2030, and find that the resource base is sufficient for global oil production to meet anticipated demand to these dates. These 'business-as-usual' forecasts give no indication if a resource-limited peak is subsequently expected.

Group 3 analyses dismiss the possibility of a hydrocarbon resource-limited peak occurring in the near or medium term, and hence see no need to quantitatively assess future oil production.

II. DISCUSSION

The various methodologies are documented in the full paper. Results from the calculations of Groups 1 and 2 are given here in Tables 1 and 2.

Most Group 1 authors assess the oil resource base by adding discovery given by industry data '2P' reserves to an estimated yet-to-find. They then use one of:

- 'mid-point' peaking (e.g., early Hubbert, Petroconsultants '95, or Uppsala/Campbell);
- some other production profile (EnergyFiles);
- field-by-field modelling (Miller, PFC);

to calculate future production.

Alternative powerful techniques are to use a linearised production plot based on the logistic curve (later Hubbert, Deffeyes), or to model production as an approximate mirror of discovery (Ivanhoe, Laherrère).

Group 2 forecasts either assume that large quantities of non-conventional oil will come smoothly on-stream as conventional declines (Shell; maybe Exxon), or have - in my opinion - a very poor knowledge of the resource base (IEA, US DoE, 'WETO' study). In these latter cases reliance is placed on USGS 'total oiliness' data, paying no attention to discovery rate or reserves growth data outside the US.

The 'WETO' model for example assumes a conventional oil resource of 4500 Gb. This should be compared to the global discovered to-date (incl. NGLs) of only 1950 Gb, and the annual discovery rate of about 10 Gb on a declining trend. Authors who propose conventional oil ultimates much above ~2300 Gb (incl. NGLs) must explain the discovery data and anticipated recovery factors that support their estimates.

Group 3 analyses include those by Paul Stevens, Peter Davies, M. Adelman, Michael Lynch, Peter McCabe and Leonardo Maugeri. These analyses rule out the need to examine the oil resource base for a variety of reasons:

- Some assume that higher prices will bring on sufficient new conventional oil to prevent difficulties in supply;
- Others assume high prices will reduce demand, thus bringing supply/demand back into balance;
- Still others consider conventional and non-conventional oil to be economically indistinguishable, and that the non-conventional resource (including shales, and perhaps hydrates) is so large that limits to conventional oil production will have no economic significance.

III. ACKNOWLEDGEMENTS

The author is grateful to J-M. Bourdaire, C.J. Campbell, K.S. Deffeyes, P. Gerling, J.H. Laherrère, R.G. Miller, and M.R. Smith for comments. Responsibility for error remains with the author.

Date	Author	Hydrocarbon	Ultimate Gb	Date of global peak
1972	ESSO	Pr. Cv. oil	2100	"increasingly scarce from ~ 2000."
1972	Report: UN Confr.	Ditto.	2500	"likely peak by 2000."
1974	SPRU, UK	Ditto.	1800-2480	n/a
1976	UK DoE	Ditto.	n/a	"about 2000"
1977	Hubbert	Cv. oil	2000	1996
1977	Ehrlich et al.	Ditto.	1900	2000
1978	WEC / IFP	Pr. Cv. oil	1803	n/a
1979	Shell	Ditto.	n/a	"plateau within the next 25 years."
1979	BP	Ditto.	n/a	Peak (non-communist world): 1985
1981	World Bank	Ditto	1900	"plateau ~ turn of the century."
1995	Petroconsultants, '95.	Cv. oil (xN)	1800	About 2005
1996	Ivanhoe	Cv. oil	~2000	About 2010.
1997	Edwards	Pr. Cv. oil	2836	2020.
1997	Laherrère	All liquids	2700	n/a
1998	IEA: *WEO 1998*	Cv. oil	2300 ref.case	2014
1999	Magoon of the USGS:	Pr. Cv. oil	~2000	Peak ~ 2010.
2000	Bartlett	Ditto.	2000 & 3000	2004 & 2019, respectively.
2002	BGR (Germany)	Cv.&Ncv. oil	Cv.: 2670	Combined peak in 2017.
2003	Deffeyes	Cv. oil*		'Later-Hubbert' method ~2005.
2003	P-R Bauquis	All liquids.	3000	Combined peak in 2020.
2003	U. Uppsala / Campbell	All h'carbons		Combined peak ~2015.
2003	Laherrère	All liquids	3000	n/a
2003	Energyfiles Ltd.	All liquids	Cv: 2338	2011 (if 2% demand growth).
2003	Energyfiles Ltd.	All h'carbons		Combined peak ~ 2020.
2003	Bahktiari model.	Pr. Cv. oil		2006 - 7
2004	Miller, BP- own model	Cv.&Ncv. oil		2025: All poss. OPEC prodn. used.
2004	PFC Energy	Cv.&Ncv. oil		2018 - base case

Table1: Results of some 'Group 1' calculations.

Notes: Table is not complete, one notable omission is the WAES study from the late 70s / early 80s. Pr.: Probably; Cv.: Conventional; xN: ex-NGLs; +N: incl. NGLs; All liquids: Conv. and Non-conv. oil plus NGLs; All h'drocabons: Conv. and Non-conv. oil and gas. * = and probably all-oil.

Date	Author	Hydrocarbon	Ultimate (Gb)	F'cast date of peak (by study end-date)	World prod. Mb/d 2020	2030
1998	WEC/IIASA-A2	Cv. oil		No peak	90	100
2000	IEA: *WEO 2000*	Cv. oil (+N)	3345	No peak	103	-
2001	US DoE EIA	Cv. oil	3303	2016 / 2037	Various	
2002	US DoE	Ditto		No peak	109	-
2002	Shell Scenario	Cv.&Ncv. oil	~4000*	Plateau: 2025 - 2040	100	105
2003	'WETO' study	Ditto	4500**	No peak	102	120
2004	ExxonMobil	Ditto		No peak	114	118

Table 2: Results of some 'Group 2' calculations.

Notes: *Shell's ultimate of 4000 Gb is composed of: ~2300 Gb of conventional oil (incl. NGLs); plus ~600 Gb of 'scope for further recovery' ('SFR') oil; plus 1000 Gb of non-conventional oil. **WETO's ultimate of 4500 Gb is for conventional oil only; it starts with a USGS figure of 2800 Gb, then grown by assuming large and rapid recovery factor gains to 2030.