Jean Laherrere 1st May 2016

US oil production at end of 2015

Steve Andrew in his mail of 20 April 2016 said that Hubbert original total for the US excluded offshore and Alaska.
Hubbert was right to exclude Alaska in 1956 because Alaska joined only the US in 1959, but contrary to Steve's statement he did include the US offshore production, because production offshore started in 1947
Hubbert did include offshore in the US 150 Gb oil ultimate in his 1956 paper "Nuclear energy and the fossil fuels"
page 16

This has accordingly been increased to 130 billion, giving a total ultimate potential reserve of 150 billion barrels of crude oil for both the land and offshore areas of the United States.

The 1962 Hubbert report on Energy resources to the Committee on natural resources also includes offshore in the 175 Gb ultimate
page 47

In 1958 L. G. Weeks (p. 434) raised his earlier estimate of 110 billion barrels for the ultimate potential reserves of crude oil for the land area of the United States to 240 billion barrels of liquid petroleum for both the land and offshore areas. This

page 73

Should the future of 175 billion barrels be approximately correct, the future crude-oil production of the United States would have to follow a curve closely resembling that shown in Figure 39.

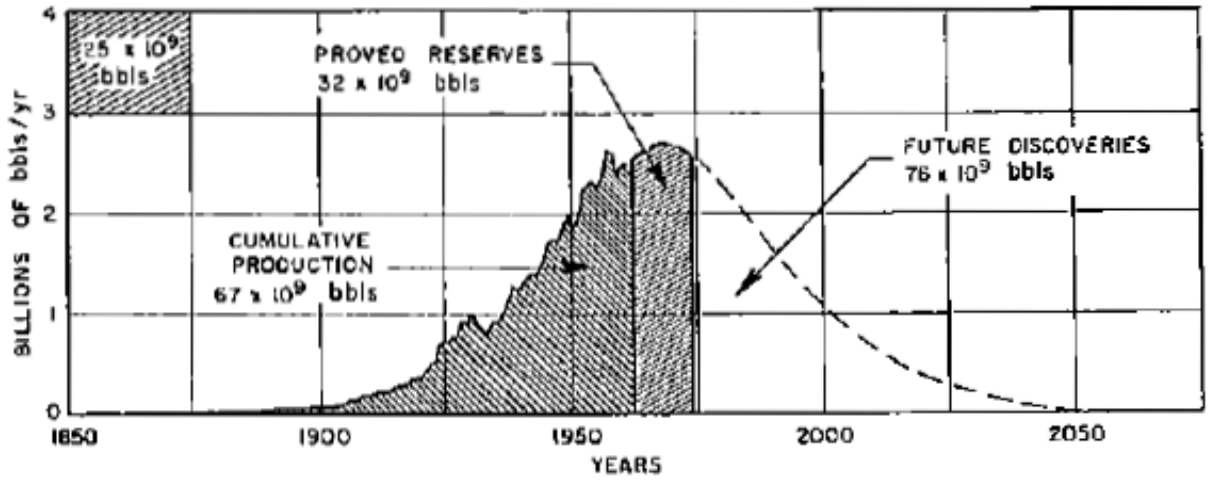


Figure 39. Estimate of Ultimate U. S. Production of Crude Oil

page 74 US 175 Gb includes offshore

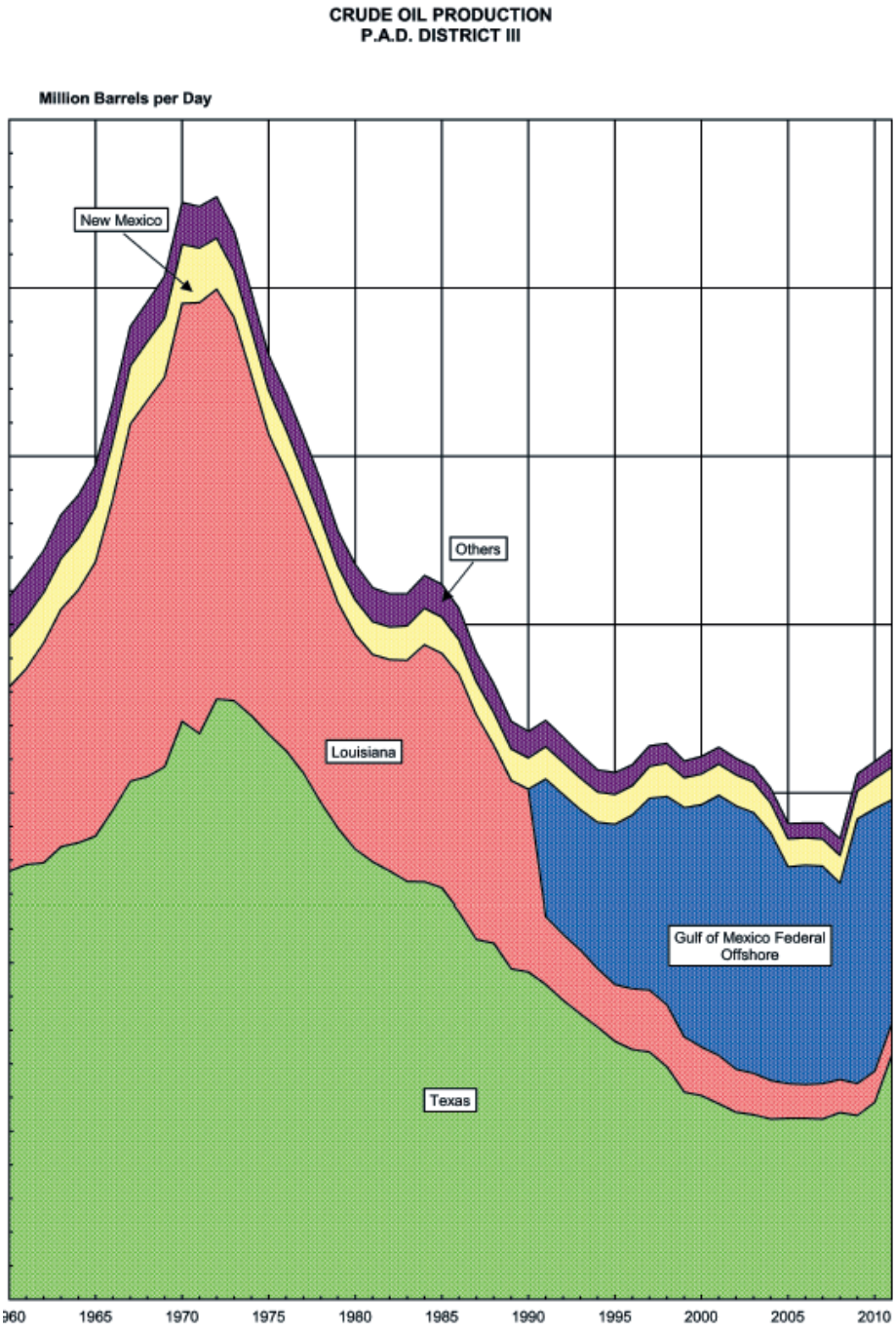
TABLE 6

Estimated Ultimate World Crude-Oil Production

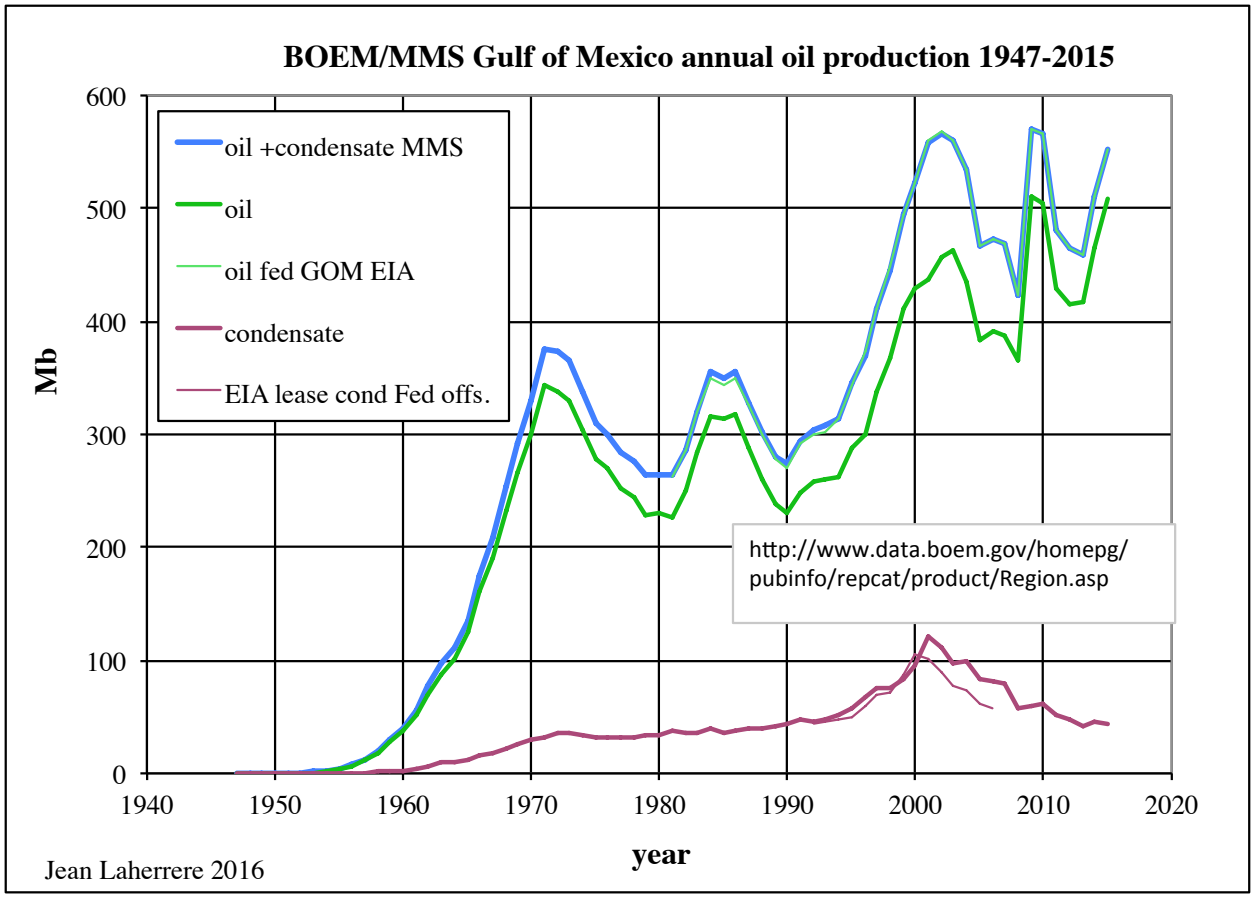
Area	Ultimate Recovery ($\times 10^9$ bbls)
United States (including offshore)	175
Remainder of North America	45
South American	80
Europe (excluding U.S.S.R.)	13
U.S.S.R.	200
Middle East and North Africa	300
Indonesia	30
Australia	3
Remainder of Asia	24
Offshore areas (excluding U.S.)	380
World Total	1,250

The US past data on offshore oil is very poor. There is no way to get the historical offshore oil production and reserves by State before 1985, in particular for the GOM. DGMN reports GOM offshore only since 1990 taken out of Louisiana, but not from Texas.

DEGOLYER and MACNAUGHTON

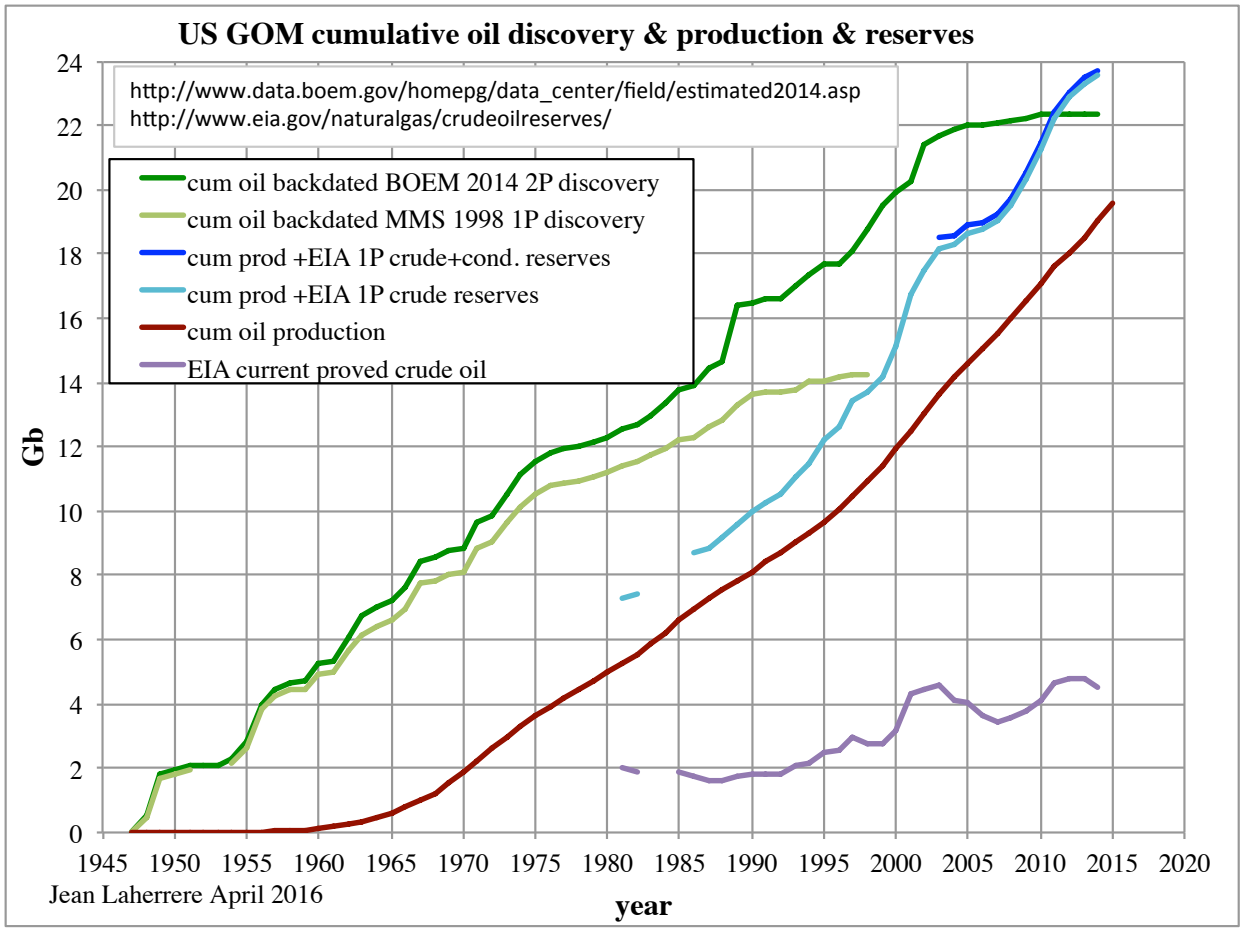


The oil production of the GOM is taken from BOEM site since 1947, there is discrepancy for condensate between BOEM and EIA

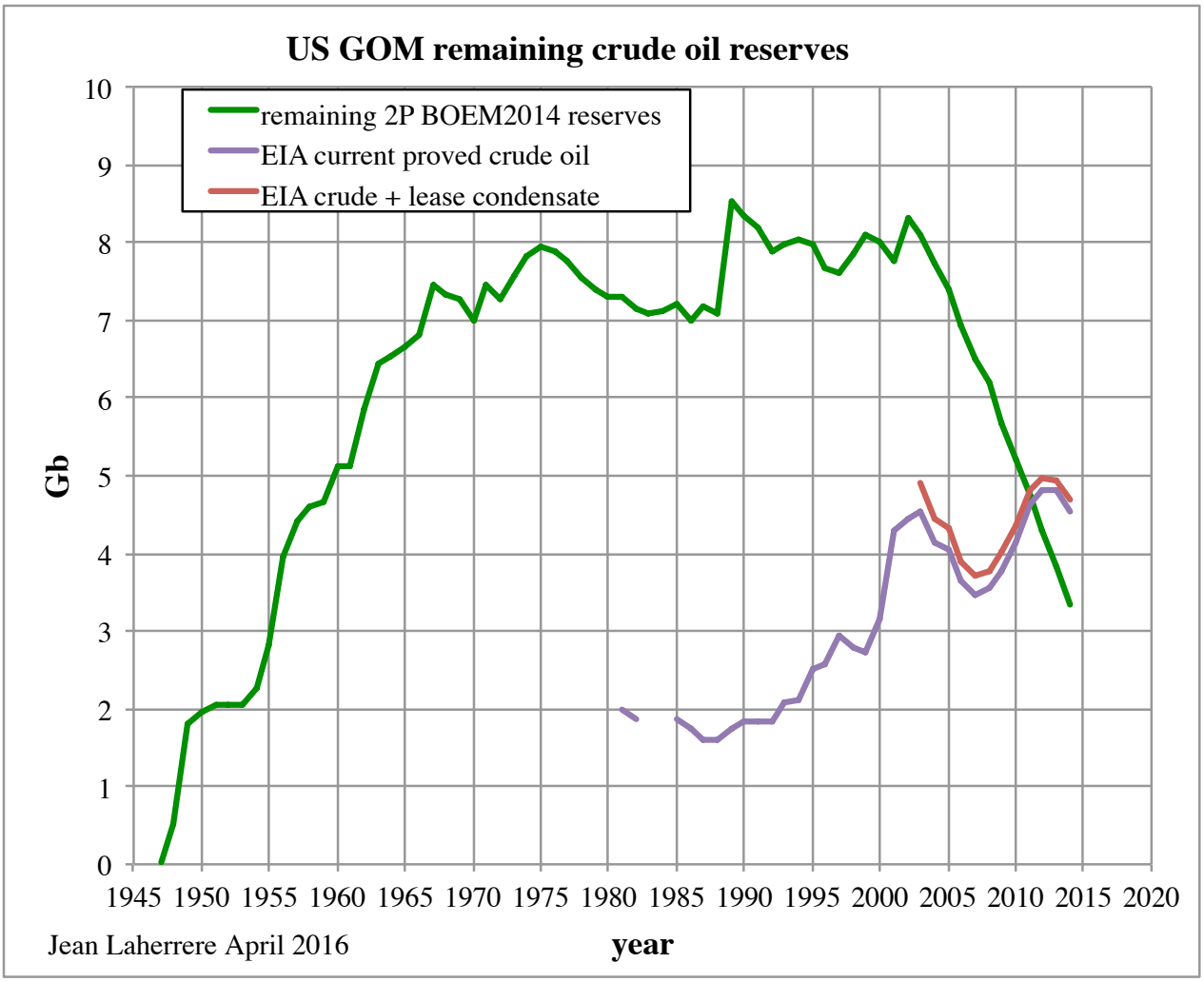


The monthly EIA & annual STEO forecasts display a bumpy production, difficult to extrapolate

BOEM 2014 reports 2P reserves since 2009, because it is incorrect to add proved reserves (with a large underestimation by neglecting probable) and because BOEM (not listed on the US stock market) is not obliged to fulfill SEC financial rules
It is obvious that GOM 1P EIA current reserves are too optimistic compared to 2P BOEM backdated 2P reserves

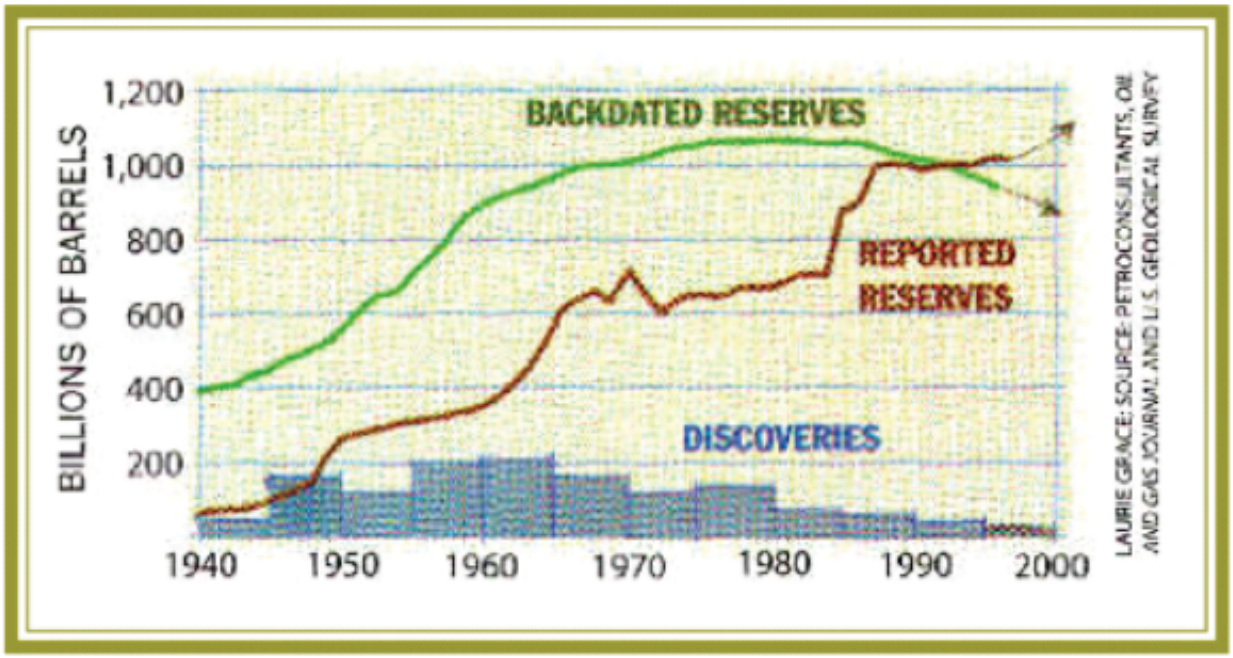


The remaining crude oil reserves display the divergence between the BOEM 2P backdated reserves and the EIA 1P current reserves.
Backdated 2P reserves (green curve) are in steep decline since 2003 when current 1P reserves (purple curve) peaked in 2012, in a complete divergence.

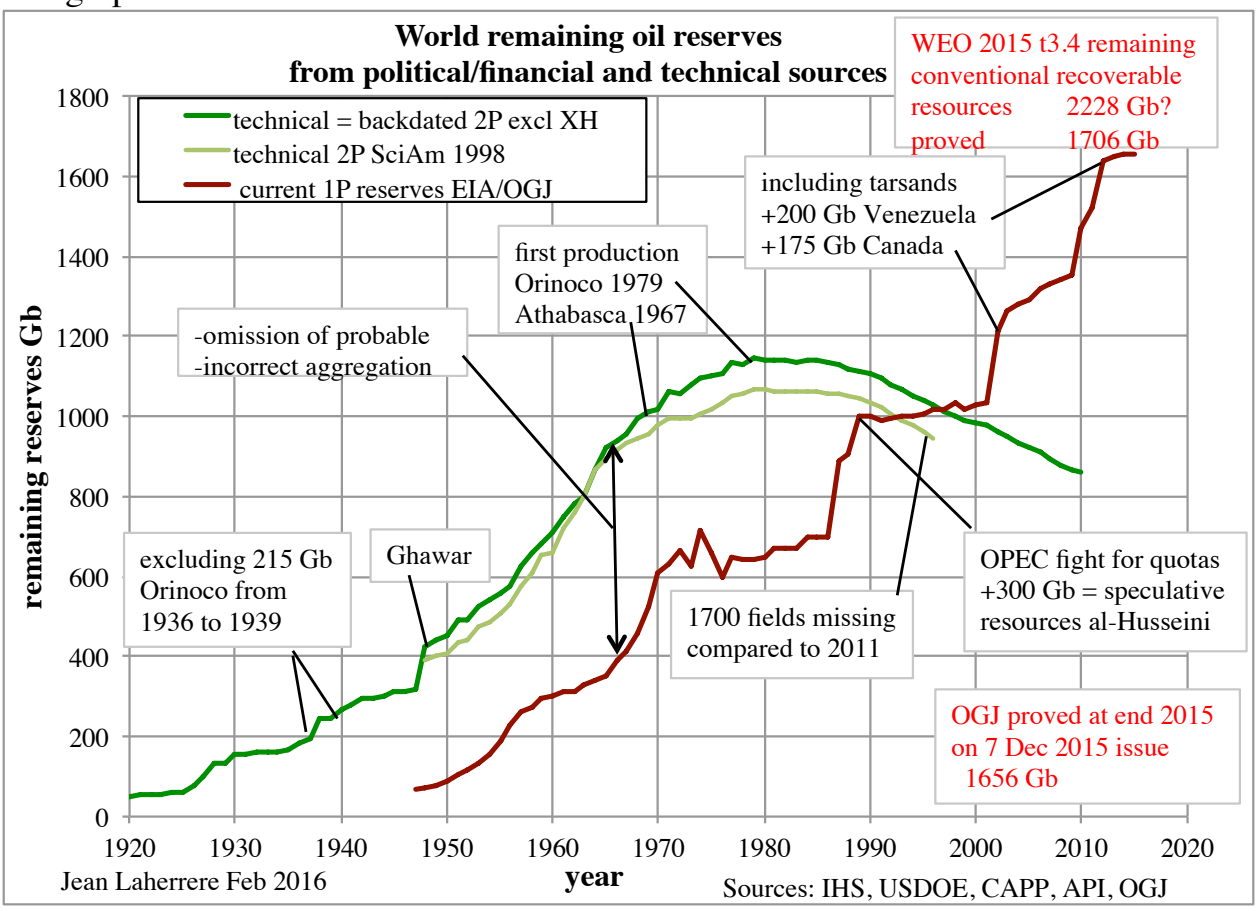


This graph is a very good example of the discrepancy between the financial current proved reserves and the technical backdated 2P reserves, as I have already shown in the past: see my paper -Laherrère J.H. 2011 «Backdating is the key » ASPO 9 Brussels 27 April
http://www.aspo9.be/assets/ASPO9_Wed_27_April_Laherrere.pdf
http://aspofrance.viabloga.com/files/JL_ASPO2011.pdf

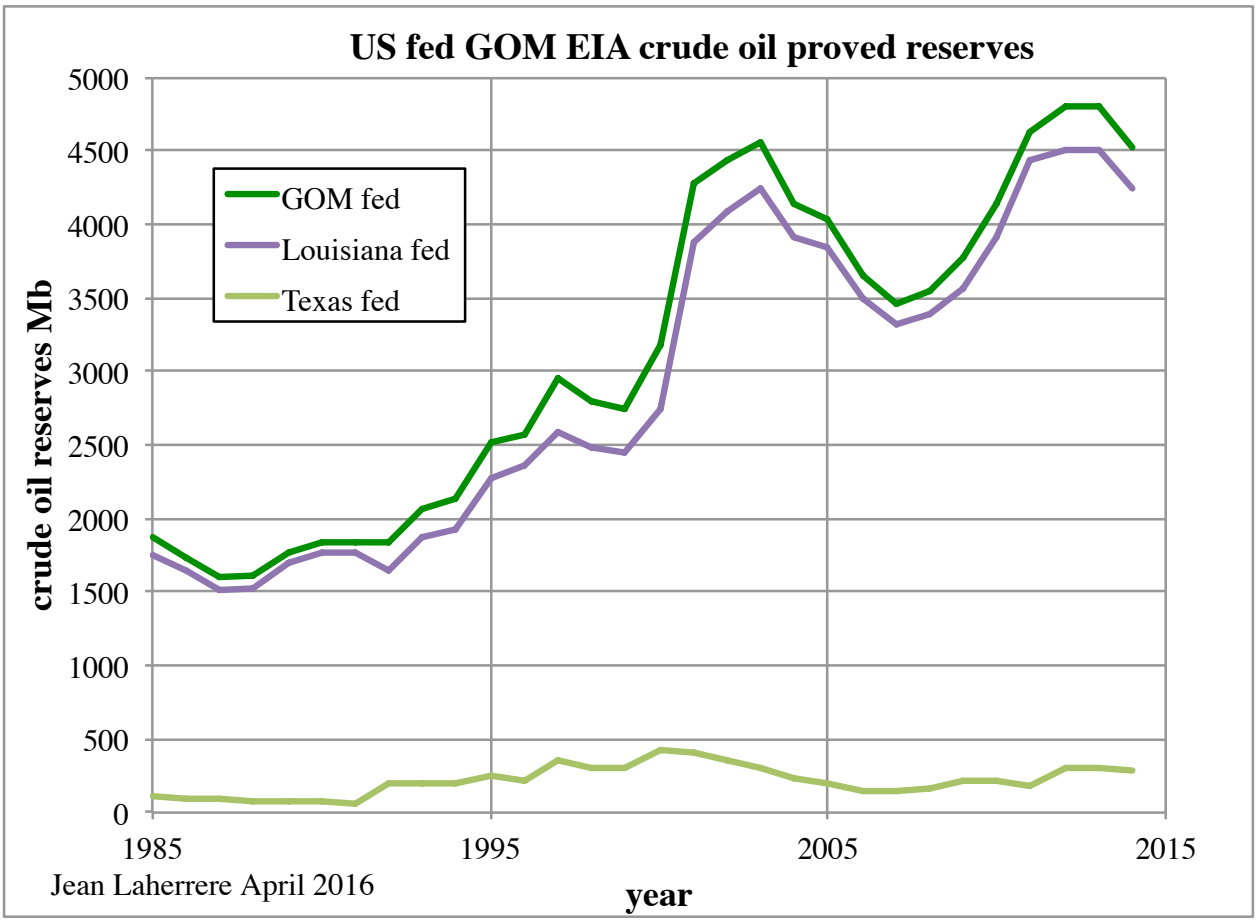
but, also my graph in Scientific American March 1998 “The end of cheap oil”



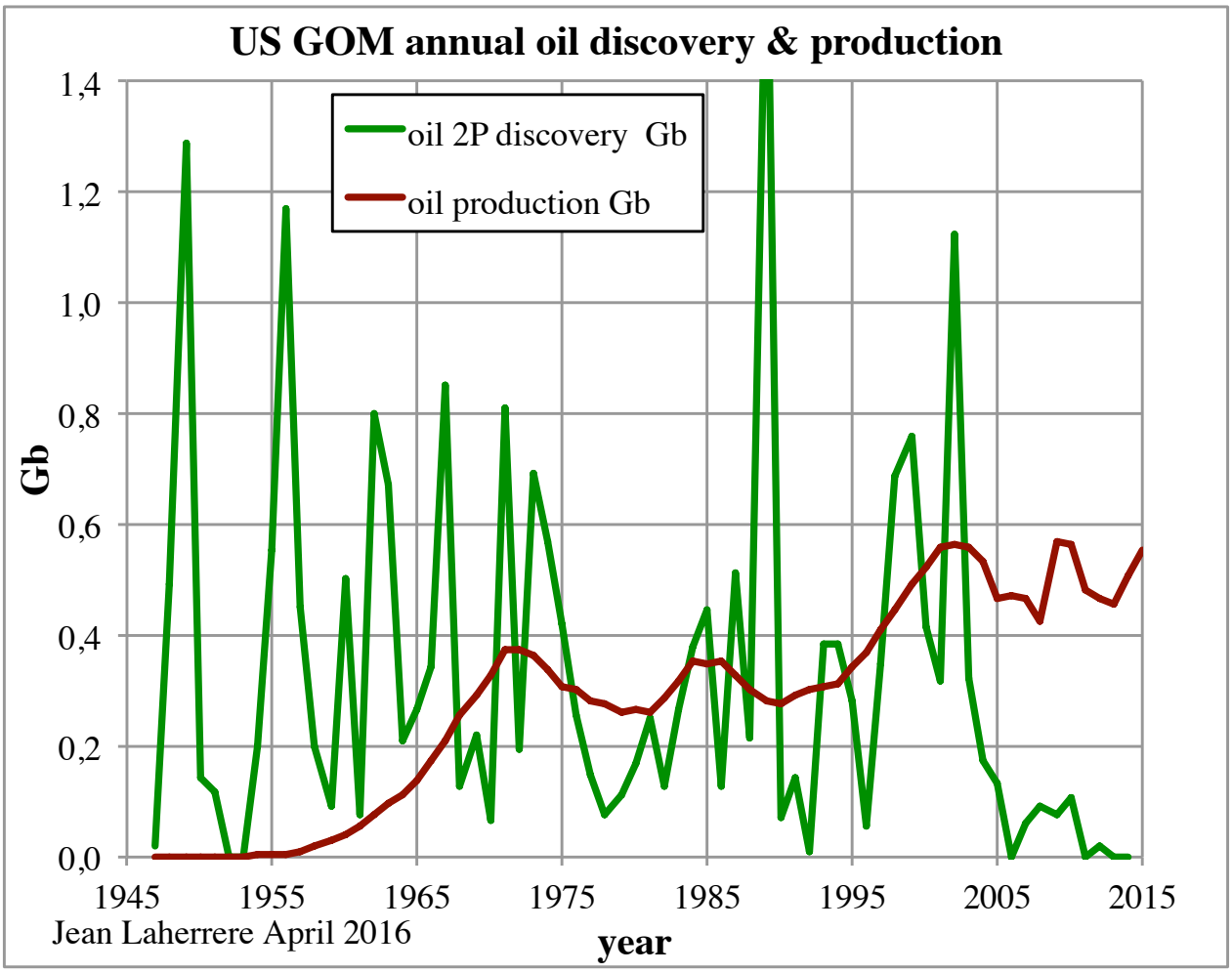
being updated in 2016



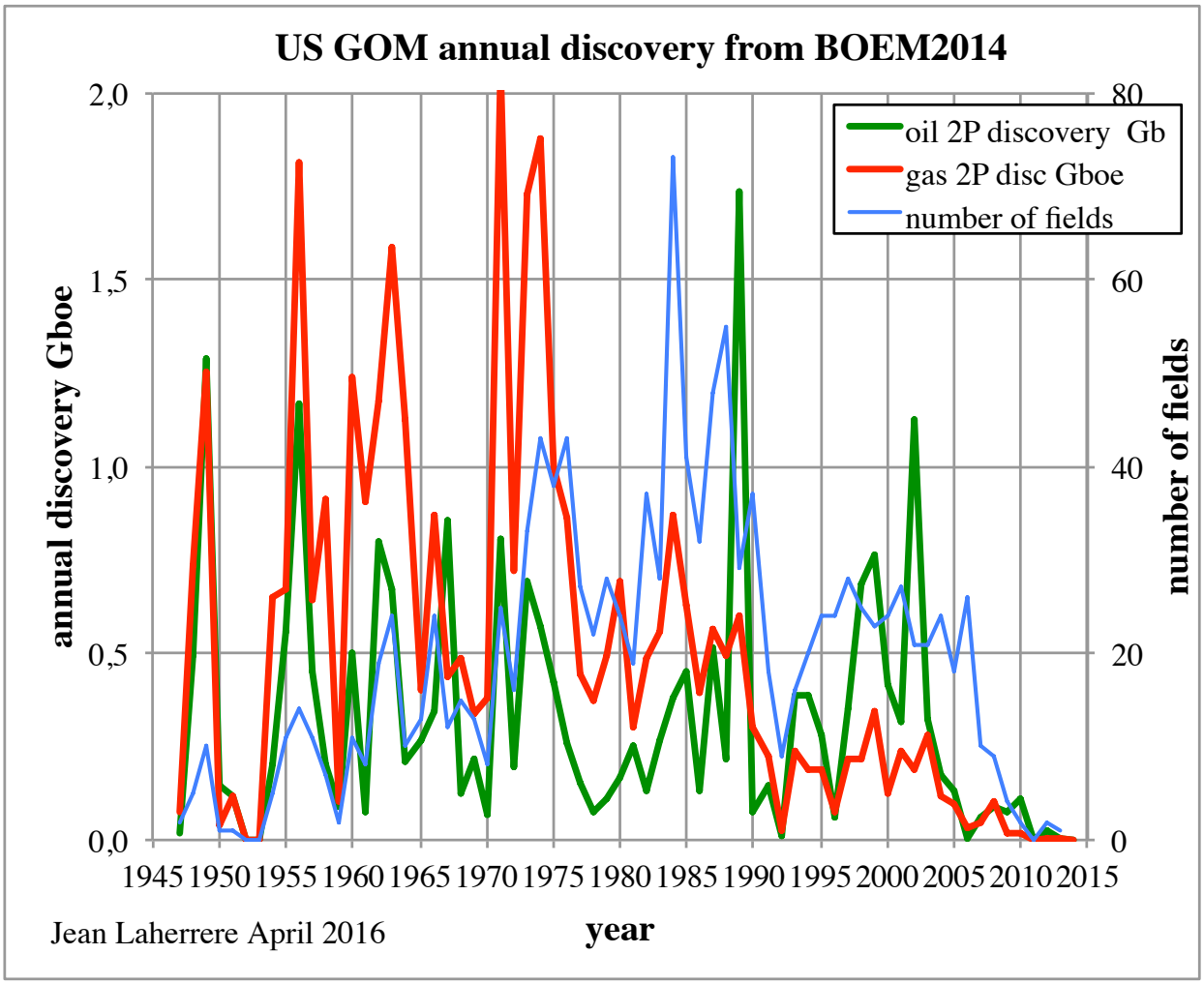
The GOM fed proved crude reserves is reported only by EIA only since 1985 (before reserves were reported with Texas and Louisiana), the main part is from Louisiana



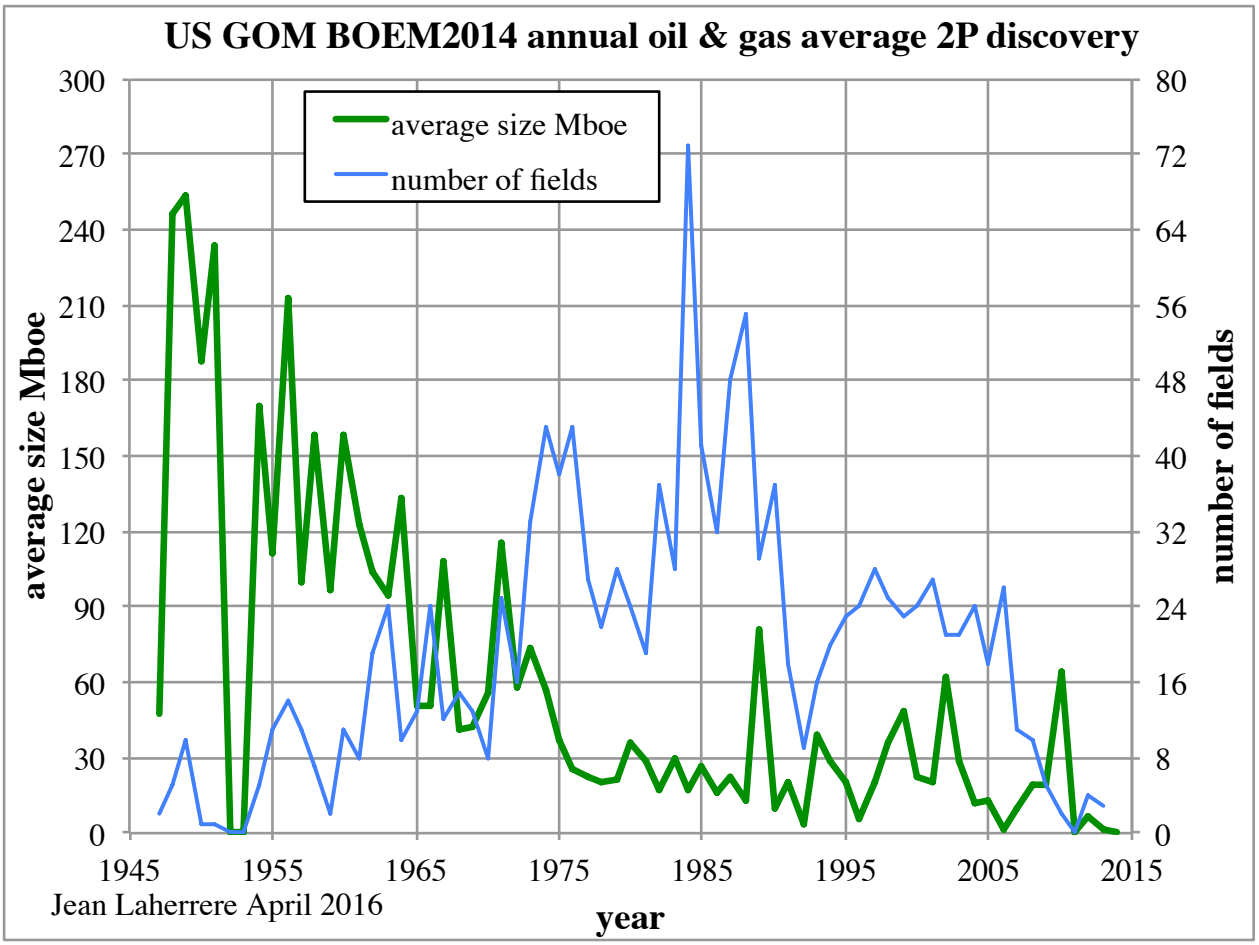
The last BOEM report at end 2014 shows that since 2006 discoveries are small compared to the past for oil



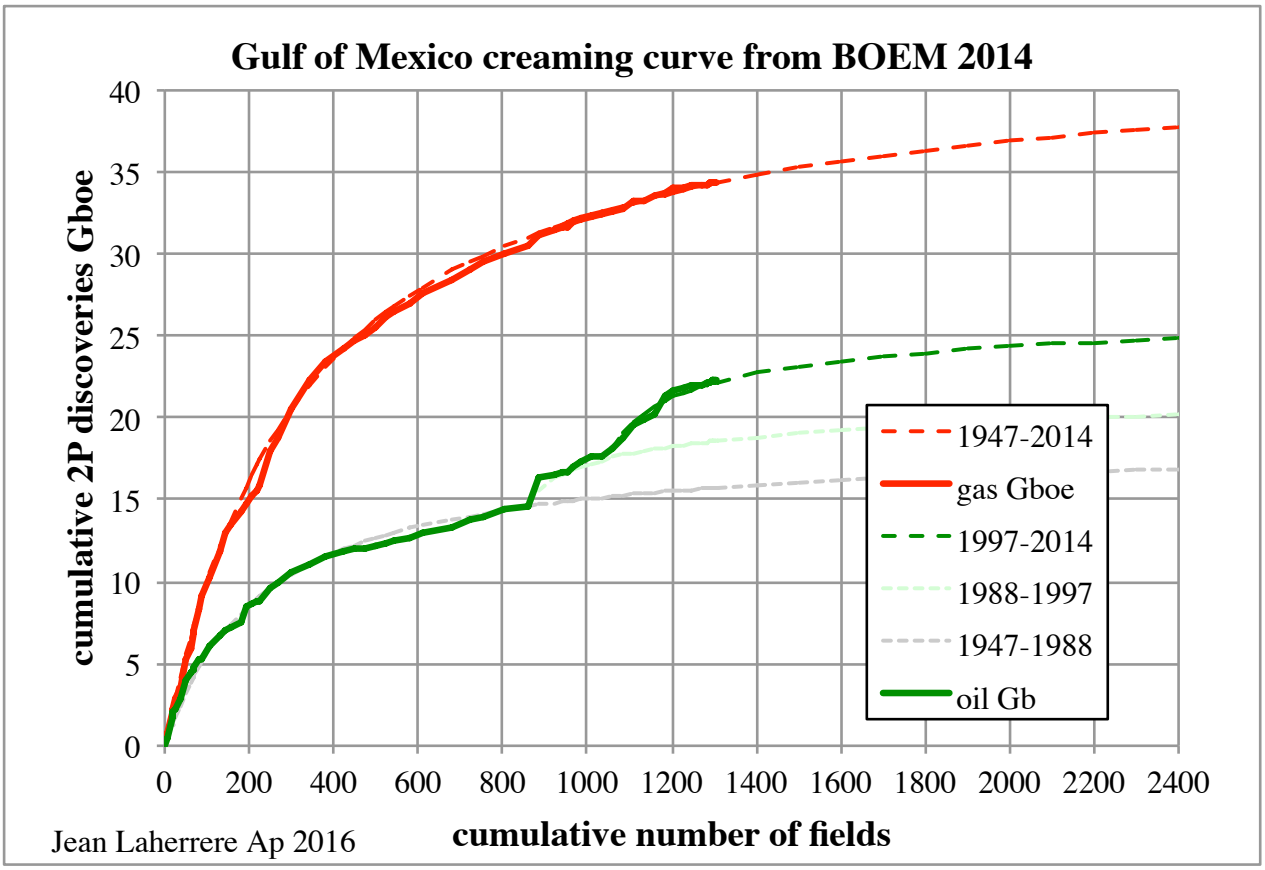
Recent discoveries represents small reserves because small in number



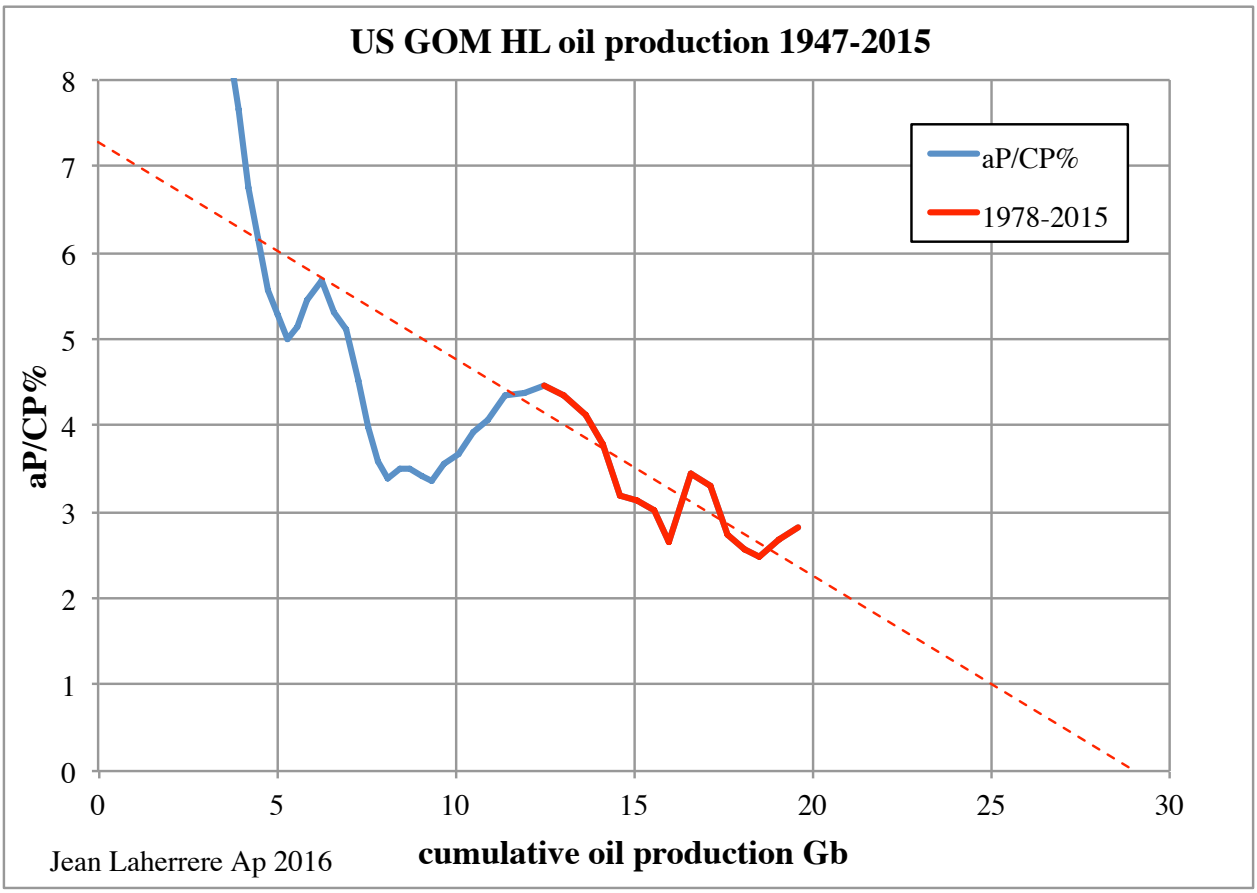
Average size in Mboe is decreasing since 1950: the GOM is a mature oil province despite the recent subsalt discoveries.



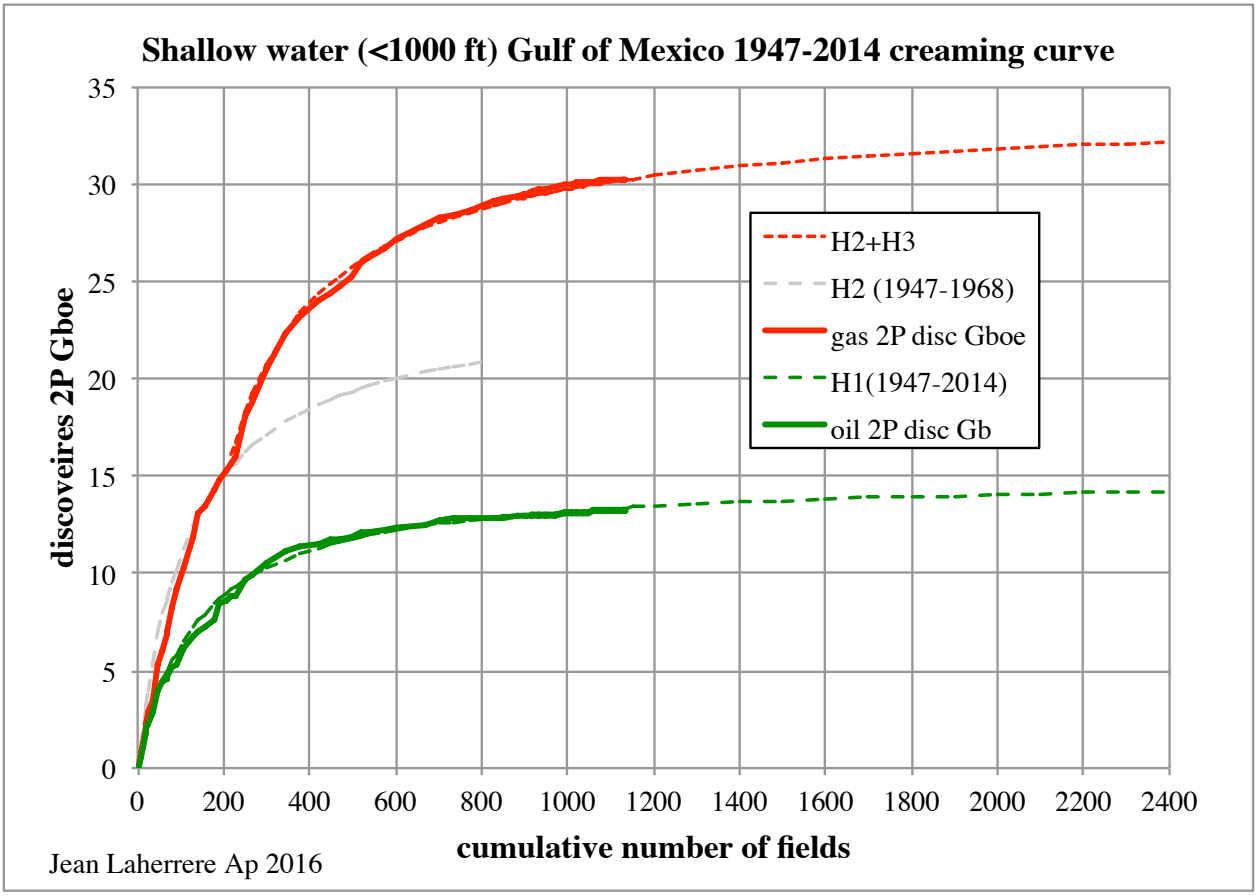
The creaming curve forecasts a GOM ultimate of 25 Gb for oil and 220 Tcf (39 Gboe)



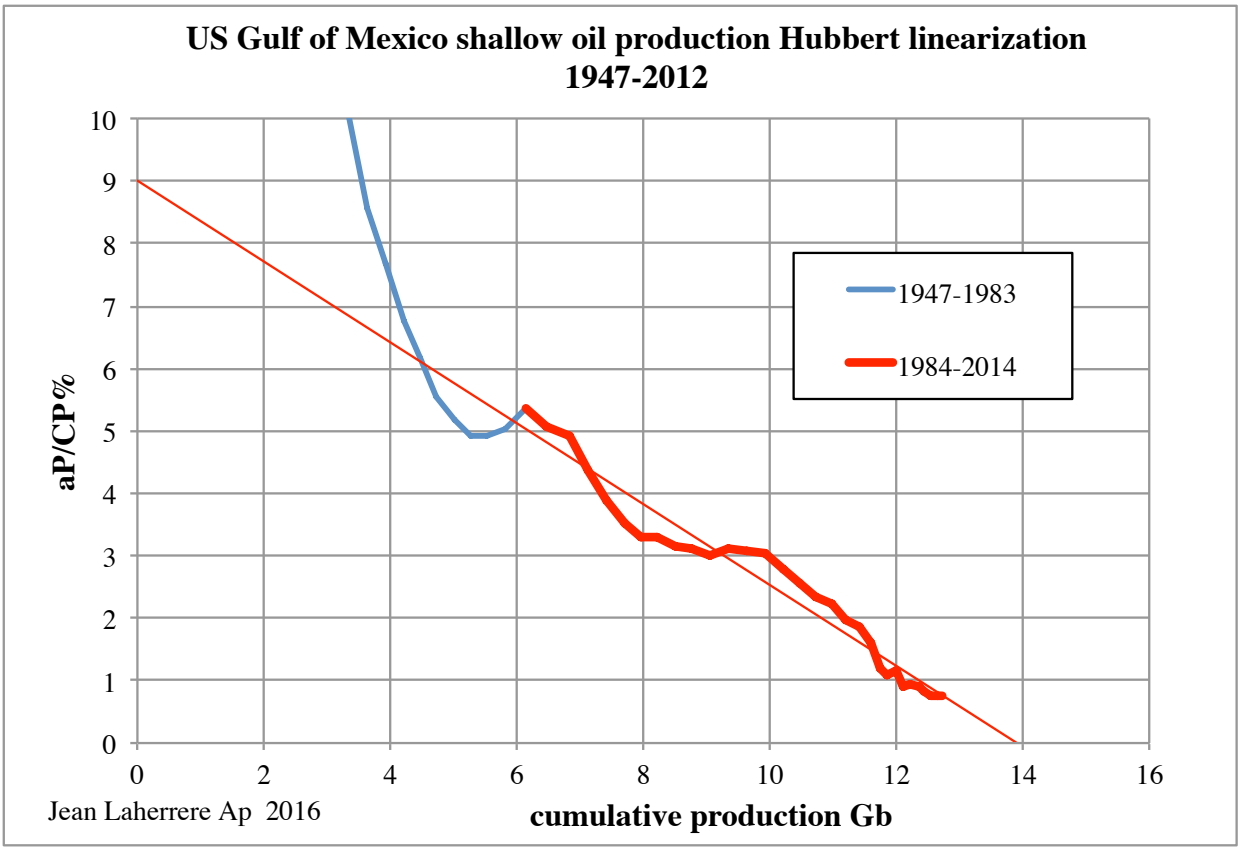
The HL of the GOM production is bumpy and difficult to extrapolate with the period 1978-2015 towards 29 Gb, more than the creaming curve!



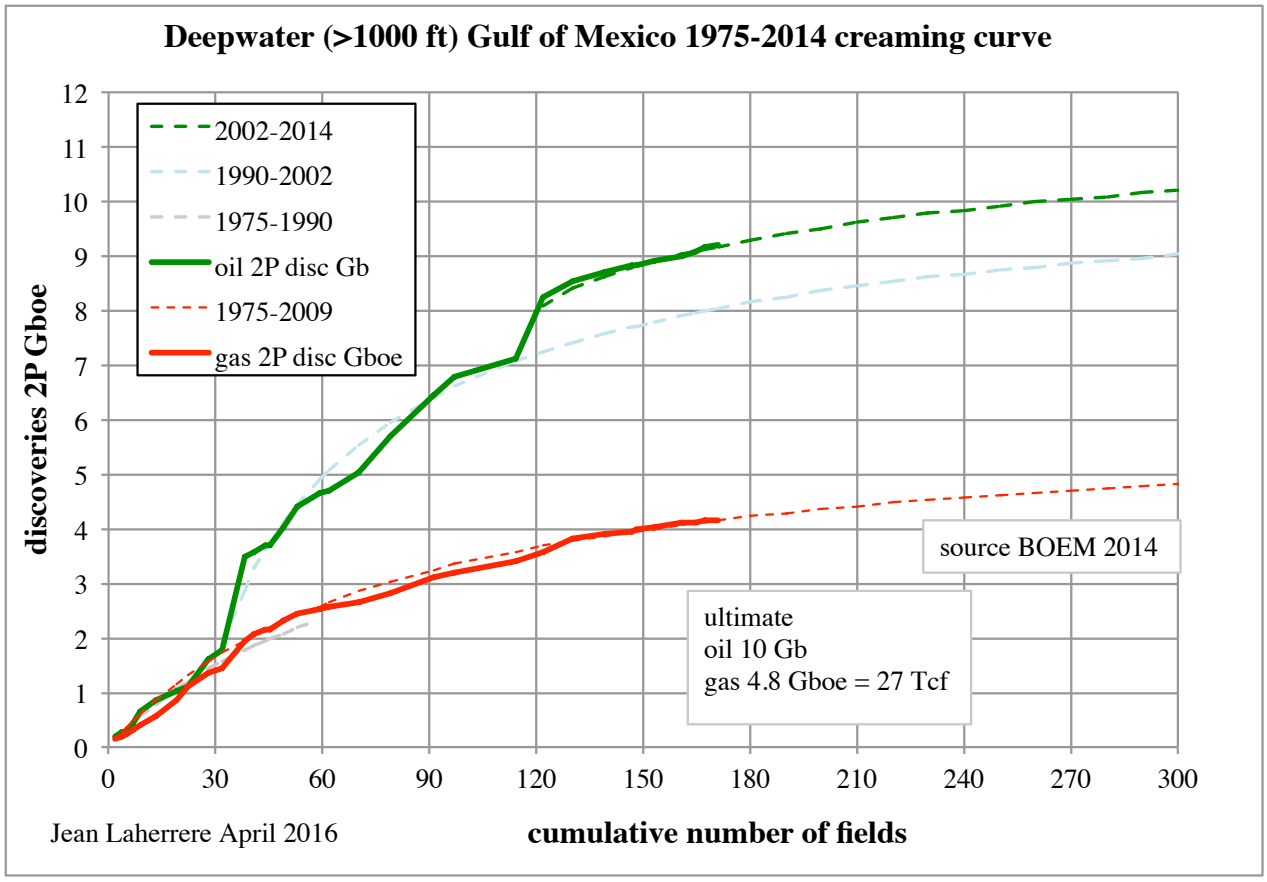
It is necessary to break down the GOM between shallow and deepwater (BOEM definition >1000 ft)
The shallow oil ultimate is 14 Gb from the creaming curve of discoveries and the HL of past production and 32 Gboe (180 Tcf) for natural gas



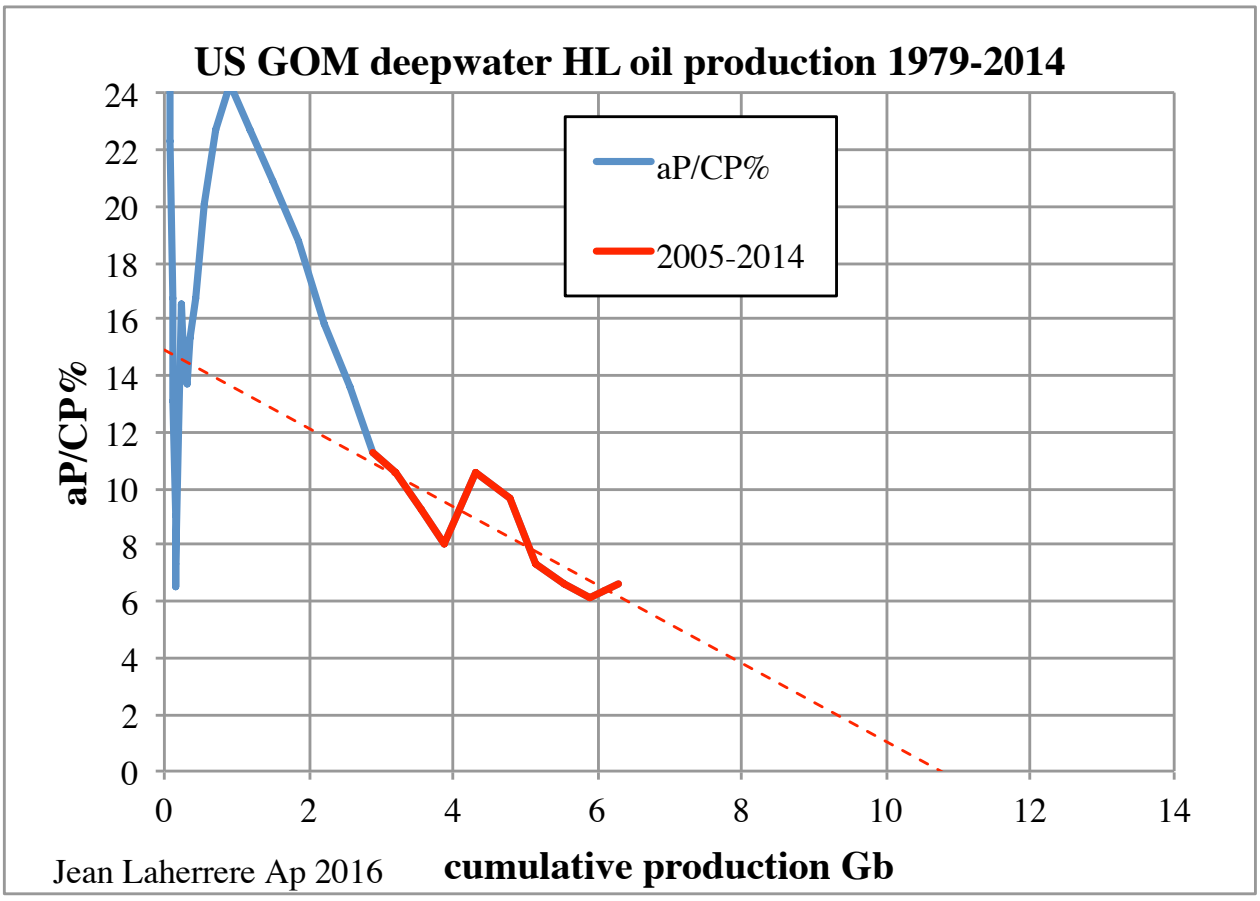
The HL of shallow oil production is bumpy and extrapolated (1984-2014) towards 14 Gb



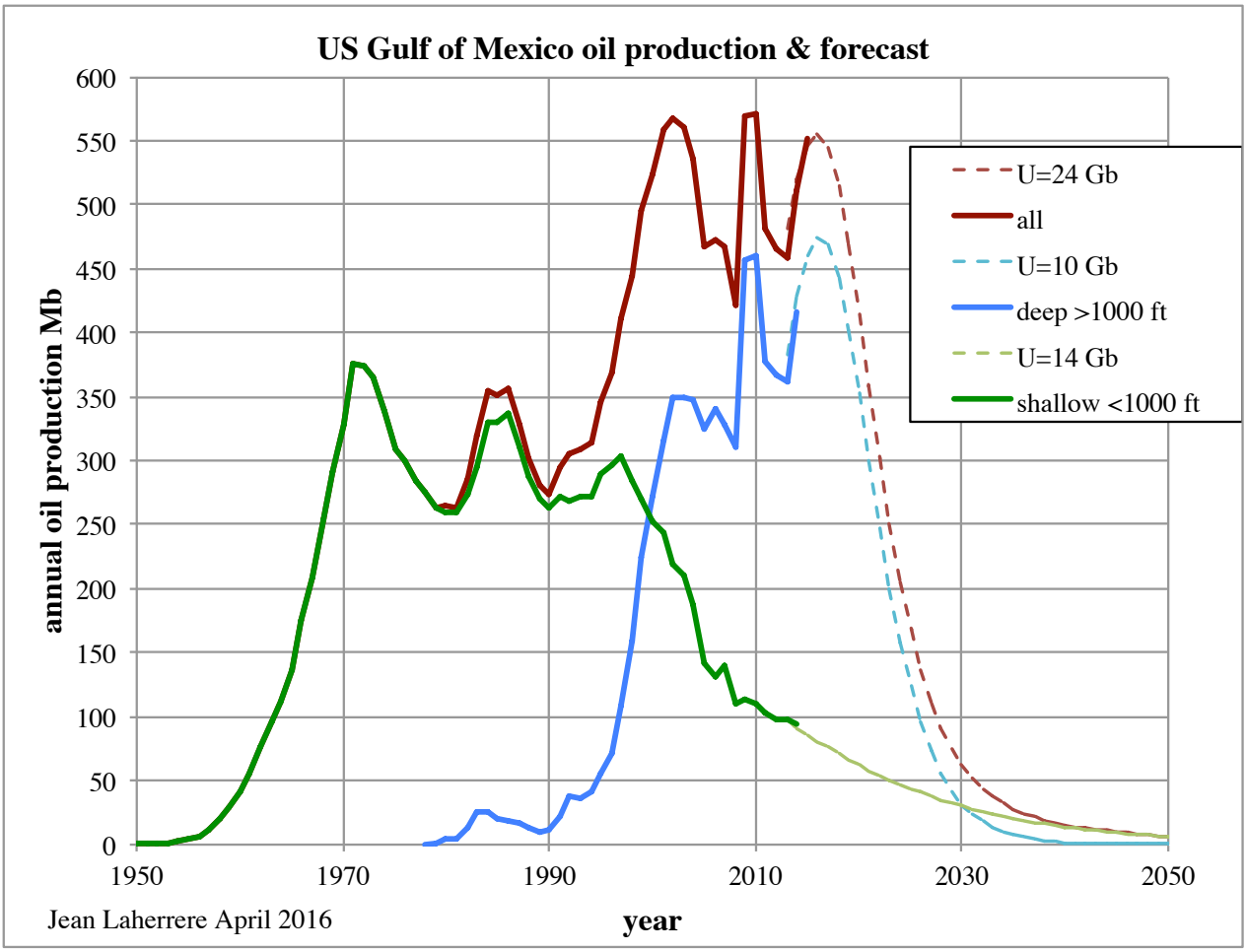
The deepwater oil ultimate is 10 Gb from the 2P creaming curve with three cycles and the gas ultimate is only 5 Gboe.
The last oil cycle is from subsalt representing only 1 Gb



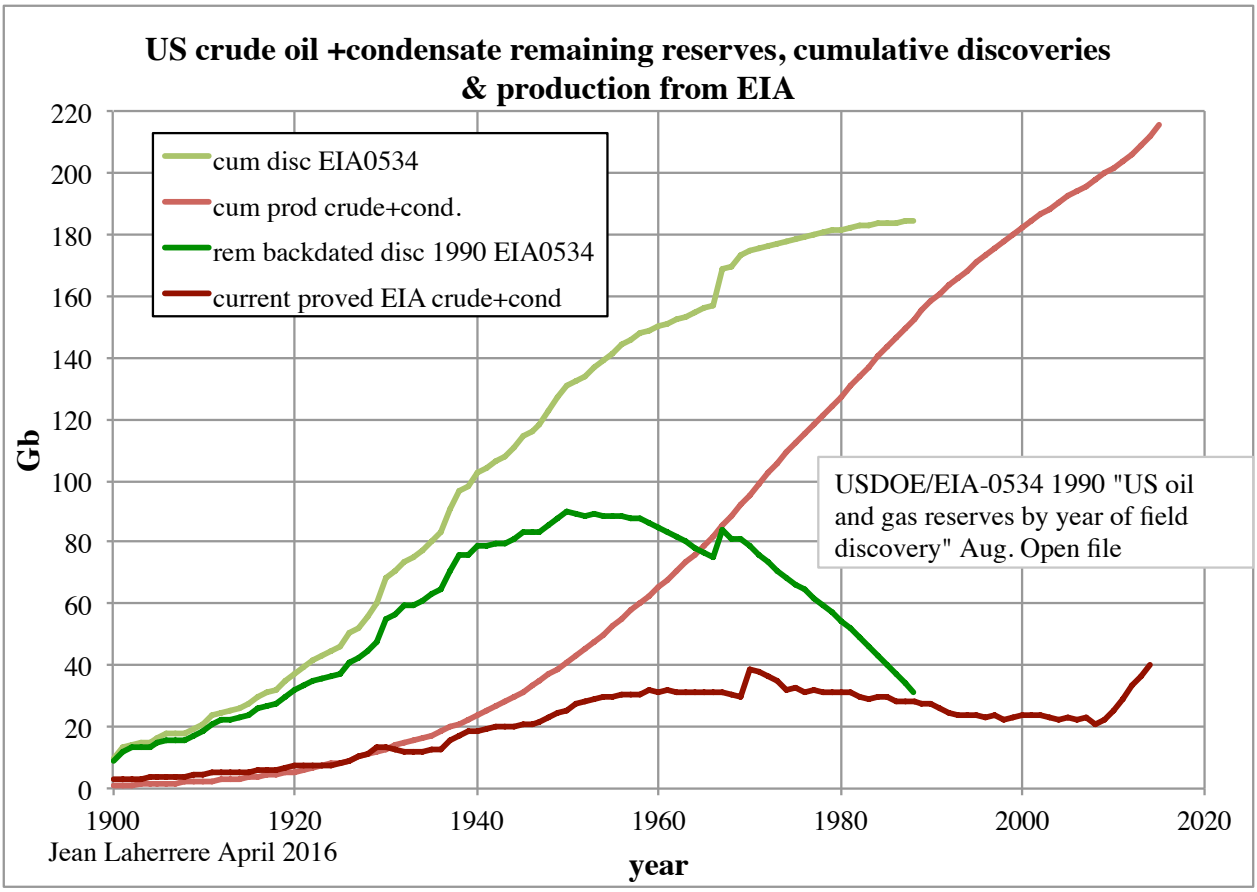
But the HL of deepwater production extrapolation is short and bumpy 2005-2014



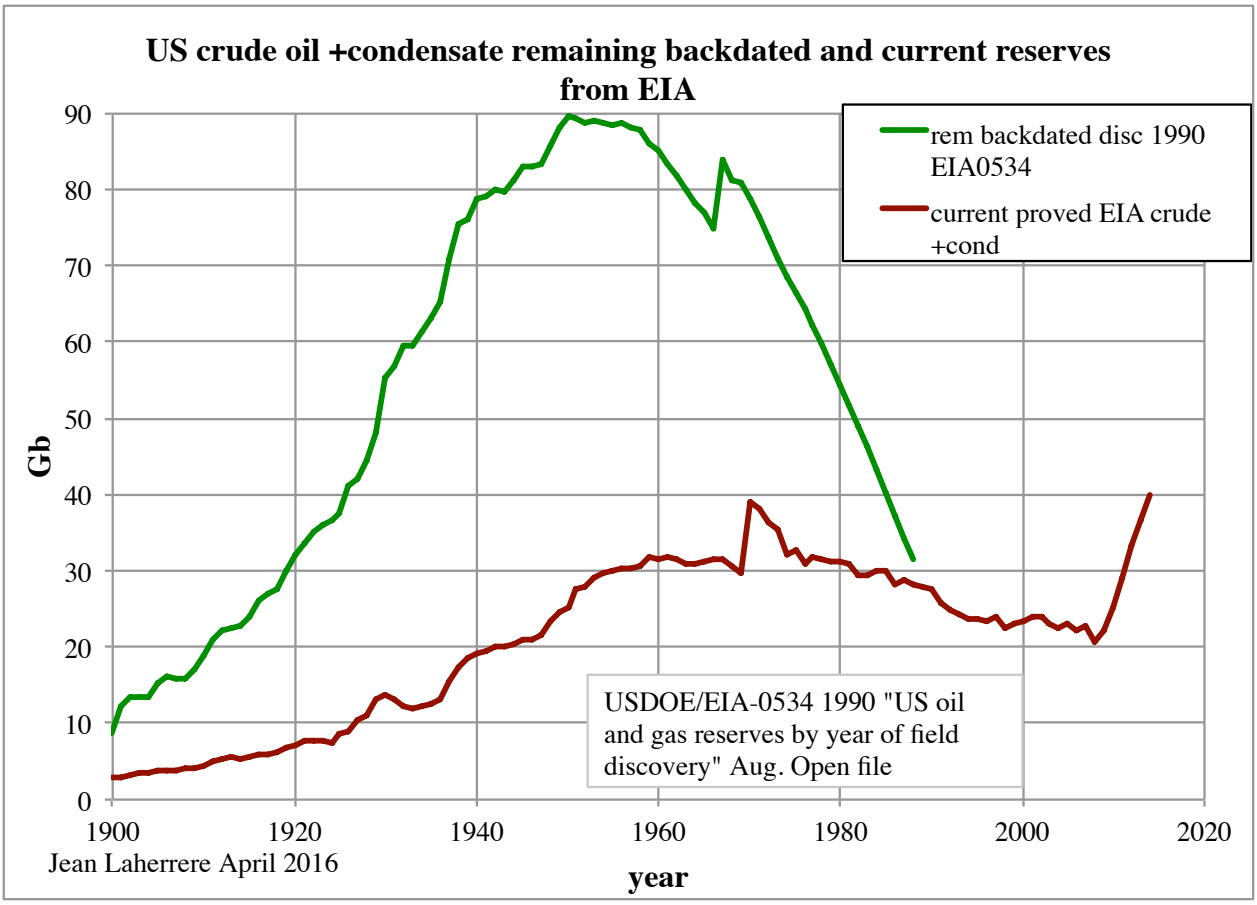
Using a deepwater ultimate of 10 Gb and a shallow water ultimate of 14 Gb, the oil production forecast displays a steep decline soon



The problem of US oil reserves is the lack of backdated reserves (estimated at the year of the report) by year of discovery as provided by the BOEM for the GOM. In fact in 1990 EIA has published in an open file (assumed to be the first of a series) titled: USDOE/EIA-0534 1990 "US oil and gas reserves by year of field discovery" Aug. Open file (followed by an article from USGS geologists Attanasi E.D. & Root D.H. 1994 "The enigma of oil and gas field growth" AAPG 78/3 March)
The cumulative backdated EIA0534 oil discoveries less the EIA crude oil +condensate cumulative production gives the remaining Backdated reserves in green which is compared with the EIA current proved reserves

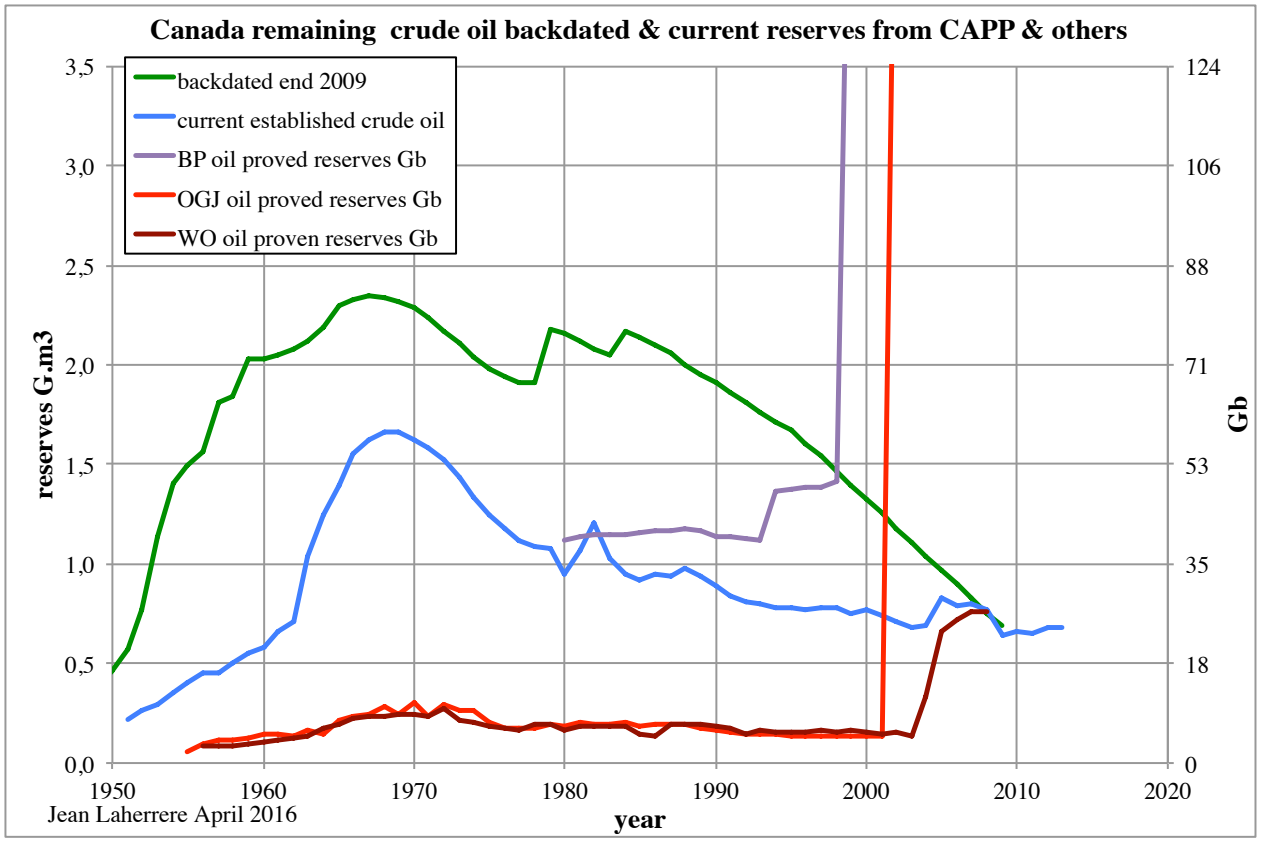


Remaining backdated oil reserves peaked in 1950 when current proved reserves peaked in 1970 (with Prudhoe Bay)
US backdated oil reserves display a steep decline since 1970 to 1988 (no more data), like the GOM backdated 2P oil reserves since 2003.
It is similar to the GOM & world above graphs on remaining current reserves and 2P backdated reserves.
Such discrepancy is huge and means that proved reserves have little value for forecasting the future: they are financial data designed by the SEC to protect the banker and the shareholders from oil crooks like JR Ewing!



But it is not good to show that proved reserves data are wrong and the open EIA-0534 was the last and cannot be found on EIA site, except as reference (reference 32 in http://www.eia.gov/pub/oil_gas/natural_gas/data_publications/crude_oil_natural_gas_reserves/historical/2000/pdf/references.pdf)!

This graph is similar to the Canadian Association of Petroleum Producers: backdated crude oil reserves (green curve) peaked in 1967 with a steep decline since 1983, when current established reserves (blue curve) is a bumpy flat since 1993.
The comparison is so drastic that CAPP dropped reporting backdated reserves after 2009 (like EIA after 0534!)!
This graph is very important because the similar graph for the world or for the GOM was comparing data from different sources: world = public data and confidential data, GOM: BOEM and EIA but for Canada the source is the same being CAPP, the only difference is the time of estimate (current = year of discovery or backdated = year of the report



The US ultimate has been estimated with a huge range 100-628 Gb from 1942 to 1978 (Biraben 1982)
Before 1956 the US oil ultimate was less than 200 Gb, from 1956 to 1974 the range is wild, but from the range is quite down because the US oil peak was fully recognized to have been in 1970!

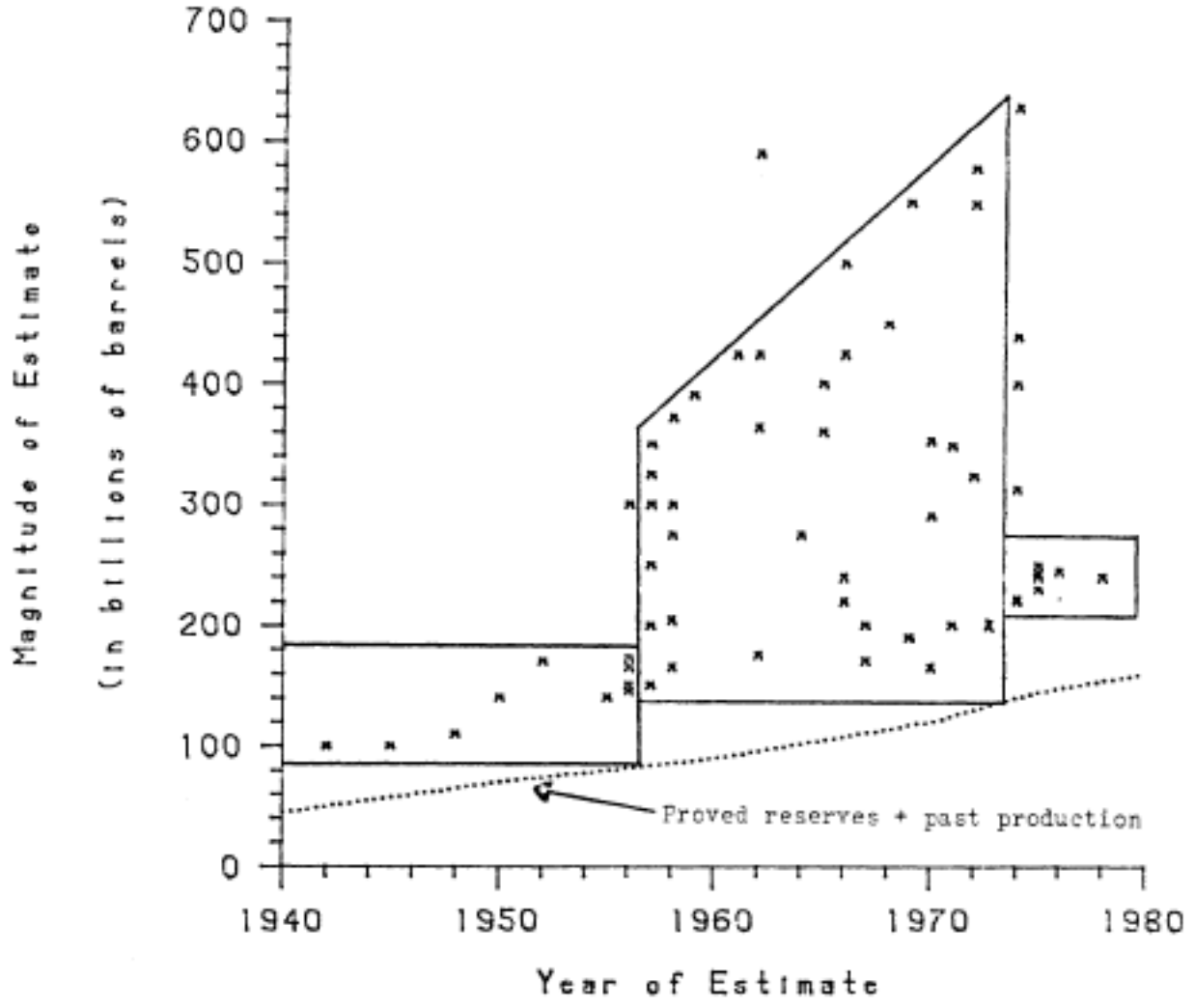


Figure 1: Historical Periods in the Estimation of U.S. Crude Oil Resources

TABLE 1
Estimates of U.S. Crude Oil Resources, 1942-1978

Date	Estimator	Geographical Area (1)	Estimate (barrels)
1942	Pratt	C	100×10^9
1945	Pratt	C	100
1948	Weeks	C	110
1950	(2)	C	140
1952	Schultz	C	170
1955	(2)	C	140
1956	Pratt	C	145
	Hubbert	C, S	150
	Pogue and Hill	C, S	165
	Knebel	C, S	173
	U. S. Department of Interior	C, S	300
1957	Oil and Gas Journal, Company A	U	150
	Company B	U	300
	Company C	U	200
	Company D	U	300
	Company E	U	350
	Company F	U	325
	Hill, Hammer and Winger	C, S	250
1958	Oil and Gas Journal	U	300
	Weeks	C, S	204
	Miller	C, S	275
	Davis	C, S	165
	Netschert	C, S, A	372
1959	Weeks	C, S	391
1961	Averitt	C, S, A	425
1962	Hubbert	C, S	175
	Moore	C, S, A	364
	National Fuels and Energy Study	C, S, A	450
	Zapp	C, S, A	590
1964	McAfee and Davis	C, S, A	275
1965	McKelvey and Duncan	C, S, A	360
	Hendricks	C, S, A	400
1966	Hubbert	C, S	170
	Link	C, S, A	240
	Moore	C, S, A	425
	Hendricks and Schweinfurth	C, S, A	500
1967	Hubbert	C, S	170
	Ryman	C, S, A	200

TABLE 1 (Continued)

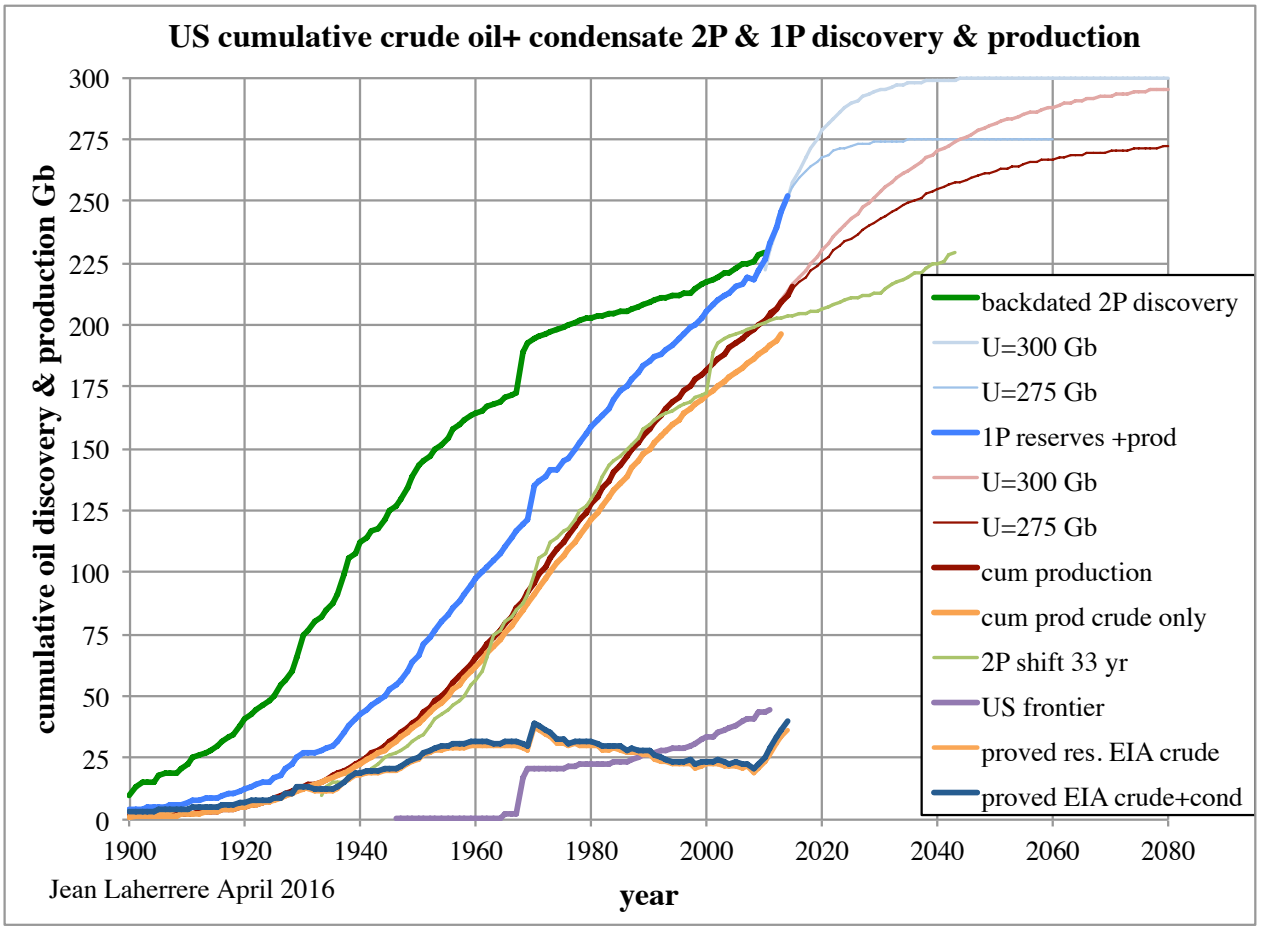
1968	Elliot and Linden	C, S, A	450
1969	Hubbert	C, S, A	190
	Schweinfurth	C, S, A	450
1970	Arps, Mortanda and Smith	C, S	165
	National Petroleum Council	C, S, A	291
	Moore	C, S, A	353
1971	Hubbert	C, S, A	200
	Cram	C, S, A	349
1972	National Petroleum Council	C, S, A	324
	U. S. Department of Interior	C, S, A	550
	Theobald	C, S, A	578
1973	Hubbert	C, S, A	200
1974	Hubbert	C, S, A	213
	Moody	C, S, A	230
	Jodry	C, S, A	235
	Berg, Calhoun and Whiting	C, S, A	400
	McKelvey	C, S, A	440
	Ford Foundation	U	628
1975	Moody and Geiger	C, S, A	236
	Resource Appraisal Group	C, S, A	243
	Miller	C, S, A	250
	National Academy of Science	C, S, A	258
1976	Exxon	C, S, A	245
1978	Nehring	C, S, A	240

(1) Geographical area codes:

A Alaska
C Continental United States
S Continental shelves
U United States, unspecified or undetermined as to exact area

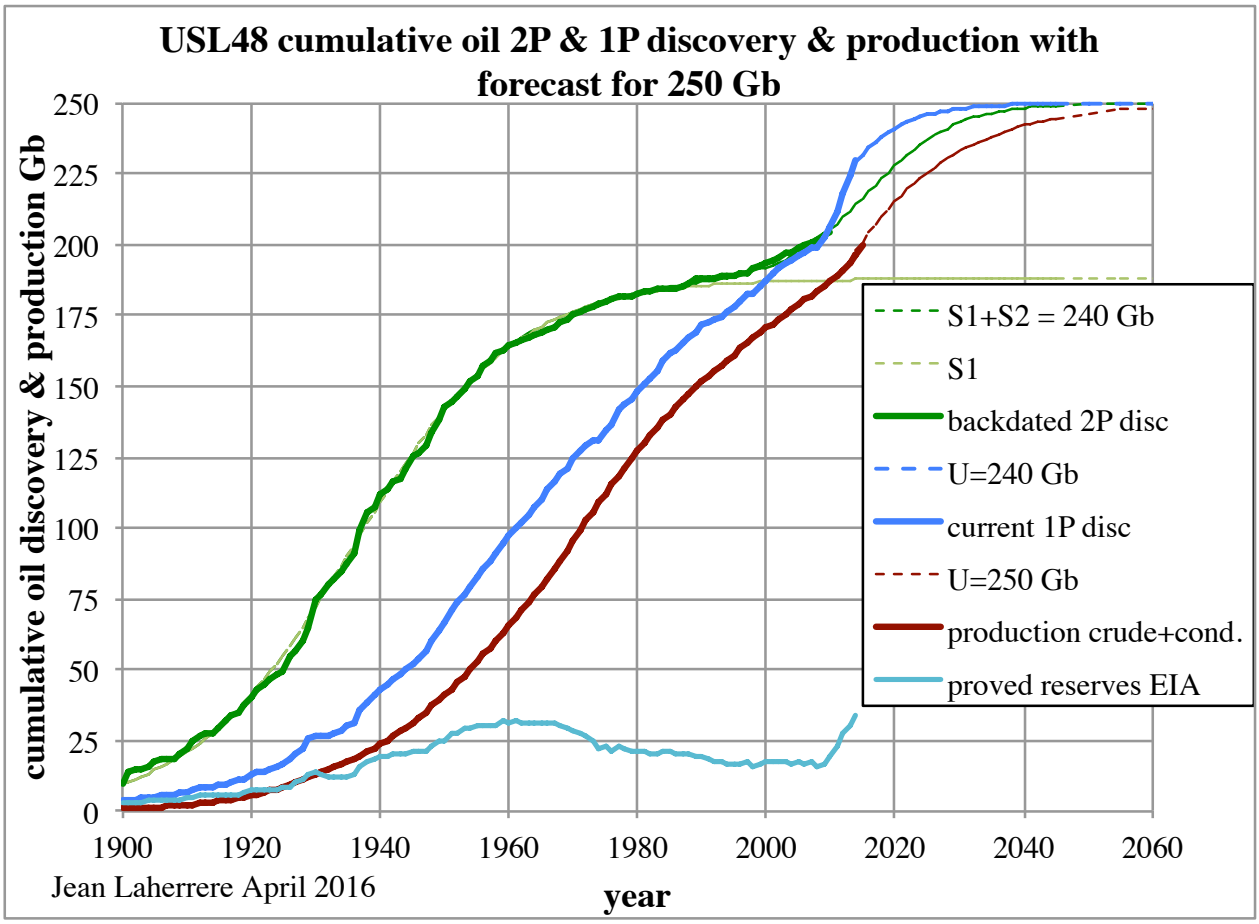
(2) Unreferenced estimates, cited in Ascher (1978).

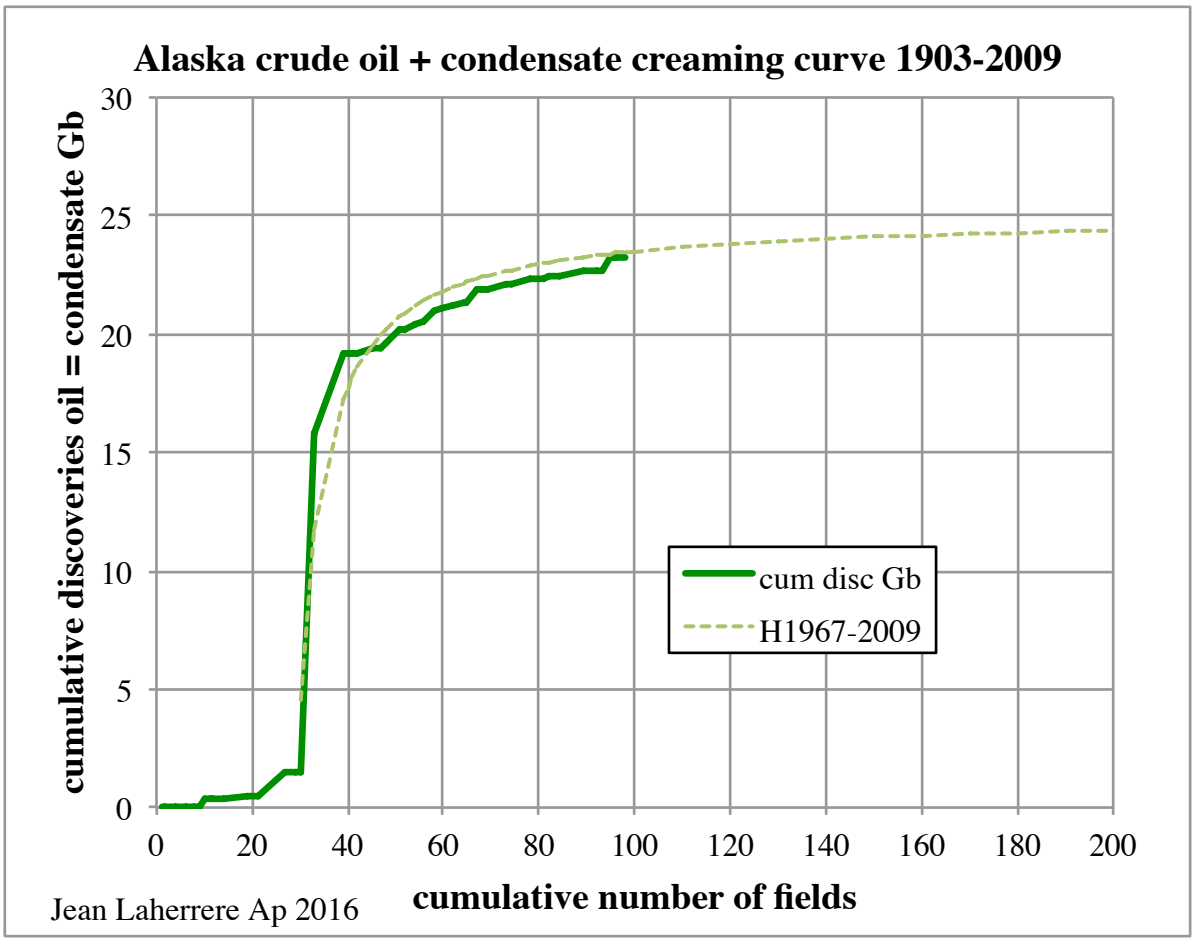
My present estimate for the US crude oil +condensate ultimate is between 275 and 300 Gb



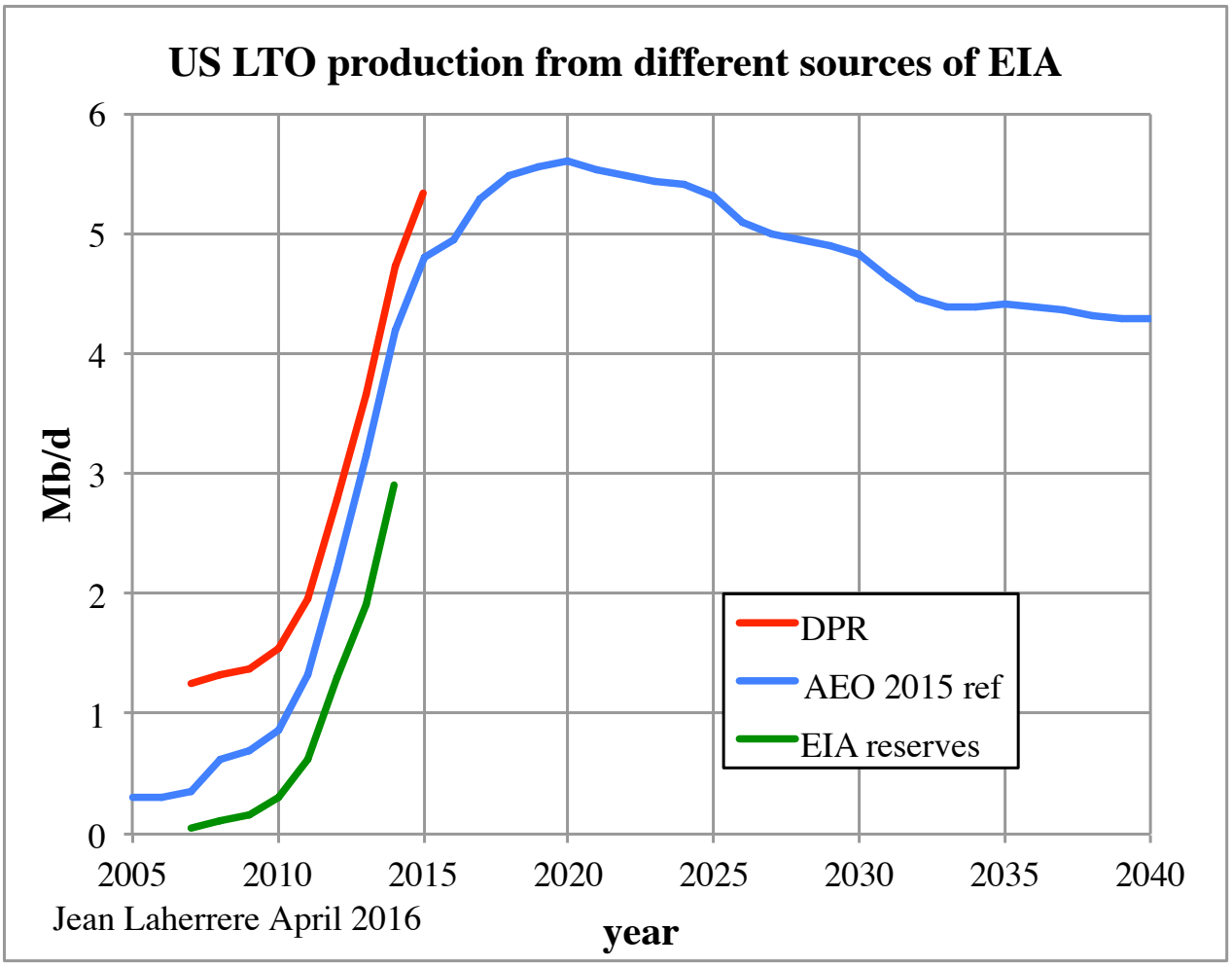
The cumulative crude oil +condensate production at end 2015 is 215 Gb

With the breakdown into USL48 and Alaska, the ultimate is 250 Gb for USL48 and 25 Gb for Alaska
There are too many fields in the USL48 to obtain the fields reserves data and to plot creaming curve
We have extrapolated EIA-0534 discoveries estimated in 1990 (needs to be updated by EIA) and EIA current proved reserves towards 250 Gb

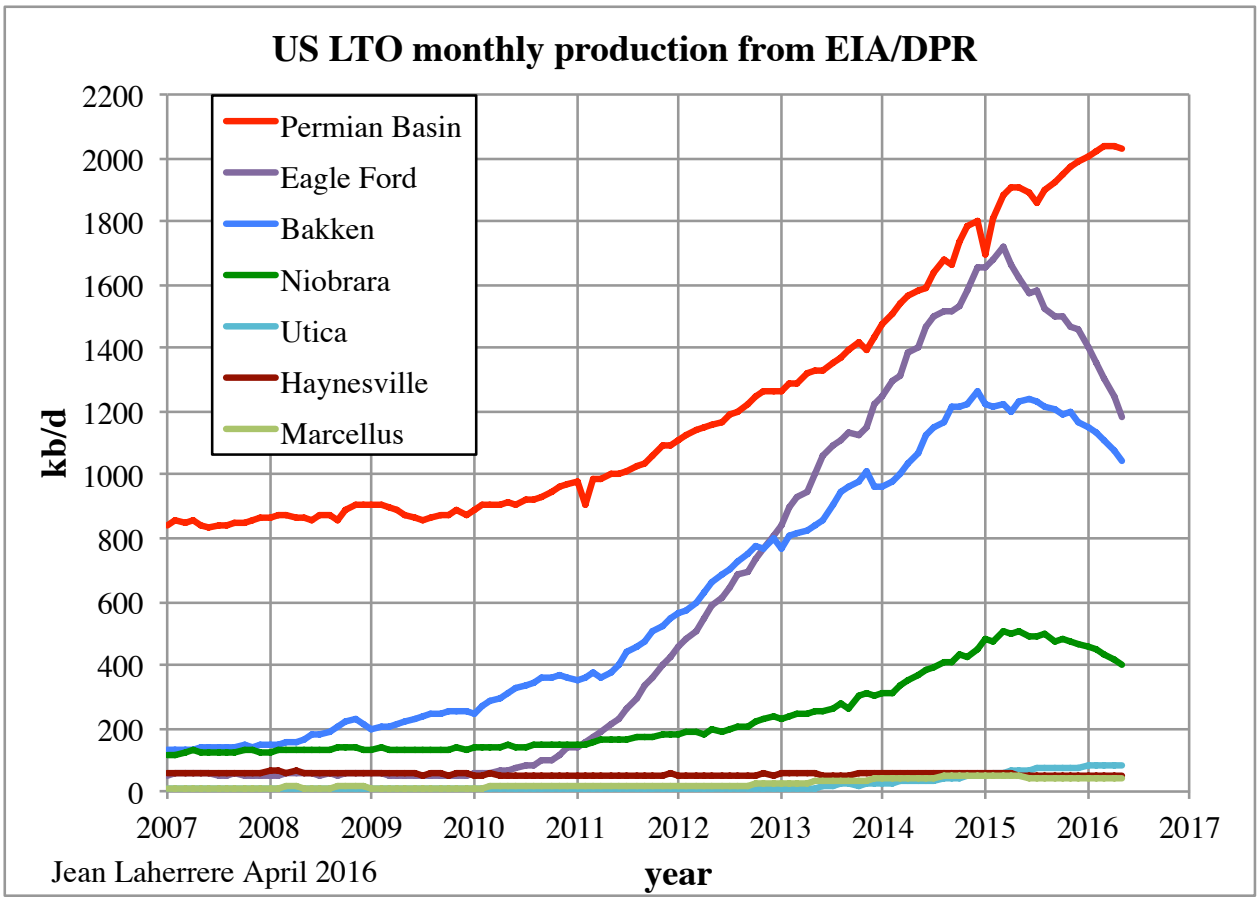

USL48 cumulative oil 2P & 1P discovery & production with forecast for 250 Gb
cumulative oil discovery & production Gb
250
225
200
175
150
125
100
75
50
25
0
1900
1920
1940
1960
1980
2000
2020
2040
2060
year
Jean Laherrere April 2016
S1+S2 = 240 Gb
S1
backdated 2P disc
U=240 Gb
current 1P disc
U=250 Gb
production crude+cond.
proved reserves EIA



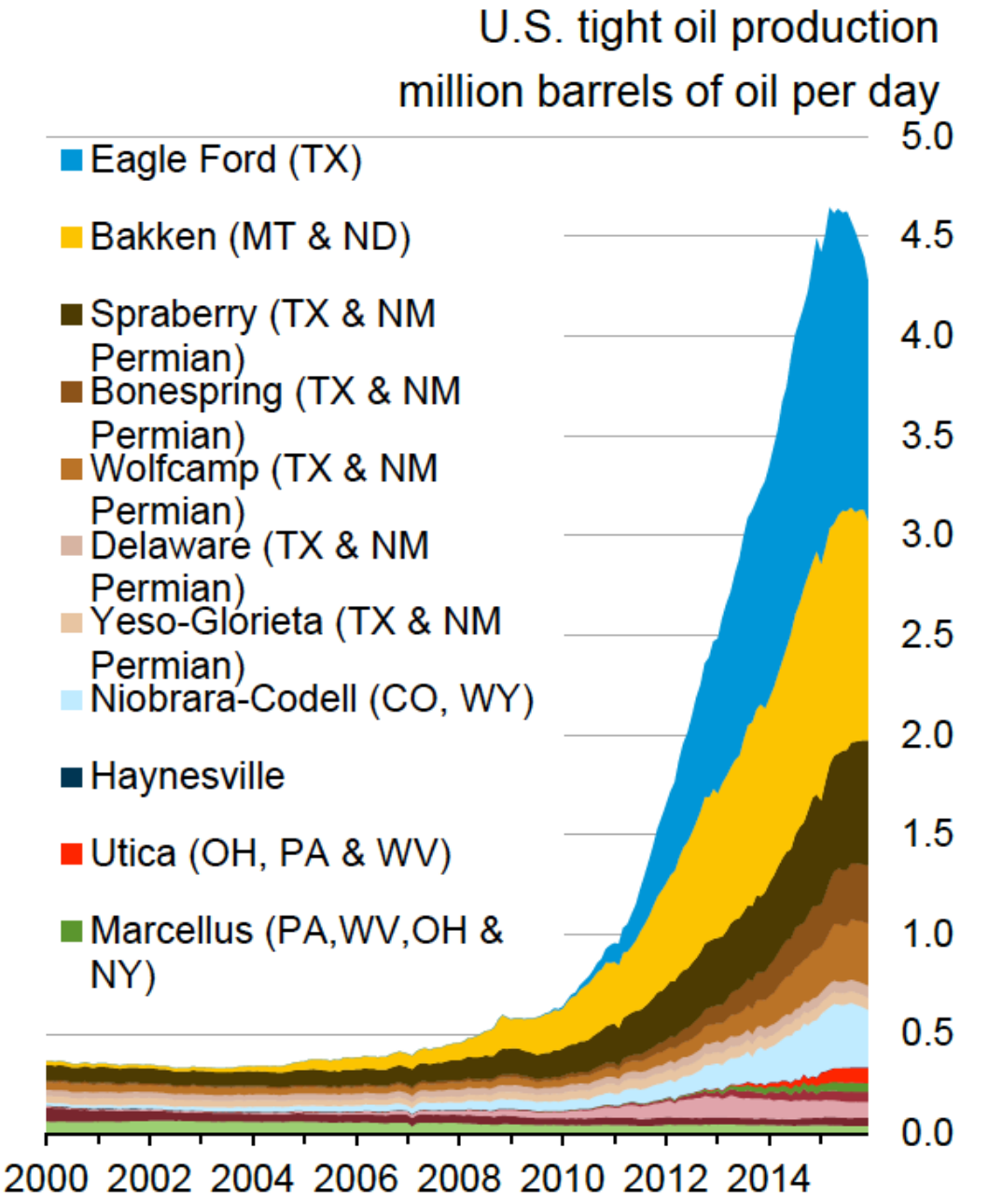
The big problem for USL48 is to get right data on LTO production.
EIA provides LTO production in their US reserves annual edition, in their forecast AEO 2015 and also in DPR (drilling productivity report): unfortunately these three EIA sources differ widely!
EIA reports for US LTO production for 2014 either 2.9, 4.2 or 4.7 Mb/d, which is the right number?
EIA should be more careful about reporting so different data, without any explanation!



The PDR breakdown (Jan 2007-Jan2016) shows that the Permian Basin LTO is the largest producer and since a long time.



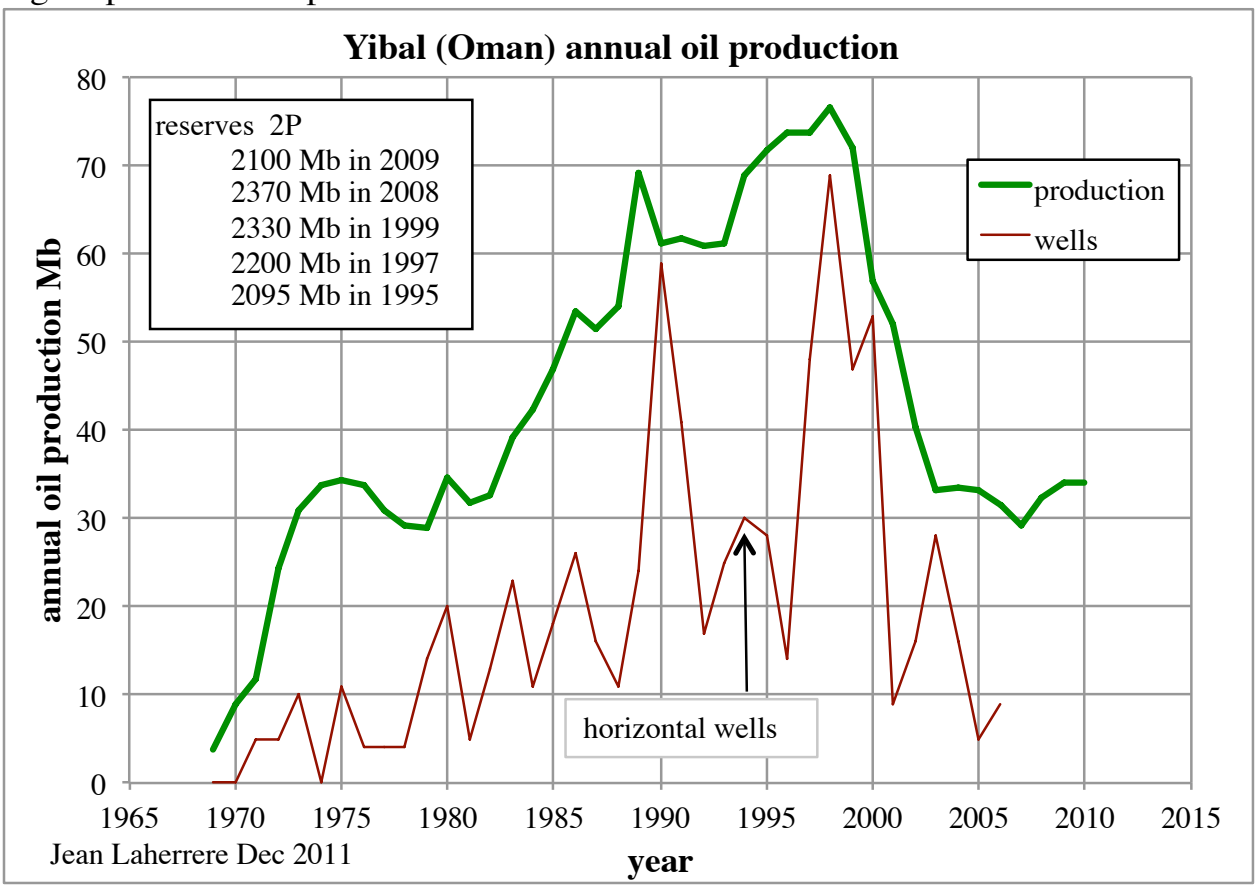
EIA shows Permian Basin LTO production already high in 2000, well before the shale play burst!



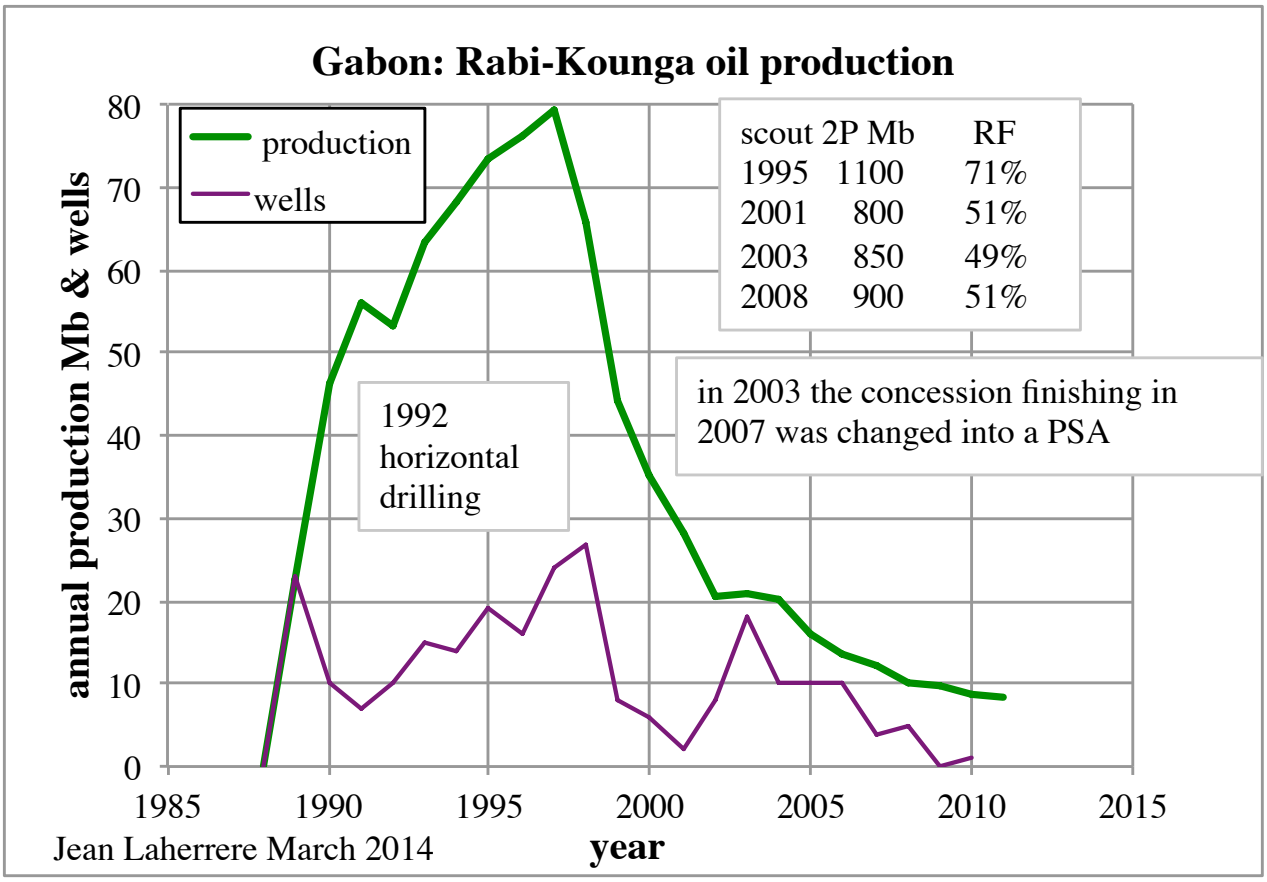
Sources: EIA derived from state administrative data collected by L
EIA's official tight oil & shale gas estimates, but are not survey da

For the Permian Basin, EIA is confusing LTO and horizontal drilling.
Remember that Shell pushed in the 90s the production of giants oil fields as Yibal

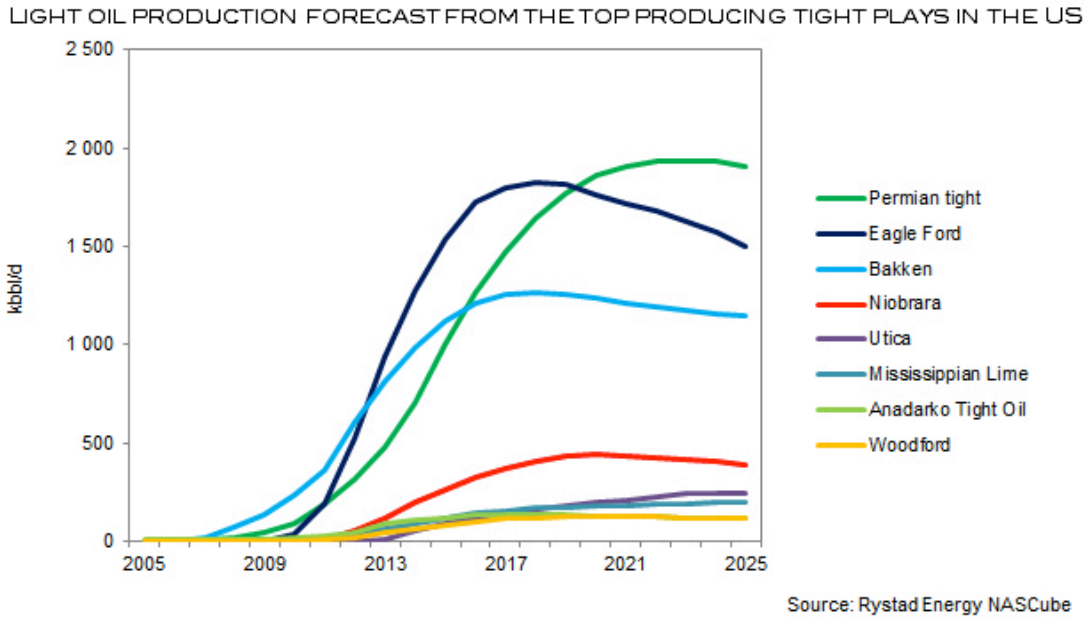
in Oman and Rabid-Kounga in Gabon using horizontal drilling with the result of higher peak and steep decline



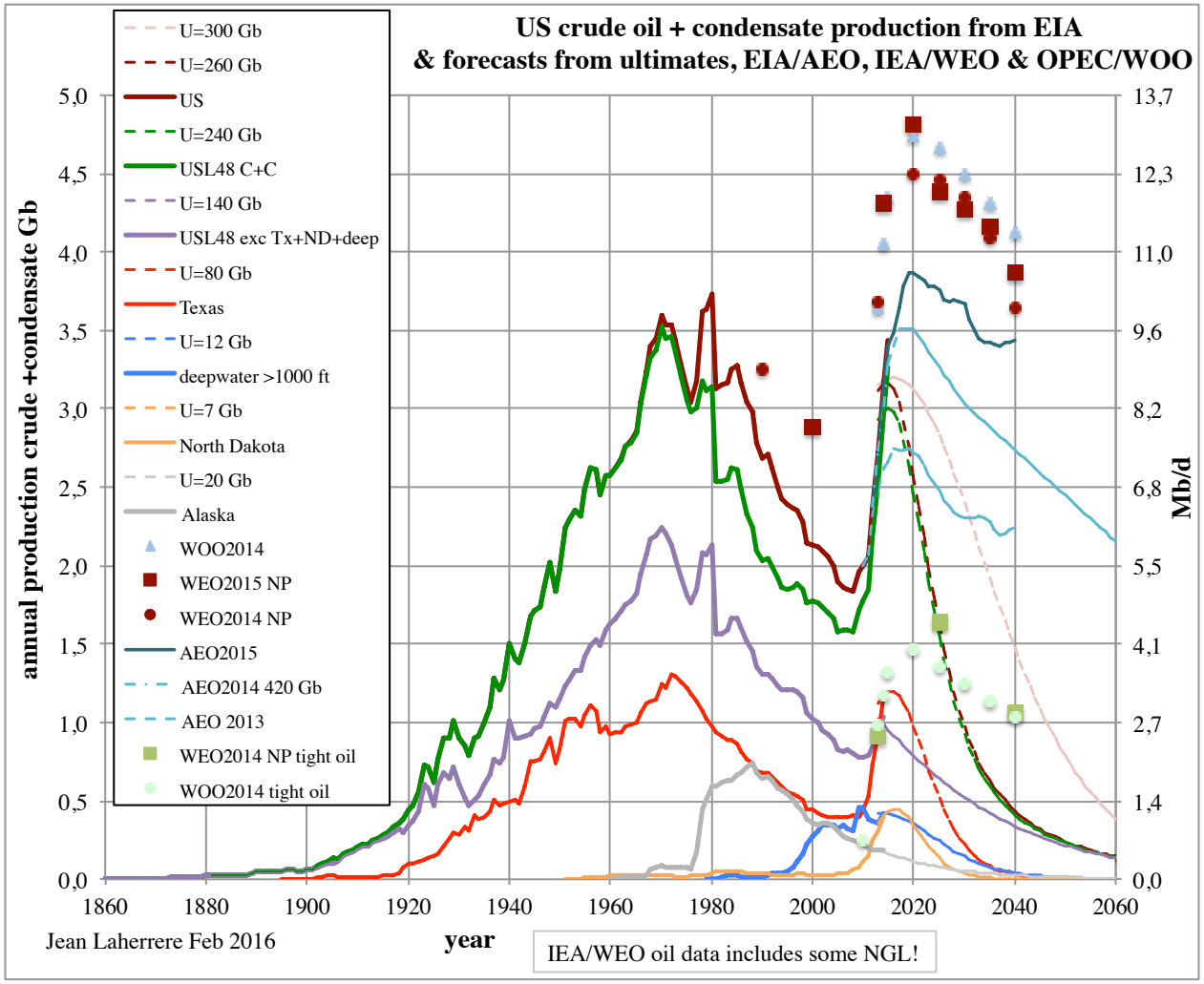
In Gabon the goal was to produce the maximum before the end of the concession!



Rystad http://www.rystadenergy.com/ResearchProducts/NASAnalysis/usshalenewsletter displays a Permian Basin LTO much lower and starting in 2009 only, in contrary with EIA.

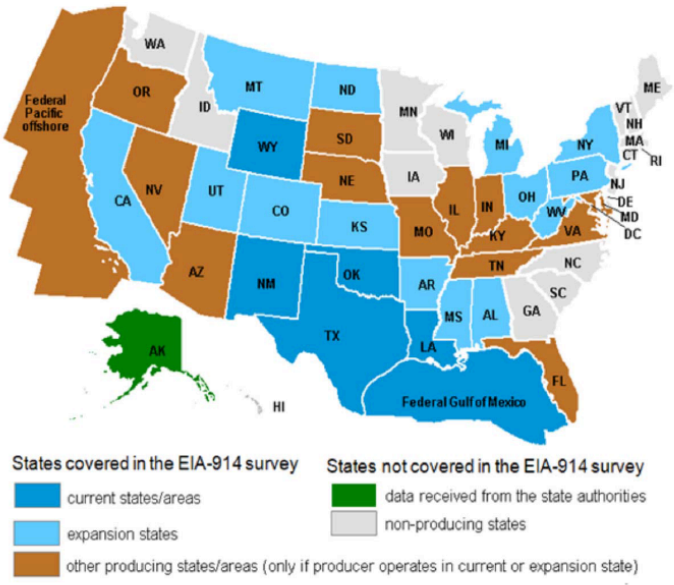


The US annual crude oil + condensate production is forecasted and compared with EIA/AEO, IEA/WEO and OPEC/WOO



The problem with US oil production is that data is not reliable.
There are so many oil producers that it is impossible to get correct data from all and that EIA does not get right data from the 50 States.
EIA guesses in their 914 survey estimates from a limited survey upon a small part of the producers in some States

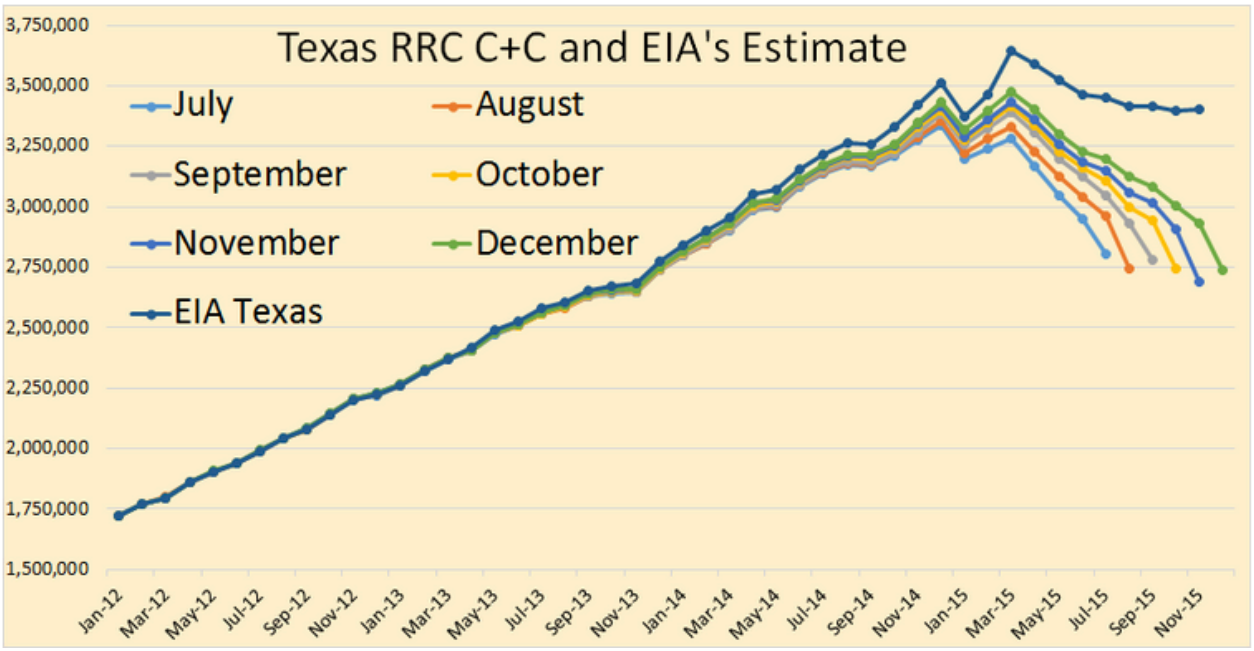
EIA-914 expansion will add 20 states/areas to oil and 14 states to current coverage of natural gas



Lower 48 states expanded survey coverage:

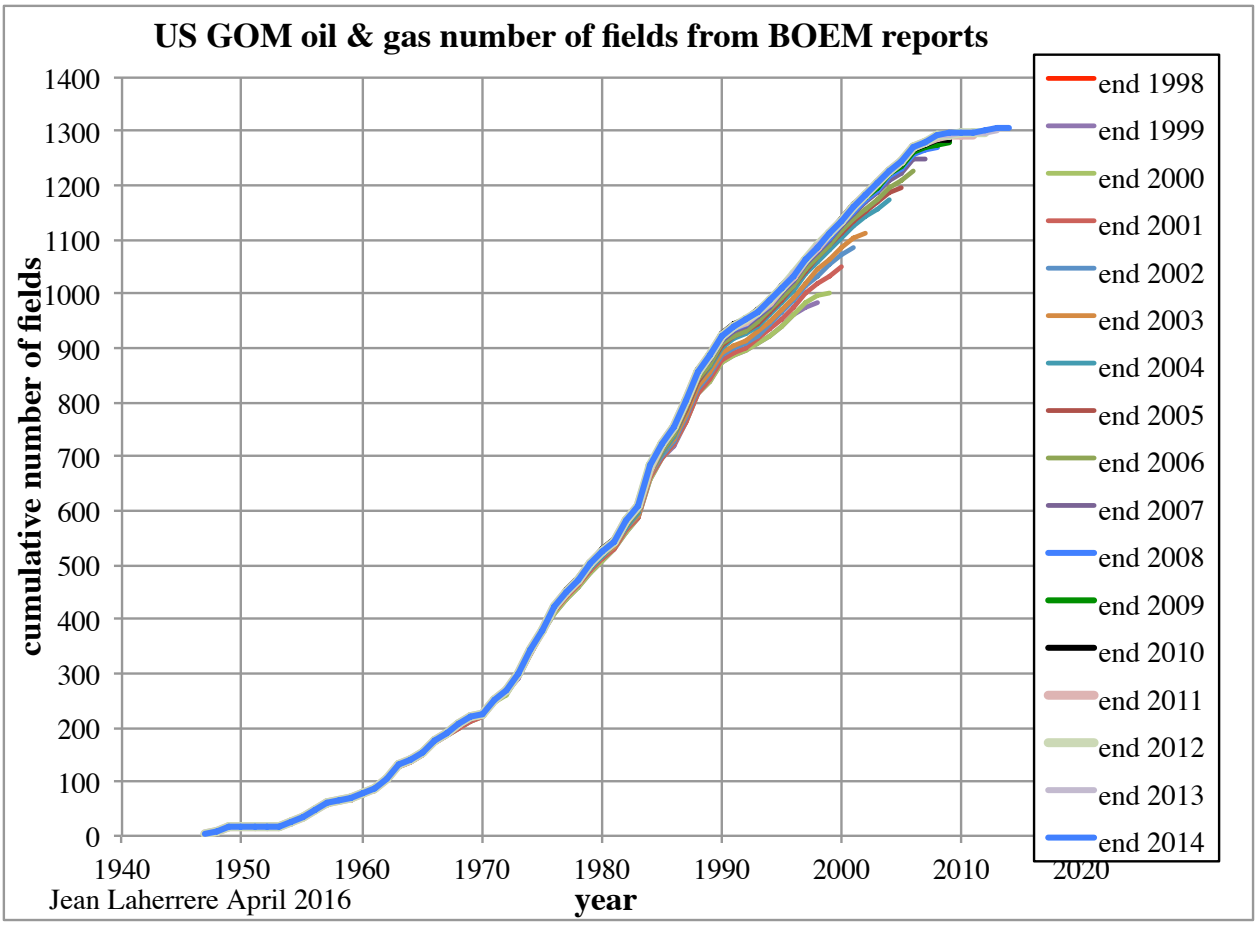
- **gas: 92%**
- **oil: 89%**

The largest producer State Texas allows producers two years to report the right data because of the confidentiality of some fields. The problem is that the owners of the oil and gas are the landowners, not the States
Ron Patterson on his site peakoilbarrel.com reports z evolution of RRC data with time compared with EIA data

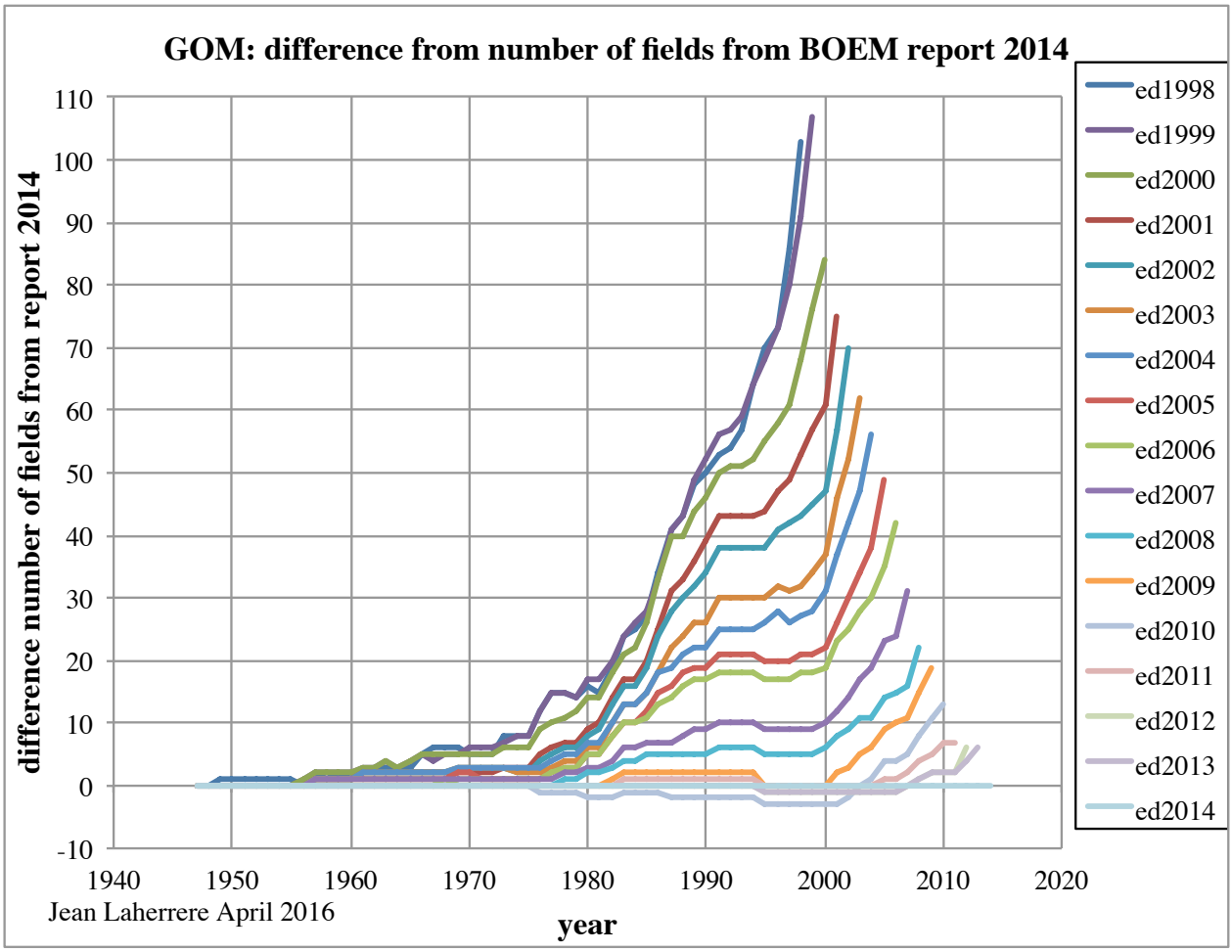


It is necessary to wait at least two years to get the same number

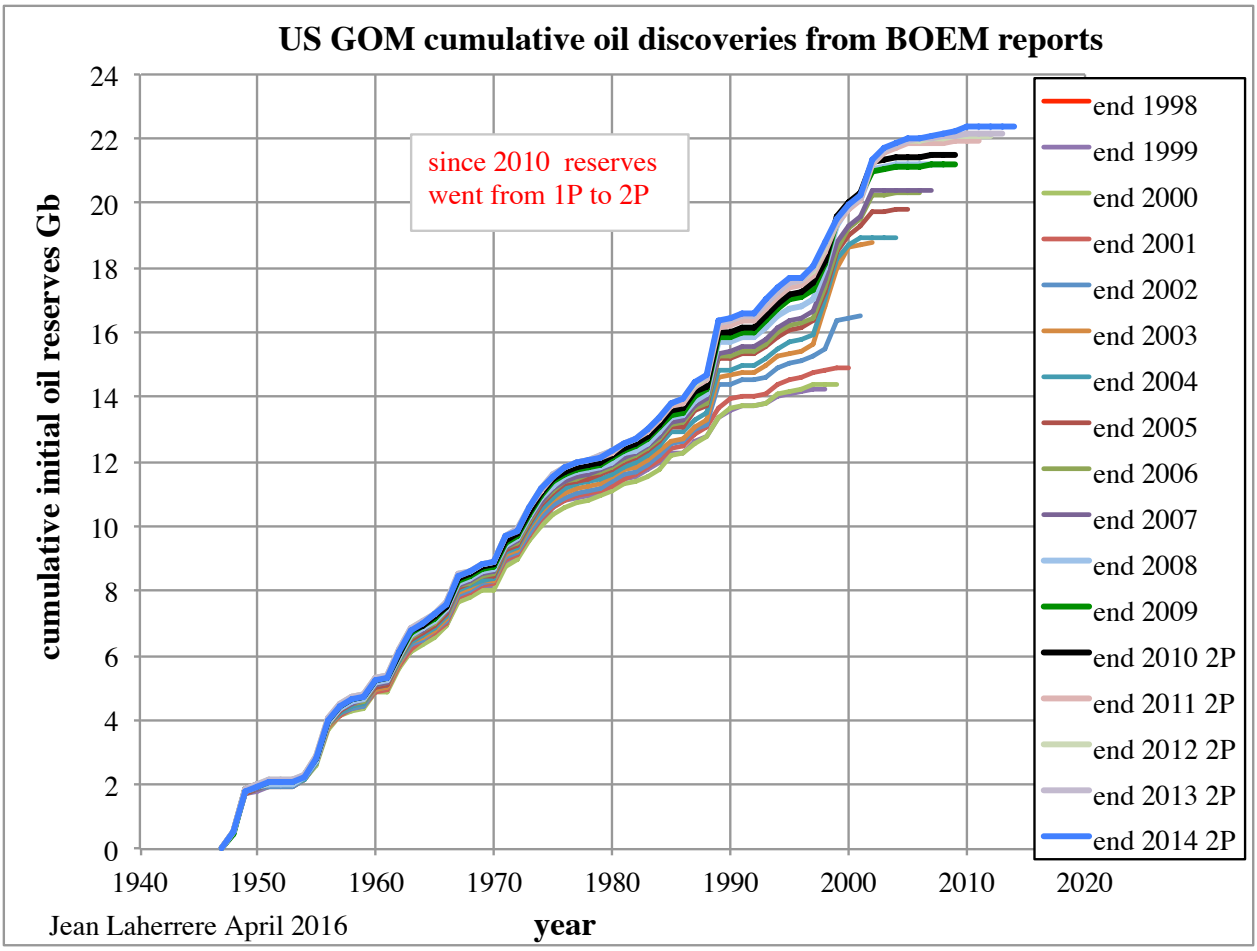
In the GOM the owner of oil and gas is the federal government, which sells leases to oil companies. The federal government should know exactly the number of fields. But for the GOM the cumulative number of fields from MMS, now BOEM varies with time



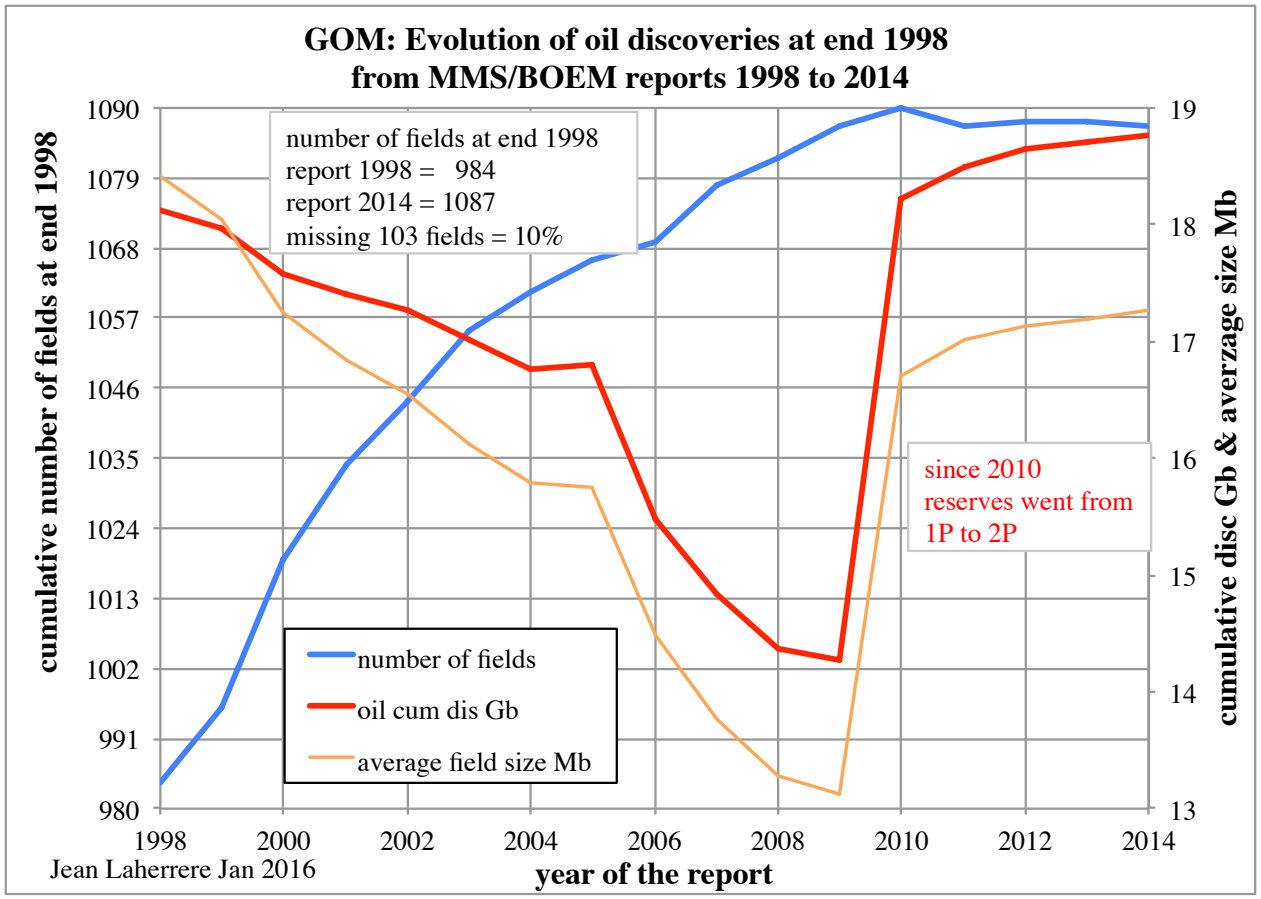
At end 1997 the report 1999 reported a number of 1003 fields with a total of initial oil discoveries of 14.4 Gb and 43.1 Gboe for oil & gas when the report 2014 reports 1110 fields, with a total of 19.4 Gb for oil and 52.7 Gboe for oil & gas, meaning that 107 fields were missing in the 1999 report and that the growth of 5 Gb for oil and 9.6 Gboe for oil & gas is due partly to the missing fields, reserves growth as moving from 1P to 2P!
How many fields are missing in the 2014 report?



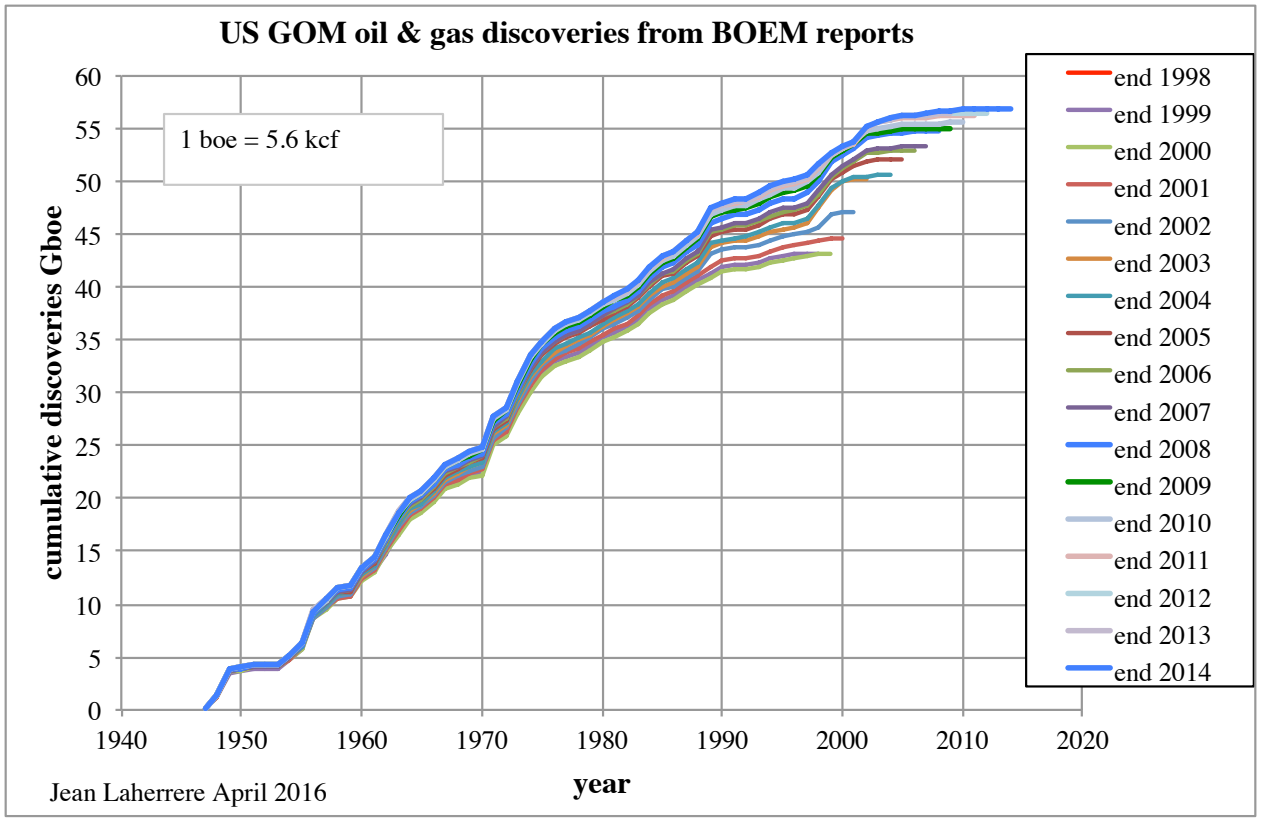
The evolution of the cumulative oil discoveries is important due partly to missing fields and reserves growth, in particular by moving to 1P to 2P.



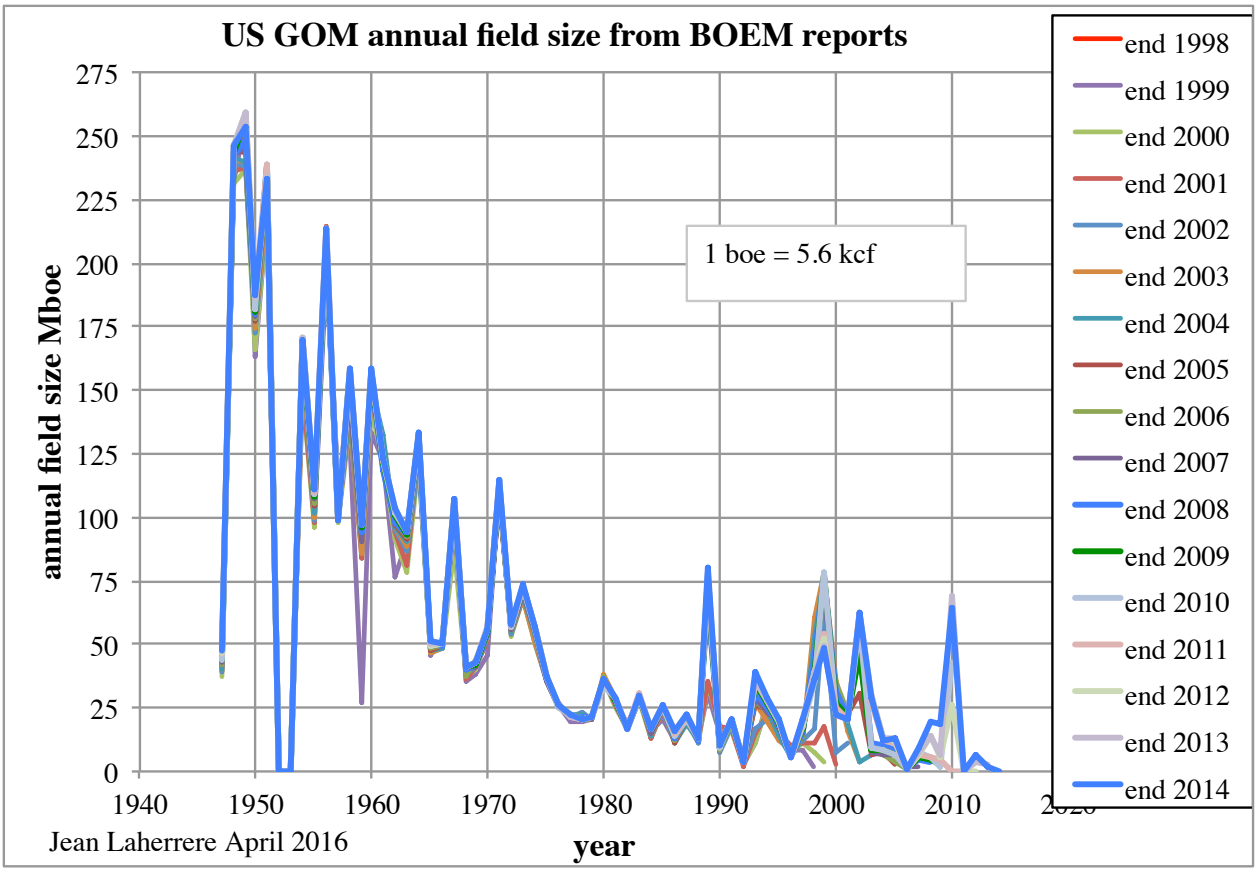
Moving from 1P to 2P has changed slightly the average size at end of 1998



The evolution of the oil & gas discoveries is less than for oil, because in the GOM the total initial discoveries represents more gas than oil (at end 2014 22,4 Gb for oil and 34,4 Gboe for gas)



The average size annual for oil & gas varies less with the different reports but it is obvious that the average size declines being over 200 Mboe in the 40s, 125 Mboe in the 50s, 80 Mboe in the 60s, 50 Mboe in the 70s, 25 Mboe in the 80s and 90s and 2000s, but less than 5 Mboe from 2011 to 2014!



I have just finished Mason Iman's book: it is a must to read.
I have greatly enjoyed this book and I have learned a lot, despite the large number of papers I have read from him and about him before.
I admire Hubbert being a real scientist: geophysicist/geologist (as myself)
When I was exploring worldwide, I knew Hubbert for his view on hydrodynamic entrapment: he was really a forerunner. But I was less interested by his views on reserves because he was dealing only with proved reserves.
He was right that you have to deal with ultimate reserves and that the world has limited resources, meaning that any activity which starts at zero will reach a peak and will decline to zero when depleted.
If Hubbert was skeptical about data, he never mentions that there are several classifications of reserves:
-SEC proved reserves with audit
-OPEC proved reserves without audit
-ABC1 Russian classification
-SPE/WPC proved, probable and possible reserves
Hubbert was not clear enough on the precise definition of his estimates, explaining Steve Andrew's confusion on offshore!

The missing point in Mason's book is the lack of critics from Hubbert on definition for reserves, resources, or conventional oil. There are several local rules, but no world consensus.
Hubbert was right on the timing of the US oil production being 1970, but he was wrong on the US ultimate being less than 200 Gb after the US oil production peaked in 1970, one of the two forecasts by Hubbert based on 200 Gb (high value of a Delphi enquiry by Wallace Pratt)
Hubbert was right being critic on USGS estimates: there were and are still presently too optimistic
Mason is right by writing page 328 that the estimates on shale resources (based on number of future wells without any consideration to sweet spots) remind of the Zapp approach on conventional (based on future success ratio being as high as in the past).

I will appreciate to receive comments from anyone

Le 20 avr. 2016 à 15:24, Steve Andrews a écrit :
Jean, thanks very much.

Come to think of it, I should have asked about the US cumulative also. Do you happen to have that?

This inquiry all revolves around the lengthy interview with Hubbert that I conducted back in 1988 at his home and which I've been asked to revisit. At that time, Hubbert was reflecting on both his estimate for the world total (which he knew was low) and the U.S. total (which he still thought wasn't way low, though perhaps modestly so). His original total for the U.S. excluded offshore and Alaska.

History will show that his first estimate in 1956 for a world total—1250 Gb—was wrong by roughly a factor of two (+/-), whereas his first total for the U.S. (170 Gb, ex. offshore and Alaska) will be closer to the mark. Later on, he moved his estimate for the world to 2,000 Gb, but he pointed out that he was not as well informed about the world total and that others' figures—including Petroconsultants'—had more work behind them.

Mason Inman's book on Hubbert—The Oracle of Oil—is worth a read. Lots of research therein.

Thanks again,

Steve

From: Jean Laherrere [mailto:laherrere.jean@nordnet.fr]
Sent: Wednesday, April 20, 2016 3:50 AM
To: Steve Andrews <sbandrews@att.net>
Cc: 'mushalik' <mushalik@tpg.com.au>
Subject: Re: estimate of cumulative oil production to date?

Steve
cumulative production at end 2014
crude less extra-heavy 1250 Gb
crude +NGL 1350 Gb
all liquids 1400 Gb