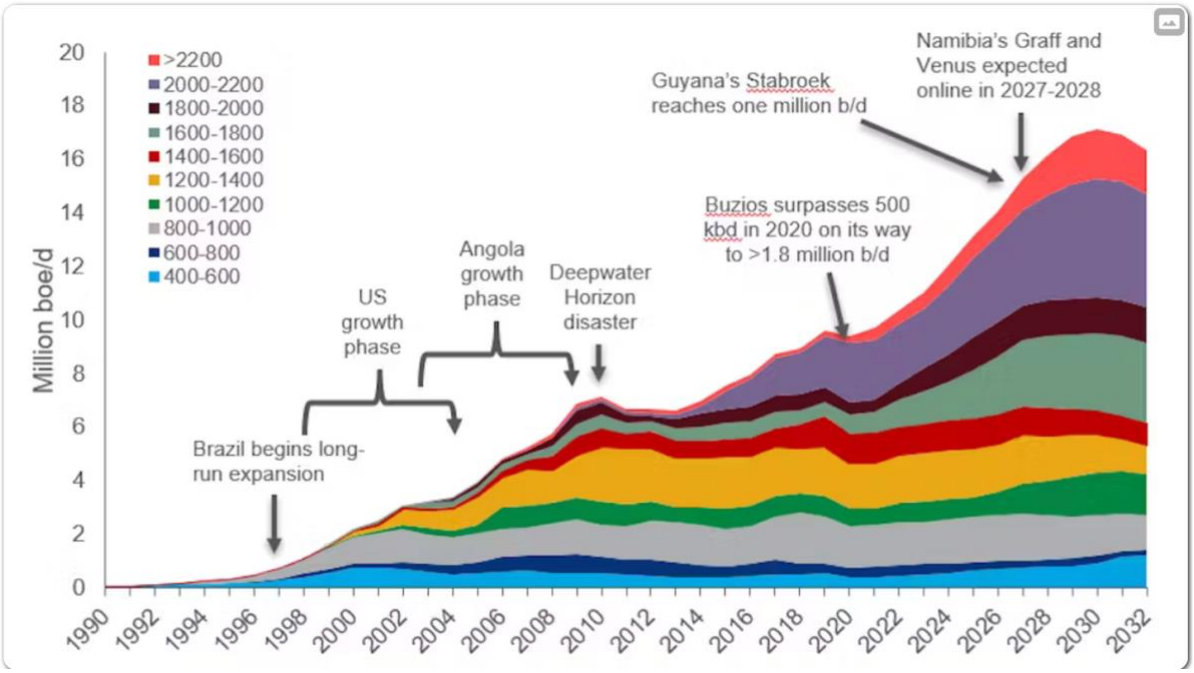
Jean Laherrere July 2023

Offshore oil production

As I say often: in the world, for football game there are rules, umpires and red cards, but for oil production there is no rule, no umpire, no red card: most of the oil data is political because many countries lie on oil data, especially on reserves.
There is no consensus on rules for oil definitions and in particular for water depths

-water depth definition
The definition of deepwater depth varies between 125 m and 500 m:
-Uppsala >500 m
-WoodMac >500 m or 400 m
-IEA >400 m
-GOM BOEM >1000 ft = 305 m
-GOM BOEM 2019 >200 m
-Schlumberger >600 ft = 183 m
-EIA >125 m
-Rystad >125 m
-ASPO >125 m

-deepwater papers
The last paper on deepwater oil production is: Offshore magazine Dec 1, 2022: "Deepwater production set for steady growth, report finds. Global deepwater production should climb to 17 MMboe/d by 2030, according to Wood Mackenzie" = WoodMac



WoodMac defines deepwater as >400 m and forecasts deepwater peak in 2030 at 17 Mb/d.
It is not clear if these data are real crude oil production as the unit is Mboe/d and not Mb/d.
I have converted the above graph in digital data (2 significant digits).

Old papers on deepwater oil production:
-Uppsala U Fredrik Robelius 2007

Giant Oil Fields – The Highway to Oil
https://www.diva-portal.org/smash/get/diva2:169774/FULLTEXT01.pdf
deepwater >500 m
Cumulative deepwater discoveries are less than 50 Gb:

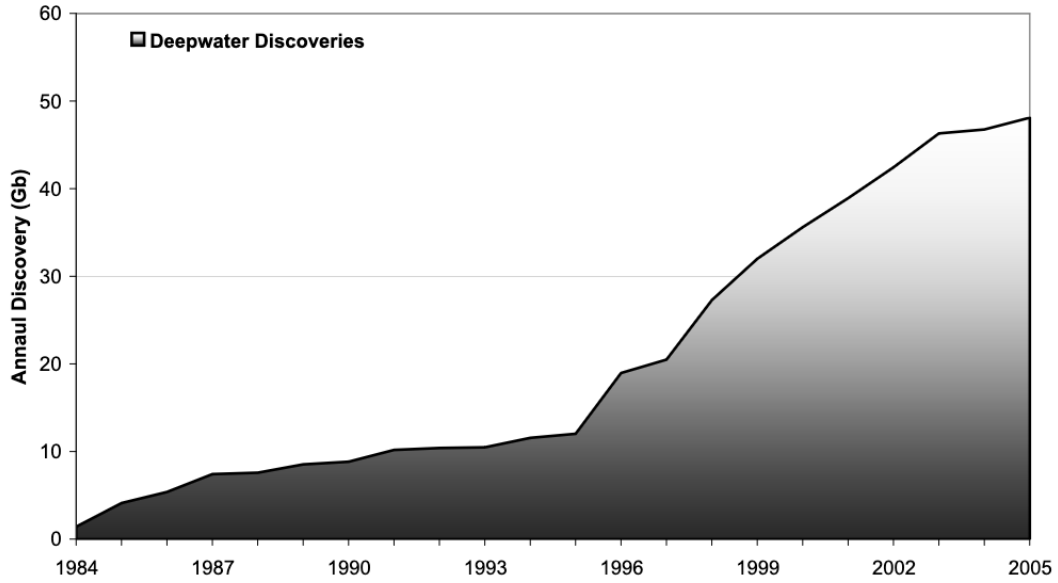


Figure 7.3: Cumulative global deepwater discovery in billion barrels (Gb) (OFN).

Deepwater oil production peak was forecasted in 2012 = it is wrong!

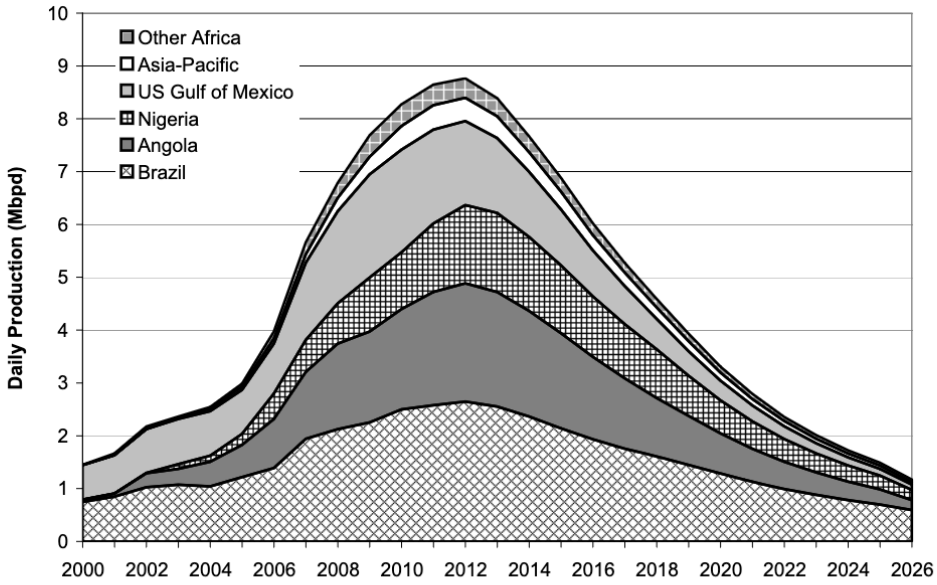
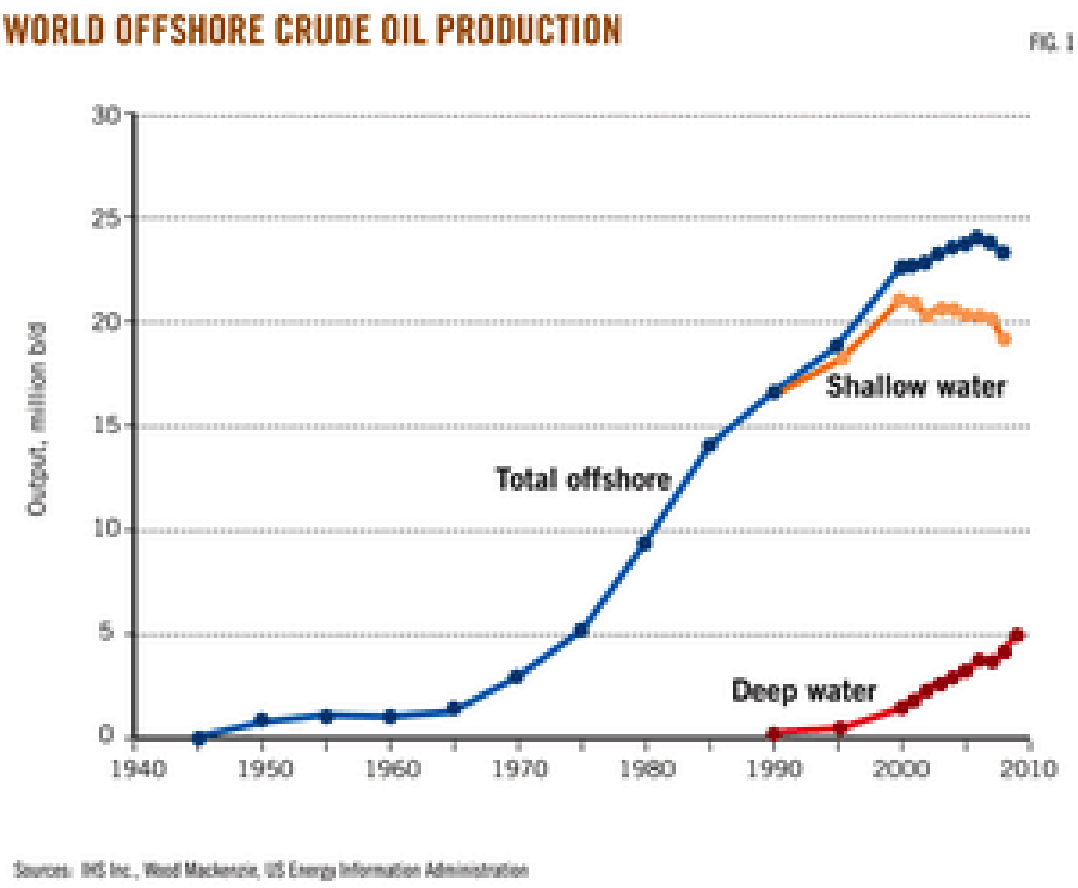


Figure 7.6: Deepwater production forecast, in million barrels per day (Mbpd) based on OFN.

This 2007 forecast is wrong for 2022 (2 Mb/d) compared with real data about 10 Mb/d.

- OGJ Nov1, 2010 Raphael Sandrea
https://www.ogj.com/drilling-production/production-operations/article/17208264/deepwater-crude-oil-output-how-large-will-the-uptick-be
"Deepwater crude oil output: How large will the uptick be?"
Deepwater depth was >400 m as the source is WoodMac



2030 deepwater oil production forecast for 2030 was 11.1 Mb/d for an ultimate of 180 Gb:

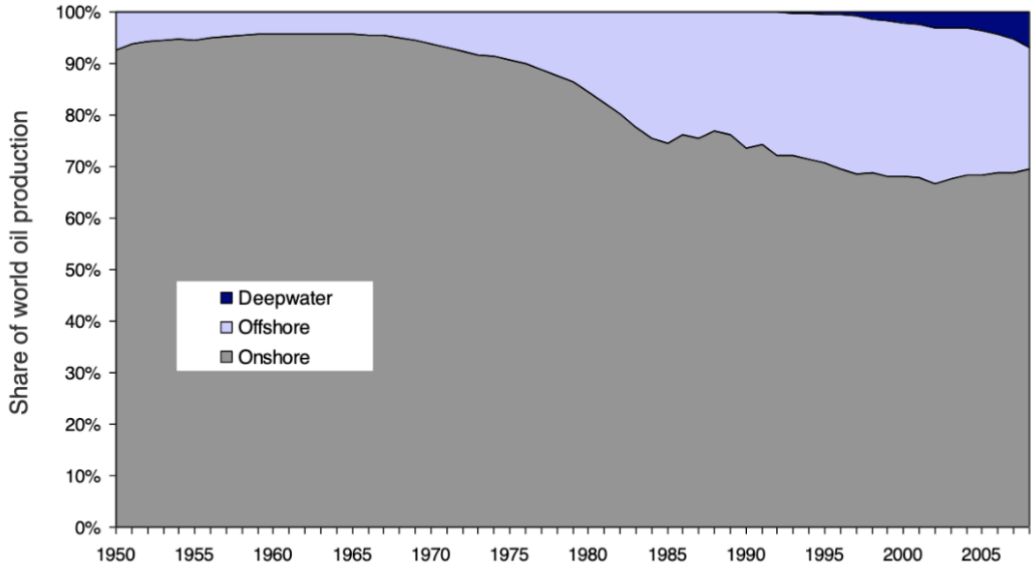
OFFSHORE CRUDE OIL PRODUCTION CAPACITY OUTLOOKS THROUGH 2030 Table 1

	Shallow water	Total offshore			Deep water		
EUR, billion bbl of oil:	320	400	450	500	80	130	180
Year	Production capacity, million b/d						
2008	19.2	23.3	—	—	4.1	—	—
2010	18.1	23.6	—	—	5.5	—	—
2015	14.2	20.5	24.4	27.4	6.3	10.2	13.2
2025	7.3	12.4	16.2	20.0	5.1	8.9	12.7
2030	4.5	8.8	12.2	15.6	4.3	7.7	11.1

-Ivan Sandrea Statoil 2011 “Potential consequences of the Gulf Oil Spill on future offshore
https://studylib.net/doc/18220624/potential-consequences-of-the-gulf-oil-spill-on-future-of...

How important is deepwater?

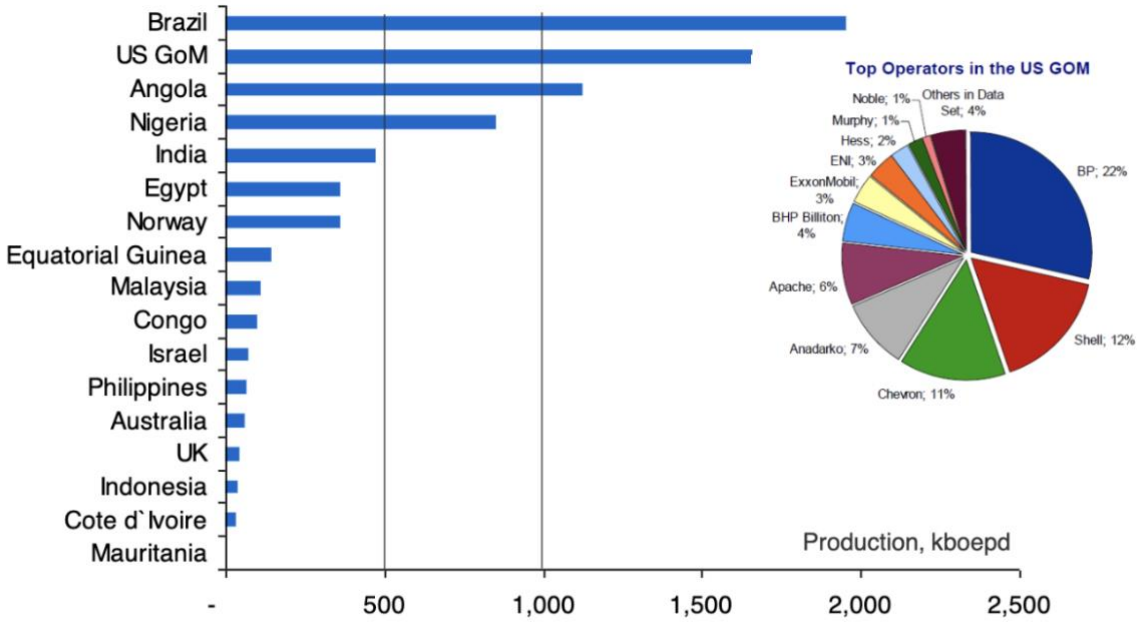
Another source of oil supply, contributor to growth



Source: Sandrea, 2010; IHS; Deepwater water depth > 500m

Statoil

Deepwater producers

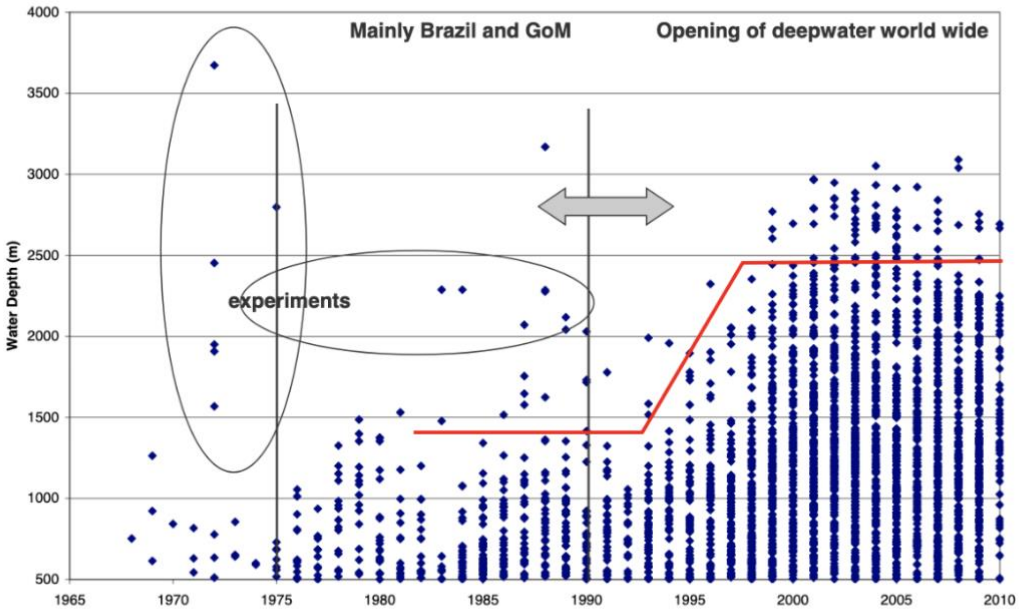


Source: WM, 2010 production; Water depth > 500m; Oil and gas but share of gas is 17%; pie from PFC

Statoil

How we got here?

Exploration water depth records broken every “decade”

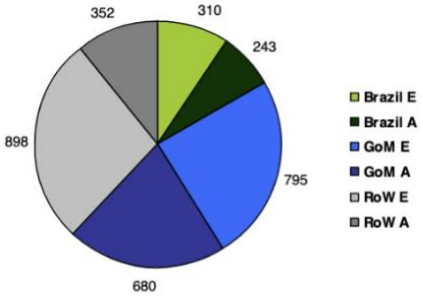


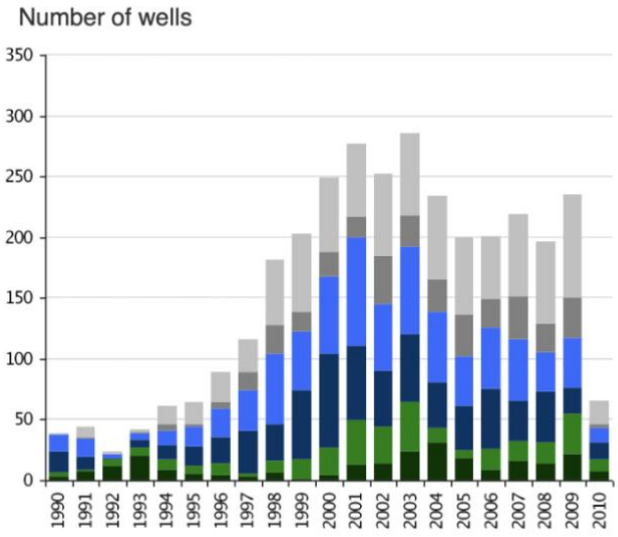
Source: Statoil; WM; Water depth > 500 m

Statoil

How we got here?

Drilling of ~200 wells per year, ~$30 bn pa





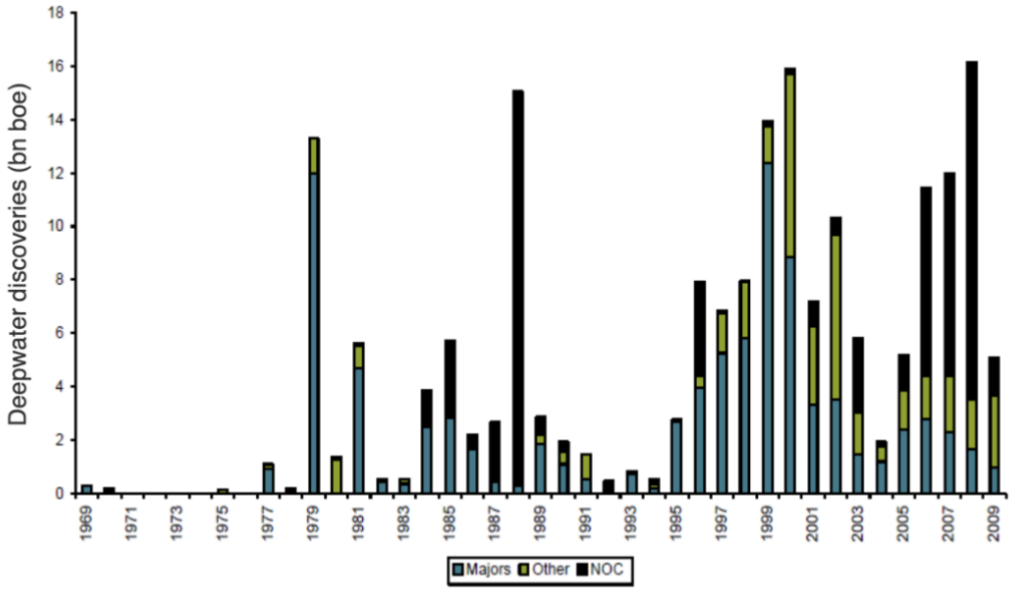
Exploration: >2000 wells

Each IOC has drilled ~500 wells, 60% in Water depth > 1000 m

Source: WM; Statoil; Water depth > 500 m

Statoil

How we got here? Discoveries by major players

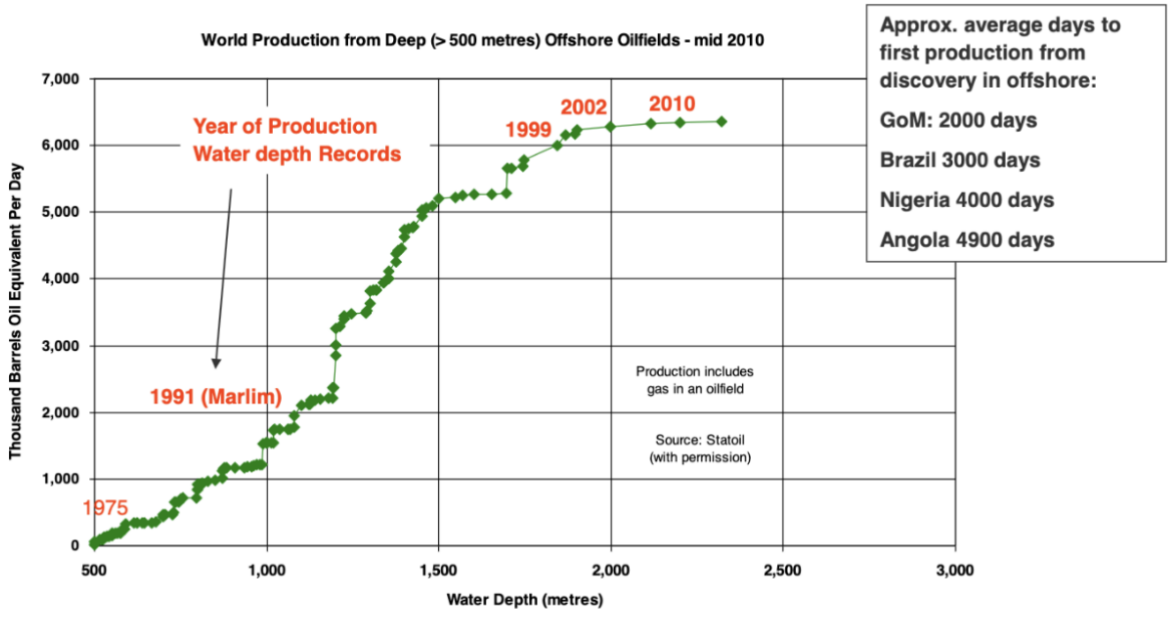


Source: IHS; Bernstein; share of deepwater discoveries; water depth > 500m

Statoil

How we got here?

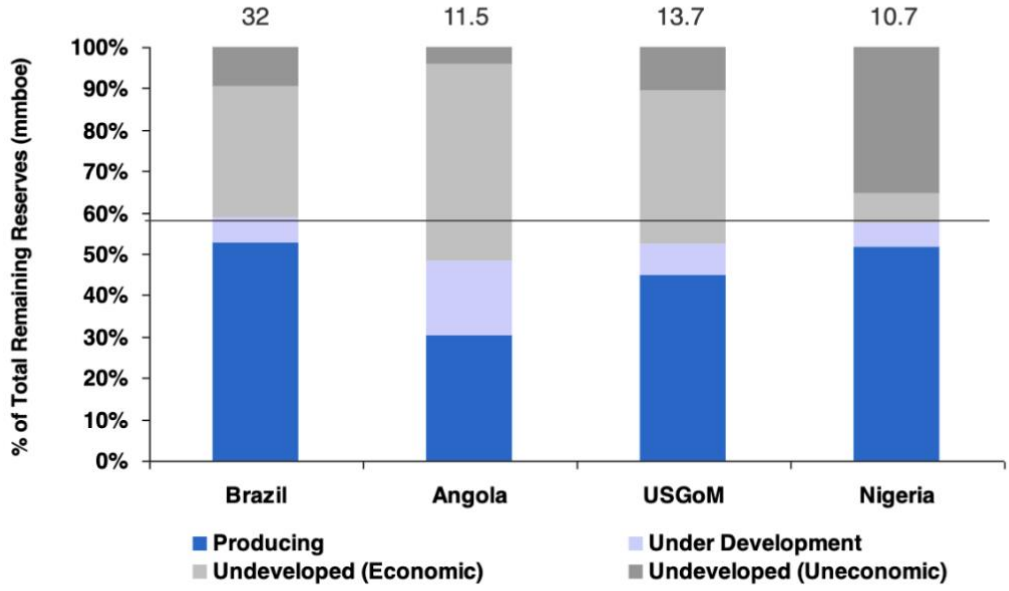
Progressive development of production technology



Source: CGES, Statoil; Water depth > 500m; Days to first production from DB data using all offshore discoveries in last 40 years in over 300m of water depth

Statoil

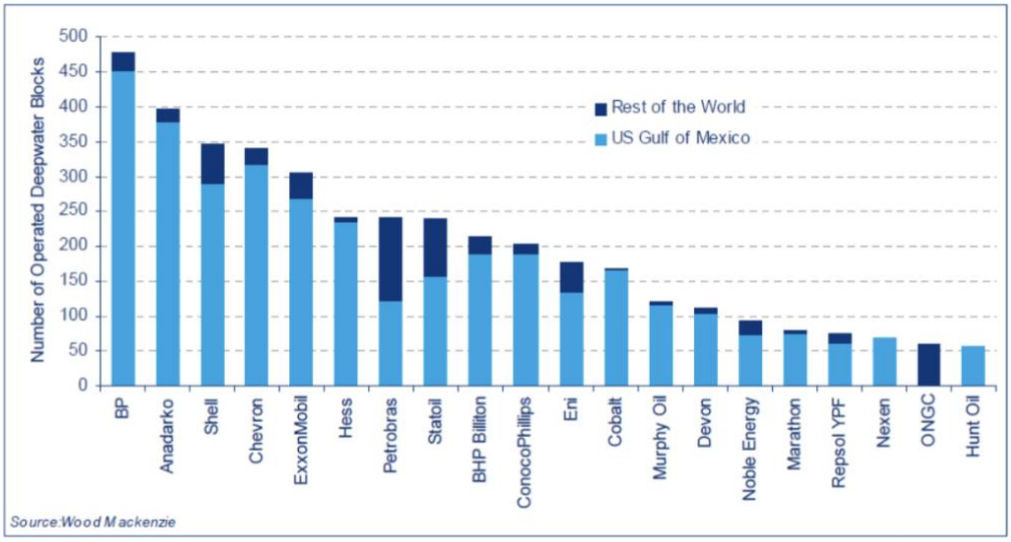
Uneconomic deepwater oil reserves. How will this change?



Source: Internal analysis, WM; excludes much of Brazil Pre Sal due to uncertainties

Statoil

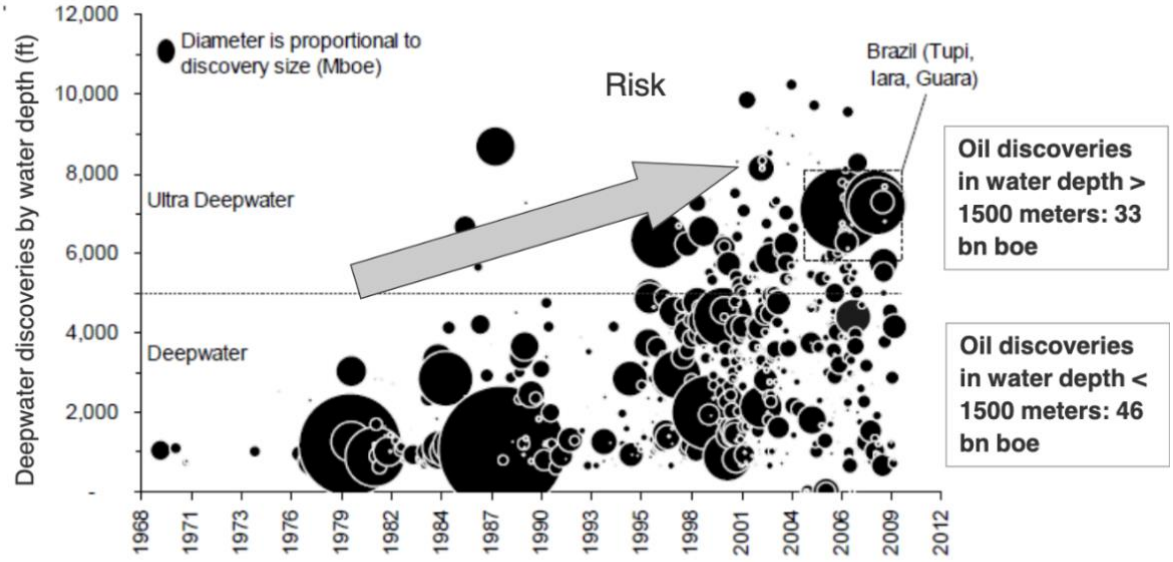
Global deepwater positions. How will this change?



Source: WM, water depth > 400 meters

Statoil

Deeper, and ultra deepwater. How will this change?



Source: World Oil; IHS; DB; Bernstein; size of bubble represents size of discovery

Statoil

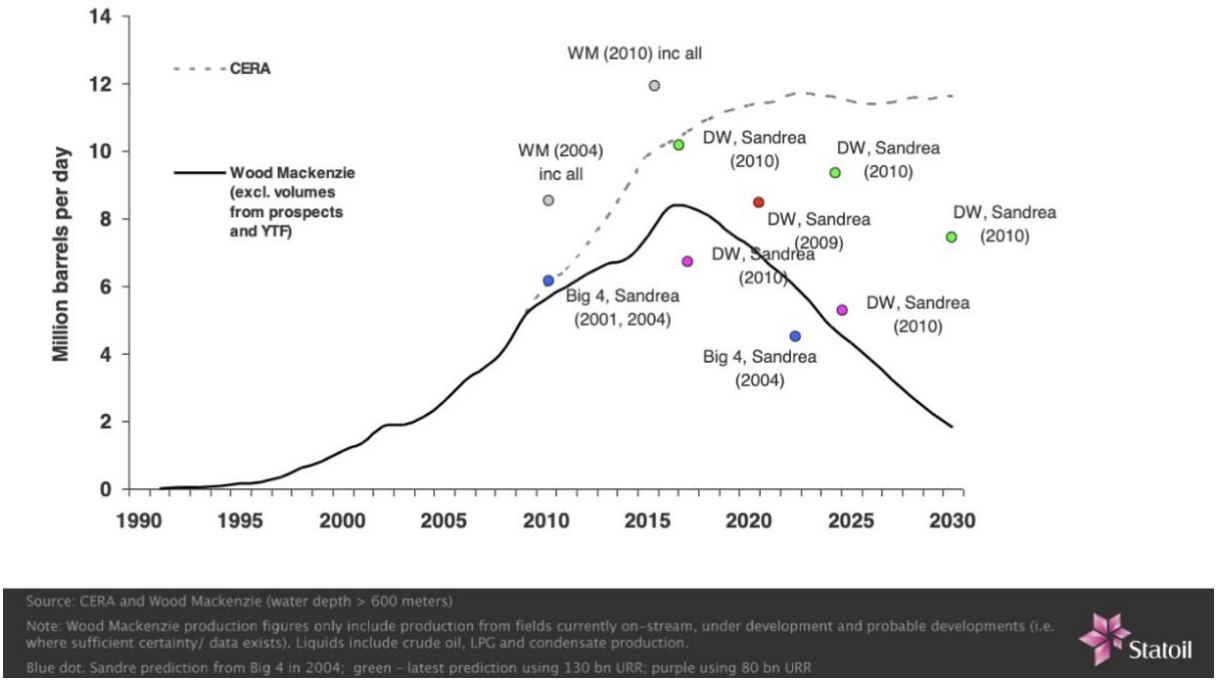
Offshore oil production outlooks

Table 1 Offshore Crude Oil Production Capacity Outlooks through 2030

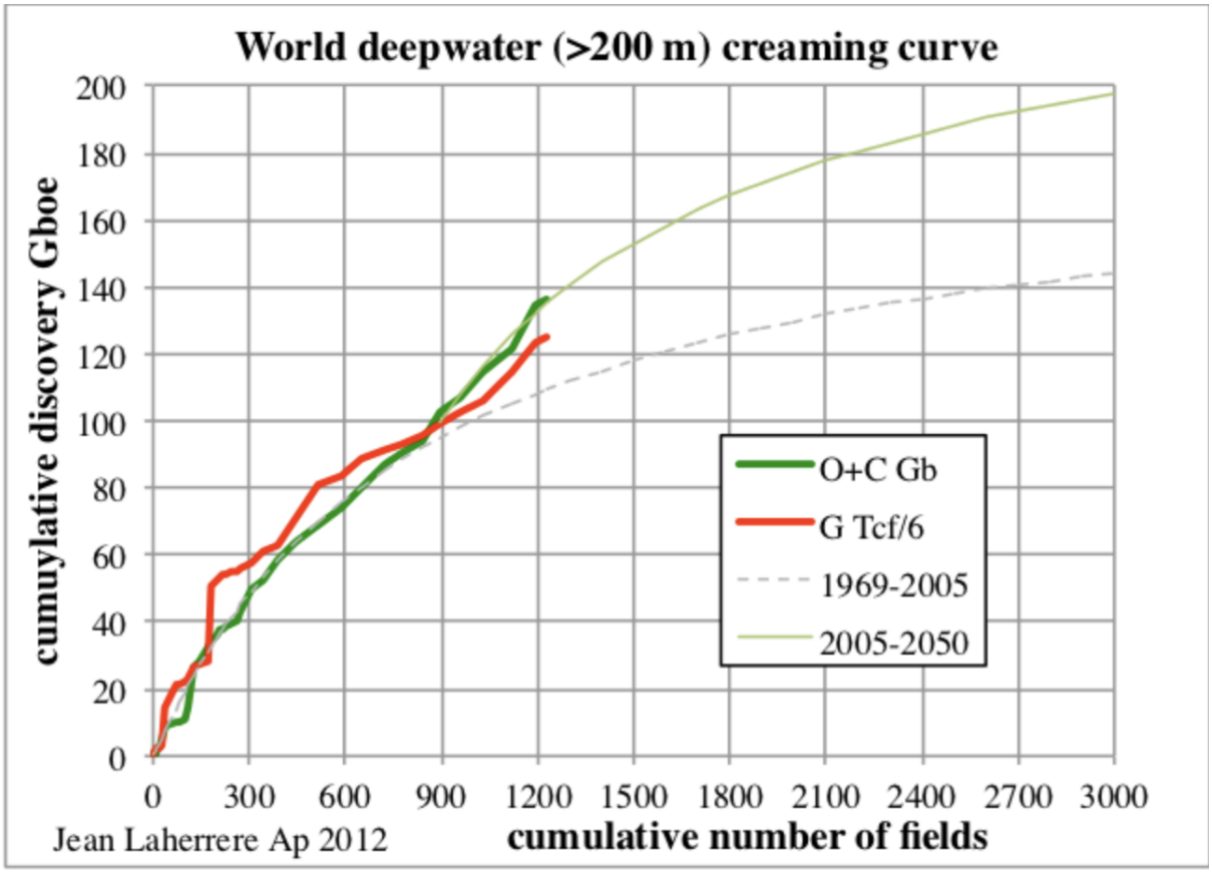
	Shallow Water	Total Offshore			Deepwater		
EUR, Bbo:	320	400	450	500	80	130	180
Year	**Production Capacity, million b/d**						
2008	19.2	23.3			4.1		
2010	18.1	23.6			5.5		
2015	14.2	20.5	24.4	27.4	6.3	10.2	13.2
2025	7.3	12.4	16.2	20.0	5.1	8.9	12.7
2030	4.5	8.8	12.2	15.6	4.3	7.7	11.1

Source: Sandrea 2010; O&G Journal

Statoil

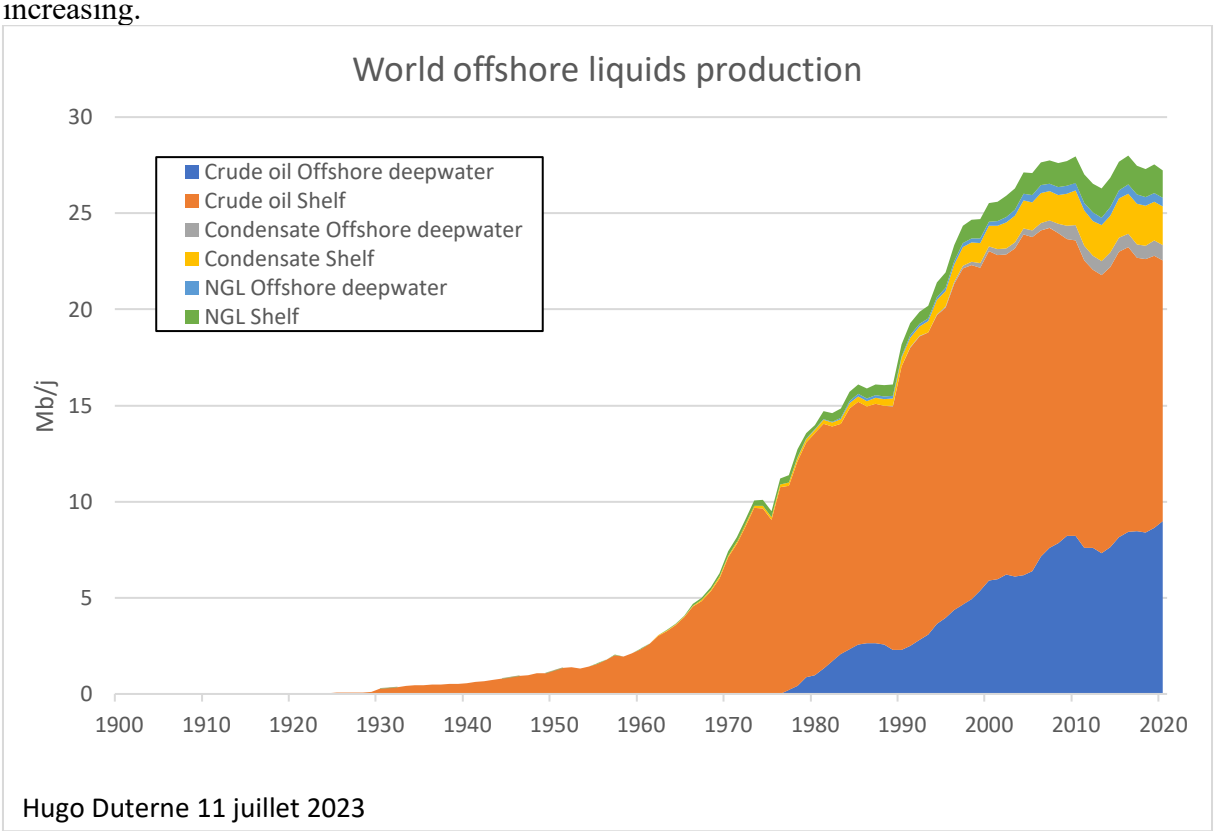


-Laherrere J.H. 2012 « Updating deepwater oil & gas discovery » April
http://aspofrance.viabloga.com/files/JL_Deepwater2012.pdf, http://www.theoildrum.com/node/9169#more
With ultimate for deepwater >200 m is about 200 Gb

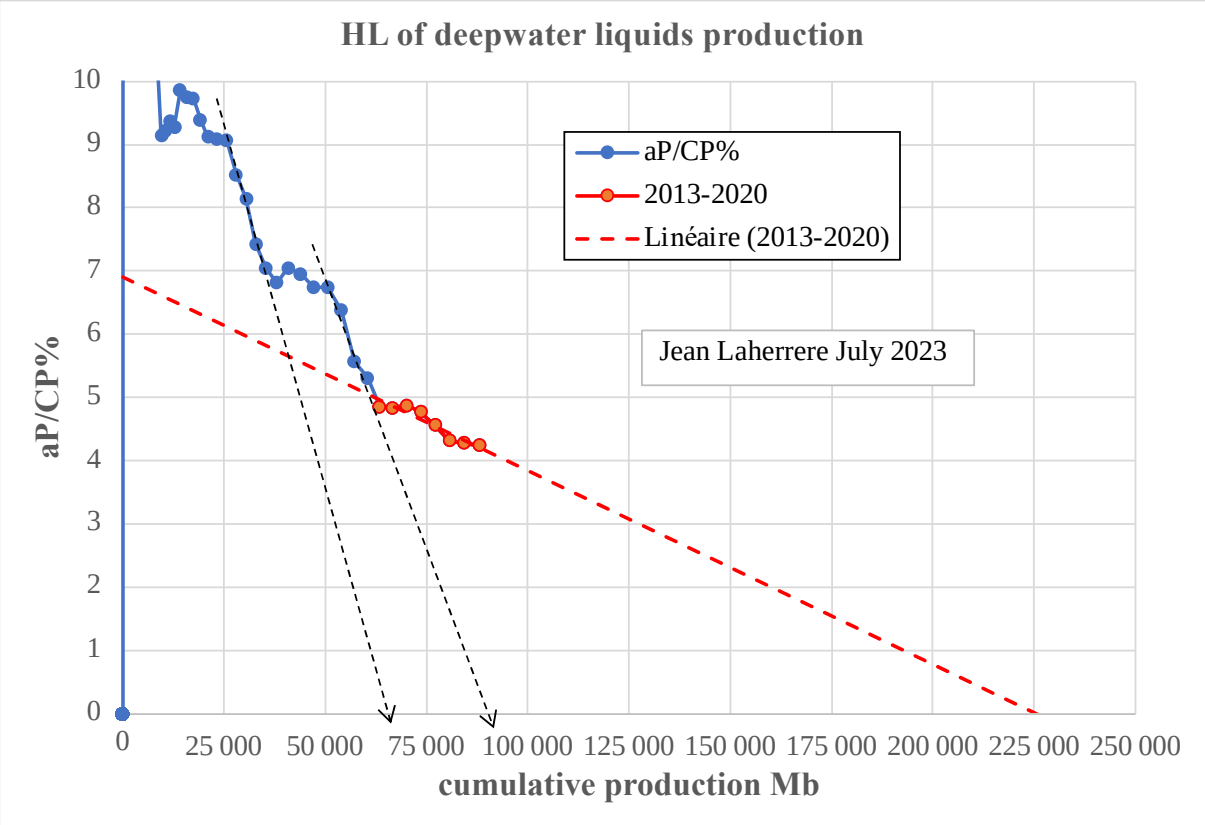


-offshore oil production

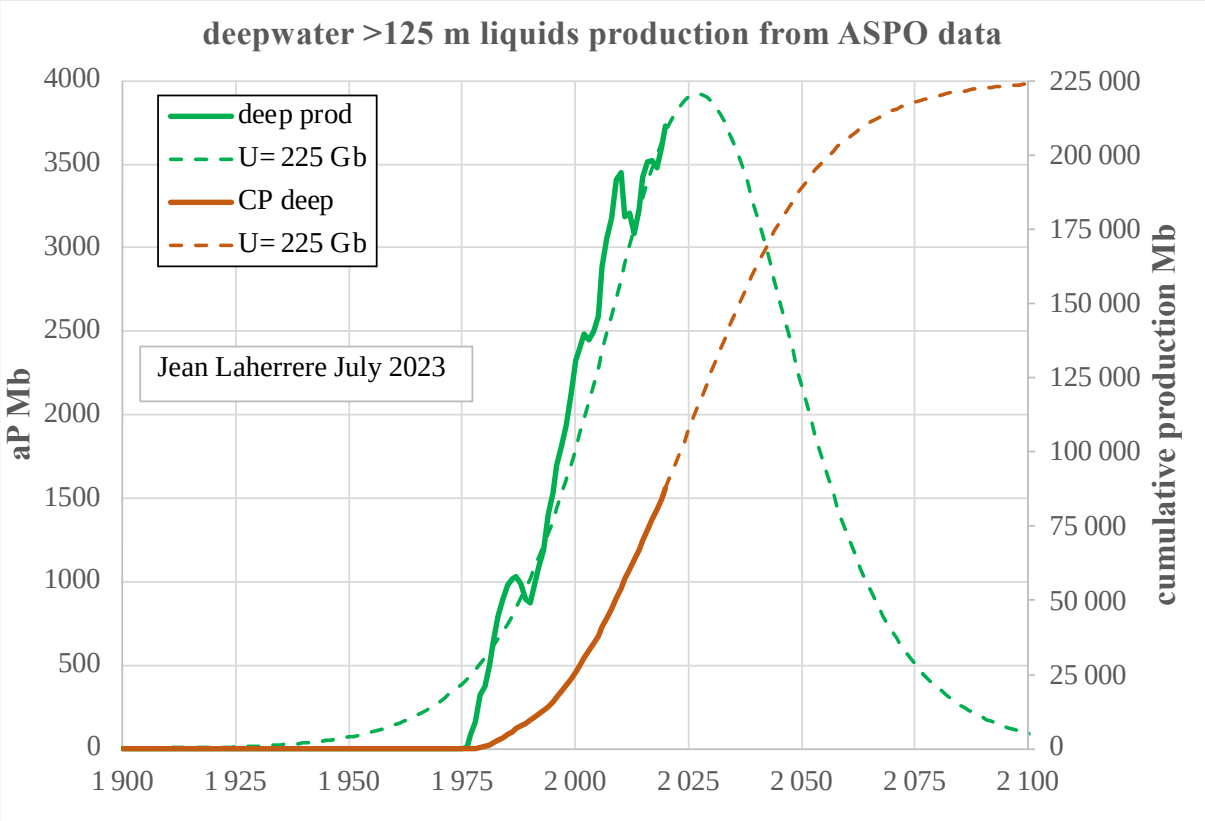
Thanks to Hugo Duterne (ASPOFrance data = https://www.gostatit.com/aspo_france), the world offshore oil production displays a plateau since 2010 where the deepwater (>125 m) is increasing.



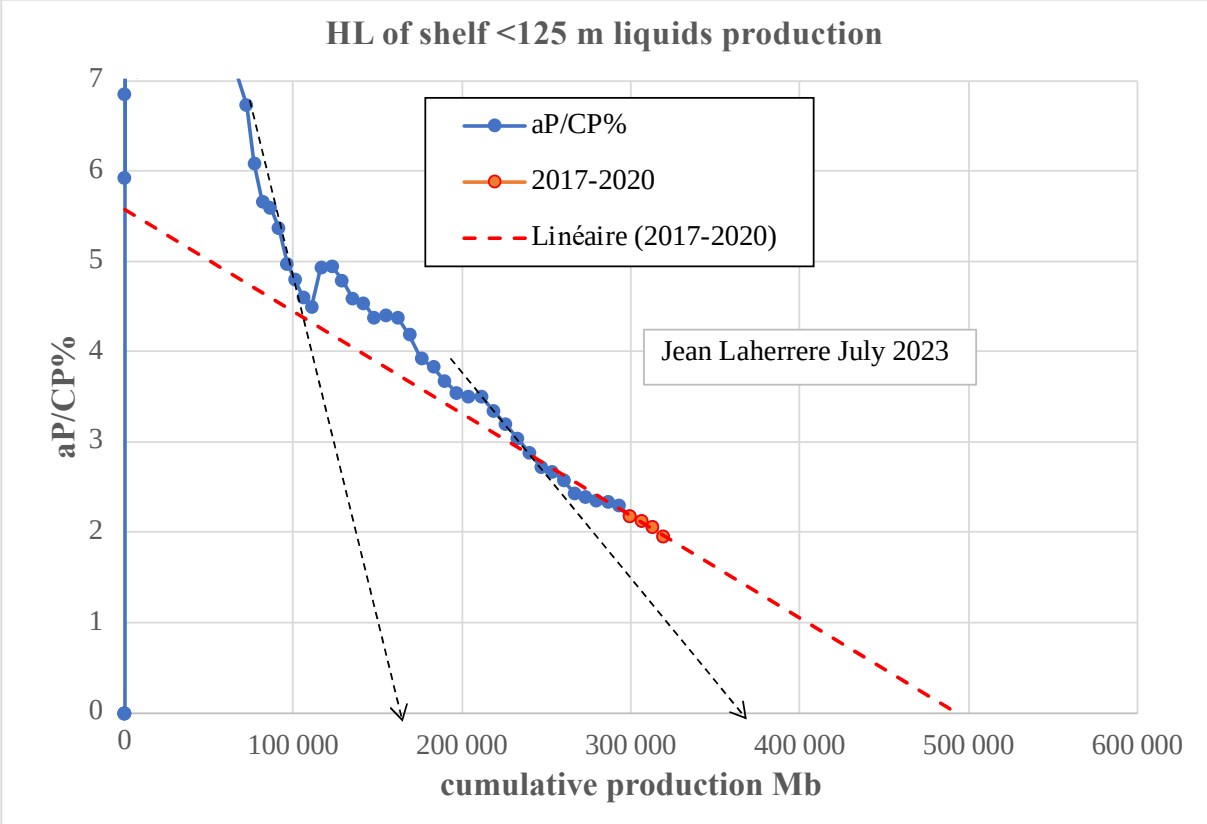
HL of deepwater >125 m oil production trends towards 225 Gb (not far from my 2012 estimate >200 m of 200 Gb from creaming curves).



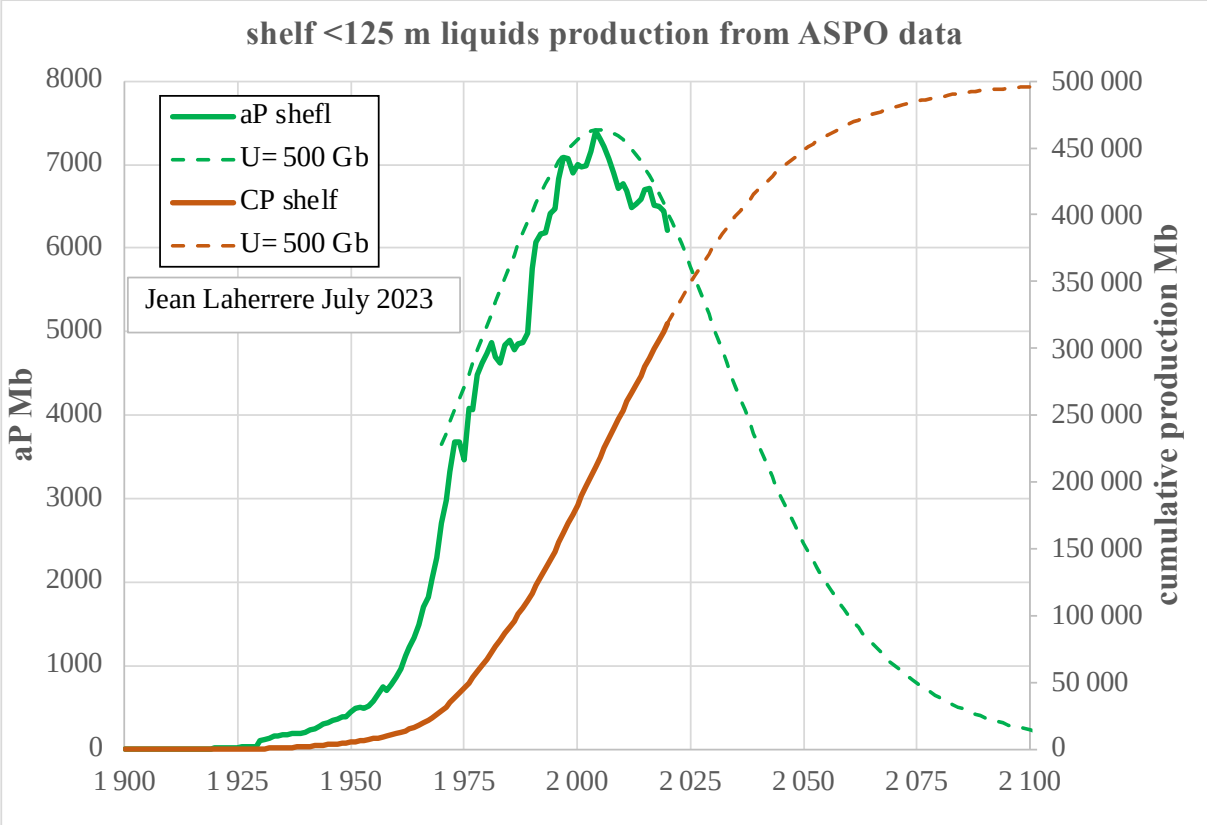
The deepwater peak for U = 225 Gb will be around 2027 at 10.7 Mb/d.



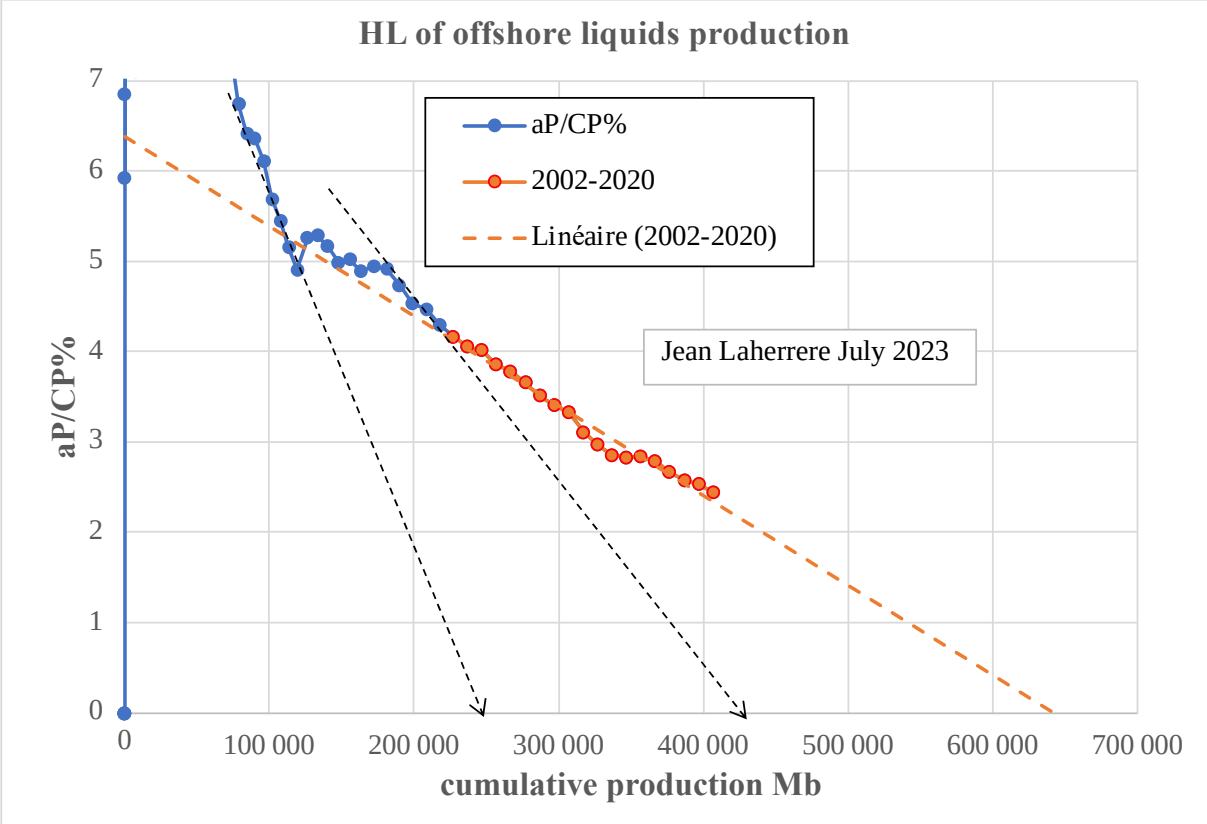
For shelf <125 m (shallow) oil production the ultimate is 500 Gb

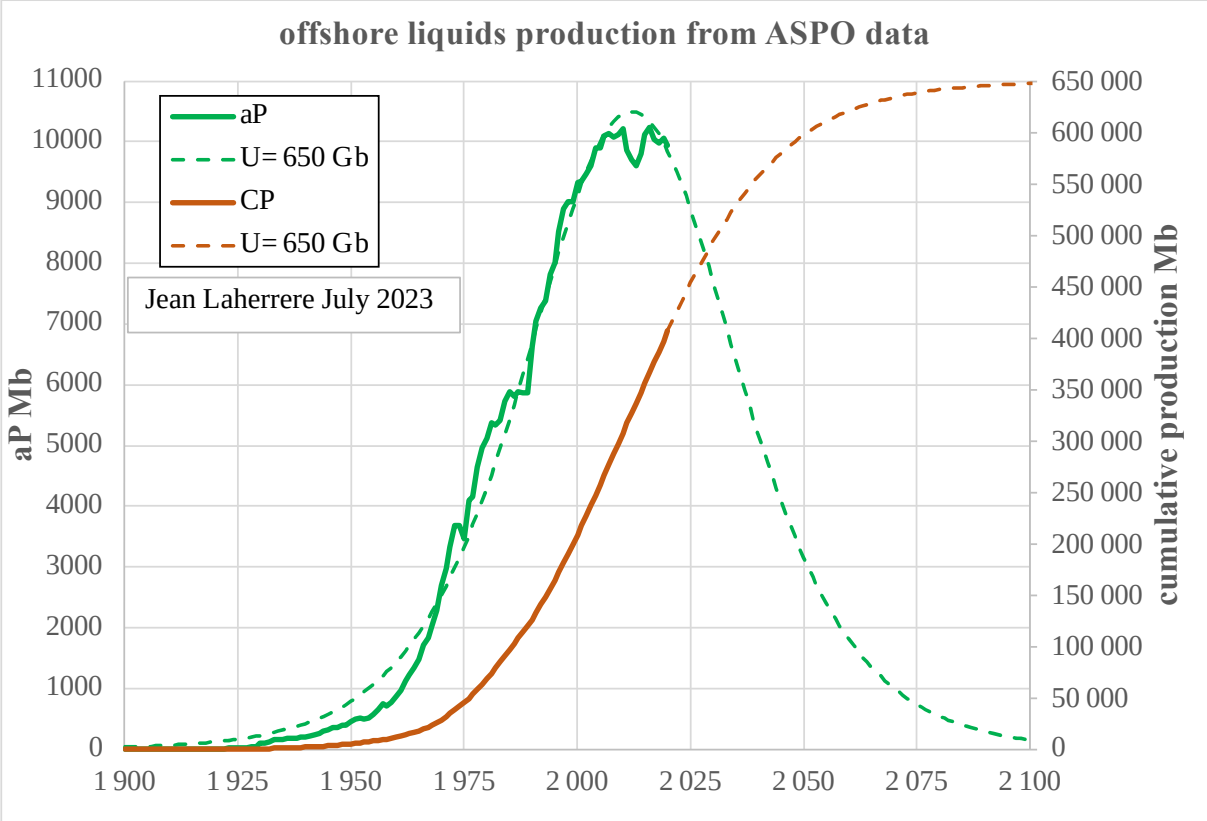


Giving a past peak in 2004 at 7400 Mb/a = 20 Mb/d

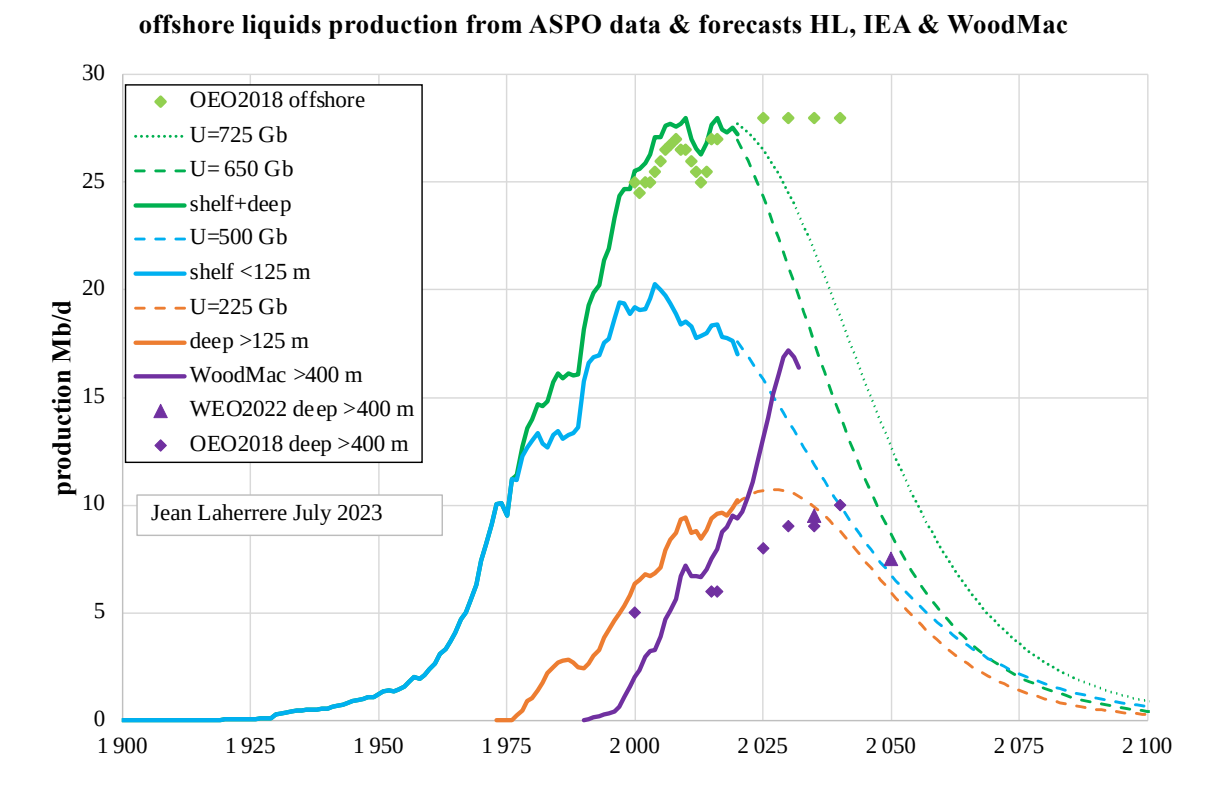


For the offshore liquids production HL trends towards 650 Gb (when the sum deep and shelf is 725 Gb)

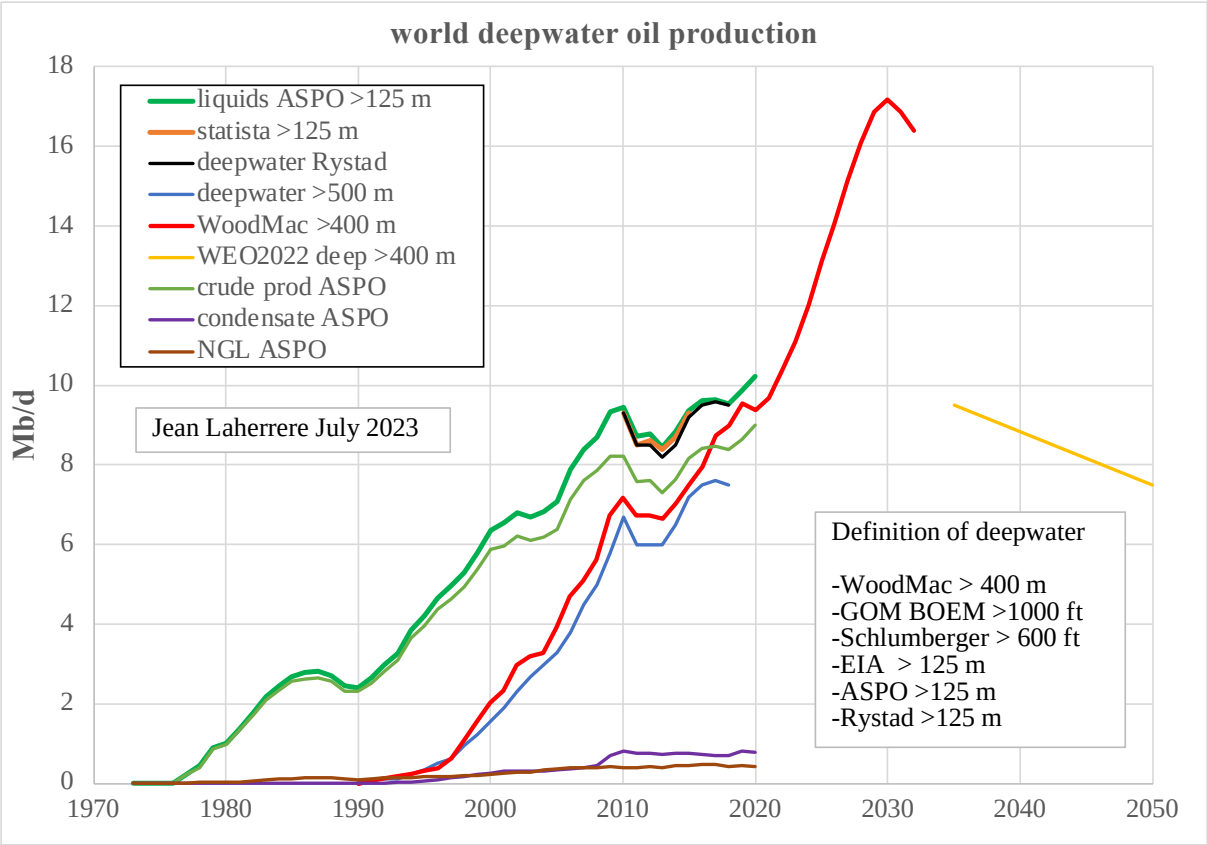




The comparison with my deep forecast (orange >125 m) and WoodMac (purple >400 m) shows that WoodMac is too optimistic, when compared with IEA/WEO2022 forecast (purple triangles) as EIA/OEO2018.
Offshore oil (liquids) production has peaked in 2016 at 28 Mb/d, when IEA (OEO2018) forecasts peak beyond 2040

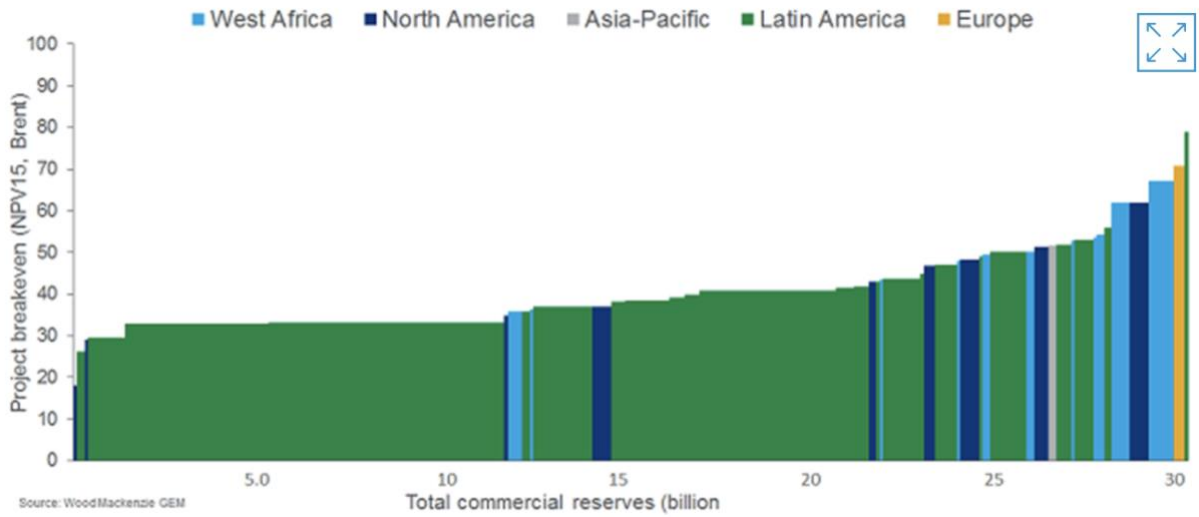


The deepwater oil production displays large variations with different sources and depth definitions:



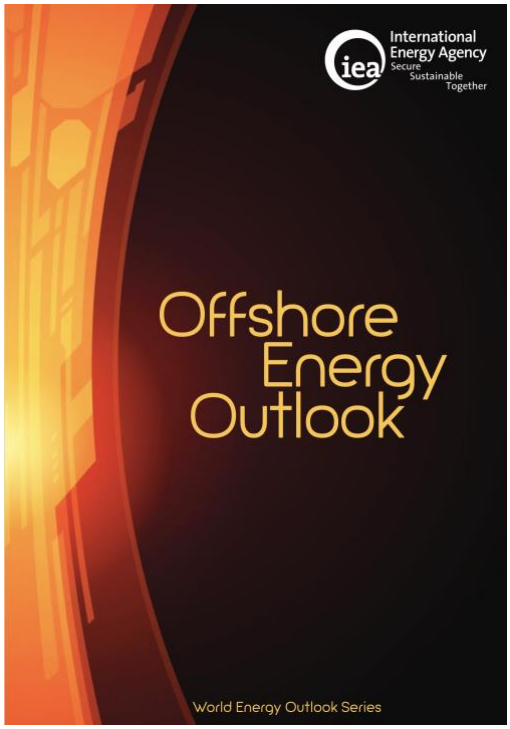
WEO2022 forecasts deepwater oil production at 9.5 Mb/d in 2035 against a WoodMac forecast of 16,4 Mb/d in 2032 = large difference!

WoodMac sells most of their reports (k$) and few are free: In June 2019 Deepwater investment bounces back https://www.woodmac.com/news/the-edge/deepwater-investment-bounces-back/ deepwater >400 m remaining oil commercial reserves are reported at 30 Gb



The cumulative production of WoodMac graph on deepwater production 1990-2032 is 110 Gb (Gboe?), with only 55 Gb from 1990 to 2022: if remaining reserves (30 Gb) are less than cumulative production, the peak is past!

But IEA/OEO2018 for WEO2017



reports deep (>400 m) reserves (reserves are always recoverable!) at 224 +78 = 302 Gb (275 Gb remaining)

Table A.1 ▷ **Oil resources and reserves** (bbl)

	Technically recoverable reserves	Cumulative production	Remaining TRR	Remaining share of TRR (%)	Proven reserves
Conventional oil	4 126	1 363	2 763	67%	1 294
Conventional	2 247	885	1 362	61%	825
Shallow offshore	795	299	496	62%	223
Deep offshore	224	26	198	88%	31
Ultra-deep offshore	78	2	77	98%	6
Other	782	151	630	81%	209
Unconventional oil	3 411	27	3 384	99%	400
World total	**7 537**	**1 390**	**6 146**	**82%**	**1 695**

Notes: bbl = billion barrels; TRR = technically recoverable reserves.

Source: IEA (2017a).

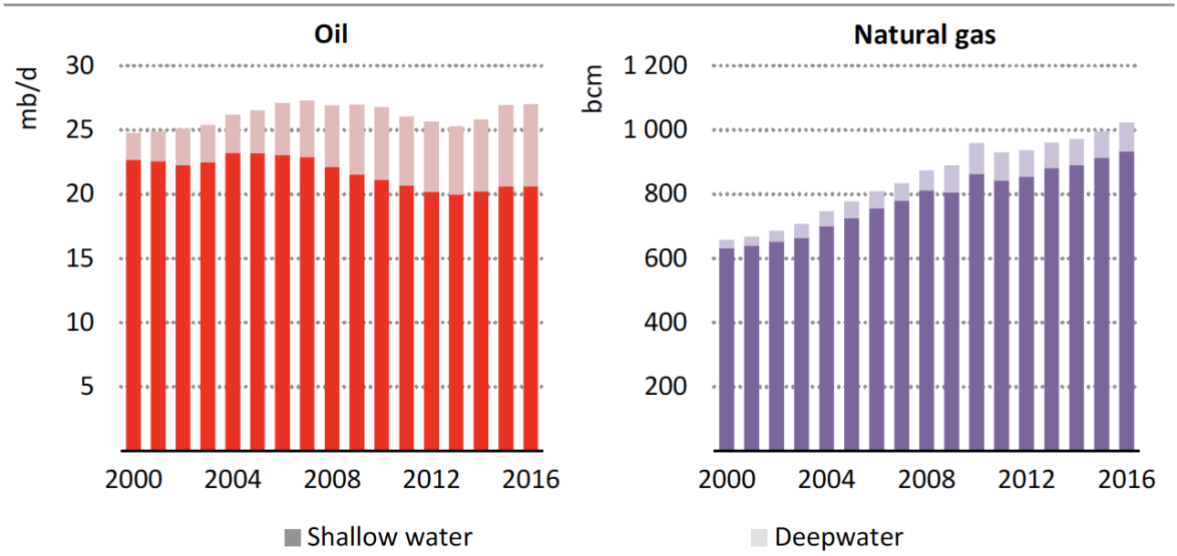
For NG

Table A.2 ▷ Natural gas resources and reserves (tcm)

	Technically recoverable reserves	Cumulative production	Remaining TRR	Remaining share of TRR (%)	Proven reserves
Conventional gas	544	113	432	79%	204
Conventional	234	86	148	63%	110
Shallow offshore	179	22	156	88%	69
Deep offshore	79	4	74	95%	22
Ultra-deep offshore	53	0.2	53	99.6%	4
Unconventional gas	375	10	365	97%	12
World total	**919**	**122**	**796**	**87%**	**216**

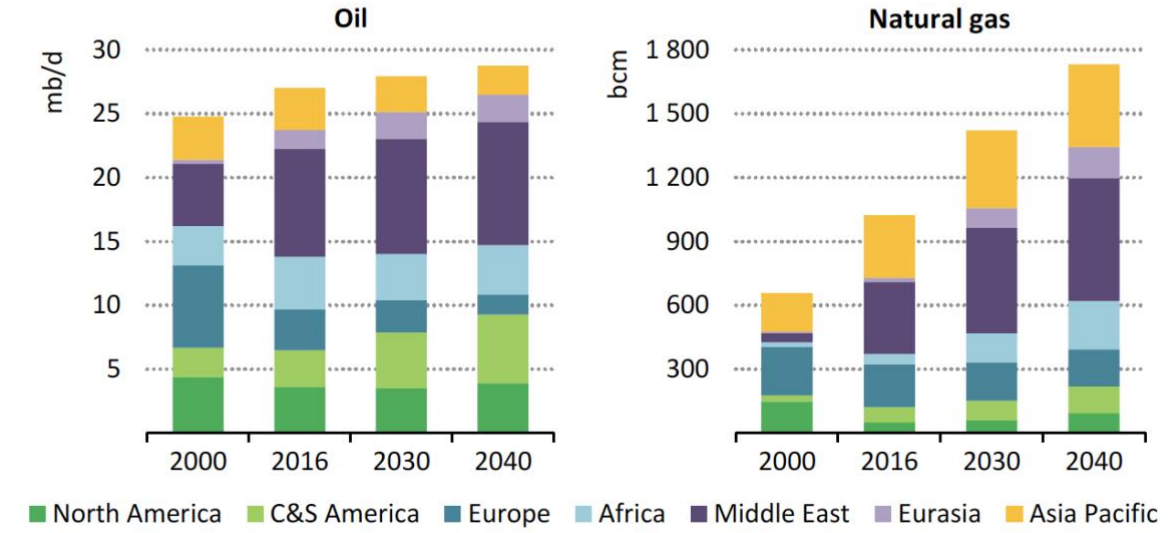
Production of shallow water from 2000 to 2016 is much more than deepwater

Figure 1 ▷ Global offshore oil and natural gas production by water depth



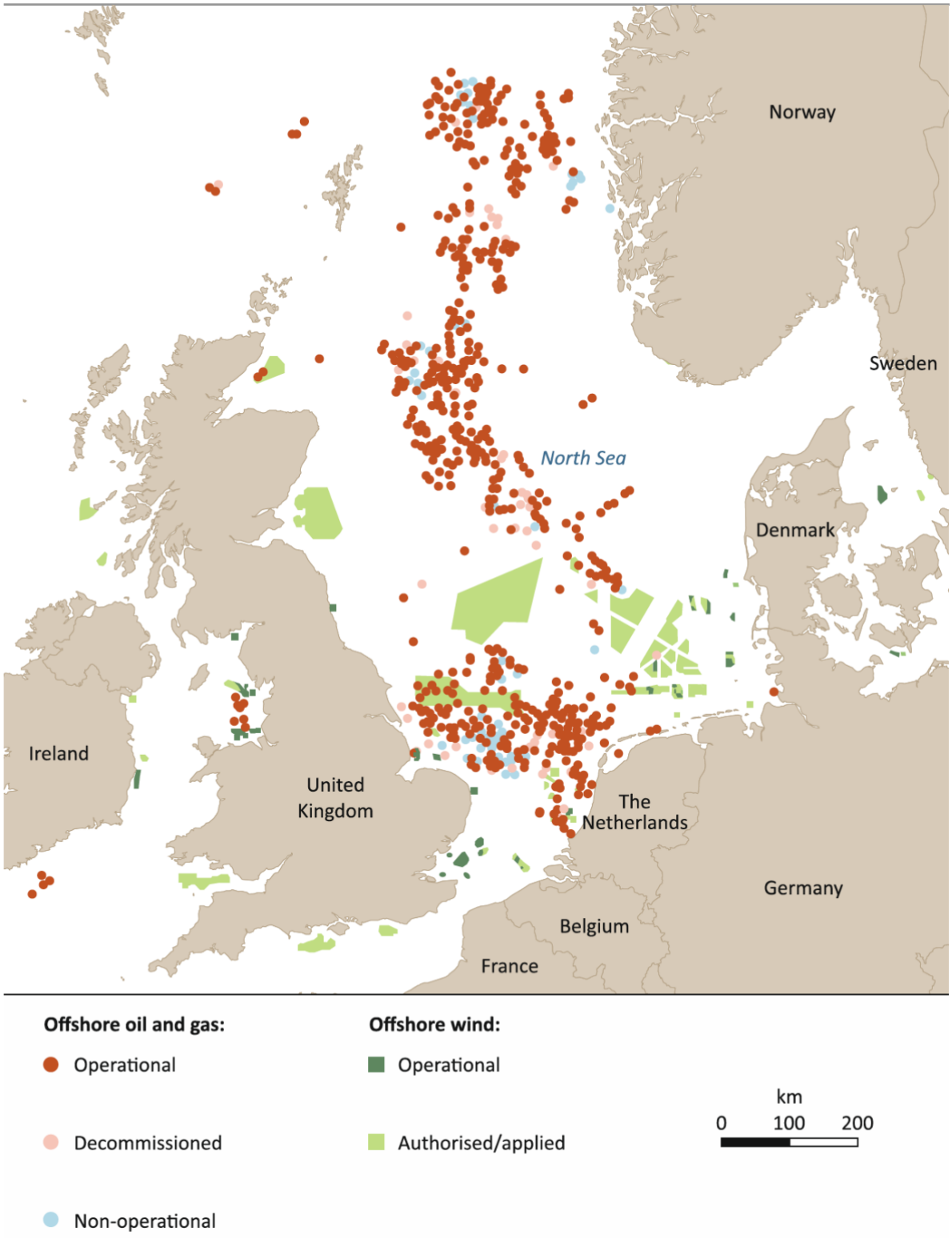
The forecast for NPS for 2040:

Figure 11 ▷ **Offshore oil and natural gas production by region in the New Policies Scenario**



There are many offshore installations in the North Sea

Figure 25 ▹ Offshore hydrocarbon and wind installations in the North Sea



WEO2018 NPS (SP today) forecasts deepwater >400 m oil peak beyond 2040 at 10 Mb/d (and not 17 Mb/d for WoodMac)

New Policies Scenario

	Production							Shares (%)		CAAGR (%)
	2000	2015	2016e	2025	2030	2035	2040	2016e	2040	2016e-40
Oil Production (mb/d)										
World	**75**	**92**	**92**	**98**	**99**	**100**	**102**	**100**	**100**	**0.4**
Onshore	50	65	65	70	71	72	73	71	72	0.5
Offshore	25	27	27	28	28	28	29	29	28	0.3
Shallow water	*23*	*21*	*21*	*20*	*19*	*19*	*19*	*22*	*18*	*-0.4*
Deep water	*2*	*6*	*6*	*8*	*9*	*9*	*10*	*7*	*10*	*1.8*
Natural Gas Production (bcm)										
World	**2506**	**3 592**	**3 621**	**4 174**	**4 546**	**4 950**	**5 306**	**100**	**100**	**1.6**
Onshore	1848	2 596	2 597	2 945	3 123	3 352	3 574	72	67	1.3
Offshore	658	996	1 024	1 229	1 423	1 598	1 732	28	33	2.2
Shallow water	*633*	*913*	*934*	*1 009*	*1 118*	*1 209*	*1 271*	*26*	*24*	*1.3*
Deep water	*25*	*83*	*90*	*220*	*304*	*389*	*461*	*2*	*9*	*7.0*

The last deepwater oil discoveries are in Brazil, Guyana (Liza et al 10 Gb), in Senegal (Baleine 1 Gb), South Africa and Namibia (Venus 2 Gb, Graff 1 Gb), nothing to explain the WoodMac increase of production beyond 2022.

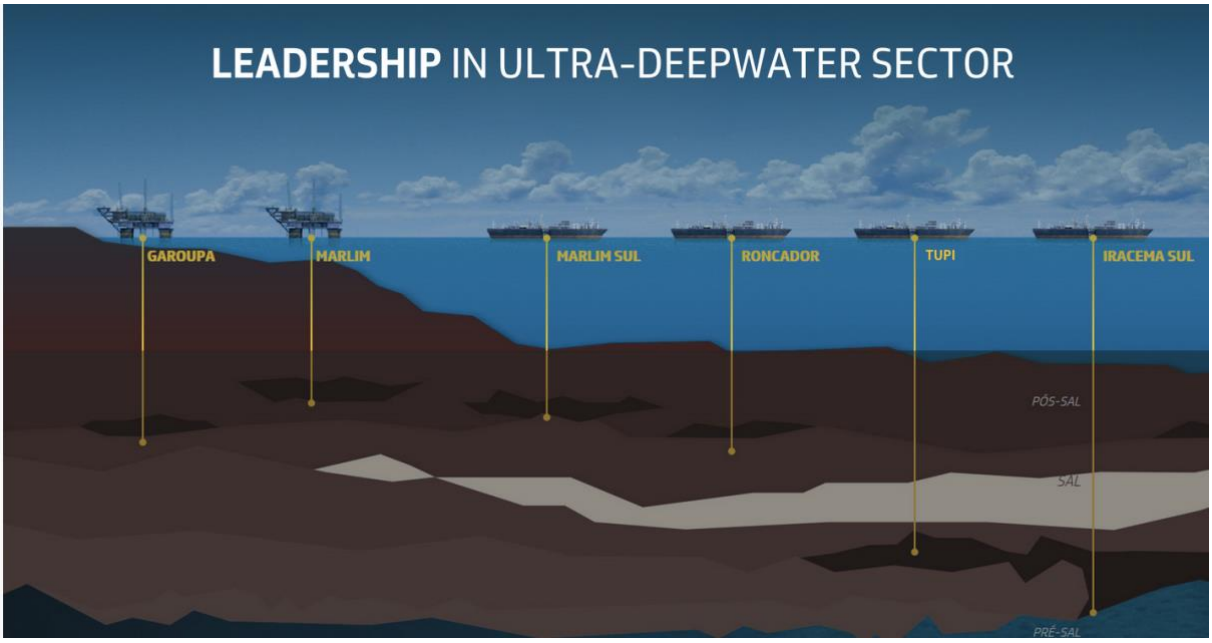
Petrobras reports for Q12023 deep production of 0.38 Mboe/d against 0.47 Mboe/d for 1Q2022: a decrease and not an increase!

PETROBRAS

1 - Exploration & Production

Thousand barrels of oil equivalent per day (Mboed)	1Q23	4Q22	1Q22	Variation (%) 1Q23 X 4Q22	Variation (%) 1Q23 X 1Q22
Crude oil, NGL and natural gas - Brazil	2,640	2,611	2,757	1.1	(4.2)
Crude oil and NGLs (Mbpd)	2,141	2,111	2,231	1.4	(4.0)
Onshore and Shallow water	56	71	82	(21.1)	(31.7)
Post-salt - deep and ultra deep	383	401	467	(4.5)	(18.0)
Pre-salt	1,702	1,639	1,682	3.8	1.2
Natural gas (Mboed)	499	500	526	(0.2)	(5.1)
Crude oil, NGL and natural gas -Abroad	36	35	39	2.9	(7.7)
Total (Mboed)	**2,676**	**2,646**	**2,796**	**1.1**	**(4.3)**
Total - comercial (Mboed)	**2,352**	**2,325**	**2,462**	**1.2**	**(4.5)**
Total - operated (Mboed)	**3,745**	**3,703**	**3,660**	**1.1**	**2.3**

But Petrobras has sold in Q12023 100% stake in deep water exploration and production (E&P) assets, located in the Espírito Santo basin, Brazil, to BW Energy's subsidiary BW Energy Maromba do Brasil (BWE).
Petrobras is a leader in deepwater production:



Conclusion

As there is a very large range on deepwater depth definitions (from 125 m to 500 m), deepwater oil production varies with sources.

It is likely that deepwater oil production will peak in few years around 11 Mb/d and not 17 Mb/d as forecasted by WoodMac (>400 m).

Nothing seems to justify the sharp increase in WoodMac graph beyond 2022, which disagrees with IEA forecast.

Deepwater >125 m oil production will peak in 2027 at 10 Mb/d for an ultimate of 225 Gb, when shallow <125 m oil production has peaked in 2004 at 20 Mb/d with an ultimate of 500 Gb: deep water oil represents only half of shallow water oil.

Offshore oil (liquids) production has peaked in 2016 at 28 Mb/d

Future oil deepwater will not save the oil coming decline.