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Oil peak or oil plateau?

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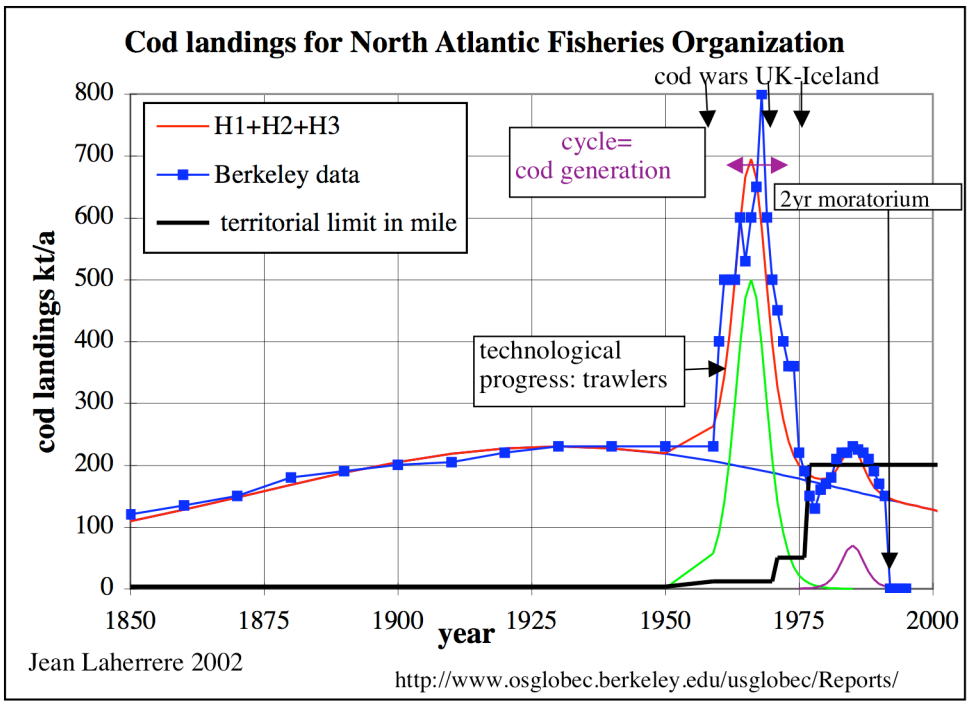
This long paper is for the students who want to know more and it is the base of my reduced presentation before the debate.

-1-Wording

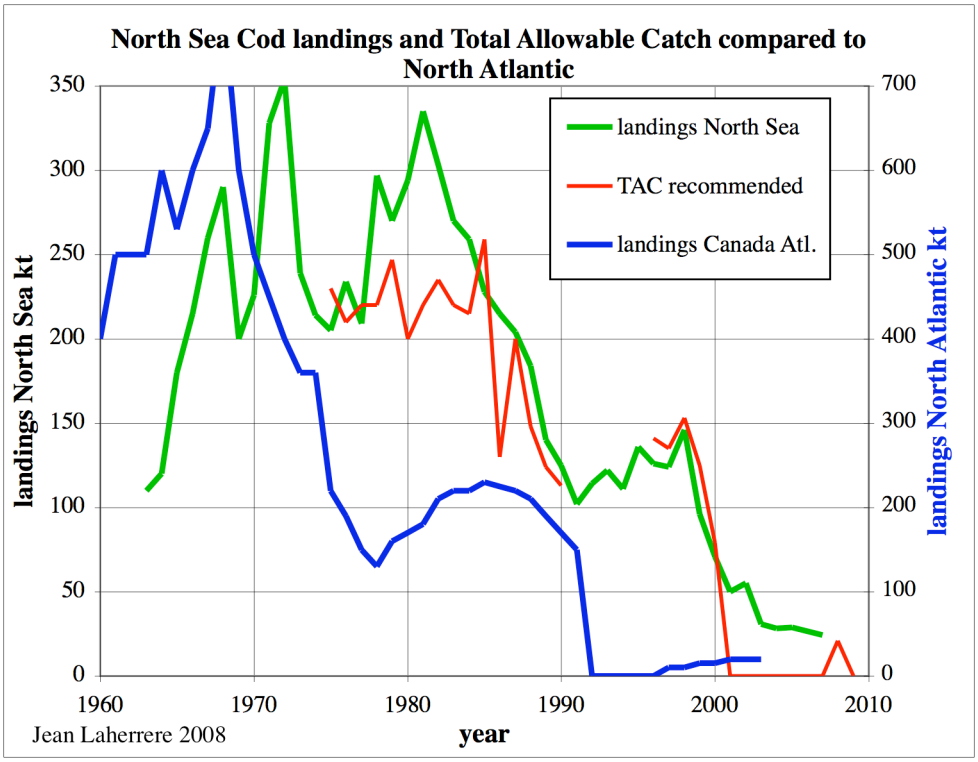
oil production = production of oil
oil peak = peak of oil, short for *peak of oil production* (and not peak of oil price) = fact
peak oil = oil with a peak = concept
Oil production can have several peaks (UK) and Peak is assumed to be the largest peak
The term ***Peak oil*** is absent in our 1998 Scientific American article with Colin = *The end of cheap oil.*
Colin Campbell did introduce the term *Peak oil* when founding ASPO few years later (ASPO was better than ASOP).
Now everyone uses peak oil (and not anymore oil peak) even in French papers, because of ASPO
In 2001 I introduced the term **bumpy plateau** to describe (without any plot) what could change my smooth peak forecast into a chaotic pattern because of constraints other than below ground. In 2004 I trusted Paul Volcker forecast of 75% of chances to have an economic crisis in the next 5 years and I believed rather that a bumpy plateau would occur by saying that the production curve would be changed but the area below the curve (which is the ultimate) would not change. Anyone can change the curve at will, respecting the area rule. In 2008 with JL Wingert in ASPO Barcelona we plotted different economic scenarios offering then a graph of a bumpy plateau
Oil = any viscous liquid which can burn (olive oil) and can be vegetal, animal or mineral
Petroleum is only mineral oil, but the main question is when the oil supply will no longer satisfy the oil demand and the oil demand represents all liquids including biofuels.
There is no worldwide consensus on the definition of oil or conventional or reserves or units.
Reserves is what will be produced in the future until the end of production.
Resources is what is in the ground and only recoverable resources will turn into reserves, leaving a lot of unrecoverable resources in the ground.
Many people play on the lack of definition to argue with others who have different definition
Any paper without proper definition of terms and not giving a value at a certain date as reference has to be rejected: most of papers are in this condition.

-2-Nature & Present basic facts

-what goes up must come down, life is cycle
-what was born will die: sun, earth, mankind and civilization
-constant growth has no future in a limited world
-natural events display several peaks and usually can be modelled with symmetrical cycles (like Fourier analysis)
-linear is local and temporary, everything is curved because Universe is limited
-US oil production peaked in 1970, North Sea oil production peaked in 2000
-North Atlantic cod landings peaked in 1965 and cod is considered extinct in the Grand Banks. Cod fishing was suspended temporarily in 1992 and permanently in 2002.
Figure 1: **Cod landings in Northern Atlantic**



Technology (trawlers) drastically increased production, but killed the cod species after bad estimation of the resources (quotas were designed to fish 20% of the cod resources when in fact they fished 60%, plus fishing their food and destroying their breeding ground)!
North Sea cod fishing is going exactly the same bad way with 15 years delay.
Figure 2: Cod landings in North Sea and Total Allowable Catch (TAC) compared to North Atlantic



Barents sea cod will follow the same pattern if right quotas are not decided and followed!
Like the subprime boom was based on the concept of ever growing housing price, the fishing industry is based on ever growing catches. Technology (trawlers, sonar, GPS, etc) has allowed to be too efficient and to catch too many fish, killing the resource. Fishing boats are too many (each country wants to fish the maximum) and fishing boat owners are pushed to land too much catches (throwing the juveniles and other species back in the sea) to reimburse the greedy bankers.

A too efficient international high sea fishing industry has killed the catches of the local fishermen and the Somalia fishermen now have nothing to fish (in addition to international ships dumping wastes in their waters) and are pushed to turn to piracy, having nothing else to fish except ships! The peak of the fishing industry is behind for many areas as shown above and its global future is bleak even for the fish farms which need sea food.
Fish landings is a very good example of what happens when technology, short term, cheating and political goals do not care about the resources. Extinction is the result!

-3-Reporting data

-uncertainty and motivation

Because of the measuring difficulty for numerous actors and of the different definition of the product and of the domain, data is uncertain and displays a range of uncertainty which should be described by three values: minimum, most likely and maximum. But most of the time only one value is reported and the choice within the large uncertainty is motivated by the desired image (rich or poor)
Most of published oil & gas data is politically or financially motivated and is therefore not reliable. Technical data is mostly confidential and can only be bought from *scout* companies

-production

-no consensus on definition

OPEC production for each country member is ruled by quotas, but because OPEC members have been cheating on quotas, OPEC past oil production figures are flawed and unreliable. Real data on oil transported by tankers must be bought from spy companies (Petrologistics in Geneva). Real data on field production and field reserves must be bought from IHS (formerly Petroconsultants), which is the only company to provide worldwide data, and others.
-Words such as **energy, oil, reserves, resources, conventional, proved, probable, light, heavy, reasonable, sustainable, dangerous are badly or not defined on purpose**
Data is either flawed by finance (stock market) or politics (quotas), or it is simply missing. Ambiguity is often favoured on purpose

-units:

the SI (Systeme International) of units is the law in Europe and in this paper uses only SI symbols (except for barrel = b, which has no official definition and the USDOE is obliged to add after barrel "42 US gallons" because Texas official liquid barrel is 31 (or 31.5) gallons.
M is million = mega.
Million should not be represented by MM or m or mm.
m is only meter or milli.
T is tera and not trillion, which can be 10E12 (US or short scale) or cubic million =10E18 (SI or long scale)!
Billion US (short scale) is giga = 10E9 = milliard = G, but
billion SI (long scale) is square million = 10E12 = tera =T = trillion US
http://en.wikipedia.org/wiki/Long_and_short_scales
For most of the 19th and 20th centuries, the United Kingdom uniformly used the long scale,[2] while the United States of America used the short scale,[2] so that usage of the two systems was often referred to as "British" and "American" respectively. In 1974 the government of the UK abandoned the long scale, so that the UK now exclusively applies the short scale interpretation in mass media and official usage.[3][4][5][6] Although some residual usage of the long scale continues in the UK, the phrases "British usage" and "American usage" are no longer accurate or helpful characterizations. The two systems can be a subject of misunderstanding or controversy. Austria, Belgium, Czech, Denmark, Finland, France, Germany, Hungary, Iceland, Italy, Netherlands, Norway, Poland, Romania, Spain, Sweden, Switzerland in Europe are long scale.
The best is to use SI prefix as kilo, mega, giga, tera, peta, exa etc like it is for your computer or your USB key: MB, GB, TB

K is Kelvin degree and thousand (kilo) is k. BERR uses wrongly K, in particular with Ksm^3, s is the symbol of second and not of standard, Ksm^3 means in fact temperature Kevin degree multiplied by second and multiplied by cubic meter.
Many wrongly use Gm^3 for billion (milliard) of cubic meter , Gm^3 is cubic gigameter or 10E27 meter or a million times the earth's volume. 10E9 cubic meter is equal to cubic kilometer or km^3. It could be written $G.m^3$, because dot means multiplied when used inside units, like milliPascal-seconde = mPa.s = centipoise
It is wrong to use comma or dot to indicate thousand, only one space should be used because comma or dot is used to indicate decimal depending on the country
http://www.bipm.org/en/si/
5.3.4 Formatting numbers, and the decimal marker
Following the 9th CGPM (1948, Resolution 7) and the 22nd CGPM (2003, Resolution 10), for numbers with many digits the digits may be divided into groups of three by a ***thin space****, in order to facilitate reading.* ***Neither dots nor commas are inserted in the spaces between groups of three***

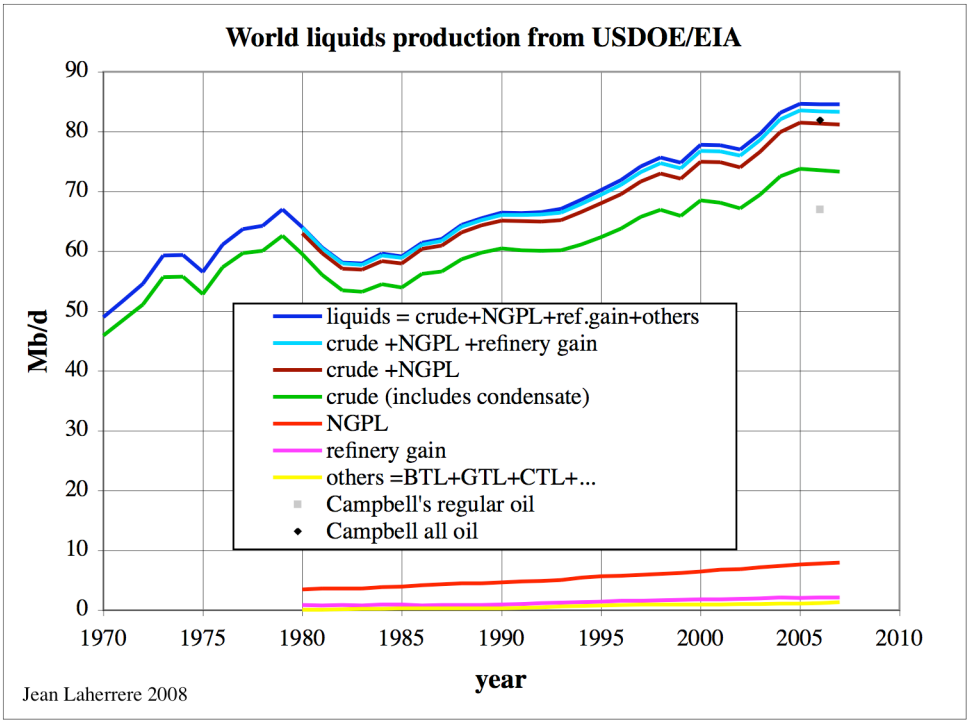
-official data.
Oil and liquids: **oil 2007 production** can vary from regular (former conventional) oil as defined by Campbell (65,9 Mb/d) to crude oil (73 Mb/d) and finally to all liquids (85 Mb/d) including NGLs, synthetic oils from coal (CTL), biomass (BTL), and refinery gains.
Losses (internal use on site, leaks, theft (in particular in Nigeria = 0,3 Mb/d, but also in Russia, Iraq) and a part of the US military forces oil consumption overseas when not going through customs (0,35 Mb/d Sohbet Karbuz http://www.energybulletin.net/node/13199) are omitted, disappearing from statistics. Stolen oil could be reported with production but not within consumption.
No one believes in official reports on oil transports by tankers and many buy the reports from Petrologistics in Geneva to get the right data.
Redundancies also occur because condensate is included in the US with crude oil at the wellhead, when it is excluded in OPEC countries because outside of the quotas. USDOE/EIA include condensate in their crude oil statistics. Condensate (at the wellhead) is one part of the natural gas liquids (NGL), the second part is the natural gas extracted from processing plants (NGPL).
Oil field belonging to two countries can be also reported 100% in both countries.
Some countries do not report their data and database either guesses the value or puts a NA (not available) sign, but some aggregations confuse no data and zero data (JODI).
The low oil price of 1999 (10 $/b) was attributed to IEA missing barrels (M.Simmons).
Processing gain in refinery is due to the fact that heavy product are not in enough demand and oil has to be cracked or hydrogenated, increasing the volume of the products, but not much the weight. Refinery gain is about 2 Mb/d, more than the production of extra-heavy oil from Athabasca and Orinoco.
Discrepancies occur because official reports are given in volume by some and in weight by others and the density is not given, but guessed or a wrong average is used.

World oil production for **2007**	definition	Mb/d
OGJ Oil & Gas Journal	oil	72.361
WO World Oil magazine	crude/condensate	74.515 796
BP Statistical Review	liquids (excl BTL. CTL)	81.532 910 152 325 8
USDoE (Depart of Energy)/EIA	crude oil	73.573 844 712 166 8
	all liquids	84.597 461 4
IEA International Energy Agency	oil	85.4
World oil consumption for **2007**		
BP	oil including biofuels	85.219 700 186 648
USDOE/EIA	petroleum products	85.896 905 19

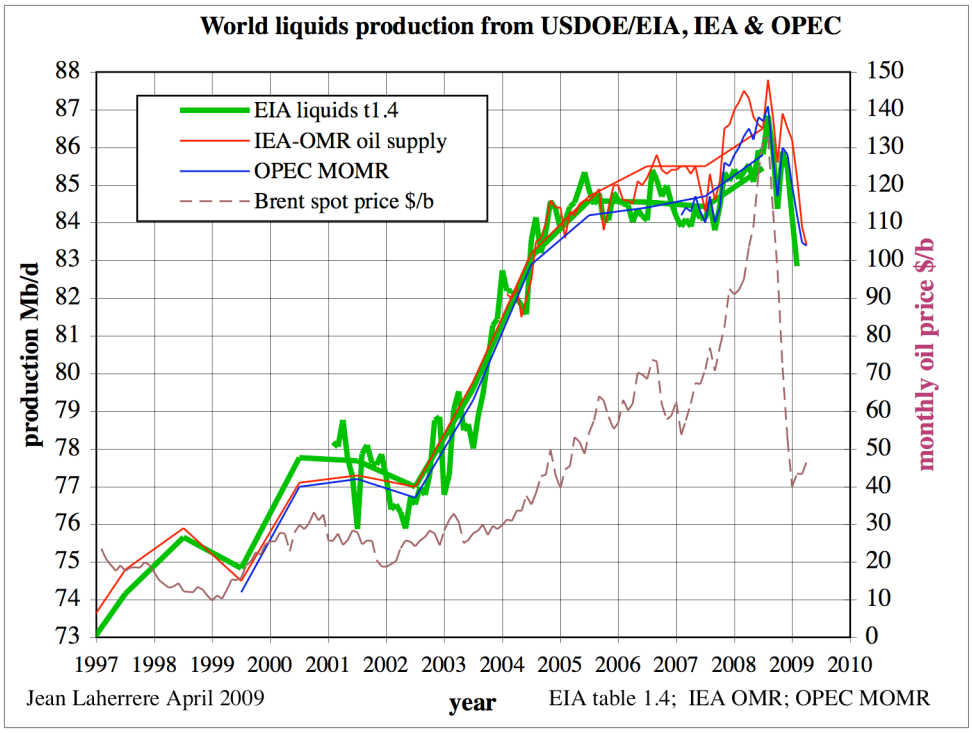
The right value should be:
World 2007 "oil" (liquids) production or consumption = 85 Mb/d with a range from 84 to 88 Mb/d

The number of significant digits is ridiculous in front of the real accuracy of the data, when the difference between IEA and EIA is about 1 Mb/d for 2007 and the BP difference between production and consumption about 4 Mb/d
In the oil industry, anyone reporting more than 3 digits shows that he is incompetent, ignoring the accuracy of the measure

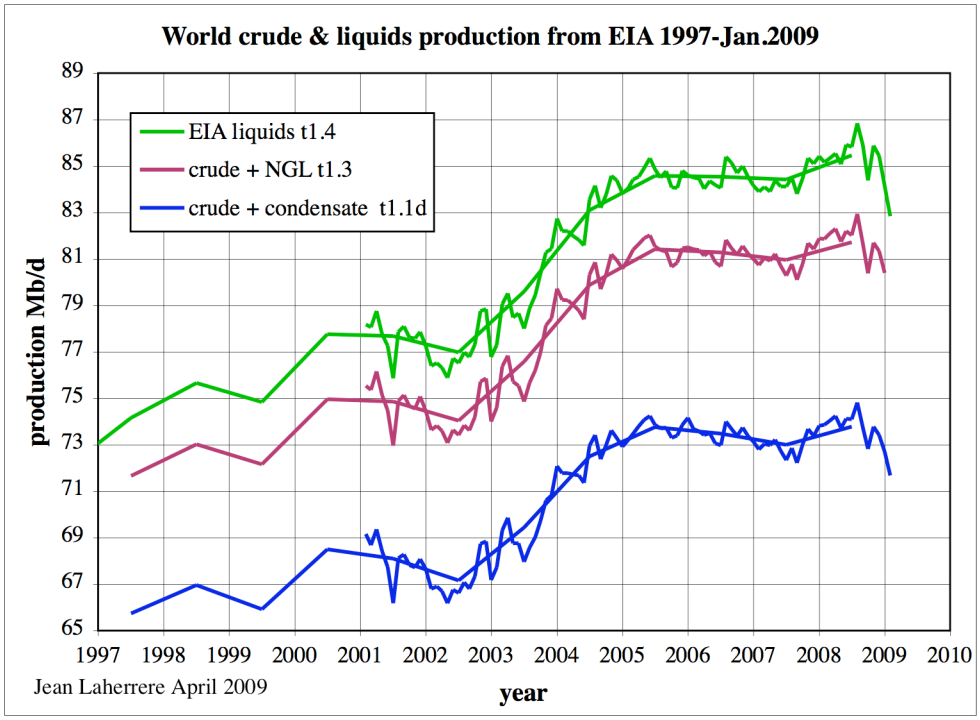
The reported world "oil" production since 1970 varies depending on the authors and their definition.
The most often reported is the liquids production with 85 Mb/d.
Figure 3: world liquids annual production from USDOE/EIA 1970-2007



The reference for monthly liquids production is the USDOE/EIA, but IEA differs.
Figure 4: world liquids monthly production from USDOE/EIA, IEA & OPEC 1997-2009



IEA since 2006 is 1 Mb/d (or more) above EIA without any obvious reason (biofuels, NGL?) because before their values were very close, but OPEC value in 2008 is in the middle.
World liquids production is best known at 3% and only two digits should be reported.
EIA values are more reliable because they are corrected (sometimes few years later) when OPEC and IEA do not correct their past values.
Liquids production peaked in July 2008 when China fill their storage for the Olympic Games, but after the games the decline was drastic when the world demand fell because the 145 $/b of July. The oil price fell like the demand.
Crude oil is on a plateau since 2005 between 73 and 74 Mb/d, but its peak is also July 2008. This peak is likely to never be reached again!
Figure 5: world crude oil and liquids monthly production from USDOE/EIA 1997-2009



-reserves

-published data

There is no consensus on oil reserves definition and estimates:
Published proved oil reserves at **end 2007**

Oil Gb	OGJ	BP	WO
World	1 331.698 077	1 237.875 464 625 99	1 183.891
Russia	60.000 000	79.432 084 5	76.000
Norway	6.865 325	8.171 588 188 604 87	6.693
Canada	176.592 000	27.664 029 323 866 1	25.157
China	16.000 000	15.493 4	18.052

Again ridiculous number of significant digits in front of the large discrepancy

-four classifications of oil reserves

There are 4 different classifications on oil reserves in use:

-US: all energy companies listed in the US stock market are obliged by the SEC (1978 rules) to report only proved reserves (**1P**), assumed to be the **minimum;** it is forbidden to report probable reserves which are included by operators in their economic study to decided field development, in particular offshore. These proved reserves are audited with the definition of reasonable certainty to exist without defining reasonable. SEC has recognized their bad practice and now has changed the rules allowing the report of probable reserves in 2010. So in 2010 there will be two US classifications: before and after 2010

-OPEC: because quotas depend upon reserves, OPEC members report proved reserves (**1P**), which correspond to their wish since it is not audited. From 1986 to 1990 in a fight for quotas 300 Gb were added without any significant discovery and are now stated by Sadad al-Husseini (former VP Aramco) as speculative resources.

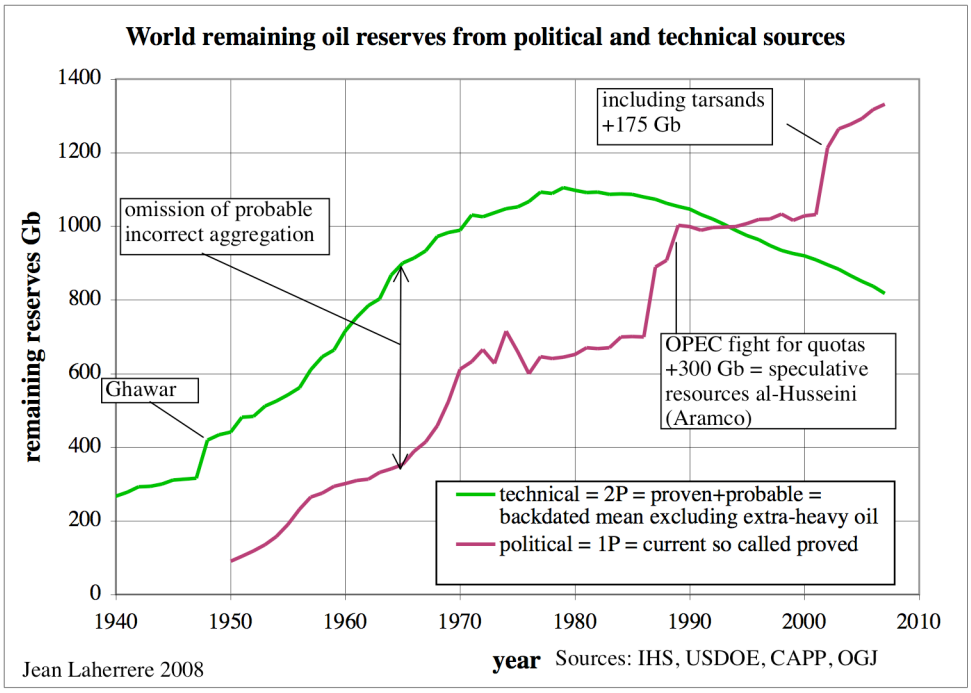
-FSU classification: ABC1 (Khalimov 1979) reports **maximum** theoretical recovery, being about equal to proven plus probable plus possible (**3P**). Khalimov in 1993 stated that Russian reserves were *grossly exaggerated.*

-Rest of the world: reports reserves as proven plus probable (**2P** close to the **expected value** used to compute the net present value of the development, when decided) following the 1997 SPE/WPC classification, definition and guidelines (I was a member of the task force). Field developments are decided on the value of 2P reserves which is the base of the net present value of the project (mean value).

When oil reserves are reported by official national agencies, they cannot be denied by any other official agency, otherwise it is viewed as diplomatic offence.
USDOE/EIA, IEA, BP Statistical Review are obliged to report the enquiry done by OGJ before the end of the year for the values at year end before any study has been done (proved reserves were ruled to be at year end prices, not yet known)

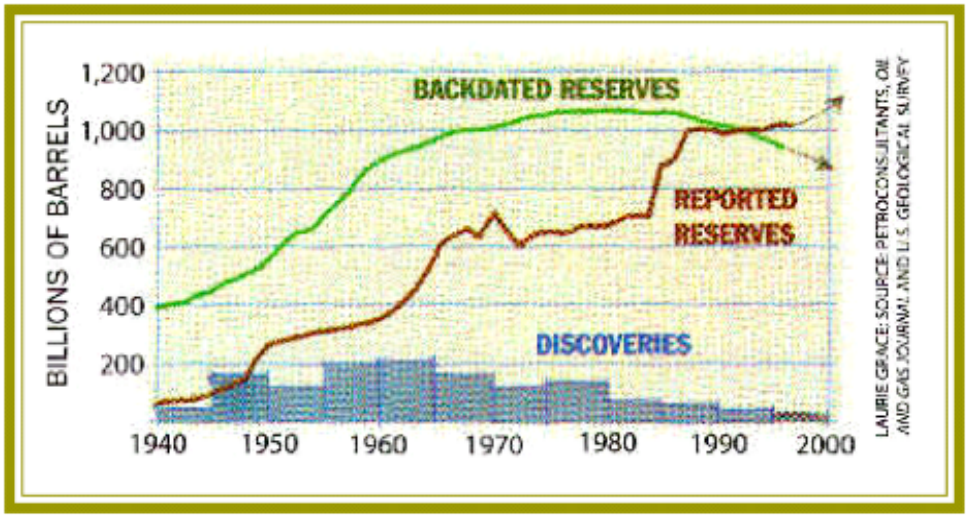
-published (political) and confidential (technical) data

The technical data is the compilation of several databases corrected to be homogeneous to a 2P value and is compared for remaining reserves to the political data (USDOE, OGJ) which is assumed to be the proved reserves. Political data is almost always rising or flat when the technical data has decreased since 1980, when discovery fell below than production.
Figure 6: World remaining oil reserves from political and technical sources 1940-2007



The same plot was given in Scientific American March 1998 "**The end of cheap oil**" (C.J.Campbell & J.H.Laherrere) and the forecast of increase for the political data and decrease for the technical was very good, except the increase of political was larger than anticipated when they added unconventional to a conventional pattern.

Figure 7: Same plot in Scientific American March 1998 Campbell C.J, Laherrère J.H. **"The end of cheap oil"** 1940-1996



Published data is mainly political and should be always treated as unreliable.

Economists, relying mainly on BP Statistical Review, are not thinking wrong, they think on wrong data.

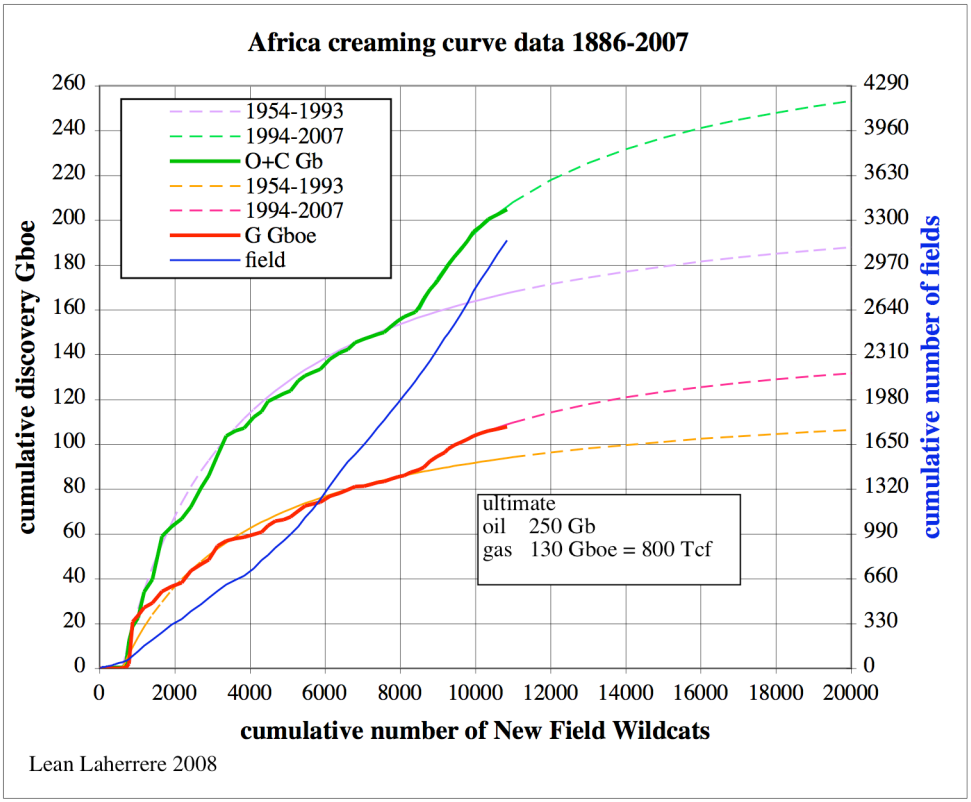
It is wrong to confuse

- political or financial reserves with technical reserves
- reserves (what will be produced) with resources (what is in the ground)
- ultimate reserves (past production + future until complete depletion) with remaining reserves at a certain date

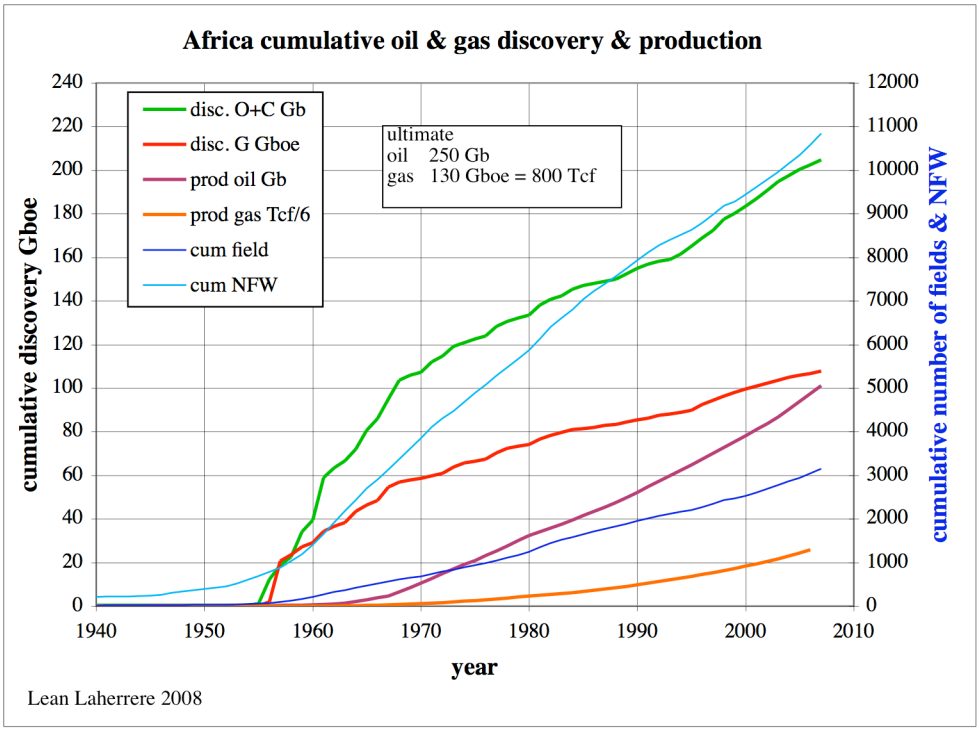
-4-**Forecasting future production**

-Creaming curve = best way to estimate ultimate

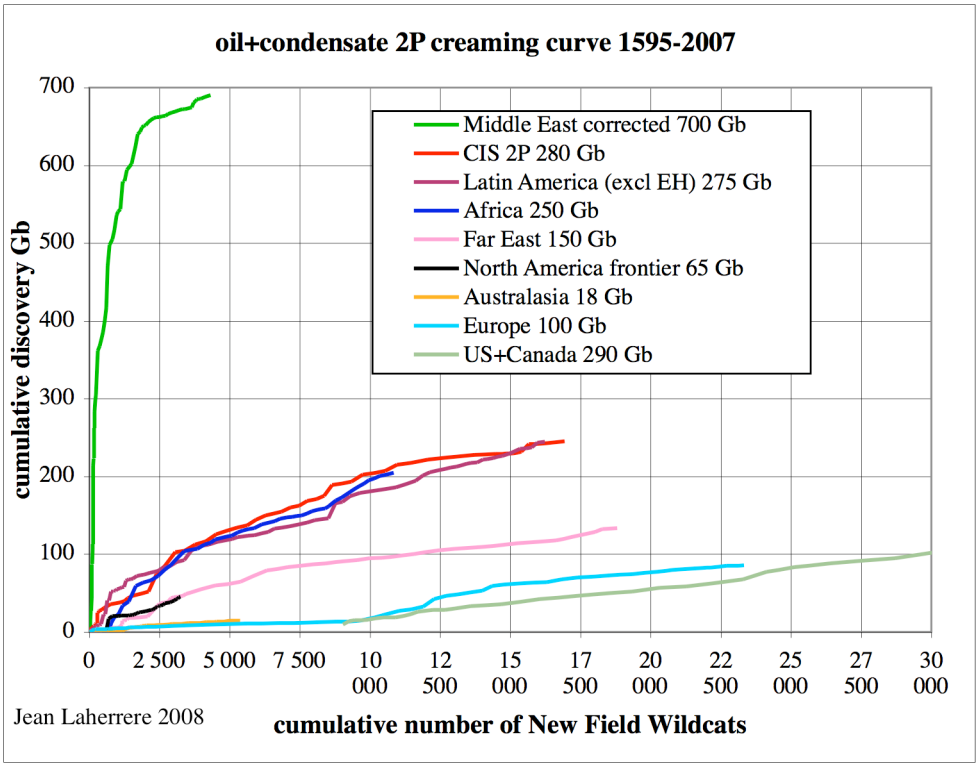
The creaming curve is the best way to present discoveries by plotting the cumulative backdated mean reserve value (technical data) versus the cumulative number of pure exploratory wells (= New Field Wildcats), avoiding the stop and go of exploration when plotted versus time. It is always possible to model the creaming curve with several hyperbolas, and the extrapolation of the last cycle up to a limited amount of wells (double the present) gives the ultimate value.
For Africa there are two cycles, the last one being mainly the deepwater cycle (with little change in the discovery ratio = blue curve) and the ultimate is estimated at 250 Gb for oil and 800 Tcf for gas
Figure 8: Africa oil creaming curve 1886-2007



Africa cumulative discovery versus time is compared to cumulative production.
A sharp rise occurs in 1956 & 1957 with the discovery in Algeria of the two largest fields in Africa being Hassi Messaoud (10 Gb) for oil and Hassi R'Mel (140 Tcf) for gas: I participated in these two discoveries.
Figure 9: Africa oil cumulative discovery & production

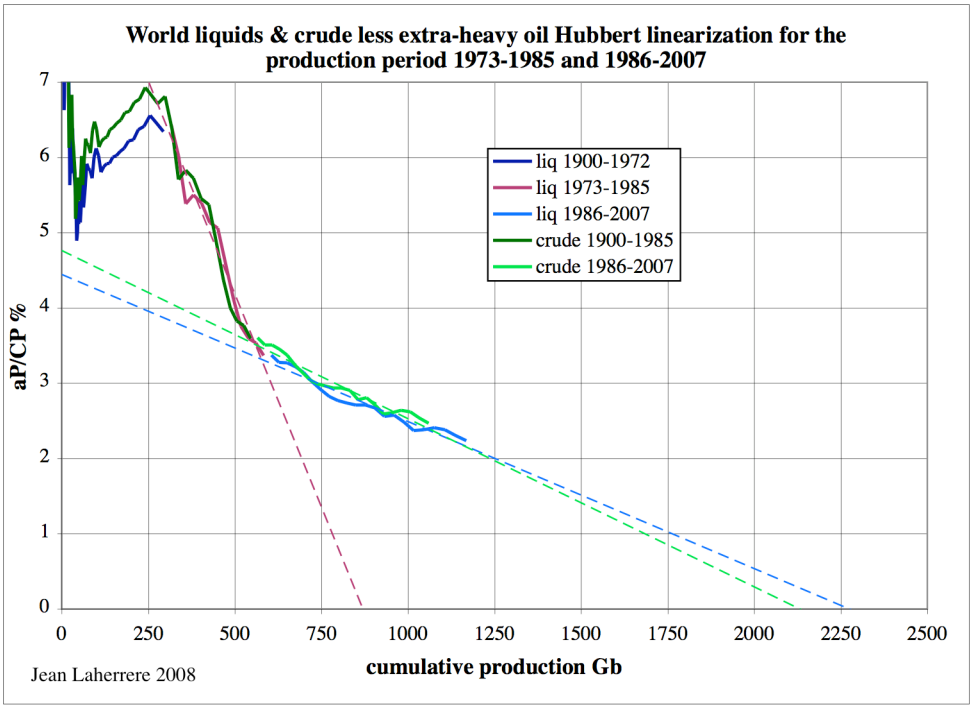


The world data from technical databases has to be corrected to obtain a 2P values in the ME (reducing by 300 Gb of speculative resources as described by Sadad Al-Husseini) and in FSU (ABCI reduced to 2P by removing 30%) and extra-heavy oil has to be removed from Venezuela. For crude oil less extra-heavy (EH), the creaming curves by continent show a large range, with ME being largely gifted. But FSU, Latin America and Africa have similar ultimates.
US has a different pattern where too many NFW were drilled because onshore oil belongs to the individual owner of the ground, in contrary to the rest of the world where oil belongs to nations.
Figure 10: oil less EH + condensate creaming curves by continent

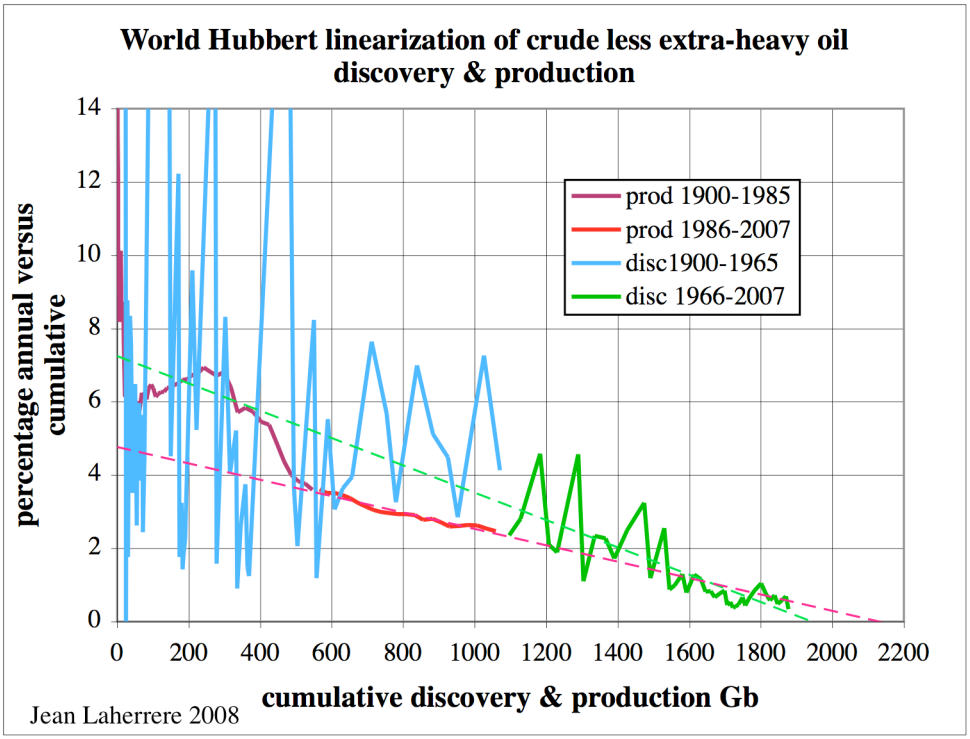


-Ultimate from Hubbert linearization

Hubbert linearization of oil production is used by many (who lack discovery data) to estimate ultimate, but linear extrapolation works only if production follows a logistic curve (in fact derivative). Some portions are linear, but not all the curve, so it is hard to believe that the last linear portion will be the last one. Constraints on production (OPEC quotas) disturb the pattern.
Oil data reported by USDOE/EIA is taken as reference, because EIA update their data (up to several years later). Crude oil includes condensate because in the US it is not distinguished at the well head.
World liquids production or crude oil less EH displays a Hubbert linearization far from being one simple linear trend. There is a roughly linear portion from 1973-1985 (first oil shock to the oil counter shock) and another rough linear portion from 1986 to 2007. The coming depression could change this trend as 1985 did.
Figure 11: World liquids and crude oil less extra-heavy Hubbert linearization for 1973-1985 and 1986-2007



For crude less extra-heavy (EH) oil, the Hubbert linearization (green trend) for the period 1986-2007 is about 2100 Gb, but the extrapolation of the cumulative discovery fits better with a 2000 Tb, yet the accuracy is not good enough to exclude 2100 Gb. But it is obvious that the linearization for liquids trending towards 2250 Gb is wrong, because the difference between *liquids* and *crude less EH oil* is much higher than 250 Gb including EH (about 500 Gb), NGL (about 250 Gb) and refinery gains + synthetic oils (= GTL, CTL and BTL) that are difficult to estimate.
We believe that the *crude less EH oil* ultimate is about 2 Tb = 2000 Gb and *liquids* ultimate about 3 Tb. The accuracy of such an estimate is less than 10 %, so 100 to 200 Gb can be added (or subtracted) in the future without changing much this rounded estimate.
Hubbert linearization of oil production is a poor way to estimate ultimate. It is done by many because it is the only data they have.
The plots for crude less extra-heavy oil discovery and production trends towards roughly 2000 Gb.
Figure 12: World Hubbert linearization of crude oil (less extra-heavy) mean discovery & production

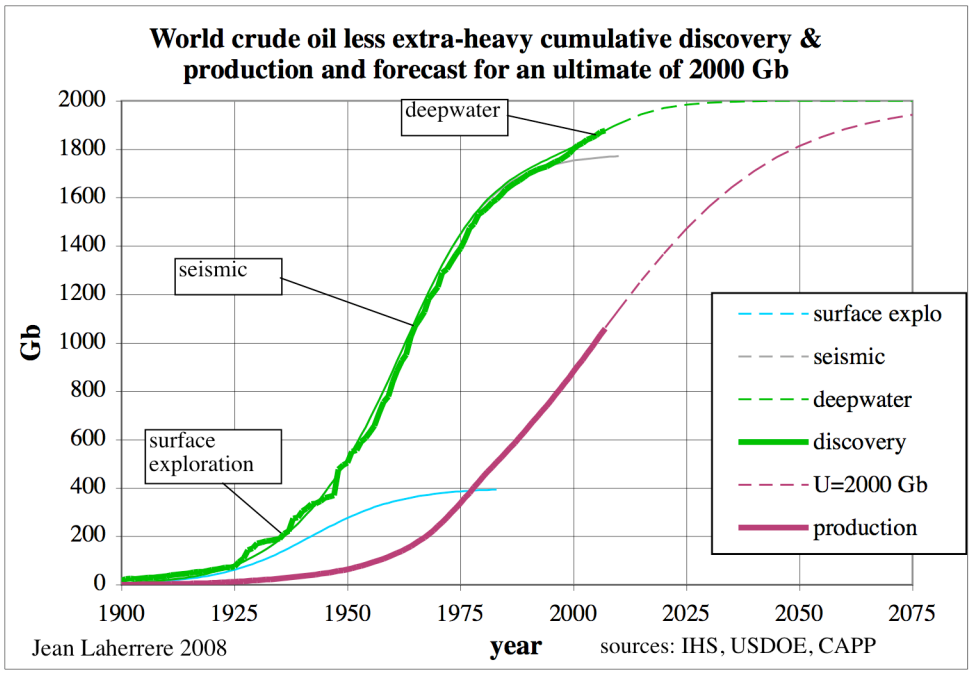


-Oil production forecast

Extrapolation of discovery data (in particular the creaming curve) is a much more reliable tool, when reserves estimates are close to the mean (expected value) and are backdated. Current proved values are useless as shown in the first graph.

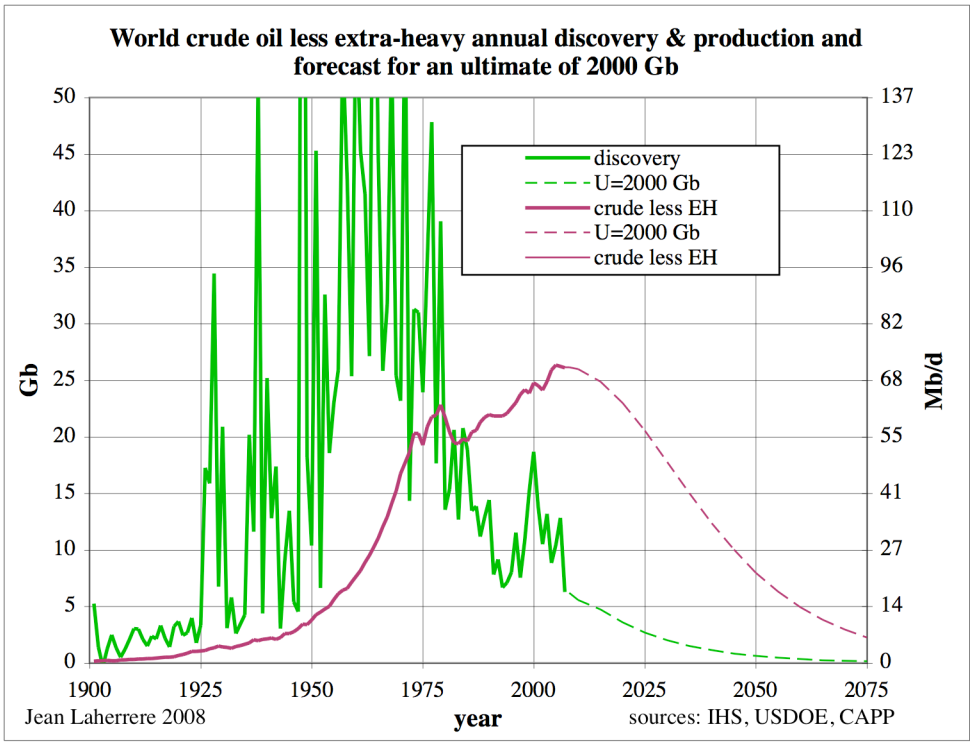
Cumulative mean backdated discovery can be easily modelled with a S curve (logistic curve) or in more detail with three S curves, the first one corresponding to the surface exploration up to 1945, the second with seismic exploration up to 1995 and the last one being deepwater. If there is no new cycle (most of the petroleum systems have been drilled (even Antarctica with JOIDES) and their potential evaluated looking at the possible source-rocks: a few wells are enough for that). The yet to find (YTF) can be deducted from the known cumulative discovery (about 1,9 Tb) and the rounded 2 Tb ultimate. YTF is less than 200 Gb for easy oil.

Figure 13: World *crude less extra-heavy oil* **cumulative** discovery and production with forecast for an ultimate of 2 Tb



The same data is displayed annually

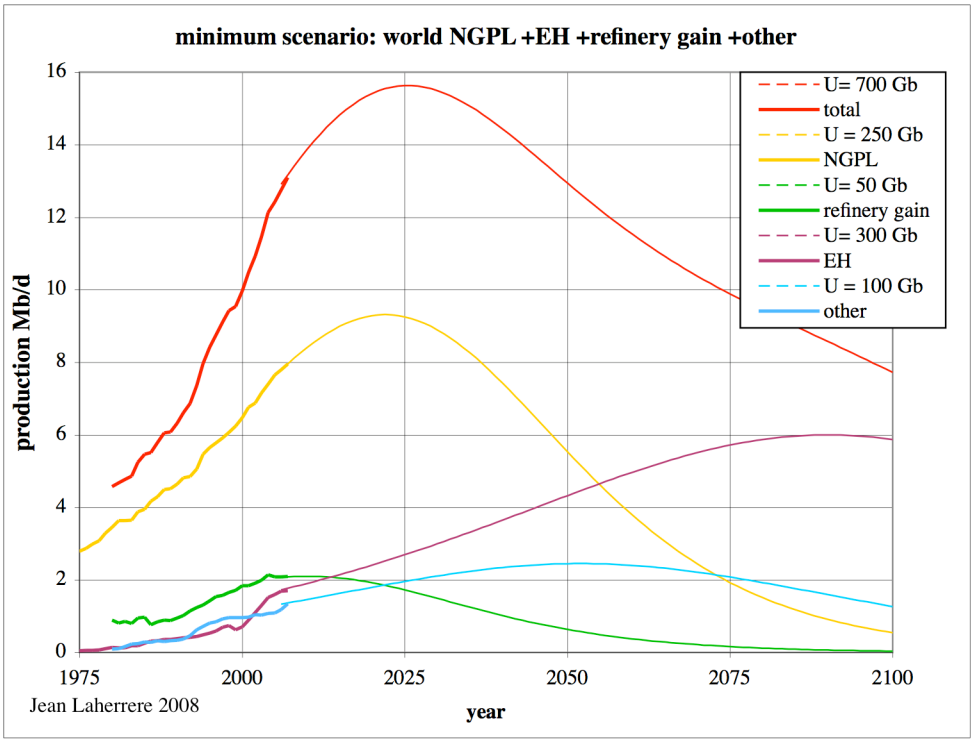
Figure 14: World *crude less extra-heavy oil* **annual** discovery and production with forecast for an ultimate of 2 Tb



To satisfy the oil demand which includes all the liquids with XTL (as GTL, CTL, BTL) the oil supply must answer by breaking down the oil supply in several items.

To obtain the minimum scenario, past data of liquids outside the crude oil less EH were extrapolated with an ultimate of 700 Gb broken down into NGPL = 250 Gb in connection with NG ultimate of 10 Pcf, extra-heavy = 300 Gb, refinery gain = 50 Gb in connection with crude oil ultimate of 2 Gb, other (XTL) = 100 Gb because biofuels are connected to oil through productivity.

Figure 15: minimum forecast of NGPL + EH + refinery + *other* production U=700 Gb

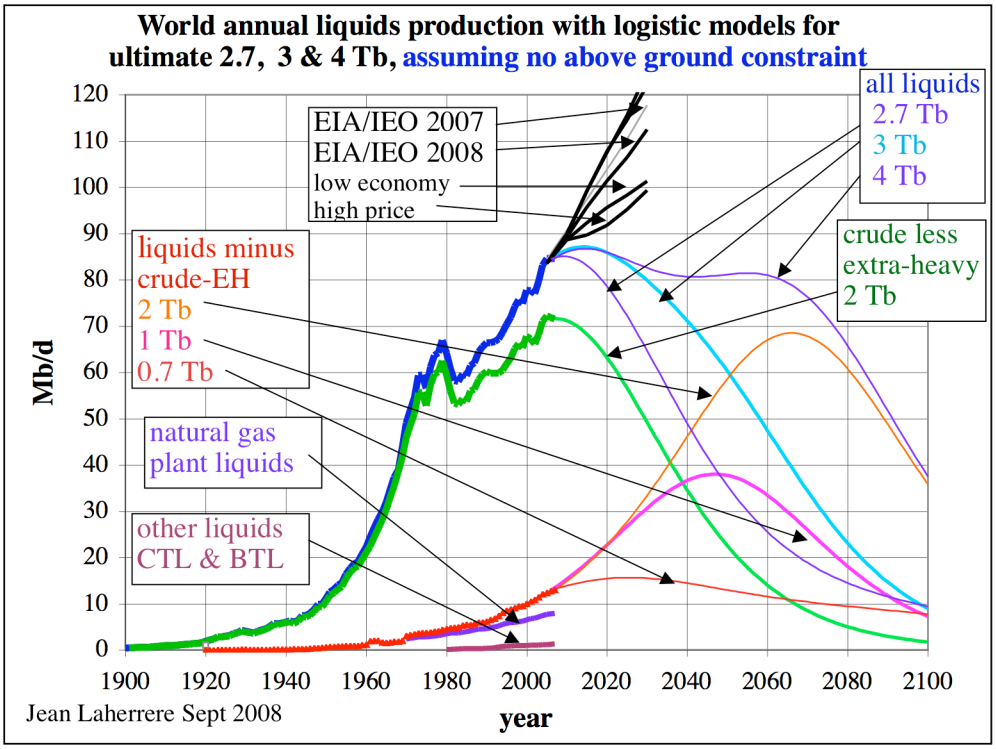


The minimum scenario for liquids is then for an ultimate of 2,7 Tb (2+0,7), when the likely ultimate is taken as 3 Tb (2 +1) and the maximum unlikely as 4 Tb (2+2)

All liquids ultimate estimated is the sum of	likely 3 Tb	mini 2.7 Tb
-crude less extra-heavy	2000 Gb	2000 Gb
-extra-heavy	500 Gb	300 Gb
-natural gas liquids and GTL	250 Gb	250 Gb
-synthetic oil (BTL, CTL) & refinery gains	250 Gb	150 Gb

In the graph the blue is all liquids, the green = cheap oil = crude less EH oil and the red = expensive = all liquids less cheap. In the unlikely maxi the red ultimate is 2 Tb, doubling the likely and it does not change the date of the peak only the slope after peak. Expensive oil needs time, not only large investment but also a large staff. Dealing with time, nature cannot be pushed too hard: *it is impossible to have a baby in one month with nine women!*

Figure 16: world liquids annual production for ultimates of 2.7, 3 & 4 Tb assuming **no constraints *above ground*,** and USDOE/EIA/IEO forecasts

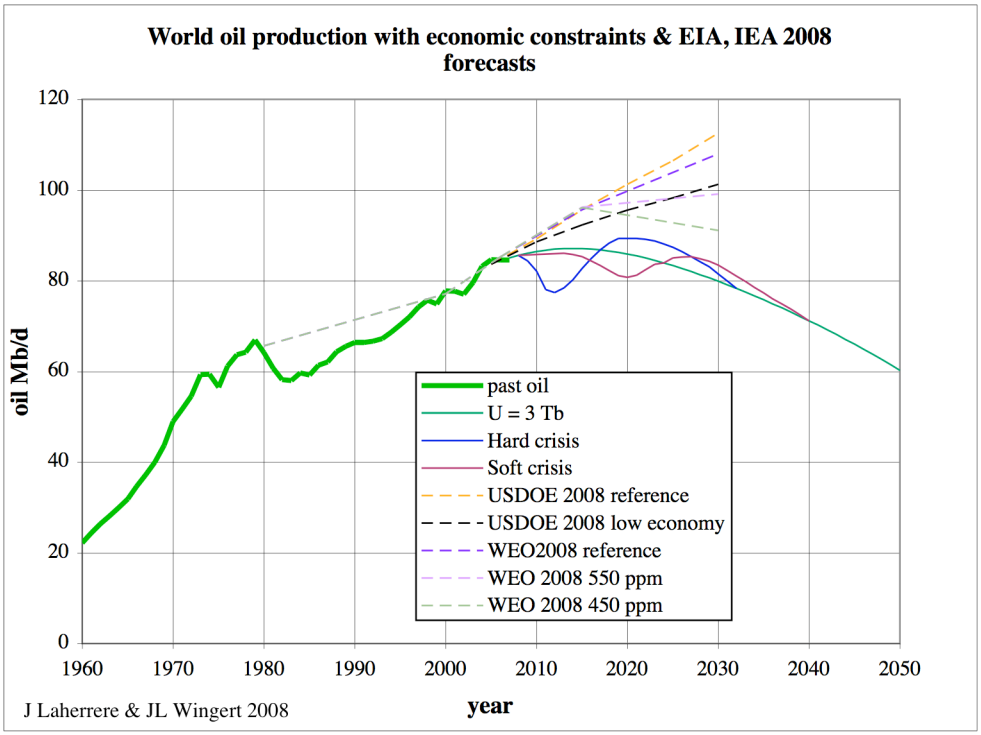


The low economy or high price EIA/IEO for 2030 is closed to 100 Mb/d. Total CEO Ch. de Margerie stated that 100 Mb/d will not be reached.

Since 2001, I was plotting a bell-shape peak corresponding to the ultimate with no other constraints than below ground, but saying in the text that in reality it should be a bumpy plateau because of constraints from above ground (Paul Volcker 2004 forecast on economic crisis.)

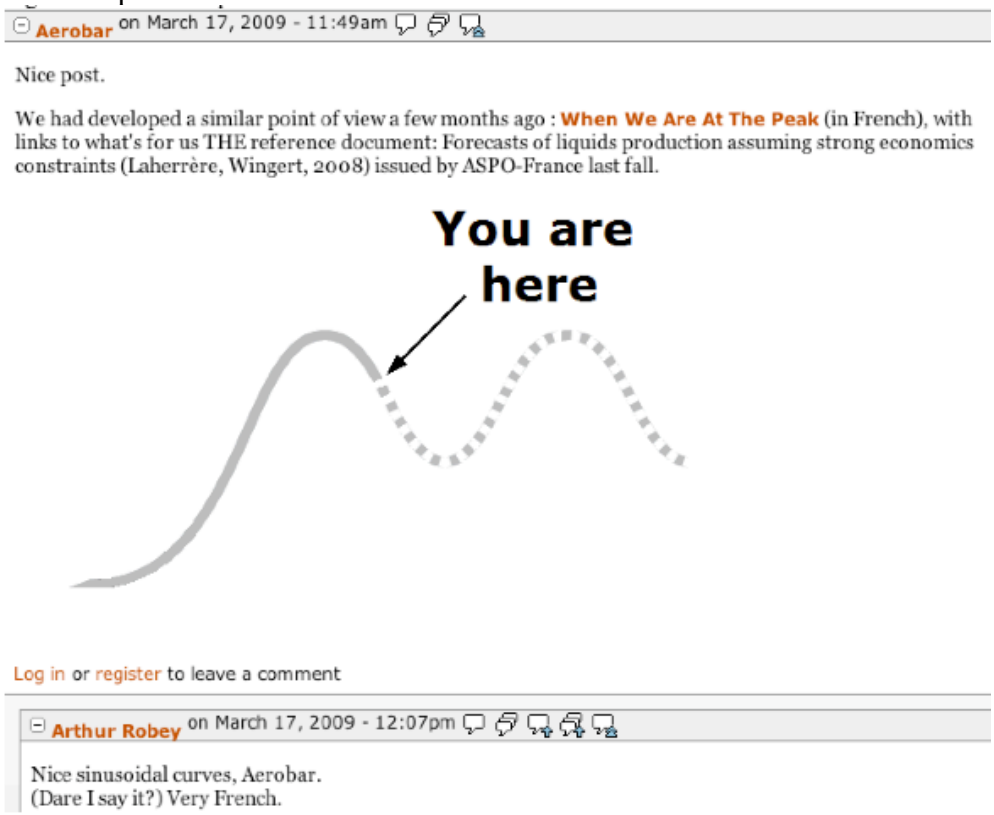
Last year in ASPO Barcelona with JL Wingert we assumed above ground constraints in particular an economic crisis (hard or soft) based on past crisis (Argentina, Japan, world) the smooth peak (green) is transformed into a bumpy plateau

Figure 17: world liquids annual production with economic constraints (ASPO Barcelona)



The oil drum paper http://www.theoildrum.com/node/5177#more showed this funny (very French) graph on our paper

Figure 18: world oil production cartoon from TOD 5177

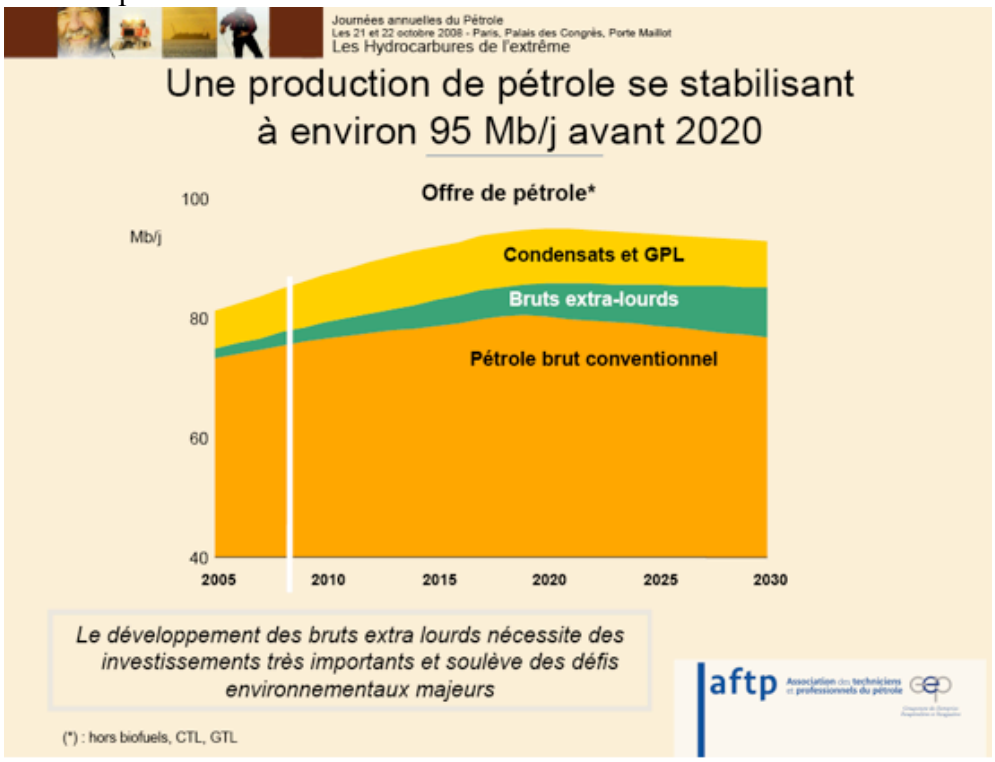


-5-Other private forecasts

-Total

Total forecasts a peak around 2020 at 95 Mb/d. *Les Hydrocarbures de l'extrême Perspectives énergétiques Laurent Maurel Directeur Stratégie Croissance Exploration & Production TOTAL Journées Annuelles du Pétrole AFTP Les 21 et 22 octobre 2008 – Paris*

Figure 19: world oil production forecast from Total 2005-2030



Total excludes biofuels (and CTL & GTL) in their forecast, despite that Total gas stations sell gasoline with 5% biofuel in France

-CERA

-CERA & IHS worldwide studies

CERA was founded by Daniel Yergin a historian who wrote in 1991 a very good book "The prize: the epic quest for oil, money and strategy" But writing oil history does not turn you into an oil expert. CERA was bought by IHS and now sells regional and worldwide synthesis reports.
In the 90s Petroconsultants (bought by IHS in 1998) was selling the following worldwide reports:
-Laherrère J.H., A.Perrodon, G.Demaison 1994 "Undiscovered Petroleum Potential" Petroconsultants report, 383p
-C.J.Campbell, Laherrère J.H. 1995 "The world's oil supply -1930-2050" Petroconsultants report, Oct ., 650p, CD-ROM
-Laherrère J.H. , A.Perrodon, C.J.Campbell 1996 "The world's gas potential" Petroconsultants report July, 200p, CD-ROM
These reports are still listed in IHS Energy Studies Catalogue (only last two) and IHS Studies worldwide site as 8-1-2, 8-1-3 & 8-1-8 out of 8 studies the most recent being 2003.
http://www.ihstechnicalstudies.com/files/IHS_catalogue.pdf
http://energy.ihs.com/Products/Studies/Worldwide/index.htm
On CERA site http://cera.ecnext.com/coms2/browse_RS_OIL_ &
http://cera.ecnext.com/coms2/browse_RS_GAS_
the only worldwide reports are 4:
-Why the "Peak Oil" Theory Falls Down -- Myths, Legends, and the Future of Oil Resources (PDF) 16p 2006 $499.00
-Worldwide Liquids Capacity Outlook to 2010: Tight Supply or Excess of Riches? (PDF) 60p 2005 $999.00
-In Search of Reasonable Certainty: Oil and Gas Reserve Disclosure (PDF) 114 p 2005 $5,000.00
-Global Oil Trends 2003 (PDF) 104 p 2003 $500.00
In the IHS-CERA catalogue for worldwide oil & gas potential, our 3 reports seem to weight a good part (in number of pages).
The update of the *world's oil supply* was done by Dr Michael Smith (http://www.energyfiles.com/) which has a very good web site with many free graphs.
Colin Campbell has published last year with S.Heapes "An atlas of oil and gas depletion" (Ed Riley Dunn & Wilson Ltd) with a geological and historical synthesis for each producing country.
CERA is unable to match the quality of such reports.

-CERA attack on Peak Oil

CERA seems to try to gain credit by attacking what we have done, by claiming that « Peak Oil » theory has failed, but its attack is simply wrong, because CERA forecasts an undulating plateau and **a plateau is an eroded peak**! I have been forecasting a bumpy plateau since 2001
http://cera.ecnext.com/coms2/summary_0236-821_ITM
***Why the "Peak Oil" Theory Falls Down** -- Myths, Legends, and the Future of Oil Resources*
Date: November 10, 2006 Full Report: $ 499.00
Overview
The peak oil debate continues to rage without any obvious progress. But, upon examination, the peak oil theory falls down because of serious flaws in logic and application. CERA's view, based on two decades of research, is highly unpopular in peakist circles. However, ours is not a view of unlimited resource. A plateau will occur-but not tomorrow, and supply will not "run dry" soon thereafter. We hold that aboveground factors will play the major role in dictating the end of the age of oil.
** Based on a detailed bottom-up approach, CERA sees no evidence of a peak before 2030.*
Moreover, global production will eventually follow an undulating plateau for one or more decades

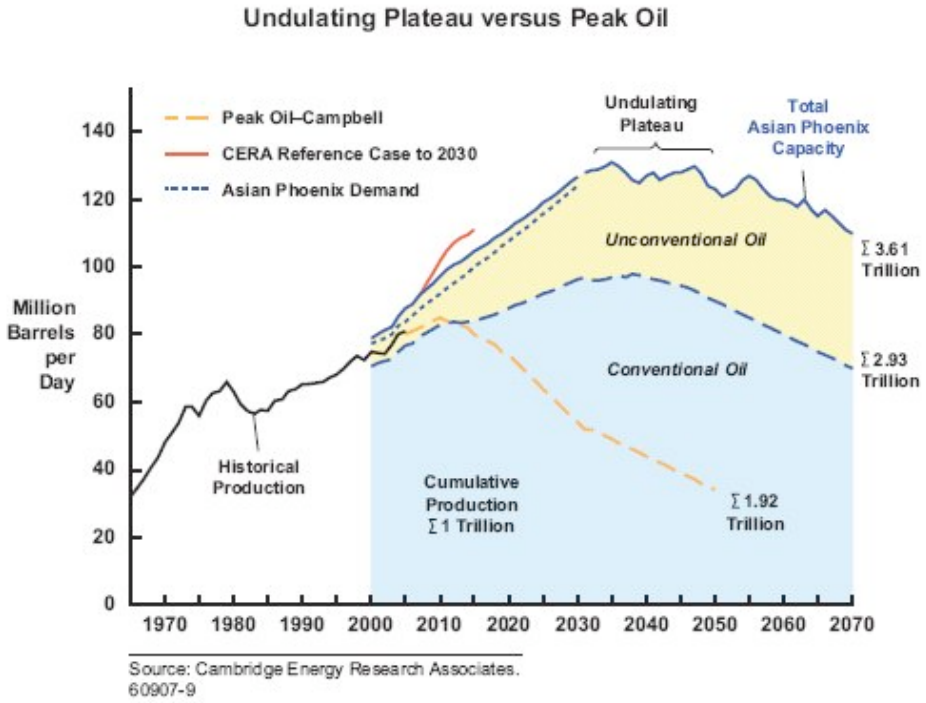
before declining slowly. Global resources, including both conventional and unconventional oils, are adequate to support strong production growth and a period on an undulating plateau.
** Despite his valuable contribution, M. King Hubbert's methodology falls down because it does not consider likely resource growth, application of new technology, basic commercial factors, or the impact of geopolitics on production. His approach does not work in all cases-including on the United States itself-and cannot reliably model a global production outlook. Put more simply, the case for the imminent peak is flawed. As it is, production in 2005 in the Lower 48 in the United States was 66 percent higher than Hubbert projected.*
** The debate should now move toward a better understanding of the key drivers of production, including the scale of global resources and the likely production outlook, which form the core of current disagreements and confusion.*
At the same time, there is a need to identify the signposts that will herald the onset of the inevitable slowdown of production growth and ensure that policymakers outside the energy community have a clear understanding of possible outcomes and risks.
The author of this report Peter Jackson was interviewed on the oil drum
http://europe.theoildrum.com/node/2283#comments
TOD 2283 March 03, 2007 interview by Luis de Sousa
Dialoguing with Dr. Peter Jackson of CERA: Is the Future of Oil Resources Secure?
Dr. Jackson shows he doesn't know or doesn't understand what the Hubbert method is.

-CERA refused to take ASPO 100 000 $ bet challenging their 2017 forecast

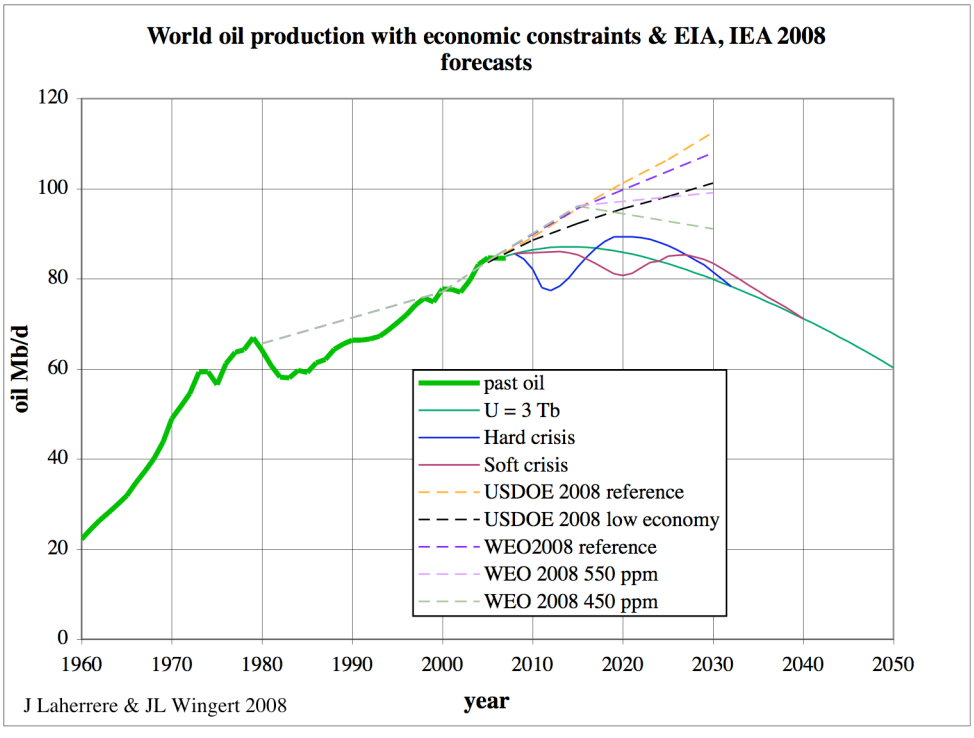
CERA is hiding its forecast by dealing not on oil production but in oil capacity. It is not answering the big question: when oil demand will not be satisfied by the oil supply
CERA forecasts a capacity of 112 Mb/d in 2017 (corresponding to 107 Mb/d oil supply) and was challenged for a bet of 100 000 $ by of a group of ASPO USA & partners. CERA did not answer! It is a win by forfeiture
http://www.energy-daily.com/reports/Wager_Challenges_CERA_Oil_Supply_Prediction_999.html
The group is betting against CERA's June 2007 forecast that world oil production capacity will reach 112 million barrels per day (mmb/d) by 2017, which extrapolates to 107 mmb/d of actual production, up from about 87 million barrels today. The 11 members of the betting pool have issued the wager to raise awareness about the fragile state of the world's future oil supplies. Participants include Jeremy Gilbert (former Chief Petroleum Engineer for British Petroleum), Matt Simmons (Houston energy banker), Jean Laherrere (retired oil executive), Herman Franssen (economist), Marvin Gottlieb (businessman), Jim Baldauf (ASPO-USA co-founder), Bob Kanner (investment manager), Scott Pugh (retired Captain U.S. Navy), Aage Figenschou (oil industry, shipping), Randy Udall (ASPO-USA co-founder) and Steve Andrews.

-CERA plateau on world wide oil production

CERA forecasts an oil undulating plateau from 2030 to 2050 at 130 Mb/d, when TOTAL forecasts that in 2030 the production will be in decline at 90 Mb/d!
Figure 20: world oil production forecast from CERA

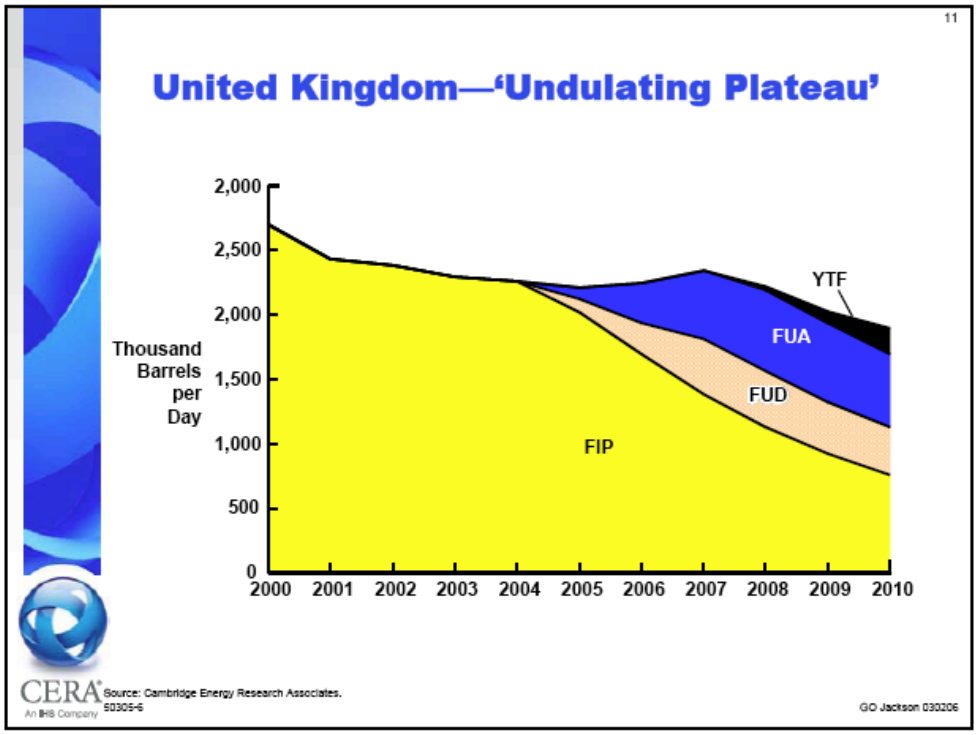


The title looks strange opposing the plateau to a peak, when its plateau could be easily smoothed to a peak!
This forecast seems to ignore the present data showing a plateau since 2005 (see figure 4).
My forecast is a plateau from 2005 to 2025 at less than 90 Mb/d and on 2030 a production around 80 Mb/d. USDOE 2008 WEO forecasts for low economy or high price about 100 Mb/d.
Figure 21: my world oil production forecast



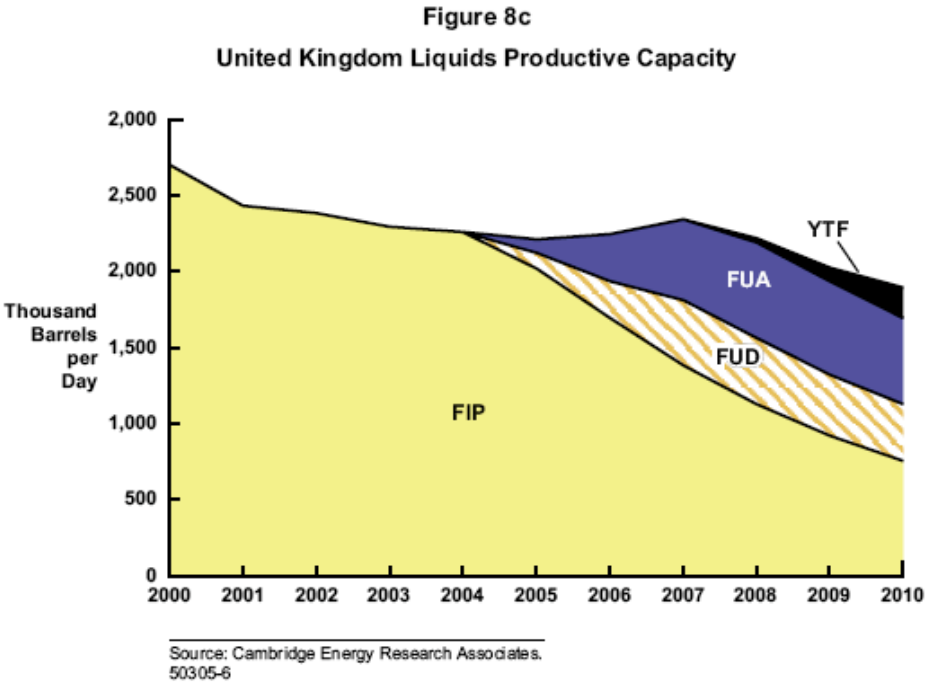
-CERA forecast on UK

CERA forecast in 2006 for UK was showing an undulating plateau from 2004 to 2008.
Figure 22: UK oil production forecast from CERA 2006



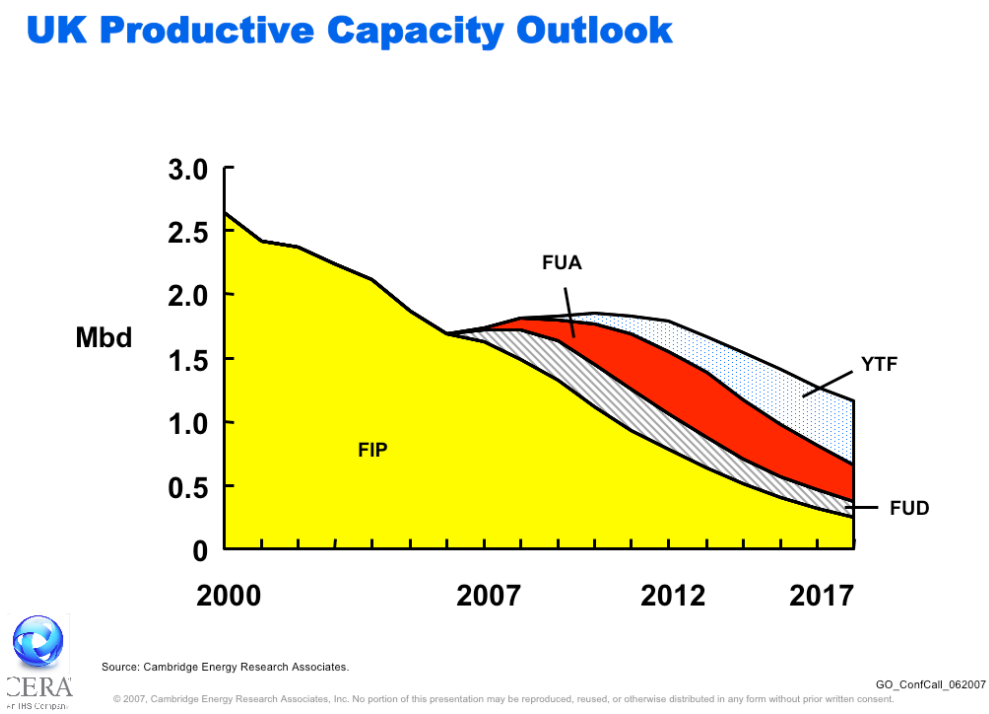
Strangely the Y-axis production displays 2 Mb/d (above 2,5 Mb/d) instead of 3 Mb/d. This mistake is kept in another graph

Figure 23: UK oil capacity forecast from CERA 2006

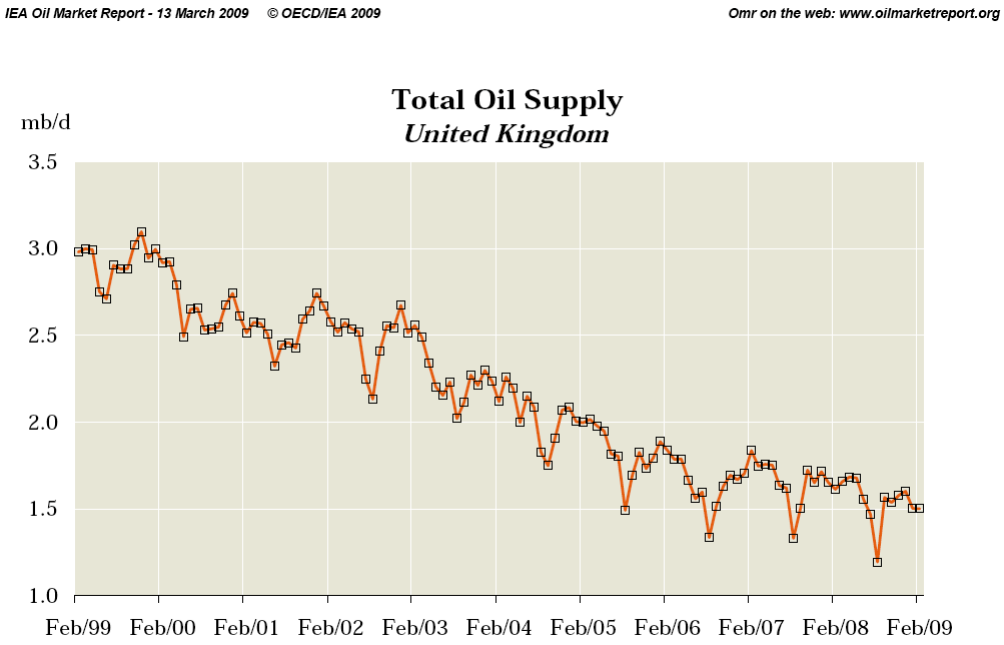


Yet the Y-axis is corrected in 2007, but the capacity for 2006 is then 1,7 Mb/d when it was 2,2 Mb/d in the last graph : it is a big change!

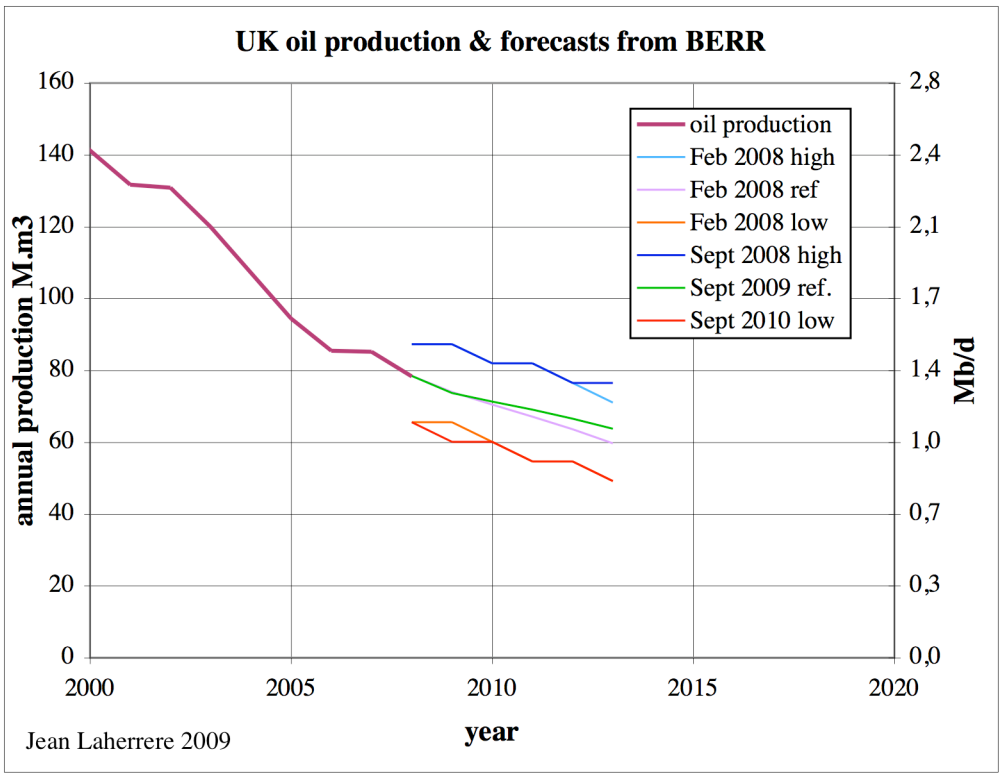
Figure 24: UK oil capacity forecast from CERA 2007



But where is the CERA undulating plateau 2006-2012 for UK in the IEA oil supply data?
Figure 25: UK oil monthly production from IEA 1999-2009

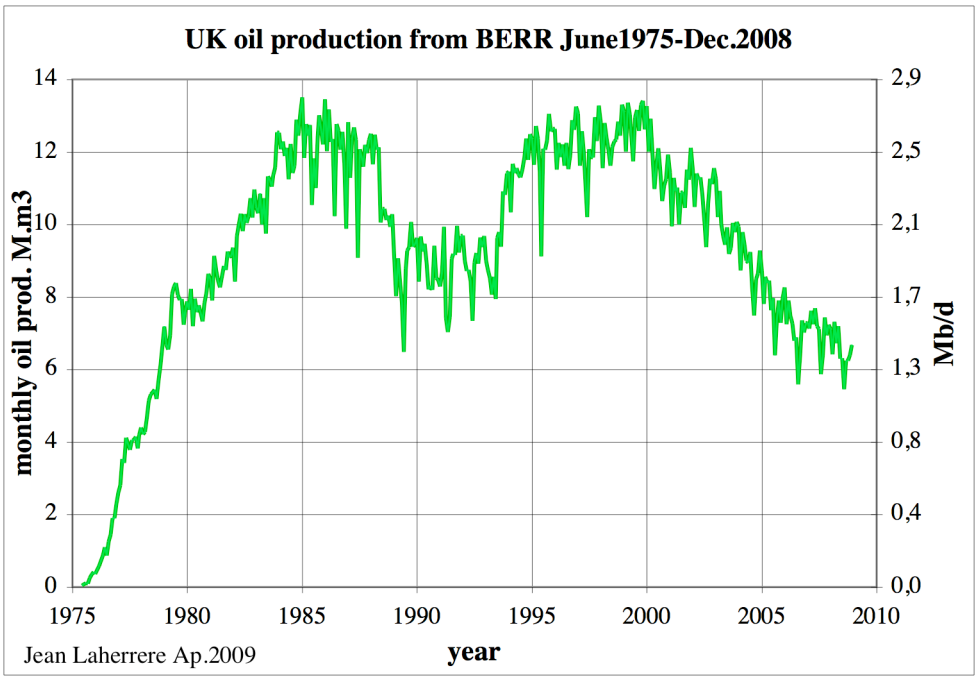


Where is the CERA 2006-20012 plateau in the BERR forecast? There is no plateau, just a little bump (due to Buzzard).
Figure 26: UK oil monthly production from BERR 2000-2013



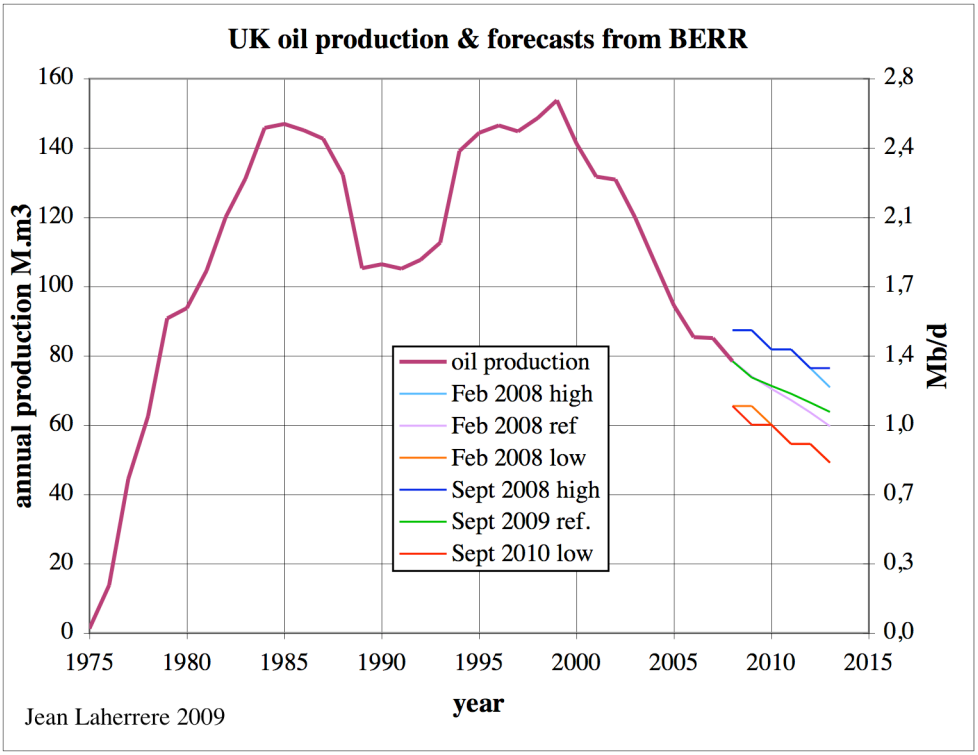
Data has to be shown always on the complete series from the start to see completely the decline from the peak, but in fact there were two peaks

Figure 27: UK oil monthly production from BERR 1999-2009

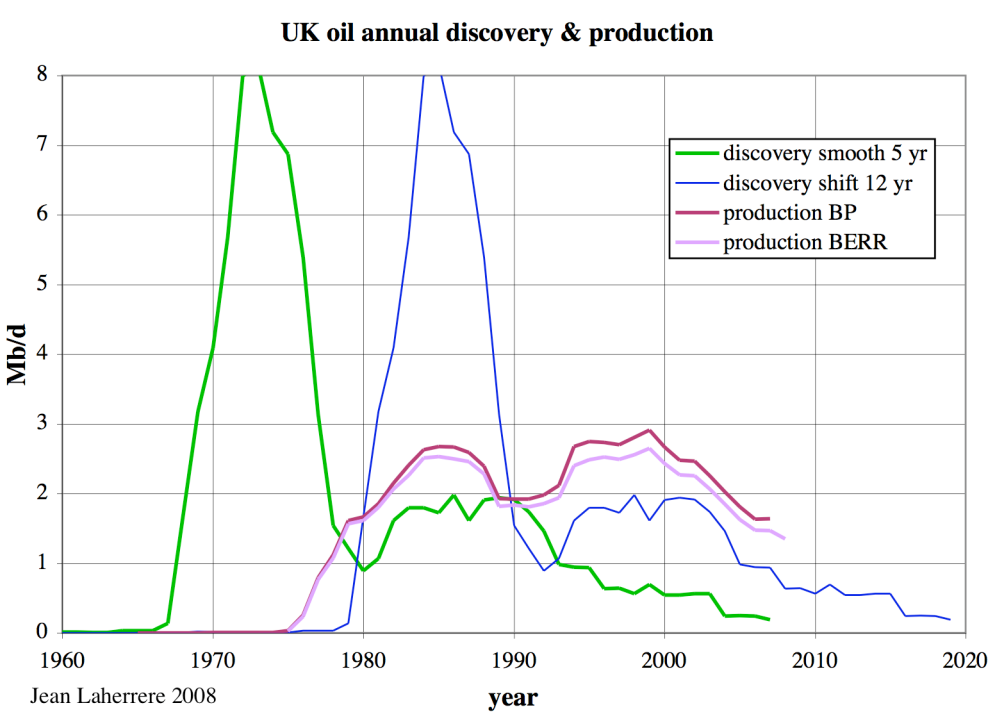


Same with annual values and forecast

Figure 28: UK oil annual production and forecasts 1975-2013



UK is a good example of several cycles of discovery and production, and any correlation with one single Hubbert cycle should fail.
The two peaks production correlates with the two discovery peaks with a shift of 12 years. The correlation is good in shape and less in value because the large discoveries of the first cycle were produced on a long term compared to the shift.
The shifted discovery with an advance of 12 years is a good forecast for production
Figure 29: UK oil discovery and production 1960-2020



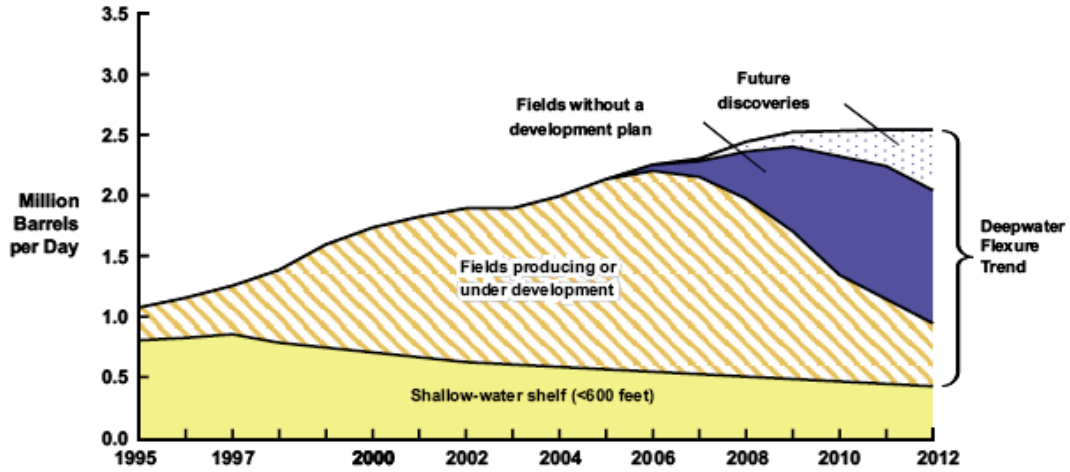
There is unlikely to be a third cycle of discovery and UK production will decline down to the end.

-CERA forecast on US Gulf of Mexico (GOM)

The Gulf of Mexico is with the UK the best place to study oil discovery and production because all field data is available on the web (BERR and MMS), except that there is a lag of about 4 years: the latest data is for end of 2004.
CERA forecasted in 2005 a productive capacity increasing up to 2012 with just a small decrease in 2003 and flattening at the end at 2,5 Mb/d. In the GOM the unused capacity should be small.
Figure 30: GOM oil capacity forecast from CERA 2005 from 1995 to 2012

Figure 8d

US Gulf of Mexico* Oil Productive Capacity Outlook

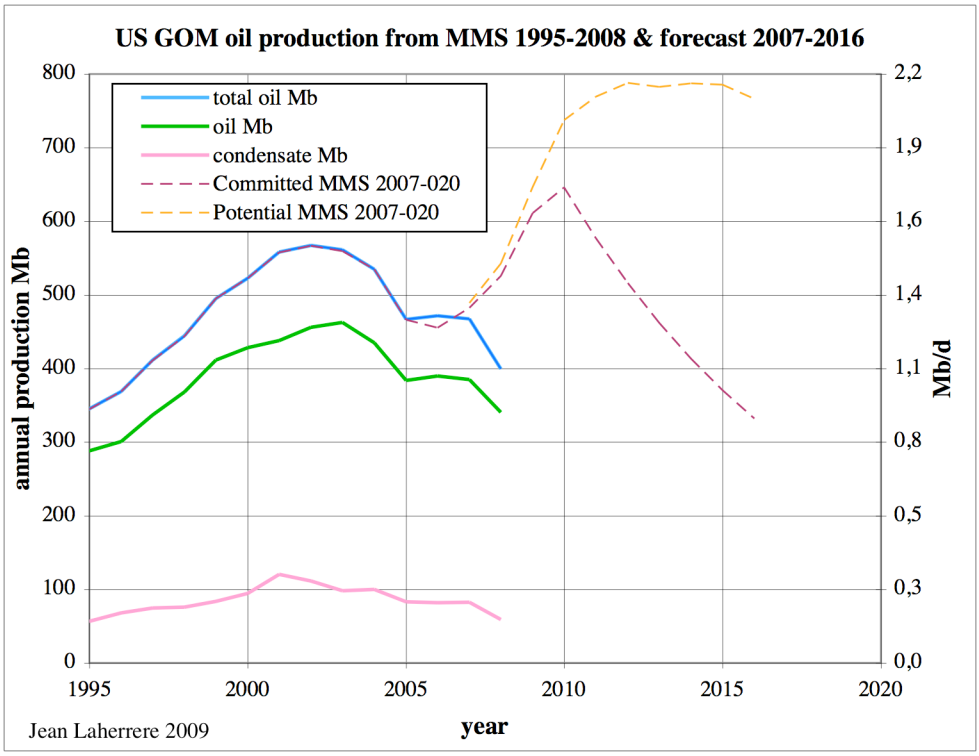


Gulf of Mexico Oil Productive Capacity
(million barrels per day)

	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2012
Shelf	0.80	0.82	0.85	0.78	0.74	0.70	0.66	0.62	0.60	0.58	0.56	0.54	0.52	0.50	0.48	0.46	0.42
Flexure Trend	0.27	0.33	0.40	0.60	0.85	1.03	1.16	1.27	1.29	1.41	1.57	1.71	1.78	1.93	2.04	2.08	2.12
Total Gulf	**1.07**	**1.15**	**1.25**	**1.38**	**1.59**	**1.73**	**1.82**	**1.89**	**1.89**	**1.99**	**2.13**	**2.25**	**2.30**	**2.43**	**2.52**	**2.54**	**2.54**

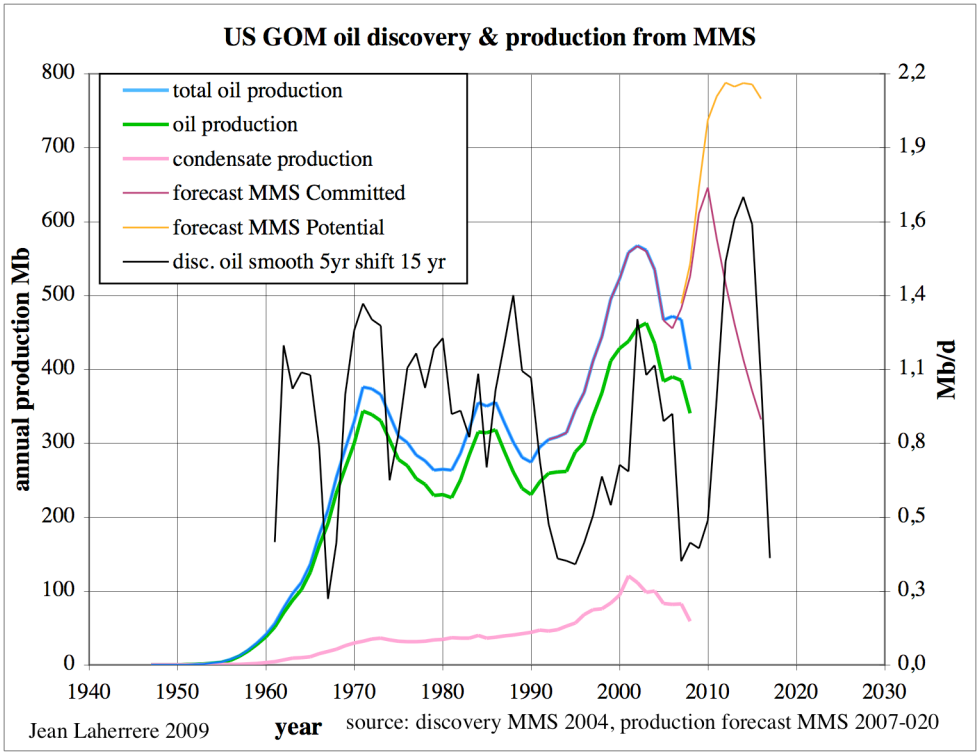
Source: Cambridge Energy Research Associates.
*Includes Louisiana and Texas only.
Updated April 2005.
40916-58

MMS data and forecast (OCS report MMS 2007-020) shows a different picture with a peak in 2002, a flat portion in 2005 (Katrina) and a decline in 2008 (Ike and Gustav). MMS forecast for 2008 was wrong because the hurricanes.
MMS forecast for 2012 is from 1,5 Mb/d (committed) and 2,2 Mb/d (potential) far from CERA 2,5 Mb/d.
Figure 31: GOM oil production and forecast from MMS 1995-2016



But again graphs should show the complete historical data and not a selected period to suit the author's motive, hiding the previous up and down. GOM oil production had already shown 3 oil peaks, but one condensate peak. Oil discovery (MMS at end 2004 only) smoothed on a 5 year period and shifted by 15 years displays many peaks and yet to develop (in particular the subsalt as Jack2)

Figure 32: GOM oil production and forecast from MMS 1947-2016

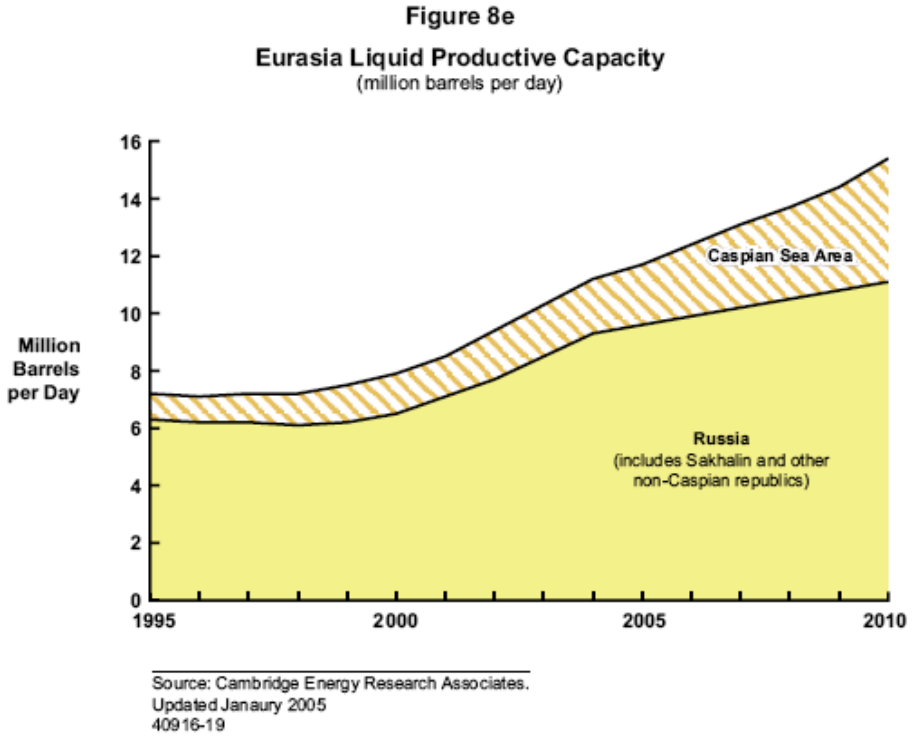


CERA GOM forecast was wrong and forecasting capacity is of little use. Consumers want production forecast and not capacity.

-CERA forecast for Russia

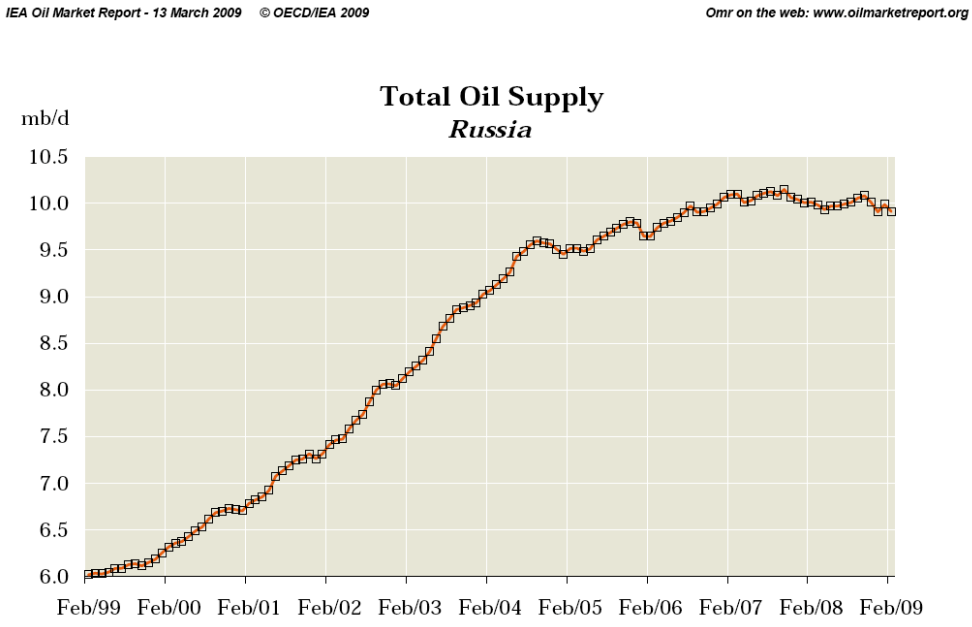
CERA 2005 forecast for Russia shows a capacity flat from 1995 to 1999 and increasing from 2000 to 2010.

Figure 33: Russia oil productive capacity forecast from CERA 1995-2010



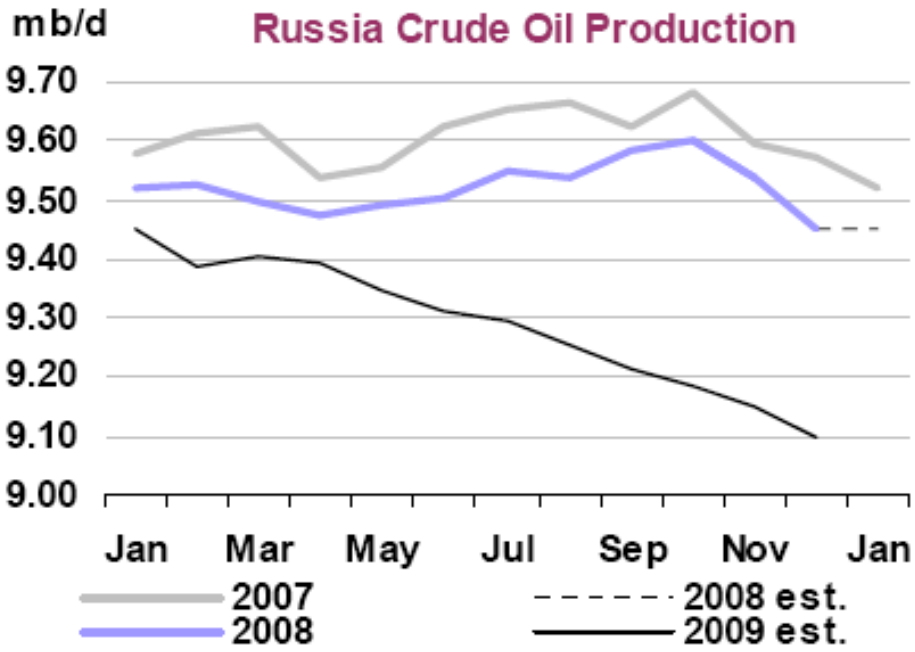
Present production data from IEA shows a peak in 2007 at 10 Mb/d and declines slightly afterwards.

Figure 34: Russia oil production from IEA Feb.1999-2009

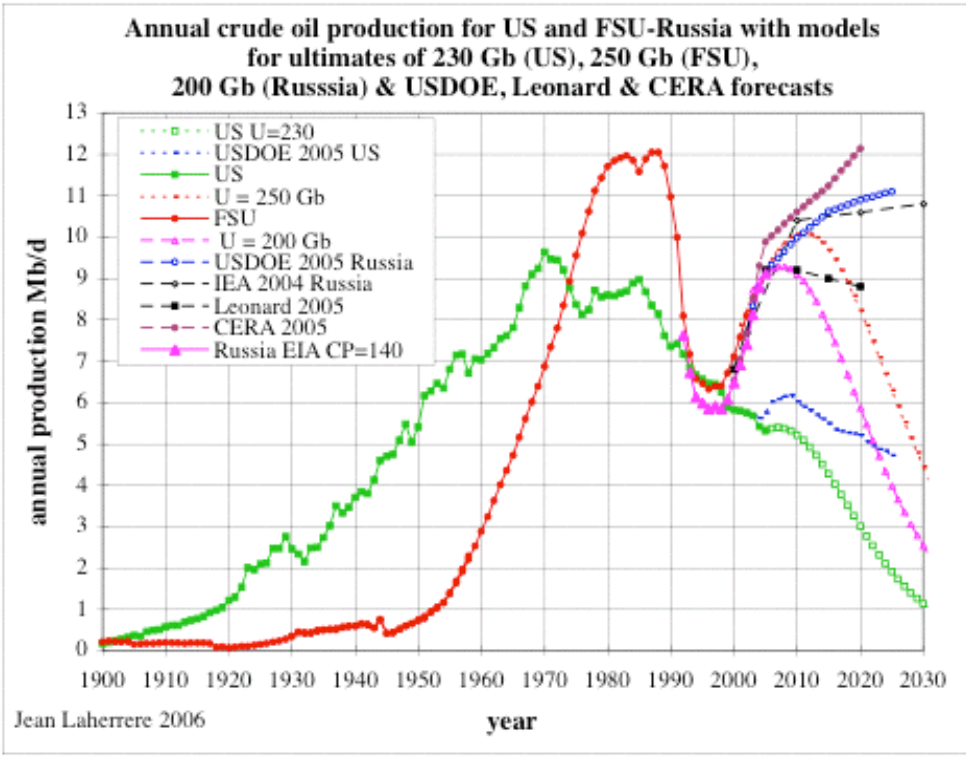


IEA monthly supply February 2009 forecasts a continuous decline for 2009, contrary to the CERA forecast.

Figure 35: Russia oil production from IEA OMR



My 2006 forecast of US and FSU-Russia production displayed the CERA Russia forecast going up to 10,5 Mb/d in 2010 against mine at 9,2 Mb/d for an ultimate of 200 Gb
Presentation to Evora University 8 May 2006 Peak oil and related peaks!
-Laherrère J.H. 2006 «Peak oil and related peaks: part 1 part 2» Evora University 8 May www.hubbertpeak.com/laherrere/Evora-part1.pdf, www.hubbertpeak.com/laherrere/Evora-part2.pdf
-Laherrère J.H. 2006 «Fossil fuels: what future? » Global Dialogue on Energy Security, The Dialogue International Policy Institute, China Institute of International Studies, Beijing 16-17 October www.oilcrisis.com/laherrere aspofrance.viabloga.com/files, www.hubbertpeak.com/LaHerrere/Beijing20061009.pdf
Figure 36: US & FSU-Russia oil production 2006 forecasts

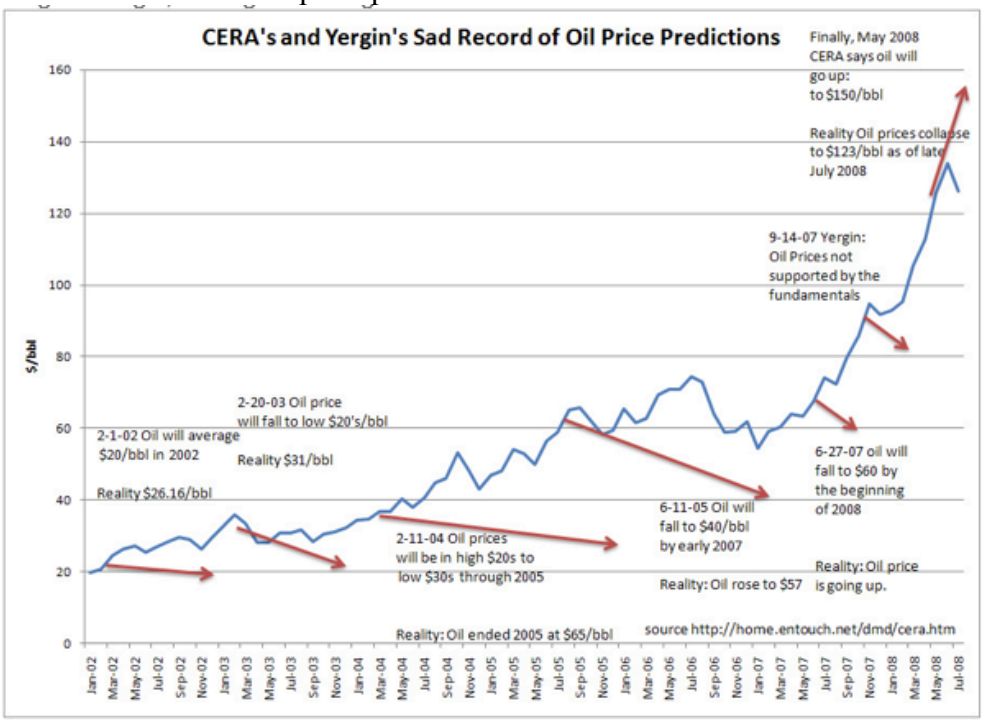


CERA 2006 forecasted very optimistic Russia oil production 10.5 Mb/d in 2010, 12 Mb/d in 2020

-CERA oil price forecasts

CERA has a poor history of forecasts. But they are not the only ones!

Figure 37: CERA sad record of oil price prediction 2002-2008



In conclusion CERA has not a good record of oil production forecasts and CERA should try to improve its record and to forecast oil production and not oil capacity.

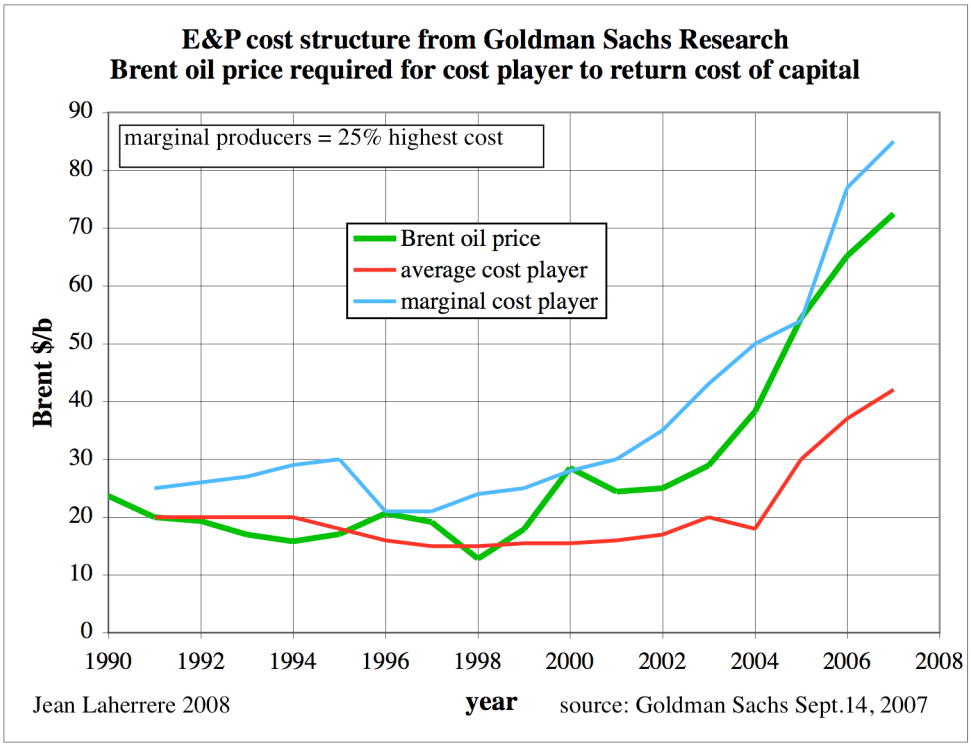
-6-Economy and other constraints

-marginal cost or breakeven point

Goldman Sachs has studied oil costs for 60 oil companies (IOCs). With the increases in oil, iron, services and equipment prices, the marginal players (25% highest cost) (blue curve) need 85 $/b in 2007 to get a fair return on capital (Brent 2007 = 72 $/b).

It means that, if oil price goes down below 80 $/b, many operators will be bankrupted.

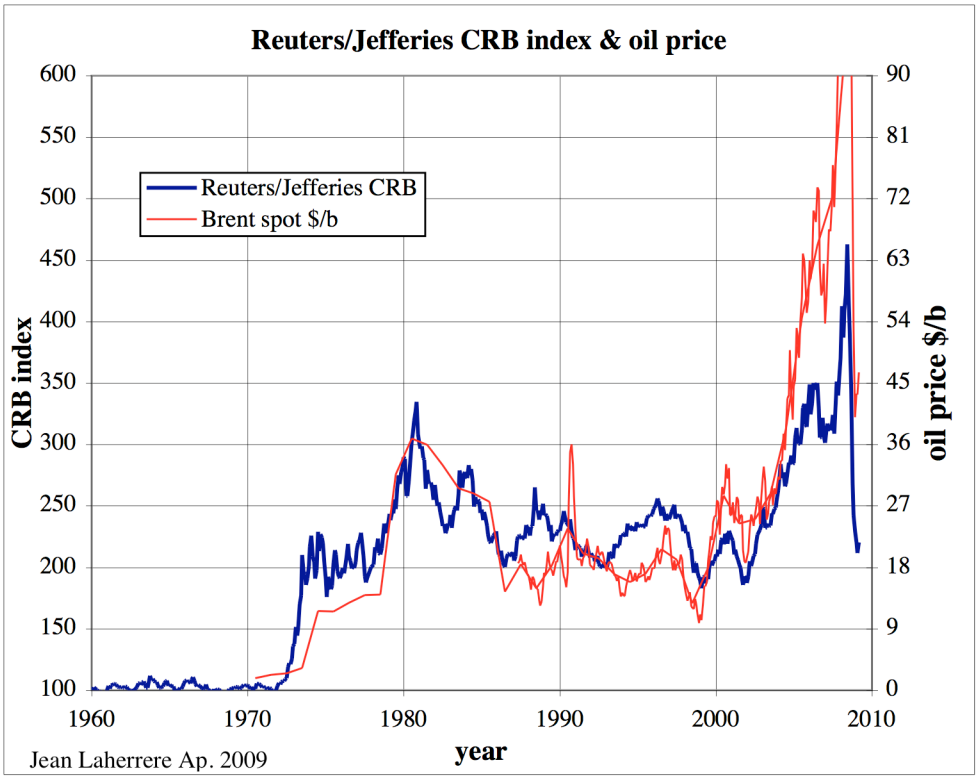
Figure 38: E&P cost required for a return on capital from Goldman Sachs 2007



Total has declared that their tarsands projects need 90$/b and deepwater 70 $/b to achieve a ROR of 12%, few years ago their breakeven point was 20 $/b!
US natural gas breakeven point has increased from 4 $/Mbtu in 2002 to 8 $/Mbtu in 2007 (Credit Suisse) close to NG US price!

-Commodities, raw materials index: Reuters/Jefferies index

Oil price depends also upon the cost of services and equipments and reciprocally.
For the last few year commodities other than energy has increased drastically (steel, copper, cement, etc) and one of the best available index is Reuters/Jefferies CRB index
Figure 39: Reuters/Jefferies CRB index and oil price 1960-Ap.2009



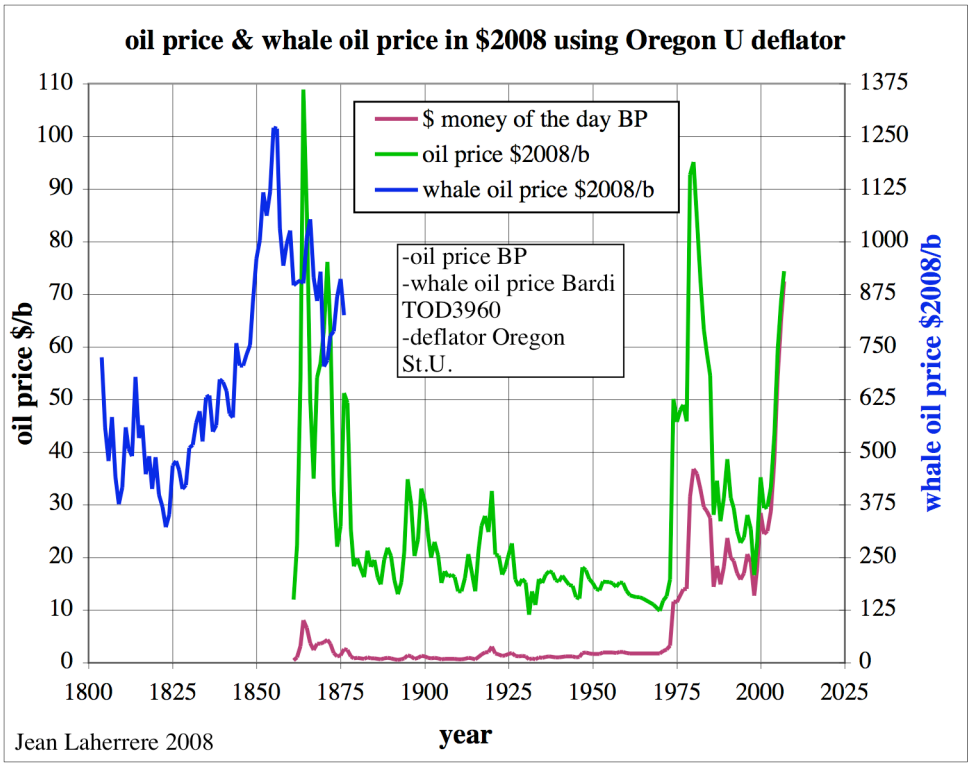
Oil price seems high compared to others commodities but oil reserves are more scarce than other commodities.

- oil price

The Scientific American article *The end of cheap oil* was published in March 1998 when oil price was 13 $/b. It was only on in October 2005 when oil price reached 50 $/b that medias started to be interested in our message.

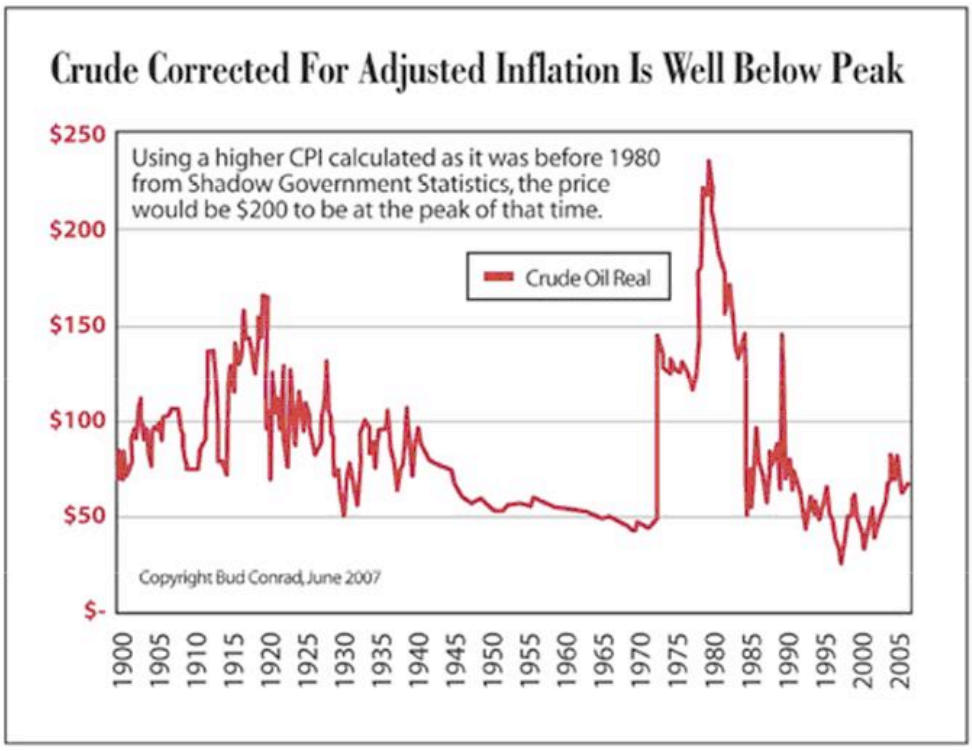
Many complain that energy is expensive but *whale oil* used for lightning was in 1854 over 1200 $2008/b in 1860 and oil price about 100 $2008/b in 1864 and in 1979 with official inflation index.

Figure 40: US whale oil and crude oil price in $2008 (official inflation from Oregon State Univ.)



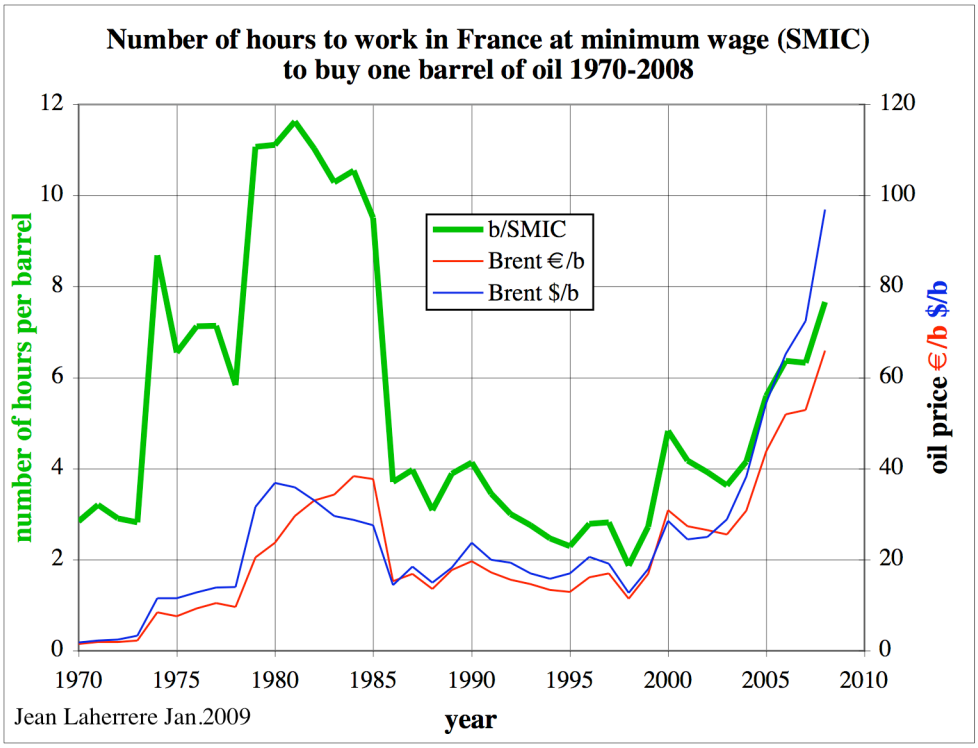
But inflation index are flawed by politics and manipulated. Conrad has corrected the inflation and estimates that oil price in 1980 was about 200 $today/b

Figure 41: 1900-2005 oil price $2005 with corrected inflation from Conrad



To avoid using manipulated inflation index, it is better to measure how many hours of work at minimum wage are needed to buy one barrel of oil. Using the French minimum wage (SMIC) more than 11 hours were needed in 1980 when only about 7 hours were enough in 2008, confirming Conrad graph.

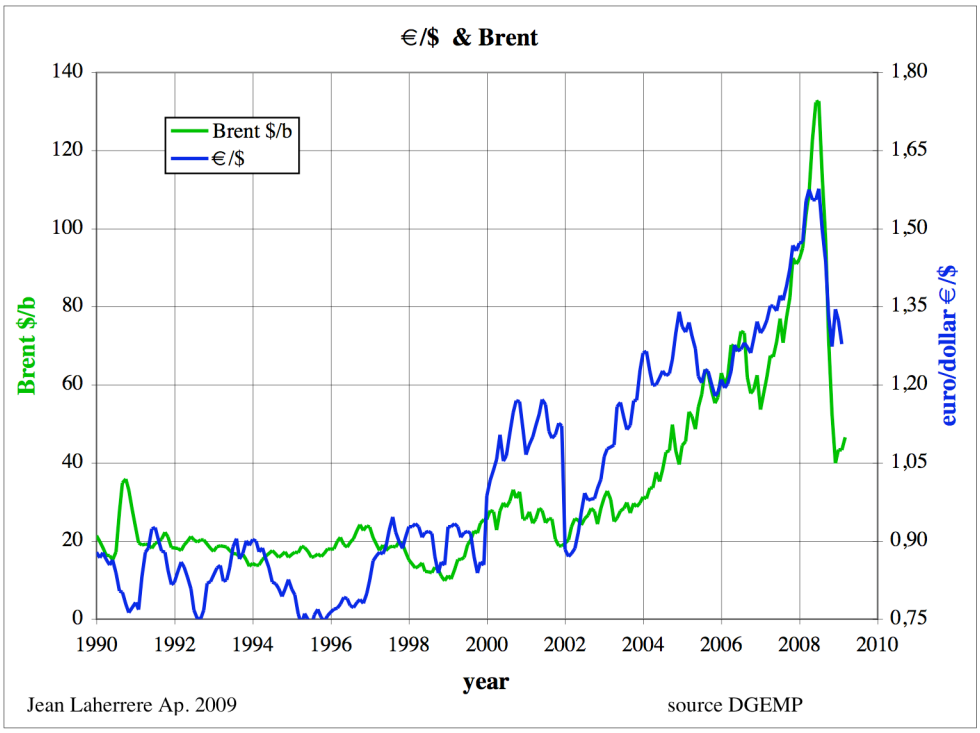
Figure 42: number of SMIC minimum wage needed to buy one barrel of oil 1970-2008



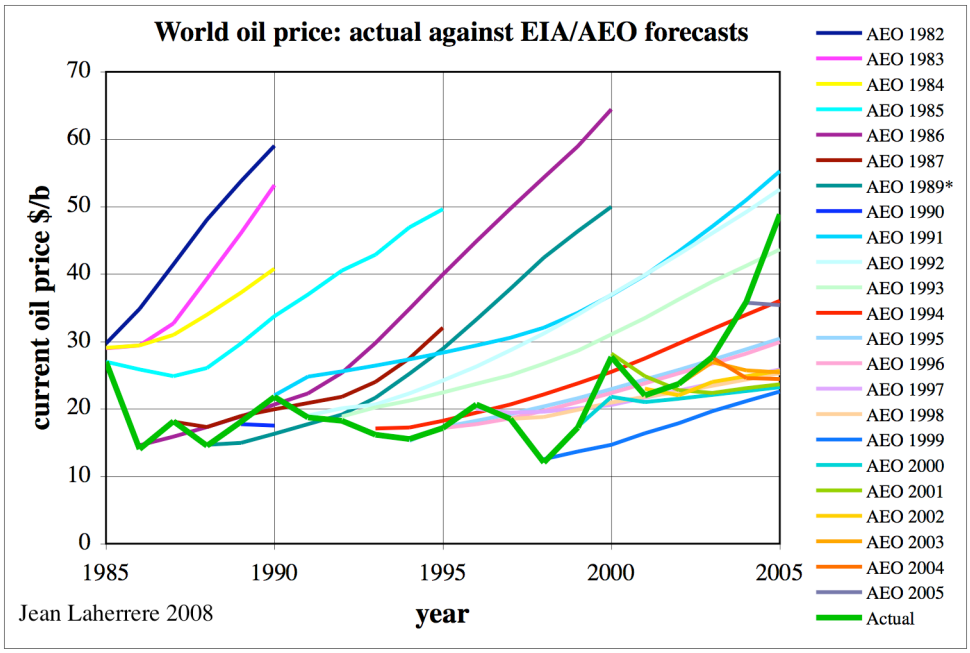
Oil price in $ are rising because the value of dollar is falling (145 $/b when euro = 1,6 $), and the recent fall in $/b is due to the rise of $ against euro (about 1,3 $ now).

The correlation for the period 1990-2008 between €/$ and Brent price seems to stand for about €= 1,3 $ corresponding to 75 $/b. The present value at 50 $/b seems low with the present 1.3$/€.

Figure 43: value of the dollar compared to euro and Brent oil price 1990-2008

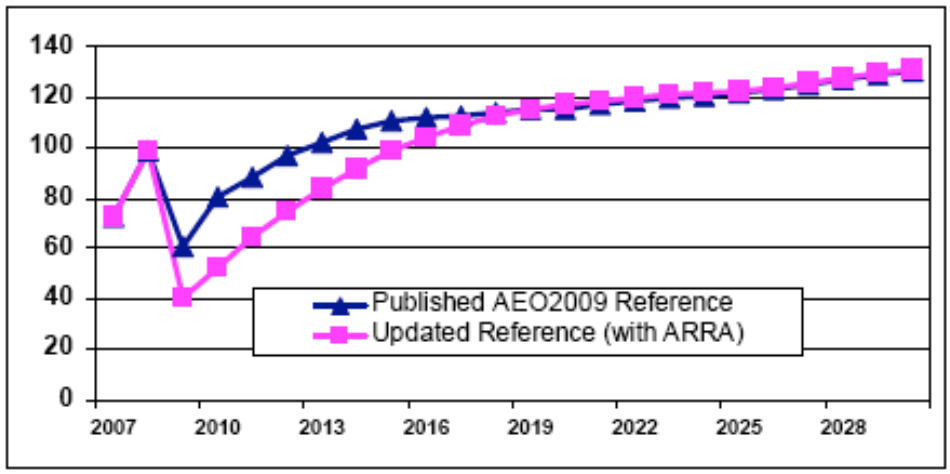


Forecasts of oil price were always wrong in particular for USDOE/EIA/AEO
Figure 44: always wrong oil price forecast by EIA from 1982 to 2005



Last EIA AEO April 2009 forecast for world oil price is quite pessimistic, believing that the crisis will last longer, but lowering the costs.
Figure 45: world oil price forecast 2007-2030 by EIA April 2009 AEO

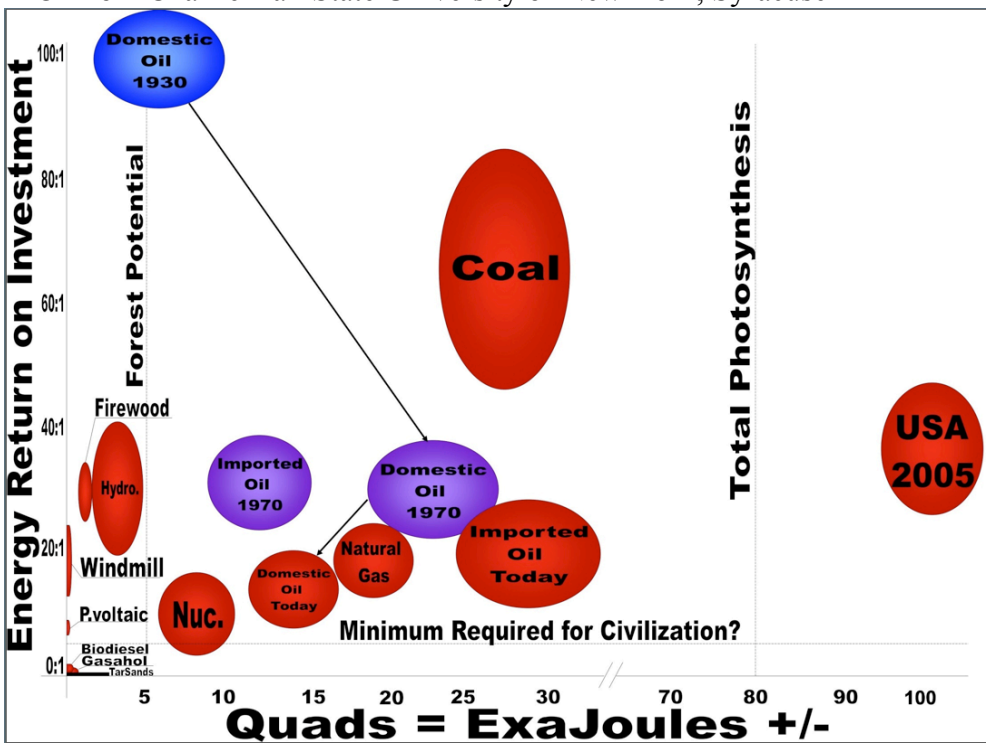
Figure 4. World Oil Prices
(2007 dollars per barrel)



Source: National Energy Modeling System runs AEO2009.D120908A and STIMULUS.D041409A.

I always refuse to forecast oil price, only to say that it will be chaotic because human behaviour is irrational.

-**limitation by EROI** or **EROEI** = Energy return On Energy Invested
Energy production is limited not by cost but by energetic balance: it should not spend more energy in the recovery that what can be produced: EROEI should be higher than 1
Figure 46: EROI from Charlie Hall State University of New York, Syracuse



-**Time is one of the most important constraints, often forgotten**
Time of development is always considered too optimistically, hoping that everything will be all right. But there is Murphy's law!
In Nature it is not possible to make one baby in one month with nine women!
Time is an important factor which is usually underestimated.

The Mc Namara law (from NASA experience) said for frontier projects that the ratio between initial proposals and reality is about pi for cost and e (Euler number = 2,7) for time.
There are many present examples of time lag: Kashagan 2013 instead of 2005, Total Athabasca projects 3 years delay, EPR nuclear plants in Finland and France

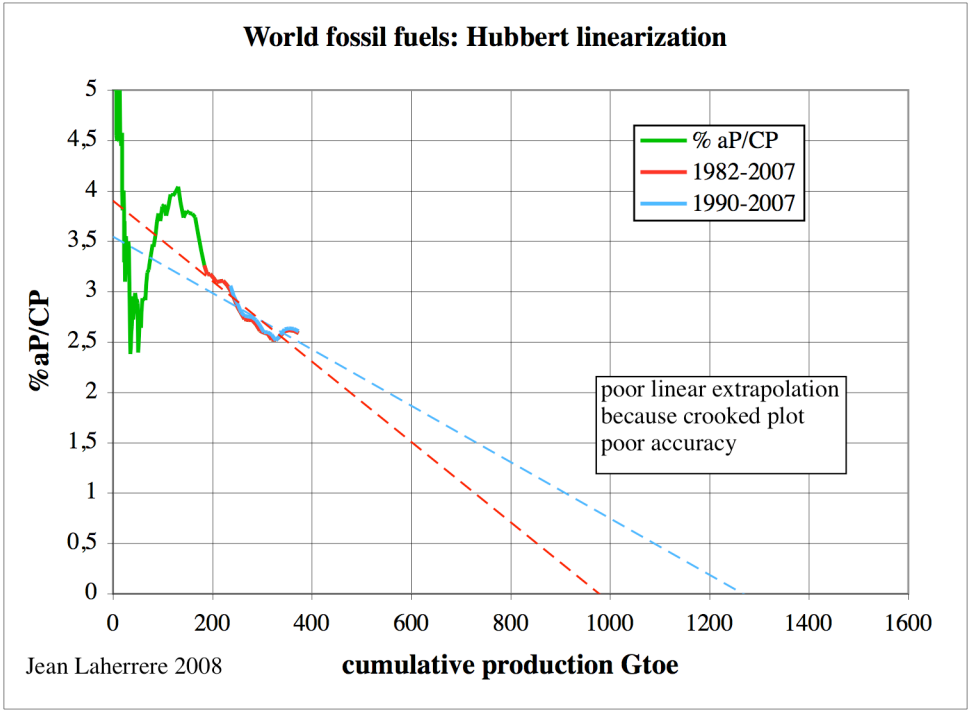
-Ageing of structures, staff and data

Matt Simmons insists rightly on the ageing of structures and staff, being as important in the short term as the limit of resources.
Oil & gas structures, mainly made of iron, rust (like bridges = Minneapolis)
Average age of oil & gas staff is around 45 years
Data deteriorates in magnetic memories if not updated, even optic disks, in addition to obsolescence of readers and software
Time factor is (most of the time) badly accounted.

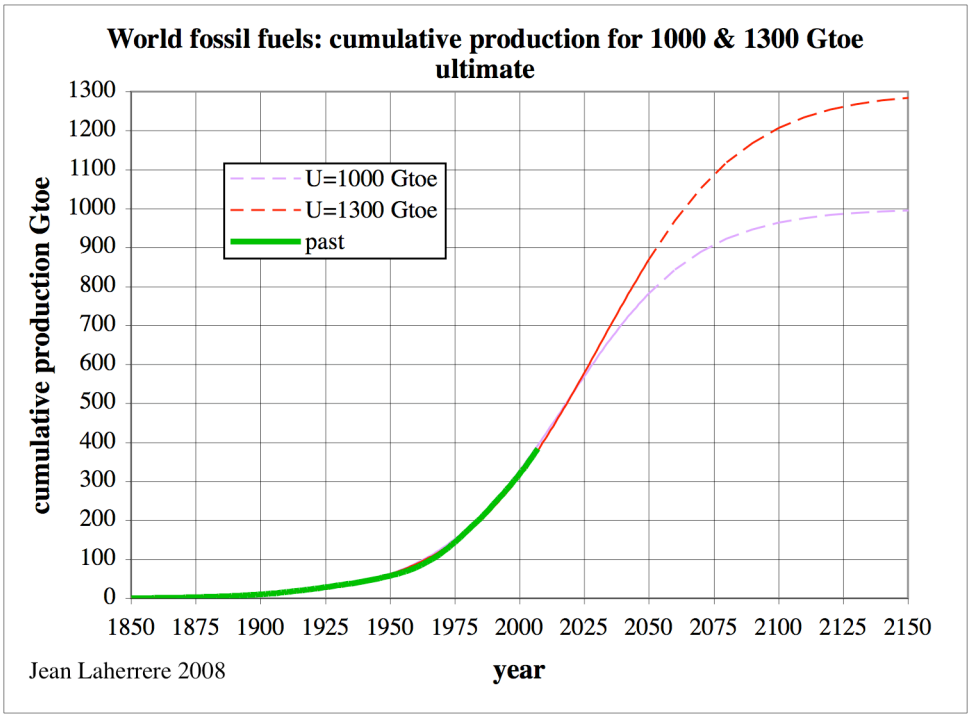
-7-fossil fuels and primary energy

-forecast on fossil fuels = FF

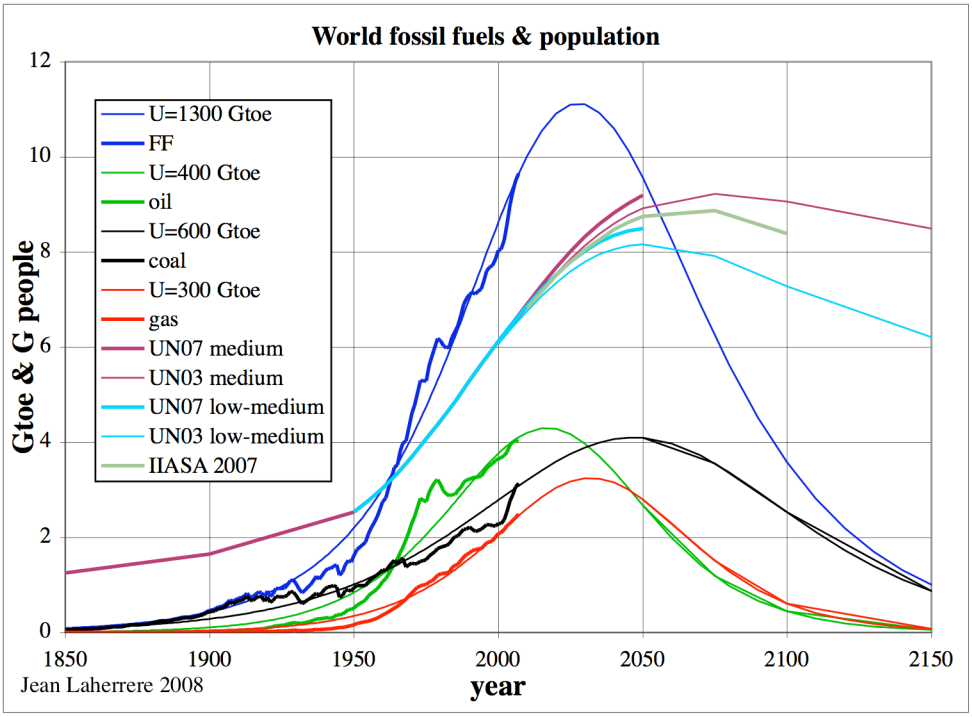
FF Hubbert linearization is crooked and any linear extrapolation completely unreliable between 1000 and 1300 Gtoe.
Figure 47: FF production Hubbert linearization



FF cumulative production can be easily modelled with U= 1000 or 1300 Gtoe (or else!).
Figure 48: FF cumulative production for U=1000 & 1300 Gtoe



From the already estimated ultimates: 600 Gtoe for coal, 400 Gtoe for liquids and 300 Gtoe for gas, the FF ultimate is taken as 1300 Gtoe assuming no other constraint than below ground.
World population with UN forecasts is also plotted (medium and low-medium scenarios) & IIASA showing a peak around 2050 at 9 G people.
Figure 49: world FF annual production with oil, gas, coal & population 1850-2150

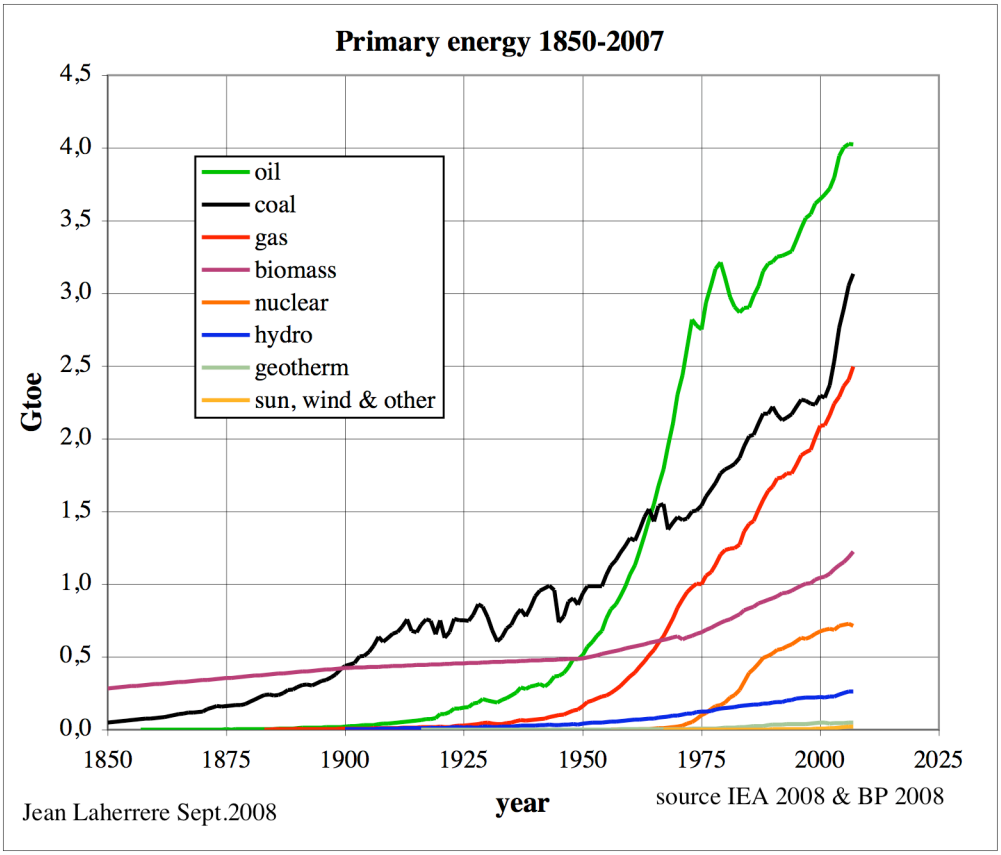


Assuming no other constraints than below ground: oil peak around 2015, gas peak around 2025, coal peak around 2050 like population.
But because above ground constraints likely plateau will prevail with chaotic energy prices.

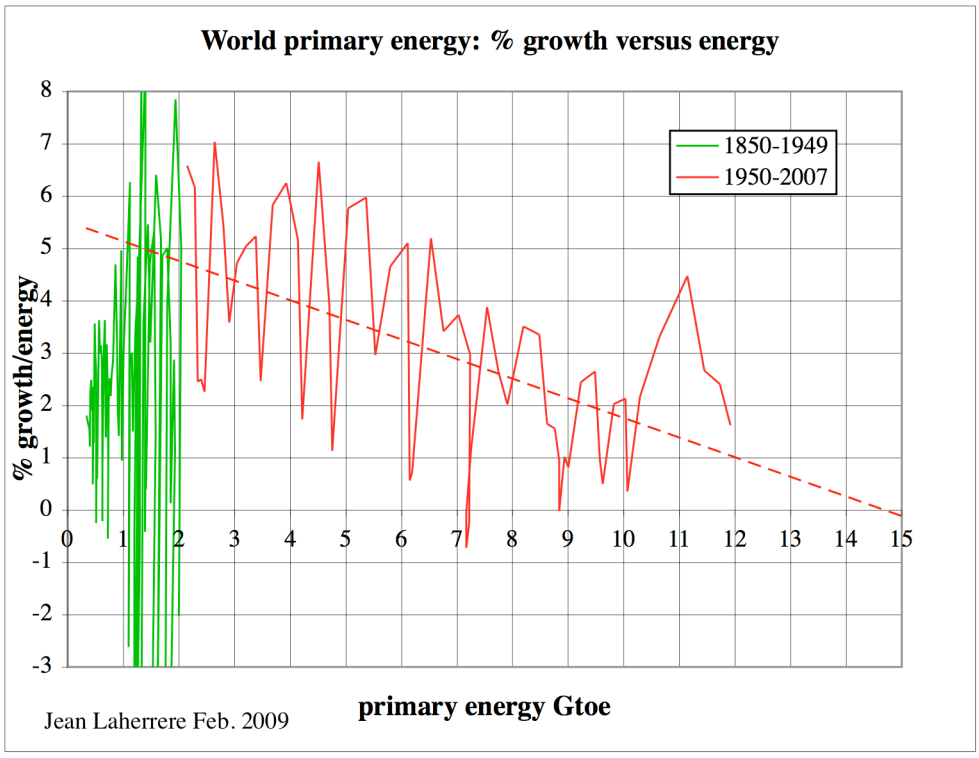
-primary energy = PE

Primary energy requires to convert every fuel into the same unit (usually the oil equivalent toe or boe) thru assumed equivalences. Oil is the largest with 4Gtoe, followed by coal 3,1 Gtoe, gas 2,5

Gtoe, biomass 1,2 Gtoe, nuclear 0,7 Gtoe, hydro 0,3 Gtoe, geothermal 0,05 Gtoe and last: sun, wind and others at 0,02 Gtoe
Figure 50: PE 1850-2007

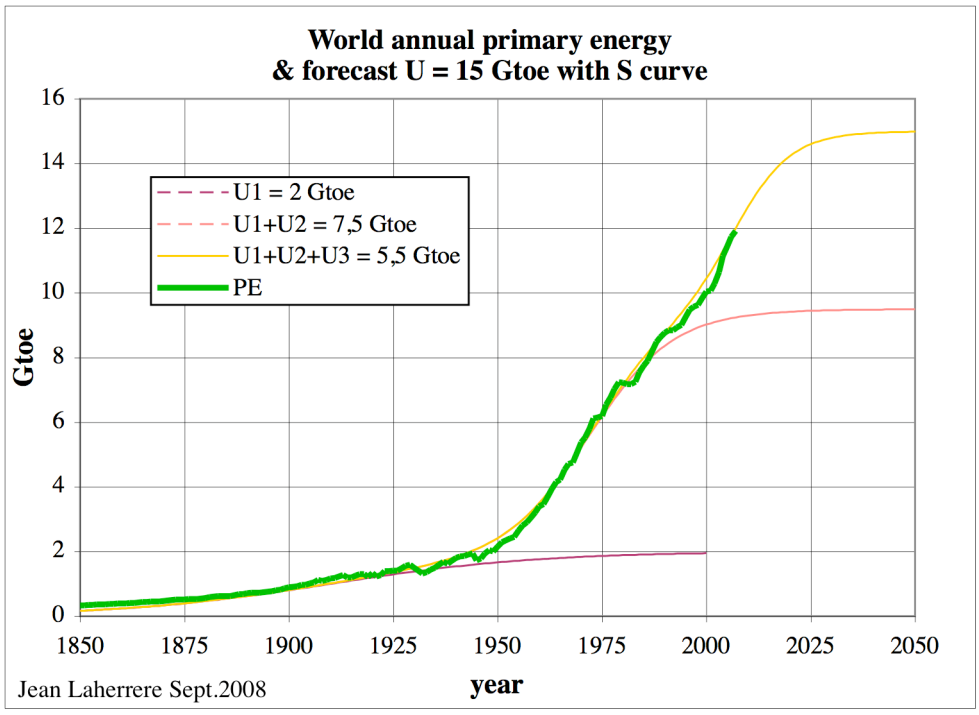


World primary energy includes fossil fuels and renewables, but primary energy cannot rise to the sky because earth is limited. Primary energy can either trends towards an asymptote or peaks and decline, like the world population.; The Hubbert linearization, despite its uncertainty, is worth trying. The plot is very irregular, but since 1950 (red curve) the linear trend going towards 15 Gtoe seems possible.
Figure 51: world PE Hubbert linearization trending towards 15 Gtoe



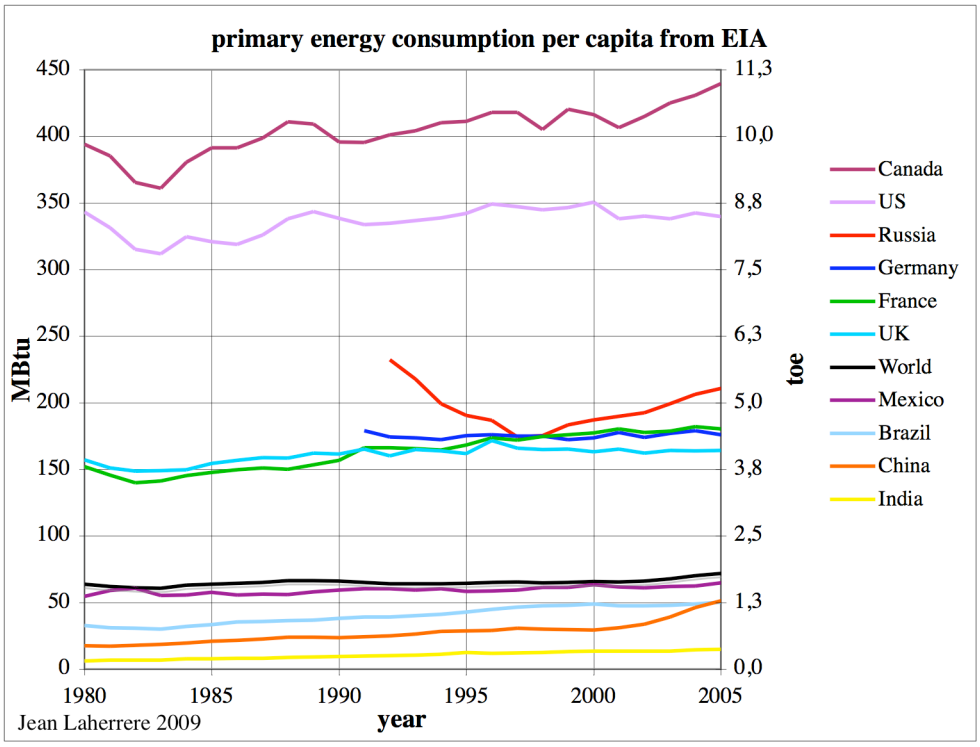
The model for an asymptote of 15 Gtoe with three logistic cycles fits past data well and is flattening quickly about 2025

Figure 52: world annual PE and model for an asymptote of 15 Gtoe

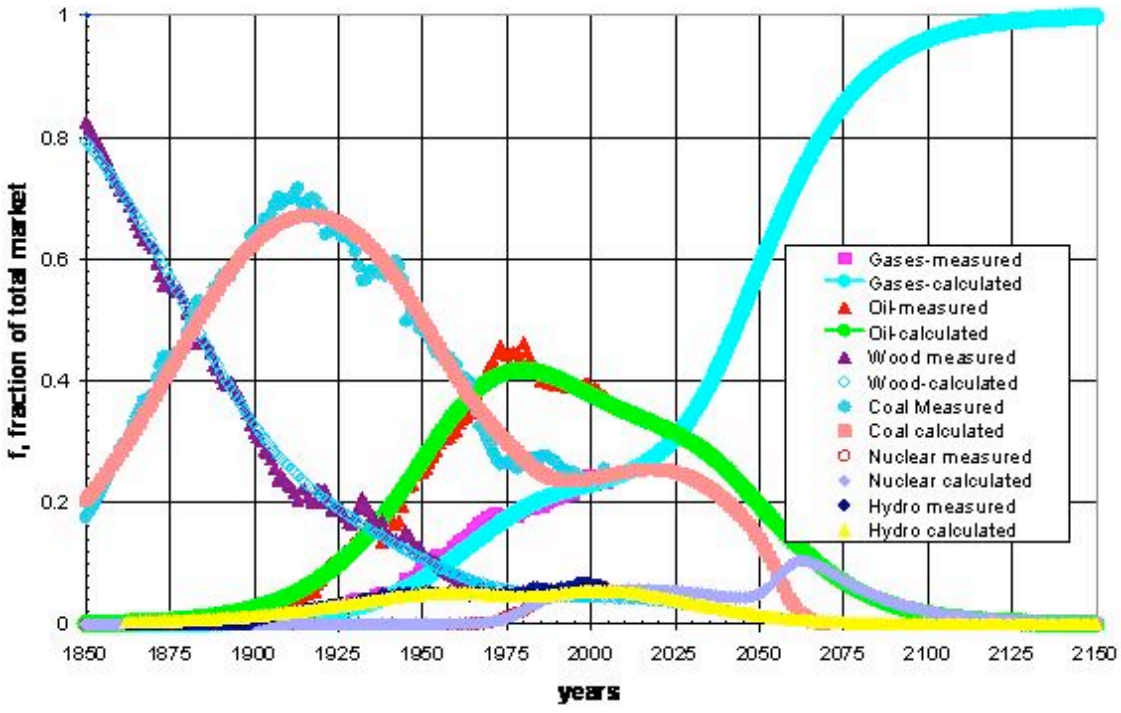


The primary energy consumption per capita in 2006 is 1,8 toe for the world, but ranging from 0,4 toe for India, 1,4 toe for Brazil and China, 4 toe for UK, 8,4 toe for US to 10,7 toe for Canada

Figure 53: PE consumption per capita from EIA

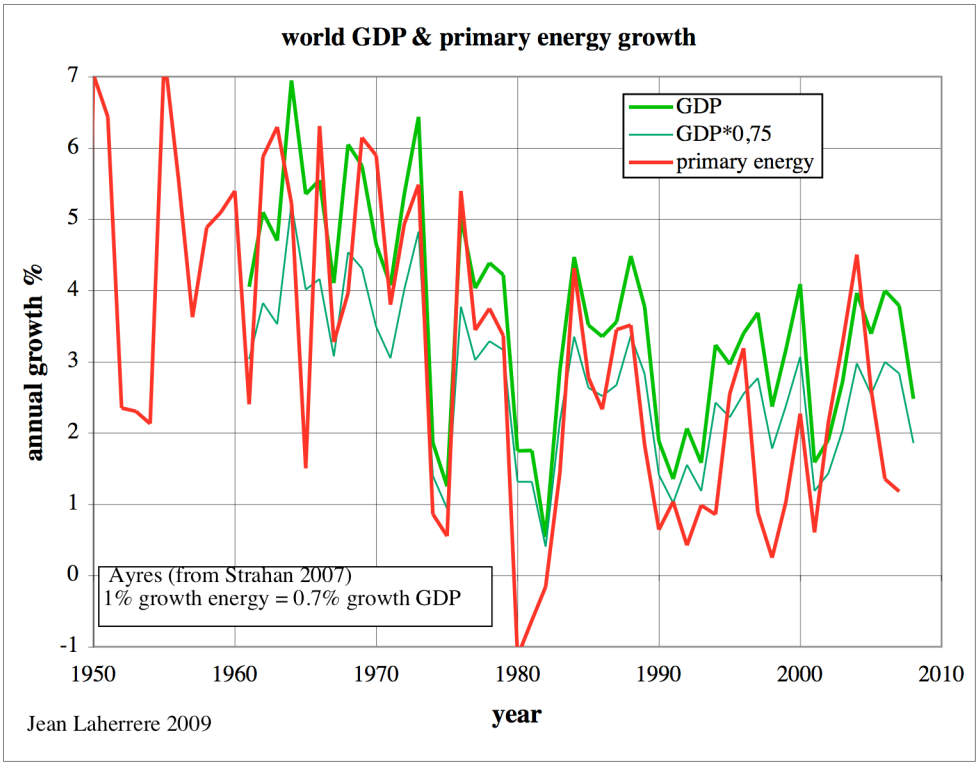


IIASA (International Institute for Applied Systems Analysis) has designed the 40 SRES energy scenarios for IPCC and has launched a GEA (Global energy analysis). They dream of a world where only gas (methane and hydrogen) energy will prevail in 2150: it is mere brainstorming, where coal disappears in 2060, oil & nuclear in 2100!
"The Past, Present, and Future of the Global Energy Market" March 5th, 2009 by Roberto F. Aguilera, International Institute for Applied Systems Analysis www.energypolicyblog.com/?p=54
Figure 54: world percentage of energy per fuel and forecast by IIASA 1850-2150

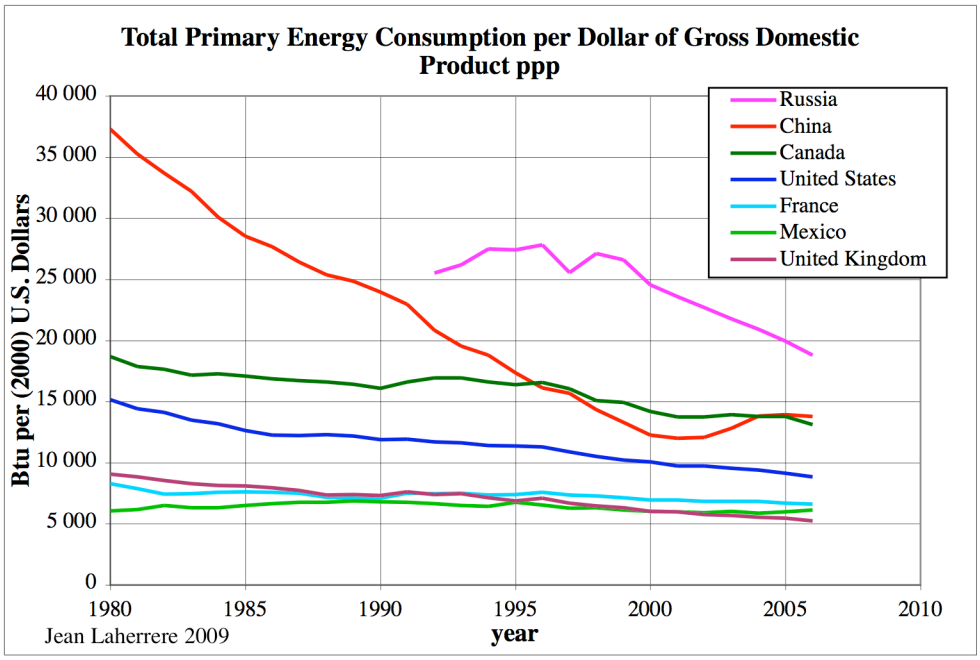


-primary energy growth and GDP growth

One of the most important and unknown fact is that primary energy cost for the last 50 years was about 5 % of the GDP when experts (R.Kummel, R.U.Ayres) estimate that the contribution of energy in GDP is about 50%, compared to 30% to capital and 20% to labour.
Energy is underestimated by a factor of 10!
The world energy growth is plotted compared to GDP growth and the correlation is fair, it seems better with GDP multiplied by 0,75, meaning that energy contribution to GDP could be as high as 75%. It is obvious that without energy all the industrial world is stopped and GDP too
Figure 55: PE growth compared to GDP growth



GDP is a poor indicator because it represents expenditures (GDP increases with war, catastrophes, drugs, AIDS) and not wealth and it has no correlation with well-being or happiness. Furthermore it is manipulated with hedonic factor. In France a commission with J.Stiglitz as leader is requested to propose a better indicator than GDP but the report seems to be delayed (due in April).
The energy intensity or PE per GDP is also a poor indicator but often used. It is flat in France and strongly declining in China or Russia.
Figure 56: PE consumption per capita

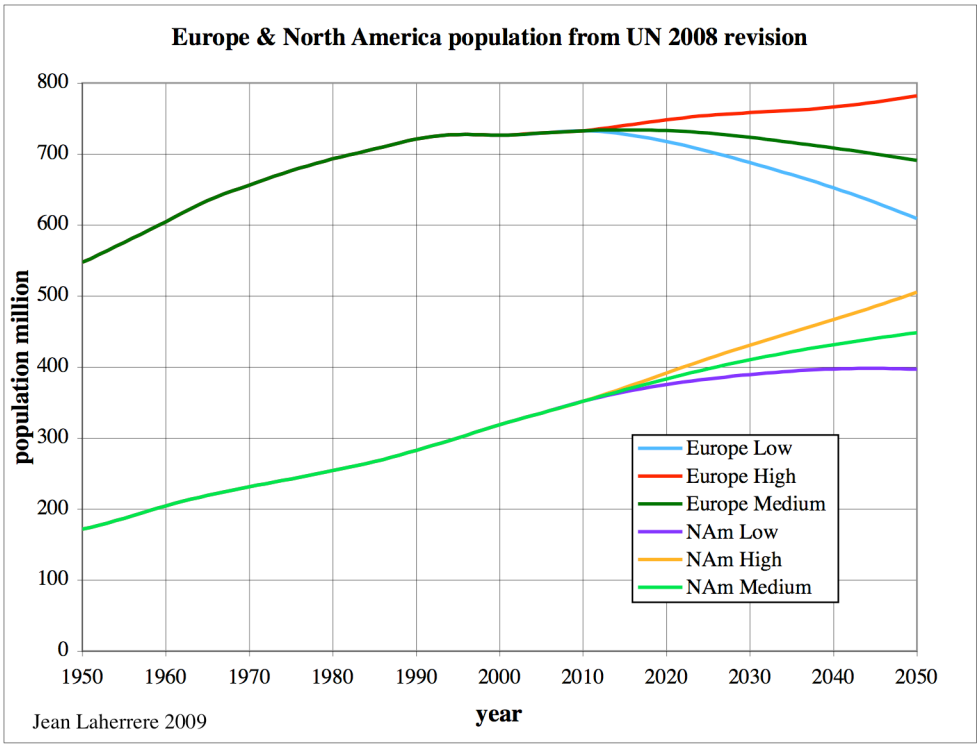


-population

One important item for GDP or energy consumption is population. Population forecasts are based on fertility rate forecasts which are mainly politically motivated. The UN forecasts wish that the fertility rate in 2300 will be the same for every country: it is utopia.

Europe's future will be different from North America's future because Europe is peaking now around 720 M and will lose 30 M by 2050 when North America will gain more than 50 M.

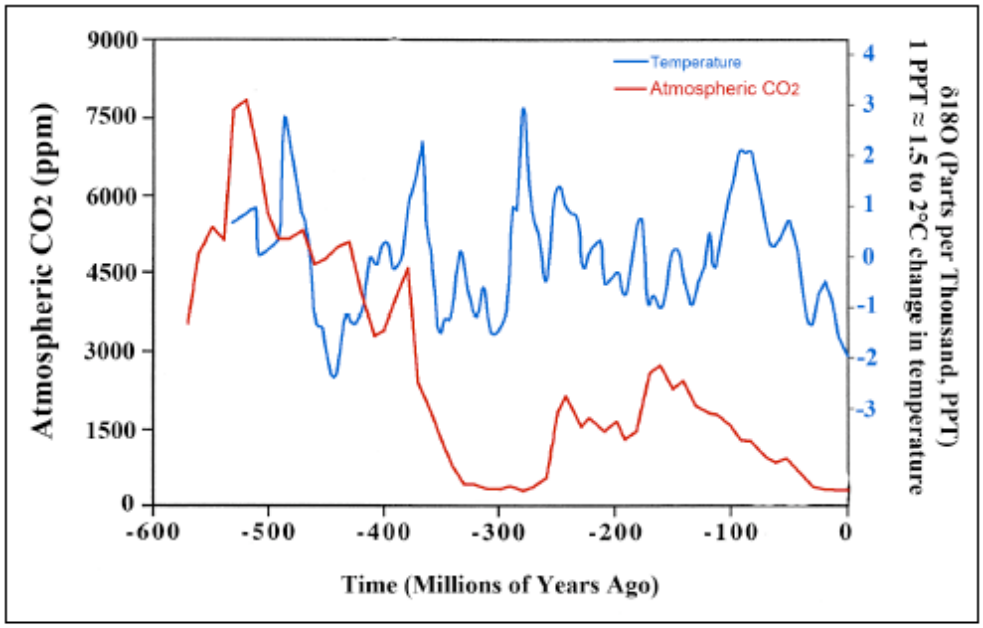
Figure 57: UN 2008 forecasts for Europe & North America population



-8- energy and climate change

Climate change is the new worry of governments (to distract their citizens from worrying about the economic crisis) and CO2 is assumed to be the main culprit for the increase in temperature. Change in CO2 and temperature have been estimated for the last 600 million years without any correlation.

Figure 58: CO2 & temperature for the last 600 million years



Source: CO_2 data from Berner and Kothavala (2001); temperature data from Veizer *et al.* (1999), updated in 2004 and available at http://www.science.uottawa.ca/~veizer/isotope_data/.

The main conclusions from the measures of CO2 and temperatures from Antarctica ice cores (mainly Vostok and Dome C) on the last 700 000 years is that the driver is the temperature and that CO2 follow with a gap of around 1000 years. Milankovitch has shown that the Earth astronomical moves around the Sun (eccentricity, obliquity and precession) cause the main cycles of 100 000, 40 000 years and 26 000 years. The last glaciations started 2 Ma ago because the continental drift closed the Panama opening and lifted the Andes and Rockies, preventing the circulation of tropical waters and atmosphere between the Atlantic and the Pacific (previous glaciation was about 300 Ma ago). The Little Ice age was quickly correlated to the Sun activity of black spots (Maunder minimum).

Temperature starts to rise after the Little Ice Age in the same time as the industrial age around 1850 just at the start of true measures of worldwide temperatures. Global warming was connected to CO2 rise but temperature fell from 1945 to 1975 (the Glorious Thirties) where CO2 growth (energy growth was at the most. This cooling was attributed to the aerosols (sulphur) which cools. But aerosols can warm, like black carbon. Many models were run to simulate the climate using big computers (climate equations are too complex and Monte Carlo runs are needed) to deal with many cells but the cell is about 200 km wide. Despite that water (vapour, liquid and solid) is the main greenhouse gas (60 to 90% depending the author), water is disregarded in climate modelling on the excuse of being too volatile, but for the main reason that it is impossible to deal with water with only one point every 150 km at the most and furthermore that shallow clouds cool and high clouds warm. Mainly CO2 (as CH4) is considered because being easy to measure and to model.

I am not competent to deal with climate models, but all my active life as geologist and geophysicist I was dealing with climate changes (change of a sediment from sand to clay, or shale to carbonate or change in velocity). Oil industry deals with big modelling: Ghawar production model uses 100 million cells, and prestack depth migration needs heavy computing. But I know that despite the quality of the model, the quality of the result = output depends upon the quality of the hypothesis and data = input.

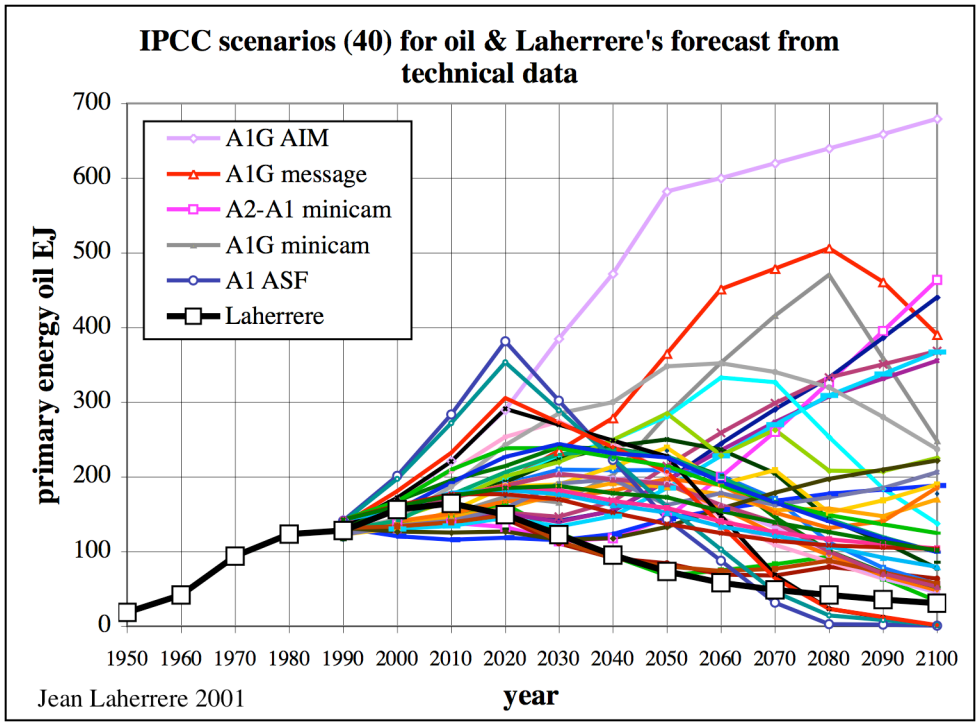
Everyone knows GIGO Garbage In, Garbage Out

Looking at the numerous models it is difficult to find two similar results and their local differences are larger than the predicted changes.

The second, third and fourth IPCC reports are based on the SRES 40 scenarios designed in 1998 by Dr Nakicenovic from IIASA. I presented a paper at IIASA workshop in 2001 *Laherrère J.H. 2001 "Estimates of Oil Reserves" IIASA International Energy Workshop June 19-21 2001 Laxenburg; http://www.iiasa.ac.at/Research/ECS/IEW2001/pdffiles/Papers/Laherrere-long.pdf* where I showed

that the scenarios for oil and gas were unrealistic when compared to the forecasts from technical conventional oil data (ignored by IIASA)

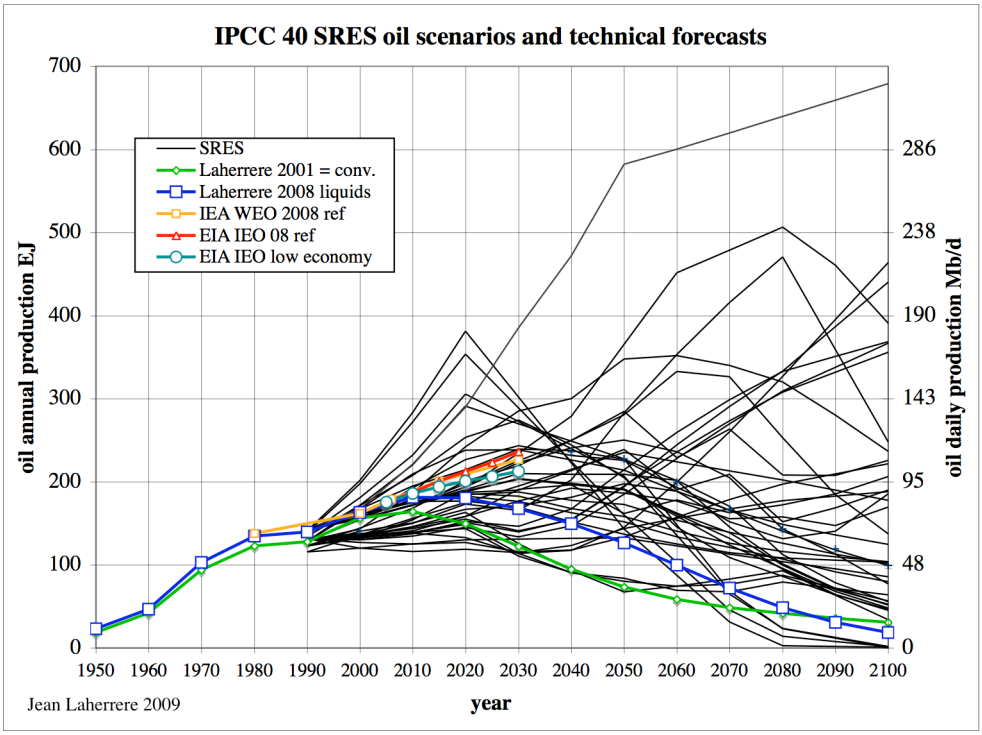
Figure 59: IPCC 40 scenarios for oil and Laherrere forecast: IIASA presentation 2001



The scenarios were designed in 1998 and even the values for 1990 (they do not care to look at the past before) present a range. In the 2007 4AR report the values used for 2000 present a range of more than 80%). My warning of 2001 was ignored for the reason that it was not presented on a peer review paper (but it is on the IIASA site!). And in 2008 I have reviewed as peer 8 papers.

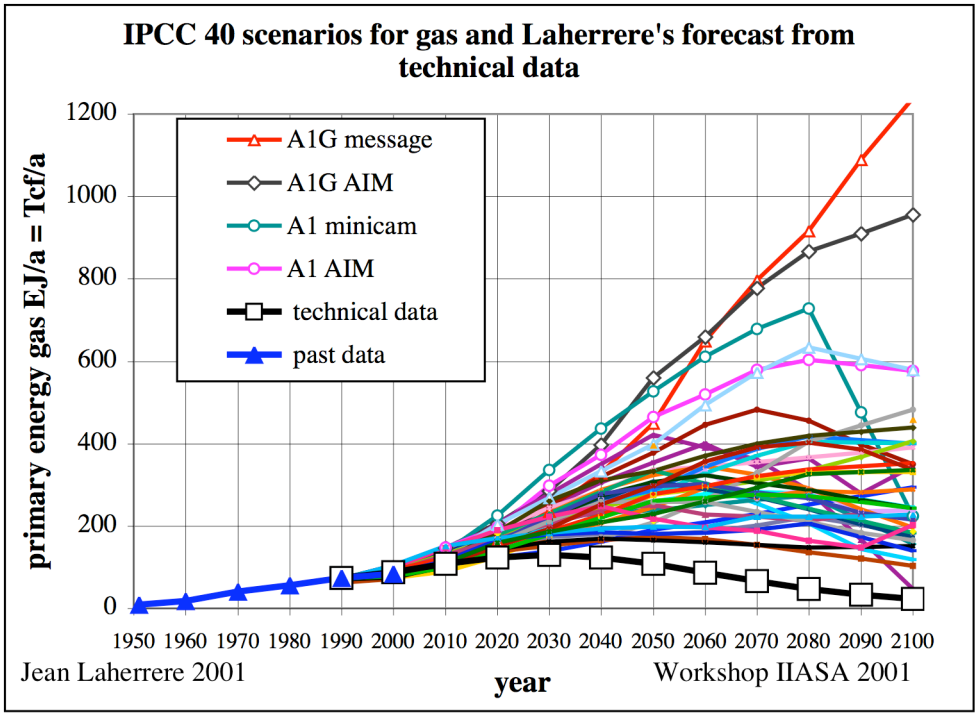
In the next graph, the SRES are compared to present liquids data and forecasts from IEA and USDOE/EIA. It appears that almost all scenarios are out of range (above 100 Mb/d) on a part of the century.

Figure 60: IPCC 40 oil scenarios and 2008 forecasts



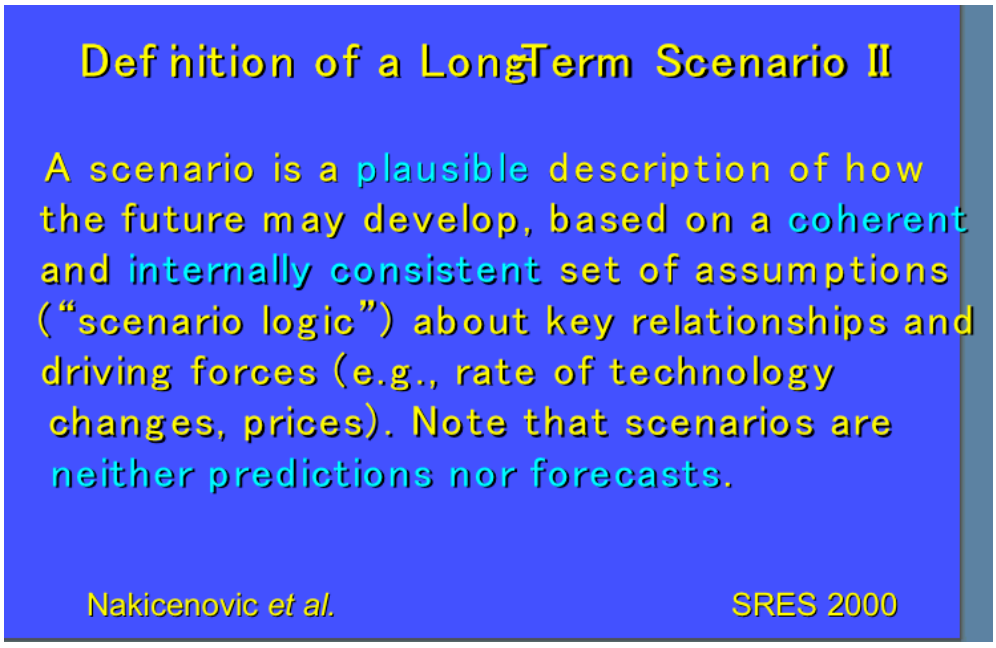
SRES gas scenarios were more unrealistic (factor >12 between now and the largest in 2100, when only 5 for oil) than oil because dreaming of an gas age based on oceanic hydrates (their resource estimate has been reduced by a factor of 100 and oceanic hydrates are too dispersed (vertical continuity = few cm, horizontal continuity = few m) to be ever produced and no one knows a way to produce them).

Figure 61: IPCC 40 gas scenarios and Laherrere forecast: presentation IIASA 2001



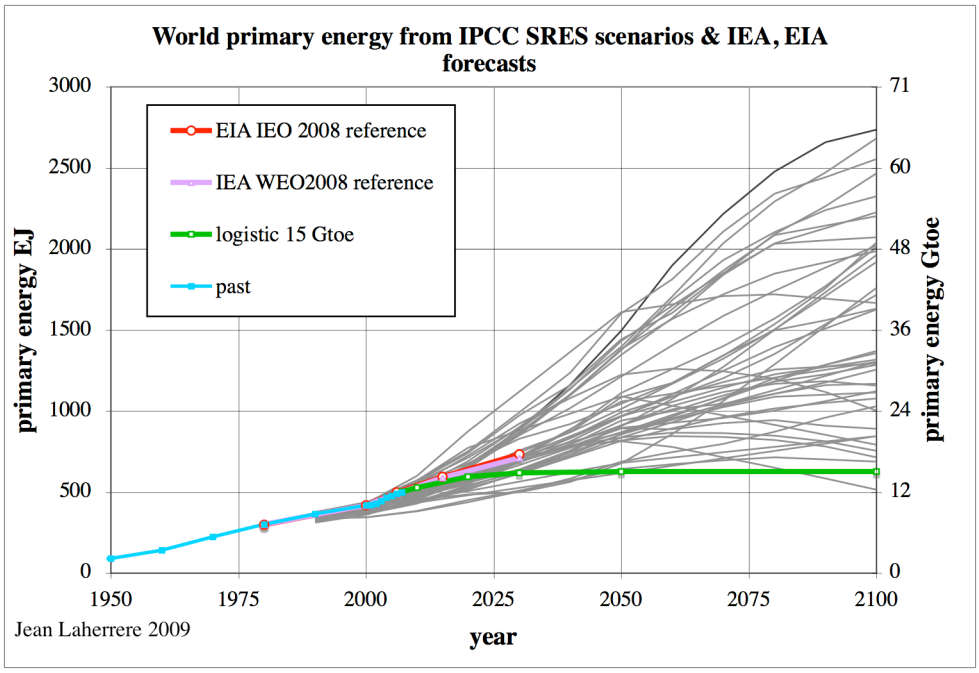
Dr Nakicenovic recognized in 2000 that the SRES scenarios were neither predictions nor forecasts (just brainstorming). However the results of the modelling are presented by most as forecast with probability, when it is obviously wrong

Figure 62: IIASA Dr Nakicenovic scenarios



The SRES primary energy scenarios presents a range in 2100 of more than 5, and they need to be calibrated at the present values and with official forecasts

Figure 63: IPCC 40 energy scenarios and 2008 IEA & EIA forecasts, with U=15 Gtoe



But Dr Nakicenovic is clever enough to have convinced the IPCC to forget in the 2013 report the energy (as population = range in 2100 from 7 to 15 G far from UN forecasts) scenarios and to adopt only 4 radiative forcings, to avoid critics from energy or population experts.

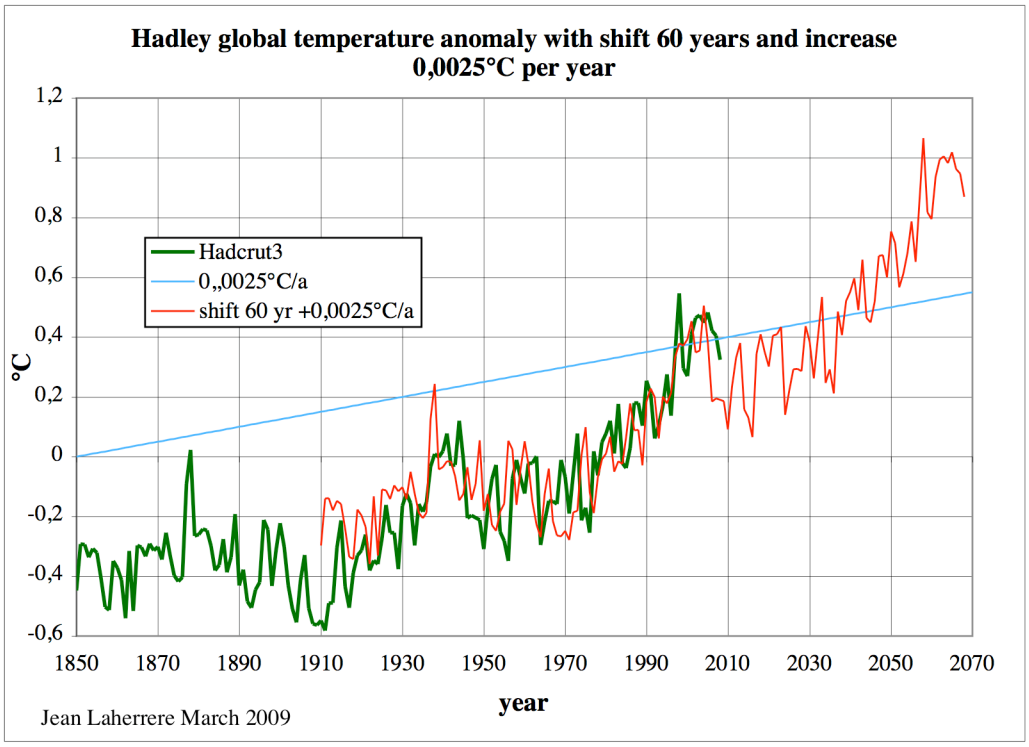
Reducing CO2 is now a big business and many are making money (Gore) and want to do more. It should be better to have as a goal to save energy because a good part of energy is wasted, in the same time CO2 will be reduced. Sequestration of CO2 will require at least 20 years to work properly in the needed volume and an additional 25% of energy. Global warming is considered by many as dreadful, but the Medieval Warm Period was warmer than now with vineyards in London, Vikings breeding cows in Greenland and cathedrals were built everywhere. Many when retired move to warmer places: English to France French to Morocco. Cooling is worse: the Little Ice Age was the War of 100 years, pest, the French Revolution is due to bad wheat crops. In the Netherlands flowers are grown in greenhouses where CO2 is increased twice or more.

Astronomers claims that they have made many discoveries but in fact 95 % of the universe is unknown (70% dark energy and 20% dark matter). It is the same with climate.

Modelling with complex and incomplete equations is a difficult way. There are simpler ways like assuming that temperature follows cycles and that the best forecast is to look at the past. For the last 150 years, measured by the Hadley Centre, for the world 60 years cycle can be guessed. There is a good fit when shifting the past temperature by 60 years and adding an increase of 0,25°C per century, corresponding to a long term cycle (1500 years? as in « Unstoppable global warming every 1500 years » “Singer S.F. & D.T.Avery 2007 Rowman & Littlefield pub).

This fit is as good as many models which are black box with unknown inputs and where Monte Carlo runs do the job. Several Russian astronomers believe in this 60 year cycle.

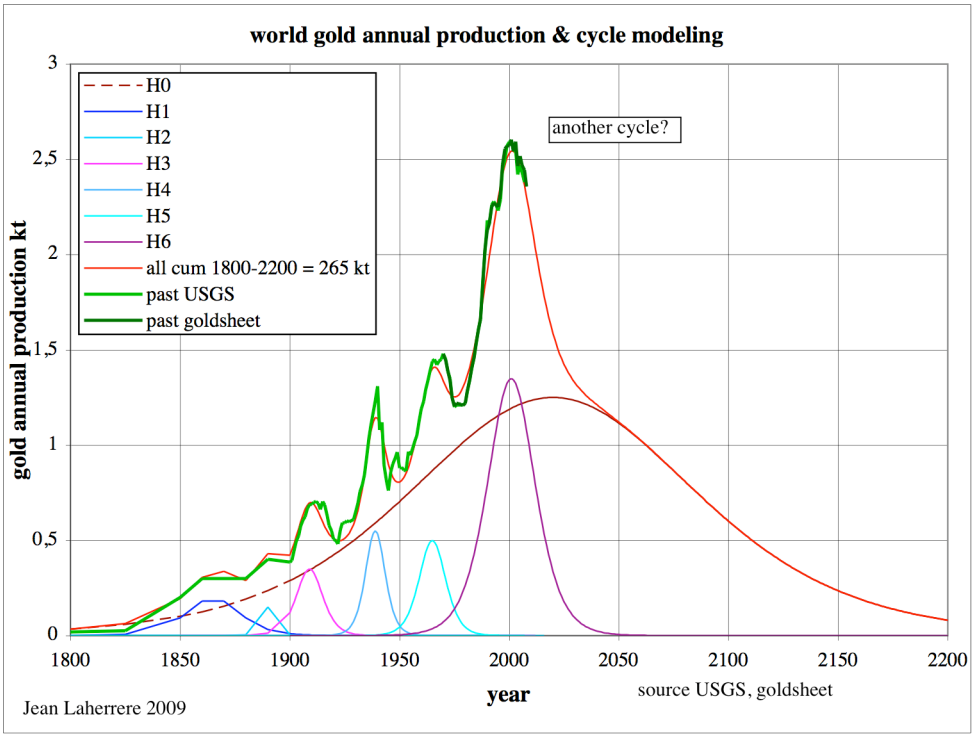
Figure 64: Hadley global temperature with shift of 60 years and increase of 0,25°C per century



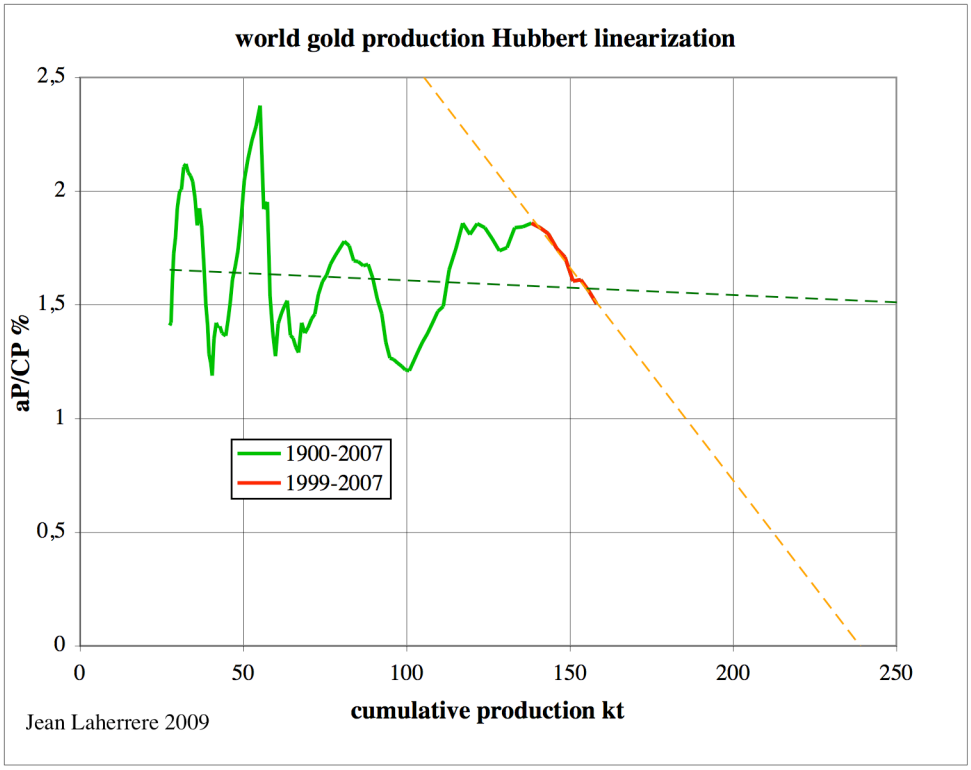
Such good correlation shows that the past ten years temperature is flat (1998 is the peak) as it was during the 40s and cooling could be expected until 2030, but warming will return in 2040.
When arguing with people where belief prevails often more than reason and where the glass could be seen as half empty or half full, the best way to finish a discussion is to bet. I have offered to several AGW (anthropic global warming) believers to bet that in 10 years (my life expectancy) the temperature will not be higher than the average of the past ten years. Most of them have refused.

-9-Gold Peak

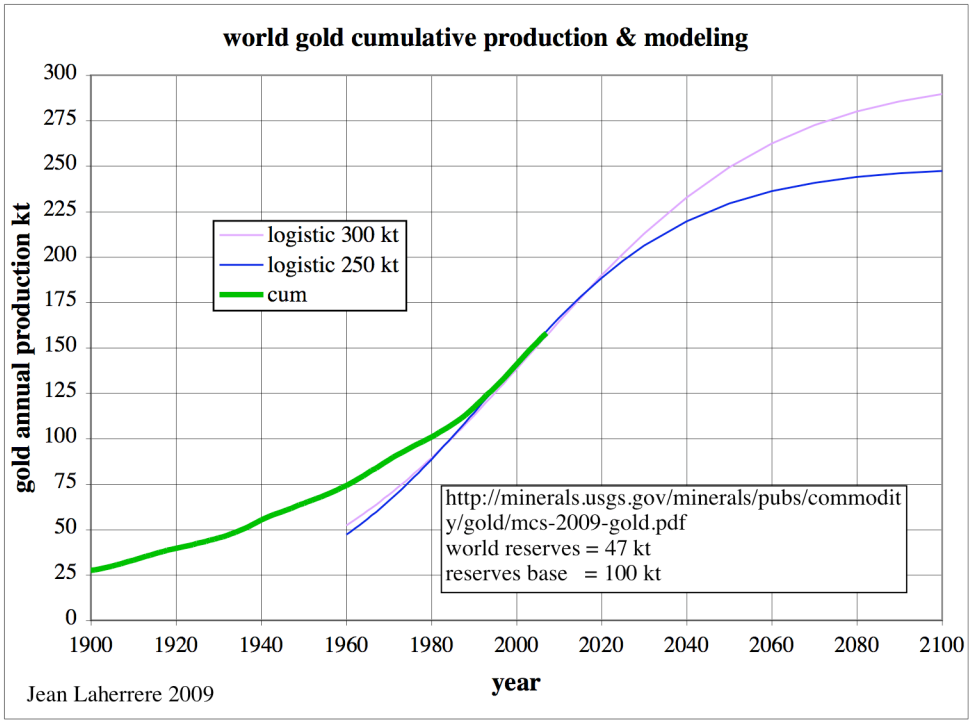
Gold production seems to have reached the maximum peak with many minor peaks
Figure 65: world gold annual production with cycle modelling



It is hard geologically to estimate the ultimate (the largest mine is gold in the sea, but uneconomical) and Hubbert linearization does not work well.
Figure 66: world gold Hubbert linearization

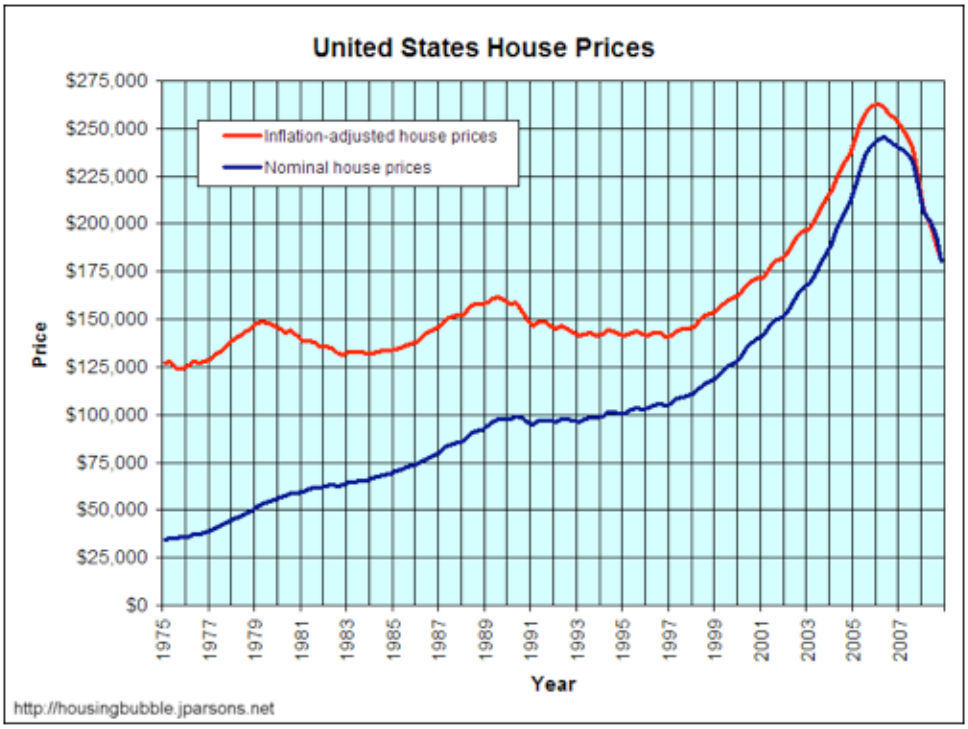


Gold ultimate estimate could be 240 kt using the trend 1999-2007 or the triple using the data 1900-2007, but it is not very reliable and we prefer a rounded 250 kt or 300 kt.
USGS 2009 ultimate varies from 207 kt (47 kt reserves) to 260 kt (100 kt reserves base).
Figure 67: world gold cumulative production and modelling 1900-2100



-10-Irrational (stupid) human behaviour leading to major failures
-Chernobyl = lack of surrounding container and operations against security rules

-Y2K bug = only 2 digits for naming a year
-Airbus 380 = electric wiring with two different software in Toulouse and Hamburg
-Collapse of Minneapolis bridge = lack of maintenance (30% of the 570 000 US bridges unsafe!)
-Katrina flooding New Orleans = weak levees built and maintained only for category 3 storms.
-US subprimes = assumption of continuous growth in housing price when it was almost flat from 1979 to 1999 (150 000 2007$) in constant dollar.
Figure 68: US house price from J Parsons



-Subprimes conversion into no risk shares (securization) = assumption that aggregation by large number reduces risks, in contrary of globalisation
-Dubai artificial islands and towers based on limitless energy
Dubai, with less than 70 km of beaches before, has now more than 1000 km of artificial beaches
Figure 69: Dubai artificial islands

Who wants to live permanently in a house without yard so close to the next one and no open sea to see? It is for millionaire hiding tax money to stay few days a year to show off! Completely artificial!

Einstein speaking about infinite: *there are two examples: Universe and human stupidity, but I am not sure of the first one.*
Newton after losing 20 000 pounds in 1972 at South Sea Company burst in the stock market: *I can foresee the move of stars but not the madness of people*
Figure 70: South Sea Co bubble in 1720 = short peak!

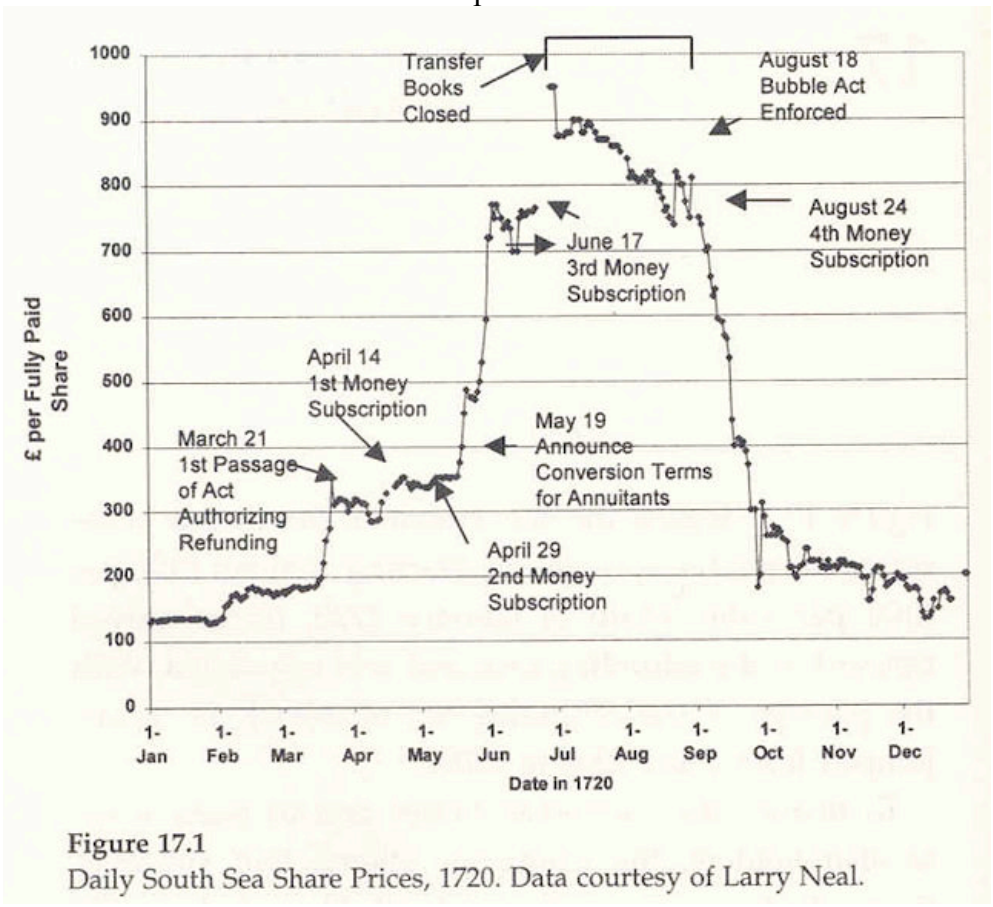


Figure 17.1
Daily South Sea Share Prices, 1720. Data courtesy of Larry Neal.

-11-Breakthrough to hope for future energy
-fast breeder
-fusion : either ITER or Mega joules
-in-situ coal gasification
-cellulose ethanol with exotic enzymes
-oil or hydrogen from algae
-cheap, light, high power battery
-in-situ oil shale paralysis
Most of these needed breakthroughs will not succeed, but, if one does, it may greatly change the energy scene.

-Conclusions
Since 2001 I have claimed that there will an oil bumpy plateau with chaotic prices.
Fossil fuels will likely plateau: now for oil; in a decade for gas, but local shortage soon; in few decades for coal.
World fossil fuels consumption per capita will stay flat for the next 20 years, like it was for the last 30 years, and then decline sharply.
It is unlikely that other energies could fill the gap to satisfy a growing demand
The only solution is to save energy by changing our behaviour, in particular our way of life in a consumption society.
The coming depression and high oil price could offer the cure for change in our way of life!

Americans use twice more energy per capita than Europeans, with similar income.
Falling oil price will damage oil savings.
High oil price will damage globalisation.
Oil industry is rusty with aging workforce.
GDP is a poor indicator of growth and is not connected with happiness or well-being, it should be changed into a well-being indicators. Other poor indicators are R/P, manipulated inflation.
Everybody wants to dream and to believe in Santa Claus, but life is real and does not always make dreams come true. The subprime bubble was based on a dream of ever growing housing price!
Official forecasts as *Business as usual* are based on a pious hope of permanent economical growth and they are doomed do fail because a constant growth is impossible in a limited world
Paul Valery wrote in 1931: *Le temps du monde fini commence*

The time of a limited world begins

But the more I now, the more I know that I do not know, and the others neither

The new generation has to design a new way of life and a new way of thinking.
Life is change and evolution.

PS thanks to Herve Duval for his correction of my broken English