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Great Debates in the Geosciences

In 30 years petroleum will have become a little-used energy source

with Kenneth Deffeyes, Jean Laherrere, Michael Lynch, Yves Mathieu,
directed by Richard Black, produced by Nicholas Arndt

When will oil production decline significantly?

Jean Laherrere ASPO, ASPO France jean.laherrere@wanadoo.fr

Problem of wording and reporting

Petroleum = *an oily flammable bituminous liquid* (Webster's)

Oil = *any of numerous unctuous combustible substances that are liquid* (Webster's)

Oil = either **crude oil** (71 Mb/d) or **all liquids** (84 Mb/d = oil demand)

Barrel = no legal definition, official reports need to add 42 US gallons (Texas liquid barrel = 31.5 gallons)

Peak of production of oil = either **Peak oil** (concept?) or **oil peak** (fact?)

Google = peak oil = 20 more quotes than oil peak = why such difference? ASPO?

Peak = either **highest point** or **a high** (lower following year); all liquids = 18 highs since 1857

Reserves = expected cumulative production at the end

Resources = what is in the ground; confused often with reserves

No consensus on definition, because ambiguity is favoured. Terms are usually not defined.

Publishing data is a political act and depends upon the image his author wants to give.

OPEC productions are ruled by **quotas**, but because OPEC members were cheating, OPEC oil productions are flawed and unreliable. Real data on oil transported by tankers have to be bought from spy companies.

There is **no consensus on how to assess reserves** and there is no world organisation to impose one.

UN Framework Classifications (1997, 2004) were completely ignored.

There are several reserve definitions in use:

-US = all companies listed on the US Stock Market = 1P \approx minimum

-FSU classification = maximum theoretical recovery \approx proven + probable + possible = 3P \approx maximum

-Rest of the world SPE/WPC = proven + probable = 2P \approx **expected** value (mean; mode; median?)

Reluctant to change or to risk

-world oil industry is dominated by US practices

-US industry reluctant to adopt metric system (crash of Mars Climate Orbiter in 1999)

-US banks reluctant to accept uncertainty and probabilistic approach

-US rules oblige companies to omit probable reserves and to report only proved reserves, defined with *reasonable certainty* (without defining reasonable!), assumed by many to be conservative: they were in the past, but not anymore

Change in shareholders

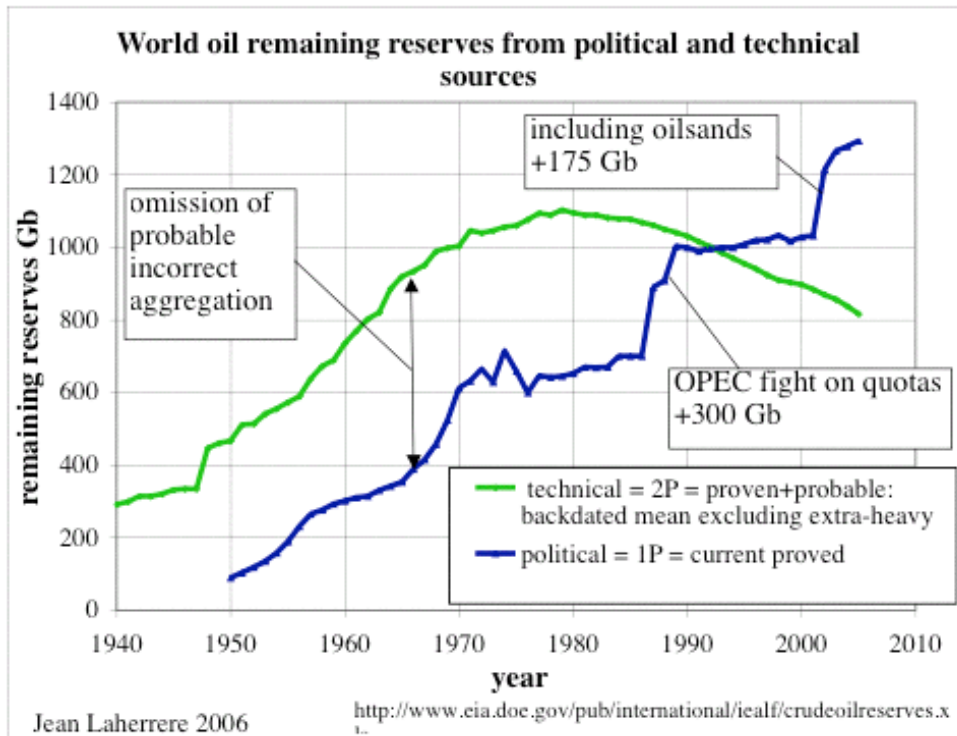
Good oil practices were 50 years ago to get maximum recovery, but now to get maximum profit to please shareholders (pension funds)

Technical reserves are confidential

-Oilfield reserves are confidential in every country except in UK (DTI), Norway (NPD) and US federal (MMS)

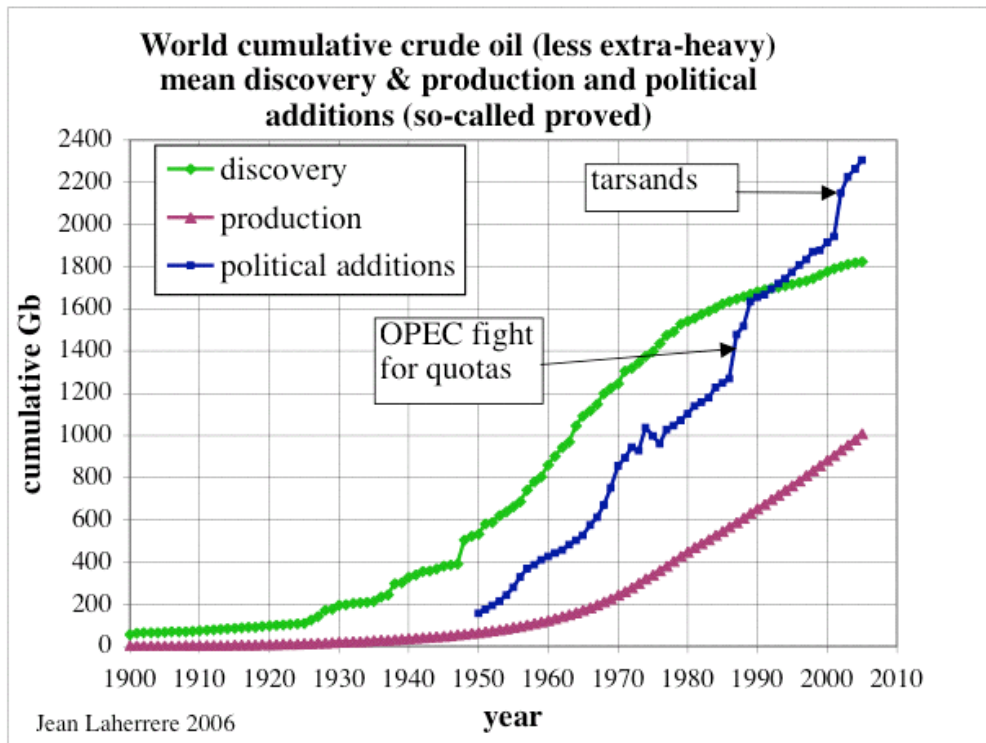
- Technical reserves database must be bought from different scout (spy) companies.
- These technical sources display very large differences, far larger than the undiscovered oil estimate
- Published oil reserves are financial (Securities and Exchange Commission) or political (OPEC)

Oil remaining reserves (known discoveries minus cumulative production) can be compared from political sources giving current proved values and from technical sources after correction of US Lower 48 and FSU to obtain the **backdated mean (expected)** crude oil (less extra-heavy) value.

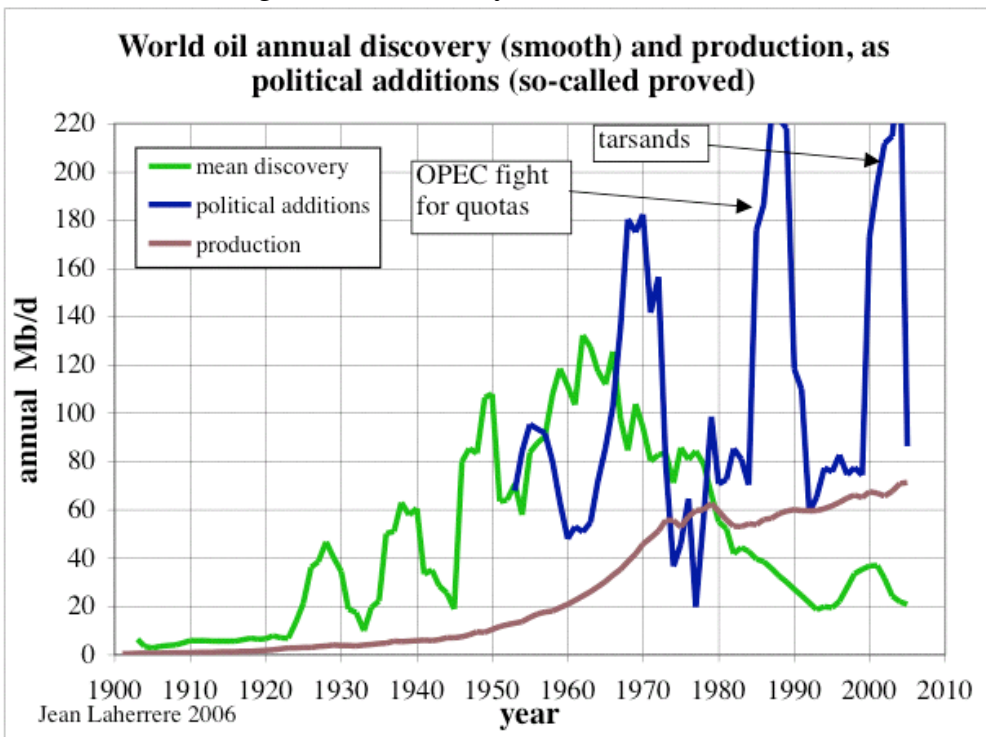


Economists have only access to political data reported to cheer bankers but useless for forecasting.

Adding the cumulative production to the previous graph, the comparison between the cumulative discovery from technical sources and political sources is striking:

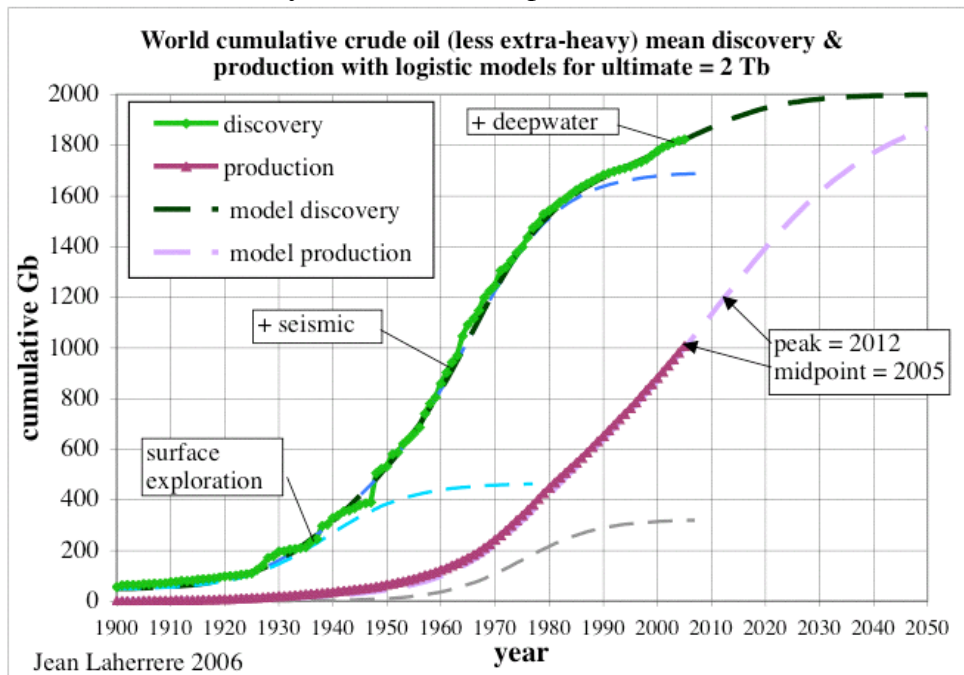


The same data annually shows very well the artefacts of political reporting, compared to the truth, which is that finding new reserves is a nightmare for oil companies (Scaroni 2006) and that since 1980 the world production is much higher than discovery.



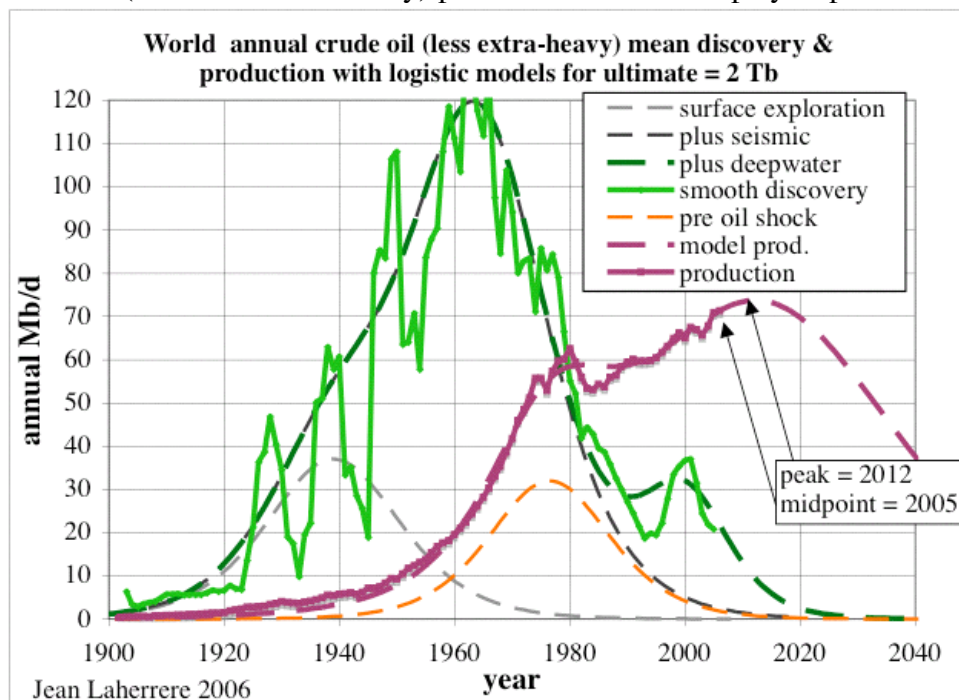
Multi-logistic modelling

The **world cumulative crude oil (less extra-heavy) discovery & production** can be easily modelled with 3 logistic curves for discovery and 2 curves for production



World undiscovered easy oil (about 200 Gb) is less than the discrepancy between technical sources.

The world annual oil (crude less extra-heavy) production forecast displays a peak around 2010

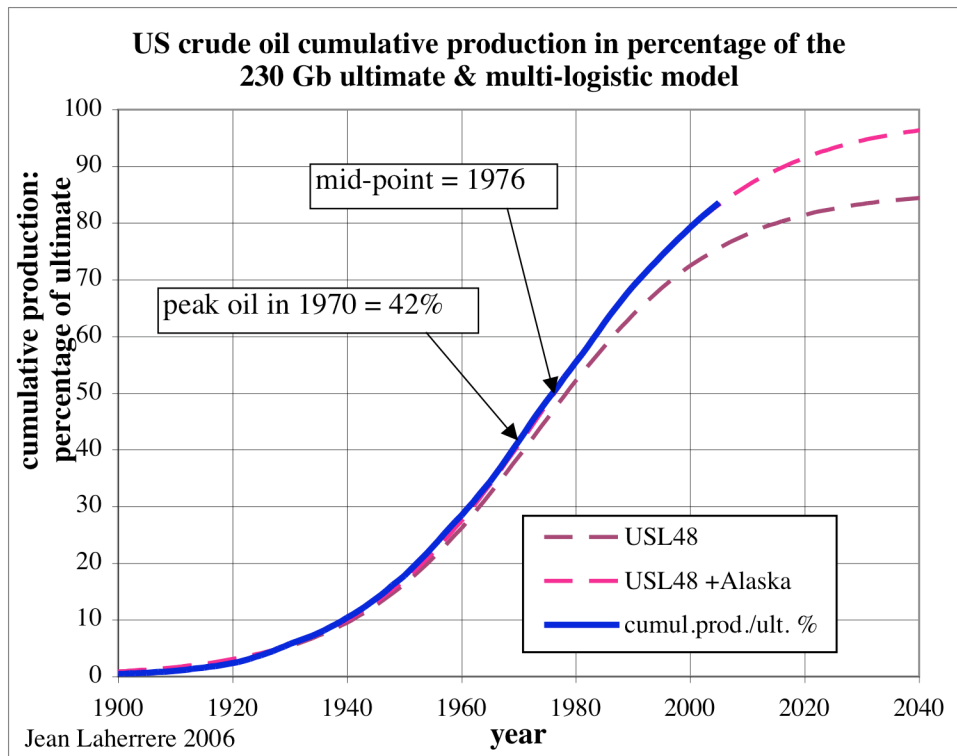


Oil Peak and Mid-point

Oil Peak does not correspond to Mid-point because dissymmetry brought by multi-cycles.

For the world crude oil peak could arrive in 2012 when **Mid-point has occurred before** in 2005.

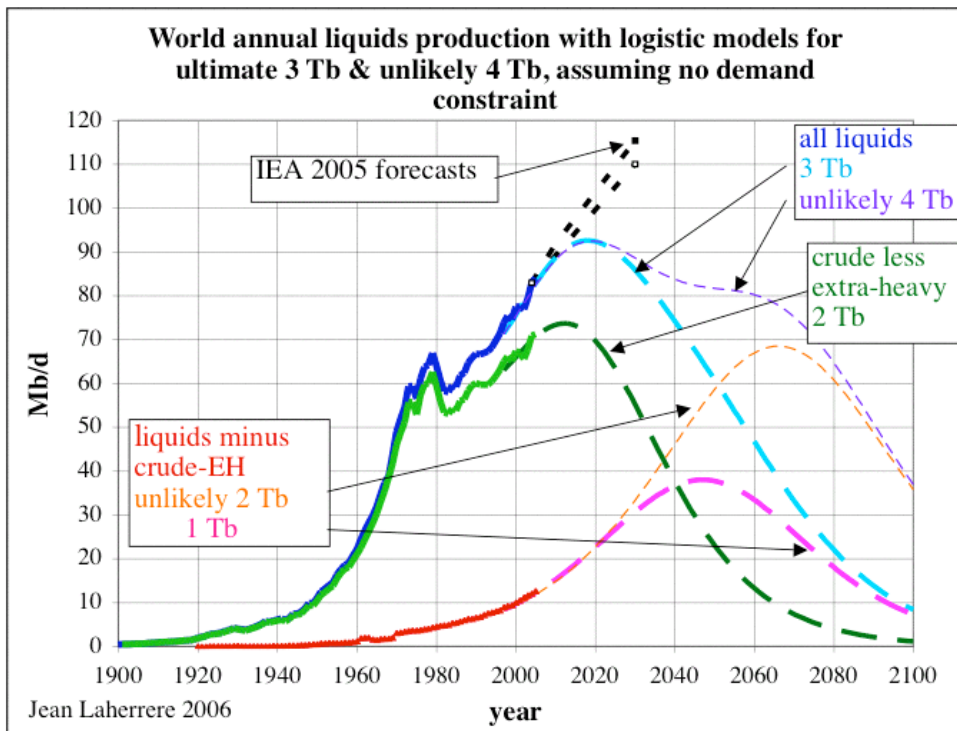
For the US there are 2 cycles: US Lower 48 and Alaska and the 1970 peak oil occurred in 1970 (at 42 % of the ultimate of 230 Gb), when the **Mid-point occurred after** in 1976



All liquids forecast

Oil demand is for *all liquids*. So the forecast of oil supply has to be given for all liquids

The **all liquids production forecast** is modelled for an ultimate of **3 Tb** with 1 Tb for NGL and expensive liquids, an unlikely 4 Tb ultimate (2 Tb for expensive oils) changes only the slope, but not the *oil peak*



Liquids will peak around 2015 if there is no demand constraint, which is unlikely with soon coming economic crisis forecasted by P.Volcker. The production will then show a bumpy plateau, but well below the 115 Mb/d forecasted in 2030 by IEA.

Exxon-Mobil states last month that the **oil peak is decades away**, but it is based on USGS study.

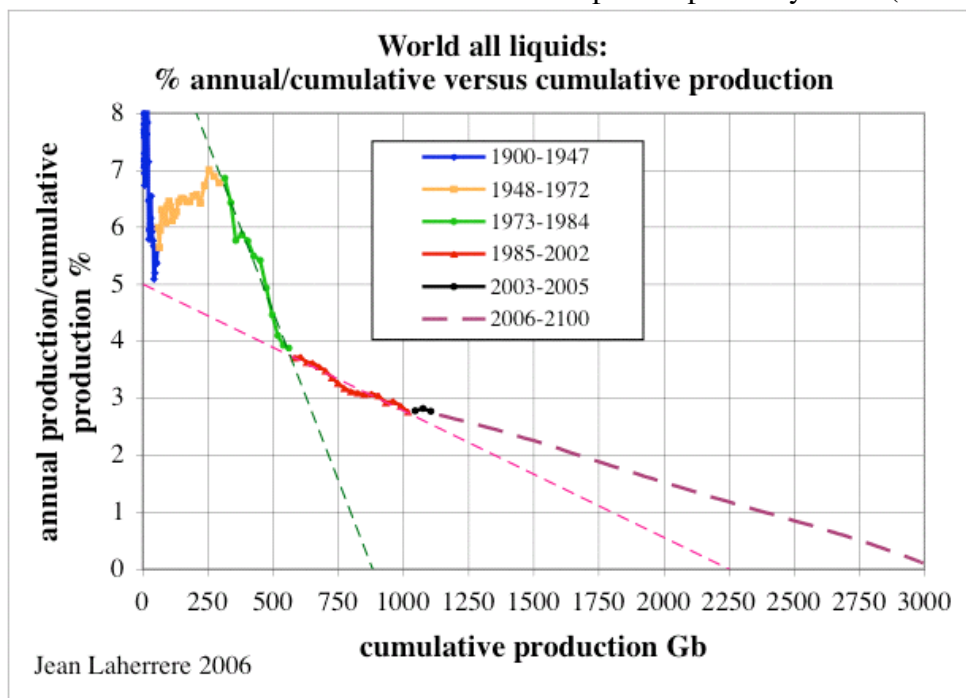
In contrary Chevron in their site states that the era of **easy oil is over**; as presently oil authorities: Henri Groppe, T.Boone Pickens and Matt Simmons; as also CEO of major companies just before quitting the oil scene as Bernabe ENI in 1998 and Bowling ARCO in 1999. Total CEO Th.Desmarest forecasts an oil peak in 2030 but by assuming a small consumption growth, contrary to Exxon-Mobil. Former VP Aramco Al-Husseini forecasts an oil peak in 2015 around 90-95 Mb/d.

US Army Corps of Engineers follows ASPO forecasts and dismisses USGS estimates.

Our Prime Minister D. de Villepin stated in September 2005 that we have entered the era of post-petroleum.

Annual growth versus cumulative production: difficult to extrapolate when multi-linear!

The plot % annual/cumulative versus cumulative production for the World all liquids displays several straight line (= logistic curve) periods: 1973-1984 towards 850 Gb, 1985-2002 towards 2250 Gb, but it is likely that the future will trend towards 3000 Gb because unconventional, synthetic oils and NGL will increase. This plot is unreliable to obtain the ultimate, which is estimated using creaming curves (cumulative discoveries versus the cumulative number of pure exploratory wells (New Field Wildcat))



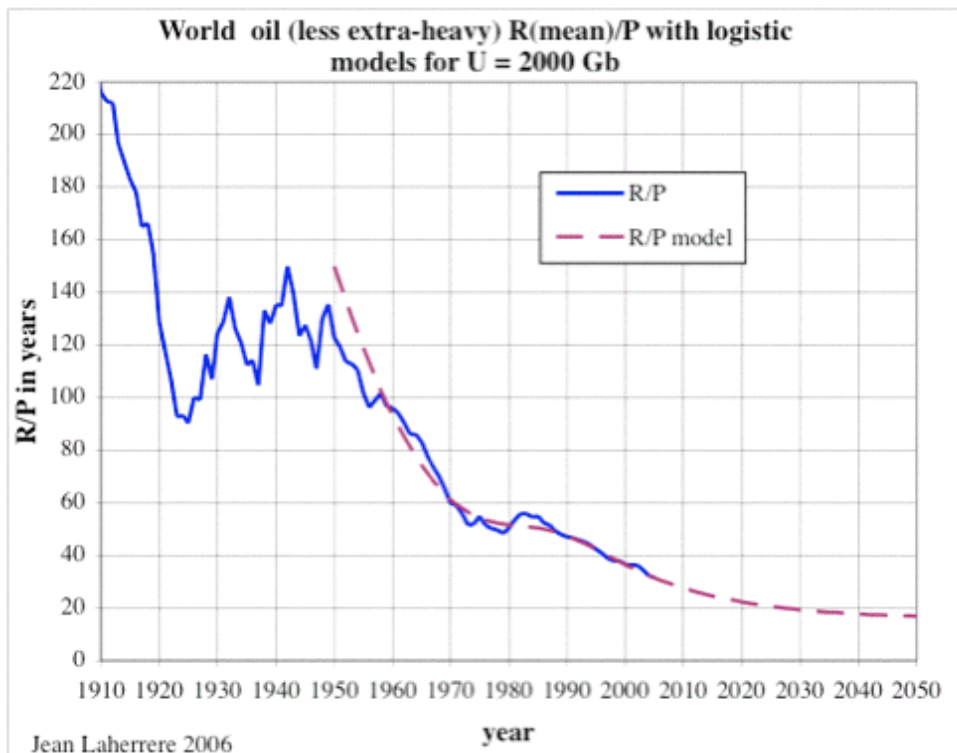
R/P

R/P is often used by economists who say that there is no problem for oil, because **R/P is about 40 years**.

Using the mean reserves (and not the so-called proved data), R/P has been decreasing from over 200 years in 1900 to 35 years today.

But the model shows that R/P will trend towards 20 years until the end of production.

US proved R/P has been 10 years for the last 80 years and will stay this way until the last barrel.



R/P is a very poor ratio to forecast oil production!

Reserve growth: bad reporting, incorrect aggregation, bad extrapolation and flawed graph!

Reserve growth has been claimed by the 2000 US Geological Survey world conventional reserves assessment as being very large due to new technology, but it is based on extrapolating the reserve growth model from the US **proved** estimates of old fields to the **proven +probable** new discovery of the rest of the world.

This extrapolation is basically incorrect, comparing apples and oranges.

Also, applying old growth to new fields assumes no progress in assessment technology!

Furthermore 2000 USGS estimate being **at end of 1995** is now 10 years old and obsolete.

Even past production data is wrong, as world cumulative gas production by 15% = 1752 Tcf against 2025 Tcf (Salvador 2005 AAPG) or US oil cumulative production by 14 % = 171 Gb against 195 Gb.

US reserve growth of proved data comes from the omission of probable value and also because it is incorrect to add the proved (minimum) field (or country) estimate to obtain the proved country (or world) value. Such aggregation underestimates largely the minimum value of the whole.

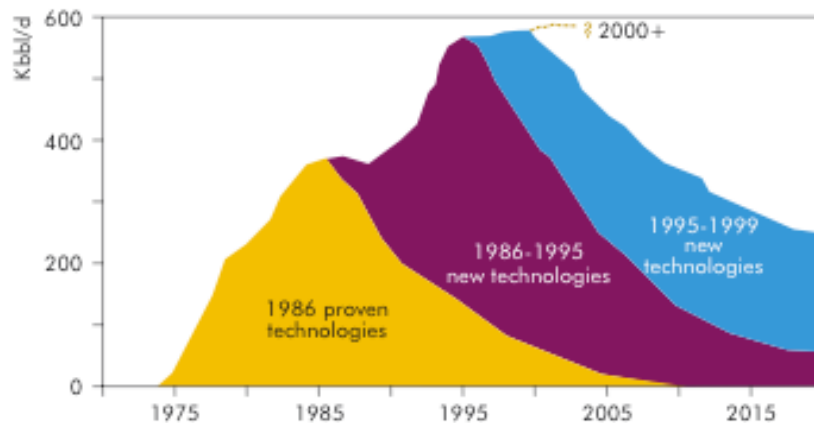
All proved estimate is done this way, without any concern that it is incorrect!

Only mean values can be added to get the mean of the whole.

US reserve growth is mainly due to bad practice of reporting (contrary to the rest of the world), ignoring the expected value which is the base of all development decisions and **incorrect aggregation!**

International Energy Agency (IEA) in May 2005 *Resources to reserves* justifies that reserve growth is due to technology, with a flawed North Sea old graph published by Shell 2002 coming from *European Network for Research in Geo-Energy* (unknown report 1999?), and badly drafted (wrong scale: 0.6 Mb/d instead of 6 Mb/d)

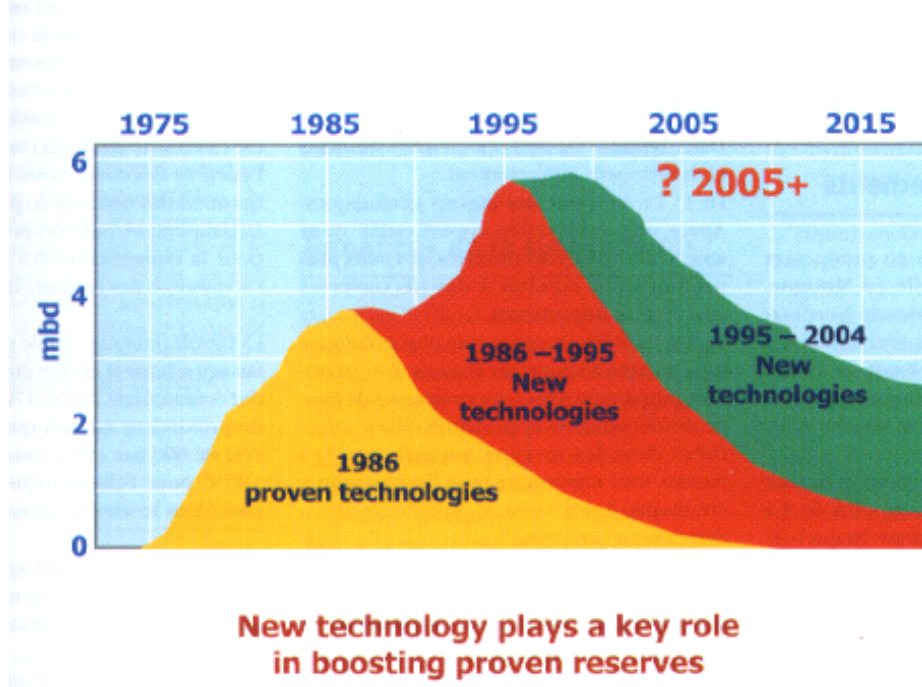
Figure 1.20 • Impact of technology on production from the North Sea, in thousand barrels per day



Source: European Network for Research in Geo-Energy - ENeRG - courtesy of Shell.

It was redrafted again in *Jan. 2006 Petrole & Gaz Informations* by IEA, correcting the wrong scale, but replacing 1999 by 2004 without updating the 1999 curve = manipulation!

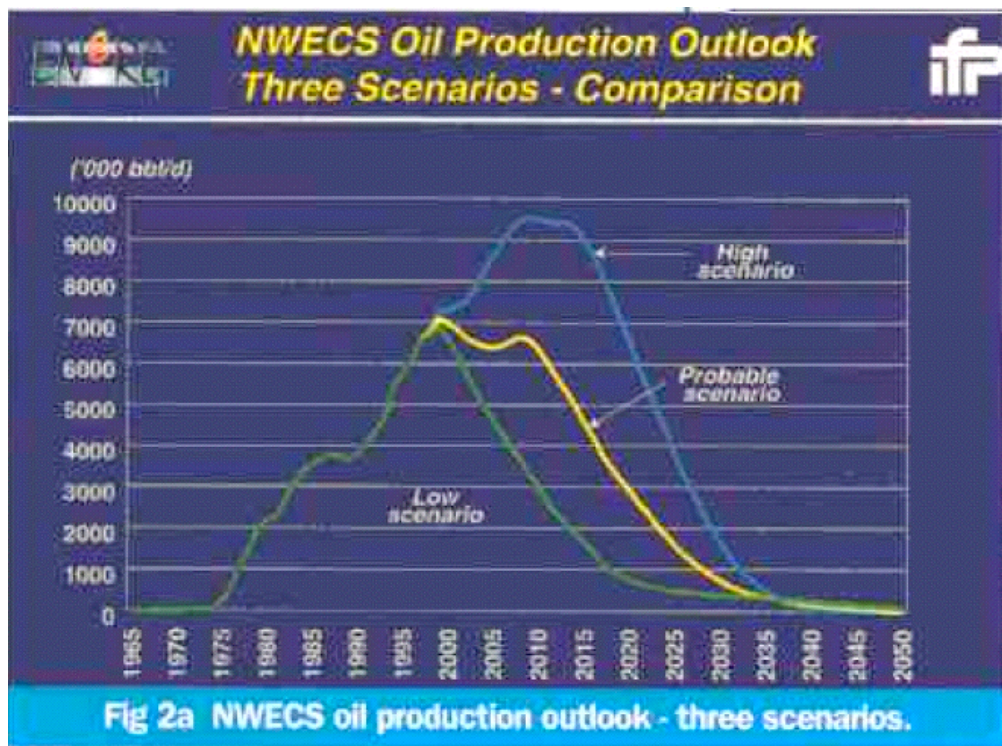
Impact of Technology on North Sea Oil Production



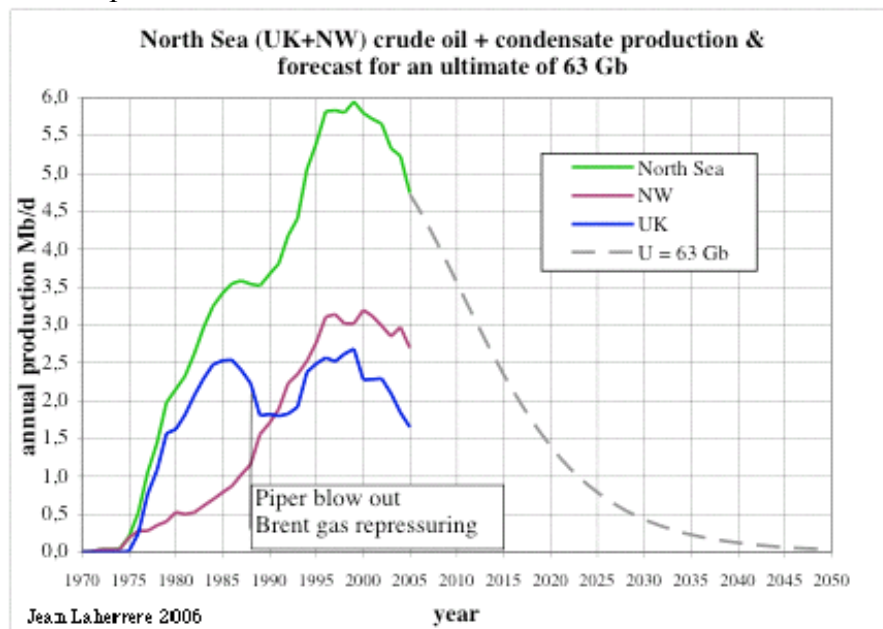
New technology plays a key role in boosting proven reserves

The 1988 trough is mainly due to Piper Alpha blow out and Brent gas repressuring works. IEA justification of impact of new technology on North Sea is very poor!

European Network for Research in Geo-Energy newsletter Feb 1998 "North Sea oil and gas production outlook- a major challenge," claimed that production decline will be delayed by 10 years, with a probable scenario displaying a second peak in 2010.



The present production data displays a peak in 1999 and a steep decline beyond, as the EnERG low scenario, but far from the probable scenario!



Technology (mainly multi-branch horizontal wells) is now used in conventional fields to produce faster and cheaper in order to get **maximum profit**, often detrimental to **maximum recovery** (Yibal Oman, Rabi-Kounga Gabon).

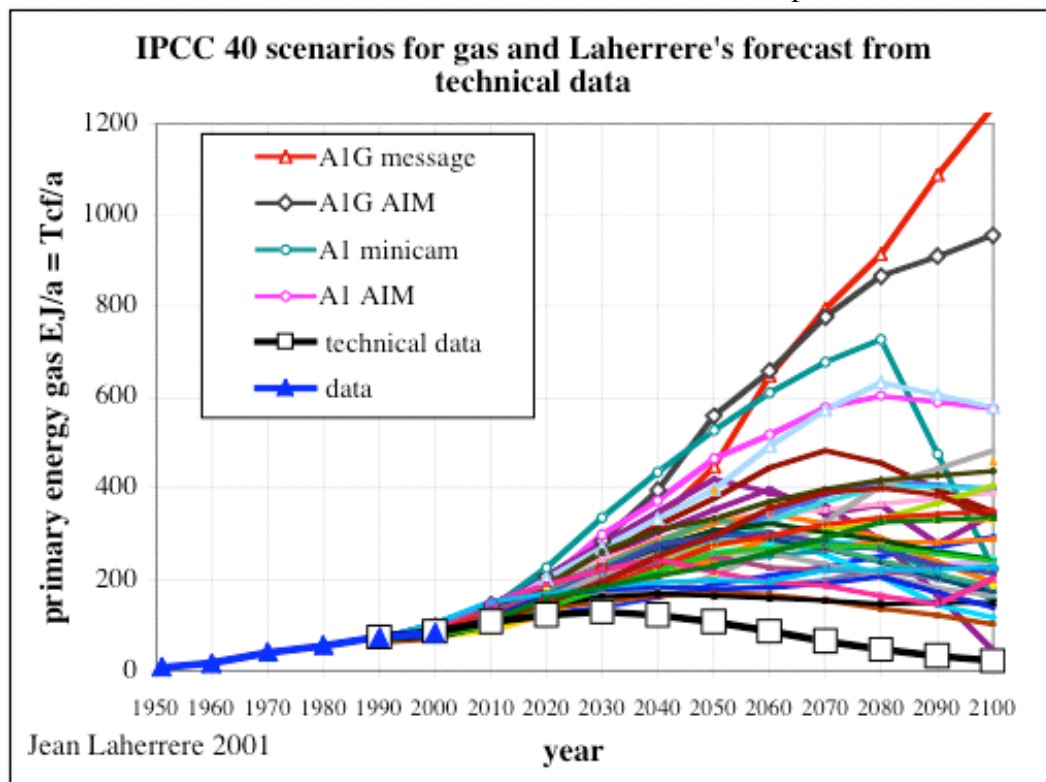
Few reserve positive oilfield growths occur in exceptional reservoir conditions as Ekofisk (compaction of chalk reservoir and seafloor subsidence) or Eugene Island 330 (large fault). Many reserve negative growths occur near the end (East Texas oilfield).

Statistically world mean reserve estimates will show no growth at the end. Reserve growth due to technology should be seen on the oil decline plot, but most claims do not show it (Forties UK).

But technology is a must for unconventional fields, but the question is not the size of the tank but the size of the tap. Athabasca and Orinoco extra-heavy oils need time and labour to build plants. The peak of extra-heavy oil production will influence only the slope of the all liquids decline.

IPCC energy scenarios for climate change report

The 2001 IPCC report used **40 energy scenarios (SRES)** designed by IIASA without any connection to past data and industrial realities. For natural gas, a gas hydrate age was dreamed to consume ten times more gas than today. The 40 gas scenarios display a large range, unfortunately outside the forecast from technical data, as I have shown at the 2001 IIASA workshop



The 2007 IPCC report will use these same unrealistic scenarios: GIGO = Garbage in, garbage out

Conclusion

Before any discussion, all terms should be clearly defined.

The problem of forecasting oil production is not to find the right model, but to have access to the technical data and to correct these heterogeneous data in order to obtain the mean (expected) value.

Unfortunately technical data are confidential and very expensive to buy from spy companies.

All political and financial data should be discarded when forecasting production!

Proved reserve growth is mainly due to bad reporting (omission of probable) and incorrect aggregation.

Reserves data should be reported as a range, and not a single value.

Reporting more than 2 digits in oil data shows that the author is unaware of the accuracy of measure.

Technology is now used to produce faster to get maximum profit contrary to maximum recovery!

All efforts to bring more transparency in production (reserves = cumulative production at the end)

were unsuccessful. As long as OPEC fight between them on quotas, data will stay flawed.

Claire Booth Luce: The difference between an optimist and a pessimist is that the pessimist is usually better informed.

I have access to several technical databases.

Liquids production will significantly decline after a likely bumpy plateau 2010-2020 and likely chaotic oil prices.

30 years from now, production of easy oil will be 35% less than to day but **production of all liquids (including from coal and biomass) only 5% less than to day.**