Presentation To Evora University 8 May 2006

Peak oil and related peaks!

Jean Laherrère
ASPO (Association for the Study of Peak Oil and gas)
jean.laherrere@wanadoo.fr

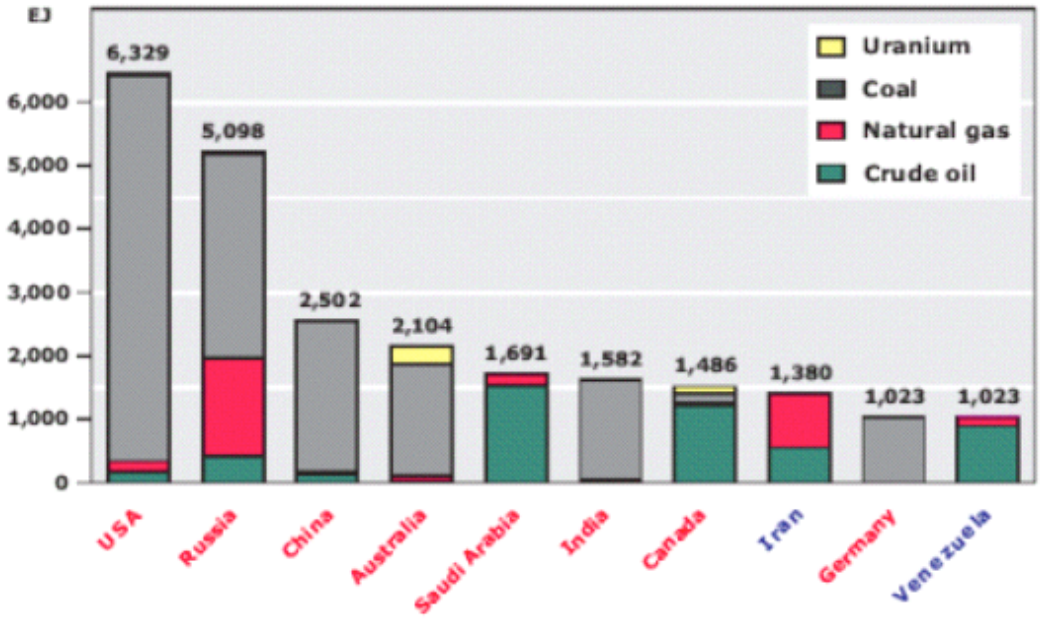
Part 2

-Resources assessment

The BGR in Germany is the only one organism in the world making complete and reliable assessment of world energy reserves and resources. The WEC (World energy Council) is just gathering heterogeneous national reports, but is reluctant to add them for a global estimate.
BGR publishes estimates every 3 or 4 years and the evolution is very interesting
Remaining reserves at estimate year in Gtoe

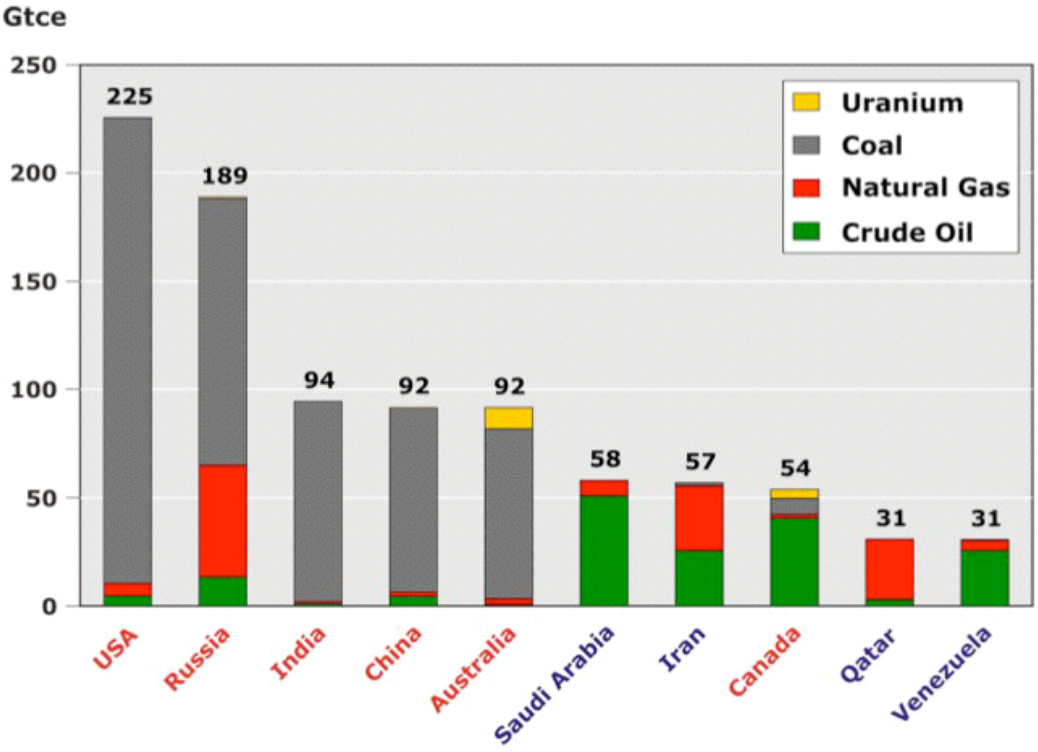
BGR- Germany	**reserves**			**resources**		
estimate year Gtoe	**1997**	**2001**	**2004**	**1997**	**2001**	**2004**
conventional oil	151	152	160	76	84	82
non-conventional oil	134	66	66	574	250	250
conventional natural gas	116	122	134	172	165	157
non-conventional gas	2	2	2	2458	1538	1538
hard coal	341	423	450	3519	2486	2299
soft brown coal	50	47	47	763	292	213
uranium	24	15	17	179	174	174
thorium	22	22	22	23	23	23

In 2001 good increase of hard coal reserves, but strong decrease in non-conventional oil reserves, non-conventional gas and coal resources.
BGR displays this interesting graph of the largest fossil fuel reserve countries. But it is very interesting to see the change with time.
Figure 75: BGR Remaining fossil fuel reserves in 2001 for the largest countries in EJ



But in 2001 by capita Australia was the most gifted with reserves of 2500 toe/cap, compared to 1600 for Saudi Arabia, 800 for Russia, 500 for US and 50 for China! Same graph in 2004 but in Gtce and not in EJ, India has jumped ahead of China and Qatar has replaced Germany

Figure 76: BGR Remaining fossil fuel reserves in 2004 for the largest countries in Gtce

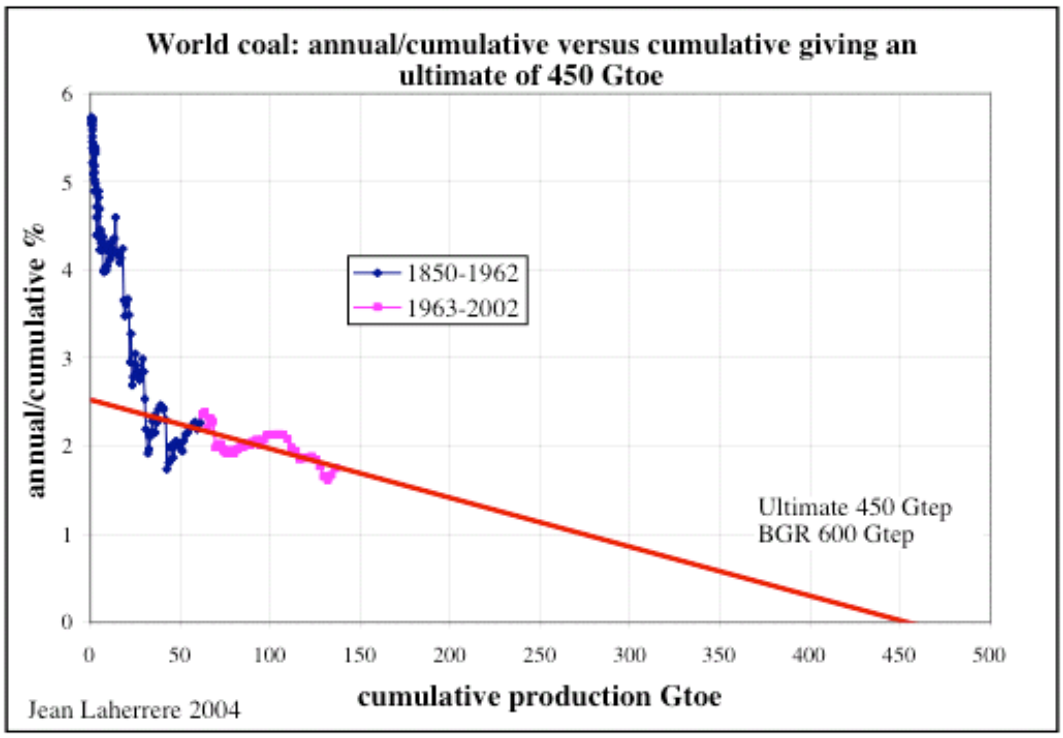


-**Fossil Fuels**

-Coal

Coal reserves are less studied and published than oil and gas but the estimates are less disturbed by politics. Past production can be plotted to see where trending. The plot annual growth versus cumulative production trends towards an ultimate of 450 Gtoe, compared to BGR estimate of 600 Gtoe

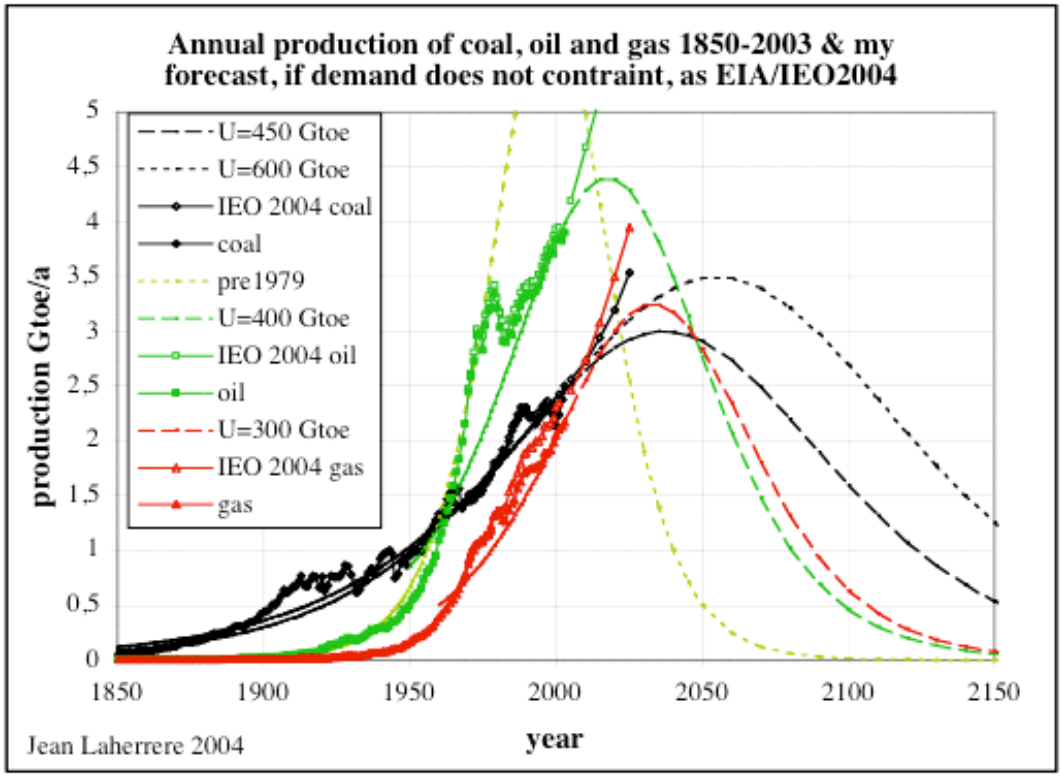
Figure 77: **World coal annual/cumulative versus cumulative production** giving an ultimate of 450 Gtoe compared to BGR 600 Gtoe



The fossil fuels production can be modelled with the following ultimates and peak (if no demand constraint):

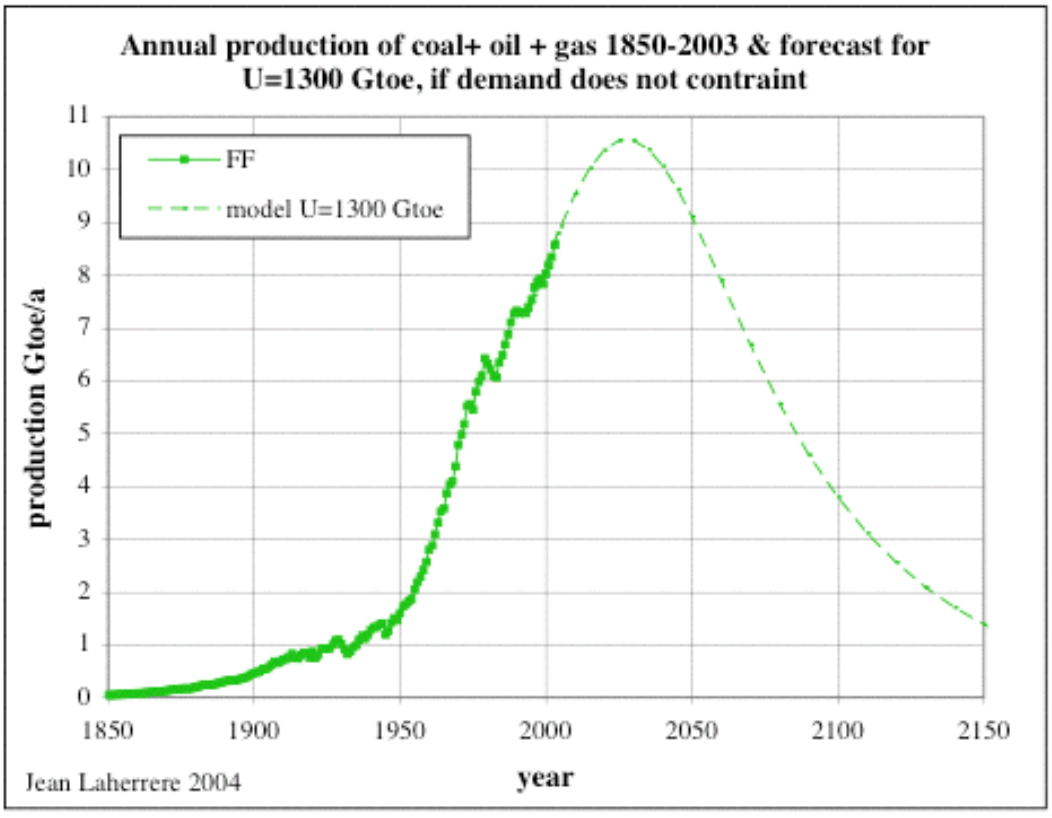
-oil = 400 Gtoe, 2015
-gas = 300 Gtoe 2030
-coal = 450 Gtoe 2040
-coal = 600 Gtoe 2050

Figure 78: **World annual production of coal, oil and gas** with Hubbert models and USDOE forecasts



Adding the fossil fuels with an ultimate of 1300 Gtoe gives a peak on 2025 just above 10 Gtoe, if there is no demand constraint..

Figure 79: **World annual production of fossil fuels (coal, oil & gas)** with model for an ultimate of 1300 Gtoe



A Shell International Ltd graph from "Evolution of the world's energy system" 1995 Shell International Ltd in paper "Using scenarios to plan for future global energy markets "N.Welch, https://www.scotland.gov.uk/library3/energy/fefr-12.asp foresaw also fossil fuels peaking around 2025 at 500 EJ (12 Gtoe) with oil in 2015 and coal in 2050

Figure 80: Shell 1995 forecast for primary energy showing a fossil fuel peak in 2025

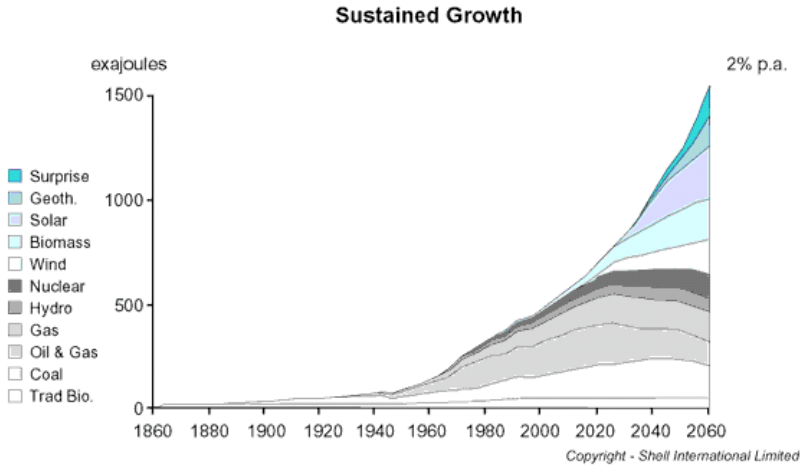
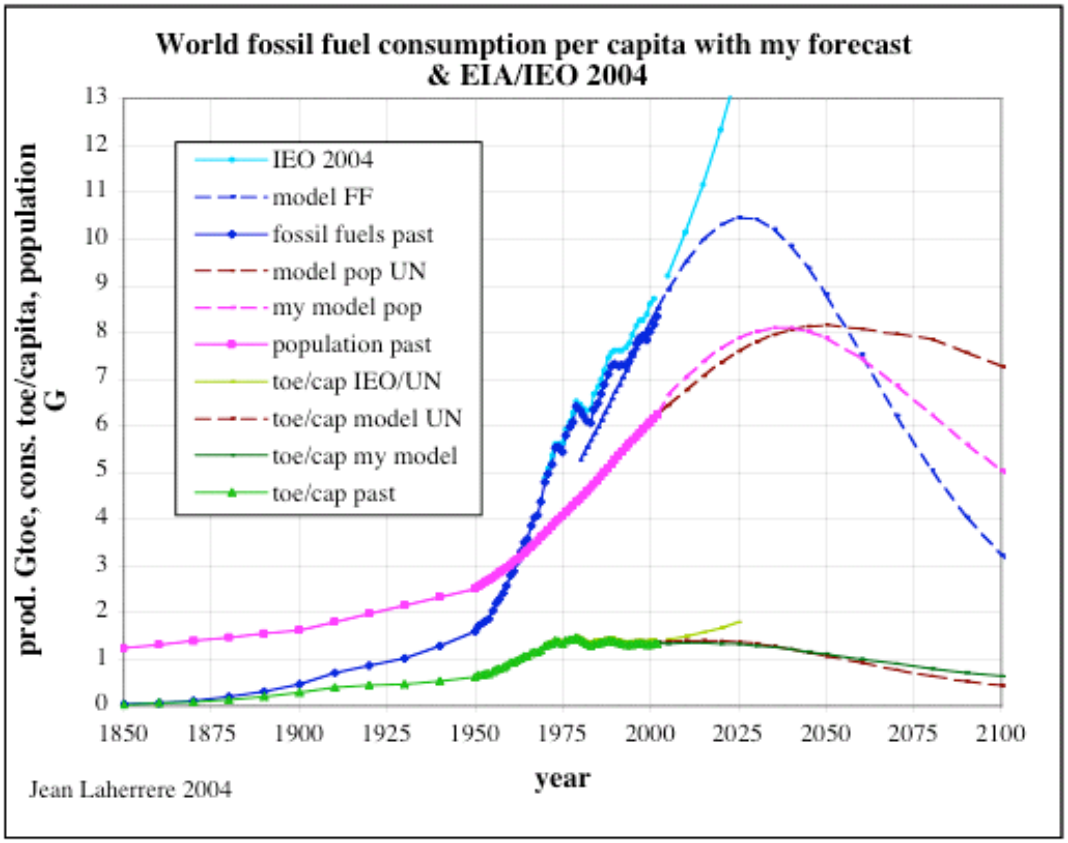


Figure 12 - Forecast mix of energy production under the Sustained Growth scenario, 1860-2060

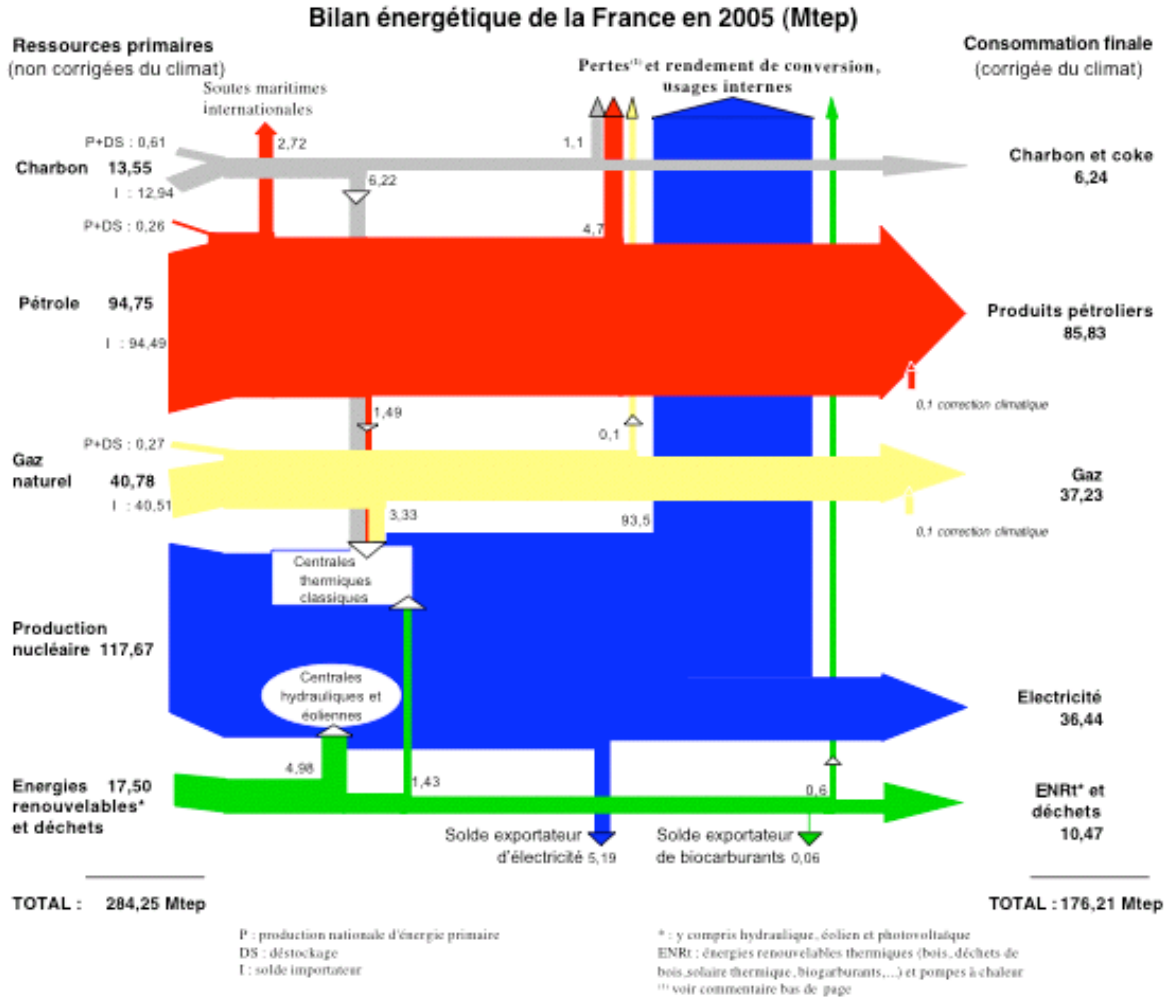
This 1995 Shell forecast was in line with my forecast.
But now Shell has dropped forecasts for literary global scenarios with fancy graphs, where the most important is to find good titles as in 2005
-a legalistic "prove it to me" world = "Low trust globalisation"
-a pragmatic "know me" world = "Open doors"
-a dogmatic "follow me" world = "Flags"

The fossil fuel consumption by capita was constant for the last 25 years and my forecast is that it will stay for the next 25 years. The only problem is how to share it between the developed and the developing countries!
Figure 81: **World fossil fuels consumption per capita** with my forecast & USDOE



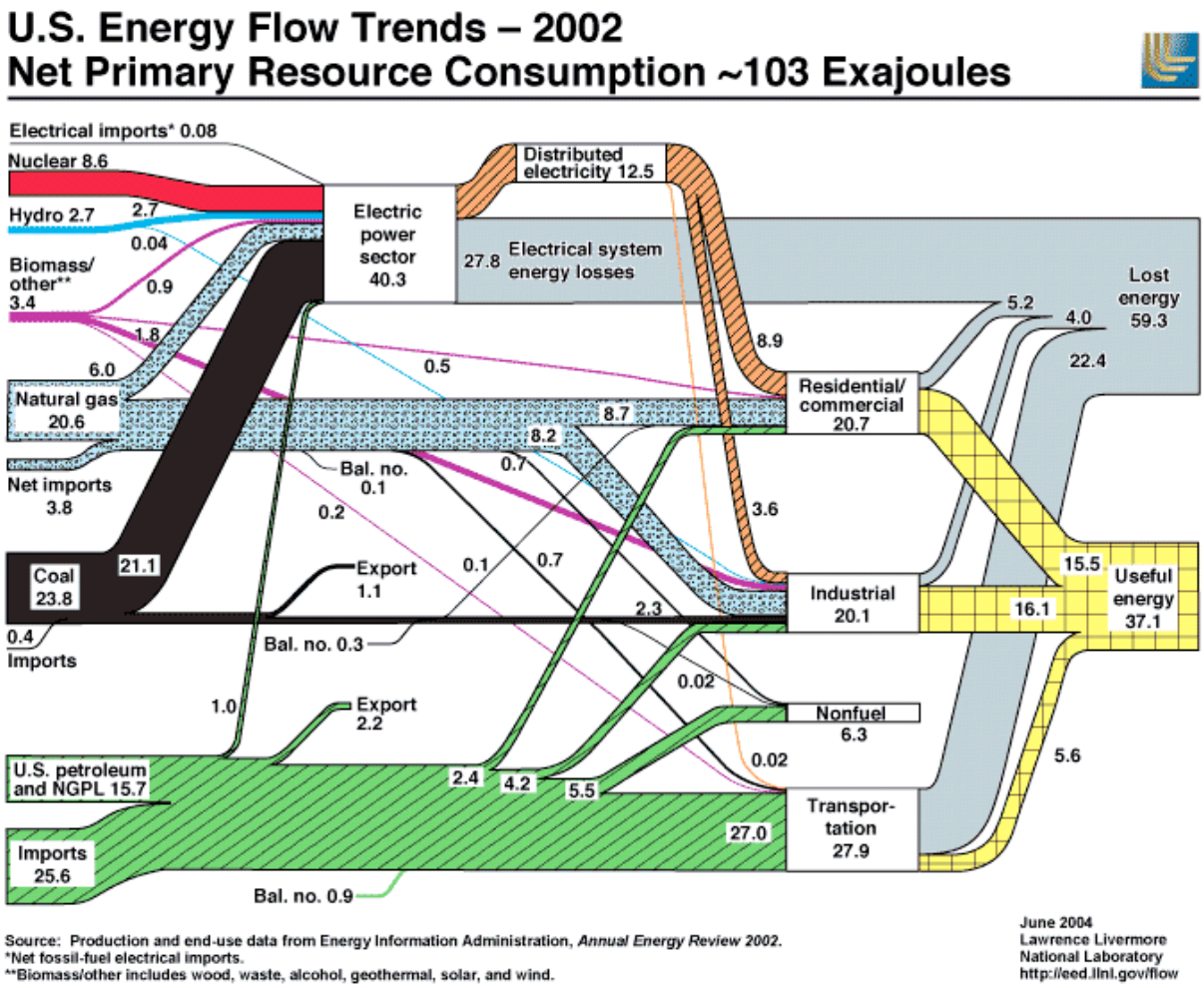
-Primary energy
As each energy is different and measured with different units, it is necessary when aggregation energy to get an energy mix to make arbitrary assumptions, mainly for electricity where one MWh can be converted either into 0,083 toe or 0,2606 toe depending upon the source. Heat can be a nuisance or a goal. The equivalence is a serious problem as being based on questionable conventions, but no one wants to

consider it as long as a consensus has adopted one arbitrary convention. Statu quo is the rule. But efficiency of conversion varies with location, technique and time. In 2001 France changed their assumptions in order to adopt IEA conventions and the change was drastic: final energy oil consumption went from 39.8 to 51.3 %
The energy flow from primary to final energy has to be looked at carefully on the losses. For France losses are the arrows going up. Energy 2005 flow goes from primary 285 Mtoe to final 176 Mtoe. In 2003 it was from 280 Mtoe to 175 Mtoe.
Figure 82: **energy flow in France en 2005 from 285 Mtoe to 176 Mtoe**

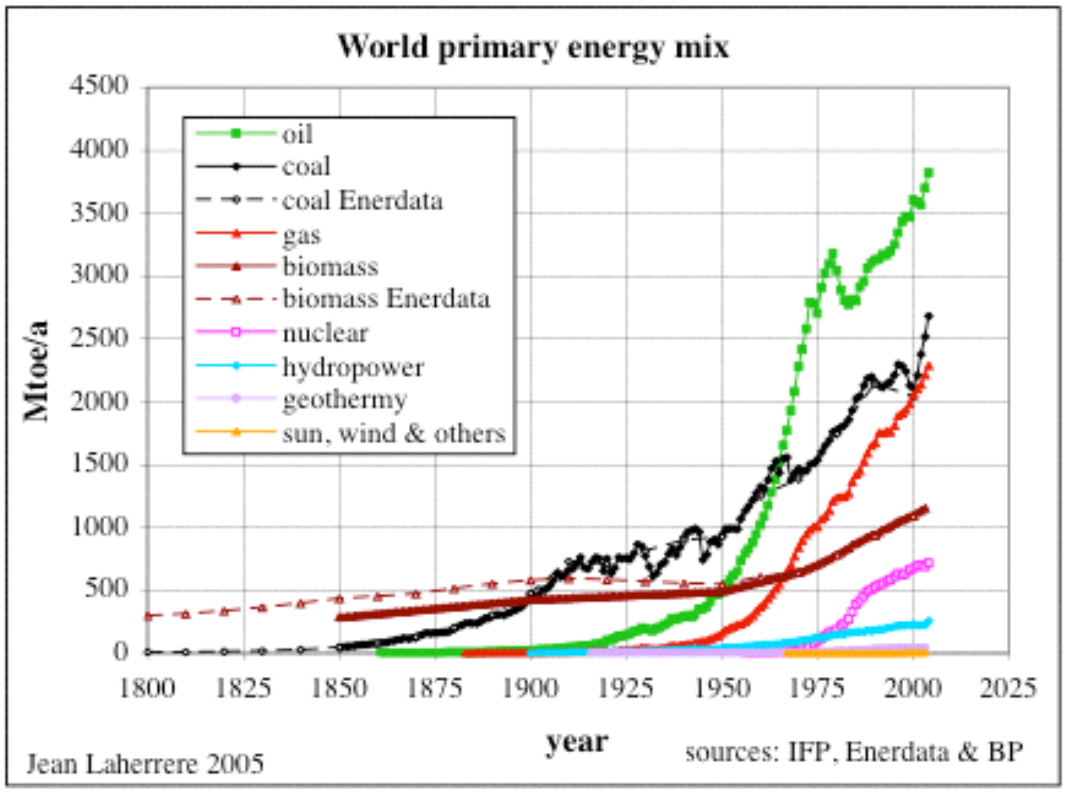


The amount of losses is huge for electricity

It is the same with the US energy flow. Lost energy is in grey, being 59.3 EJ, when the useful energy in yellow is only 37.2 EJ.
It means that 61% of the energy is lost !
Figure 83: US energy flow for 2002: **lost energy = 1.6 useful energy**

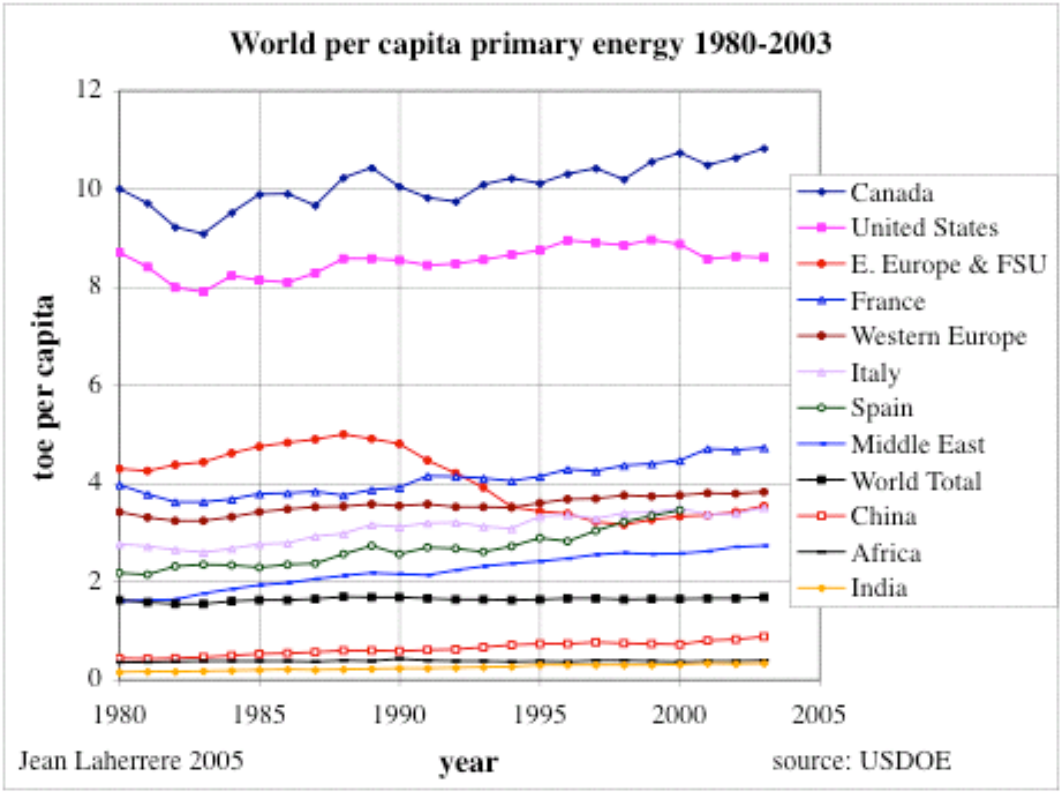


The primary energy mix is difficult to obtain as historical series. There as few sources (IFP, BP, Enerdata) and some omits non-commercial biomass.
Figure 84: **World primary energy mix 1850-2004**



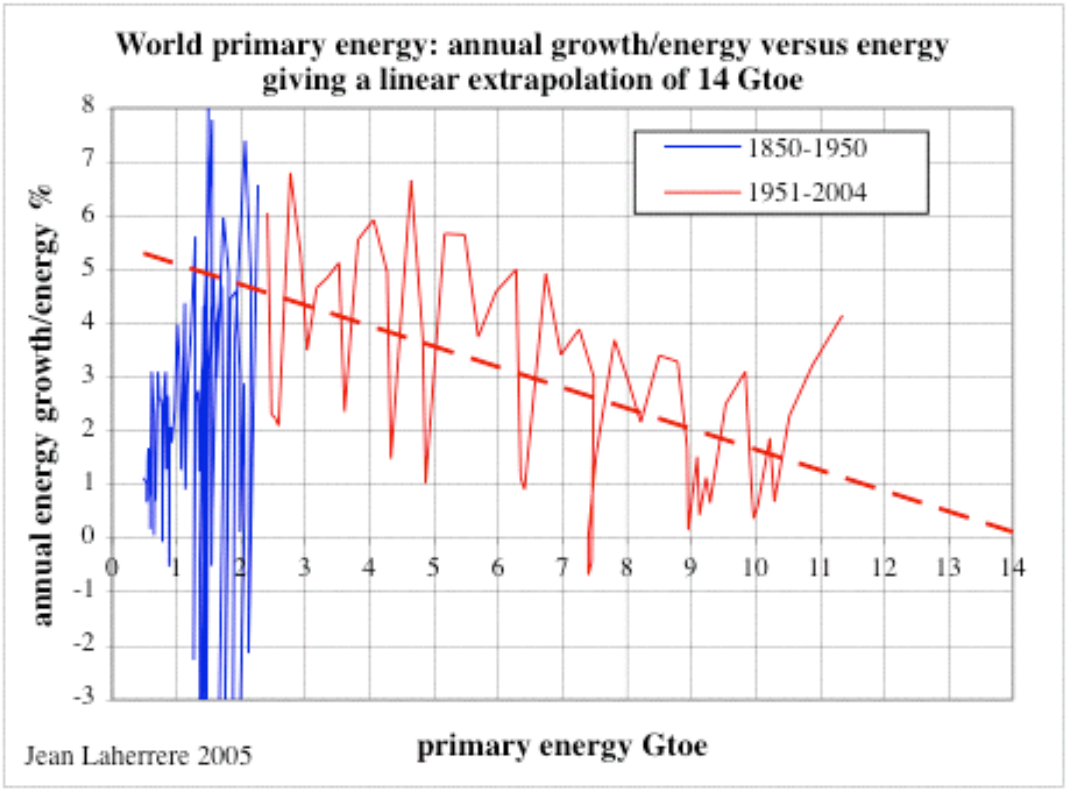
Muscle (human and animals) is omitted! Only horses in horsepower of cars!
Food is also a kind of energy and some should be added in the energy mix.

The primary energy per capita varies widely, from 11 toe/a in Canada to 0.5 toe/a in India
Figure 85: **Primary energy per capita** 1980-2002

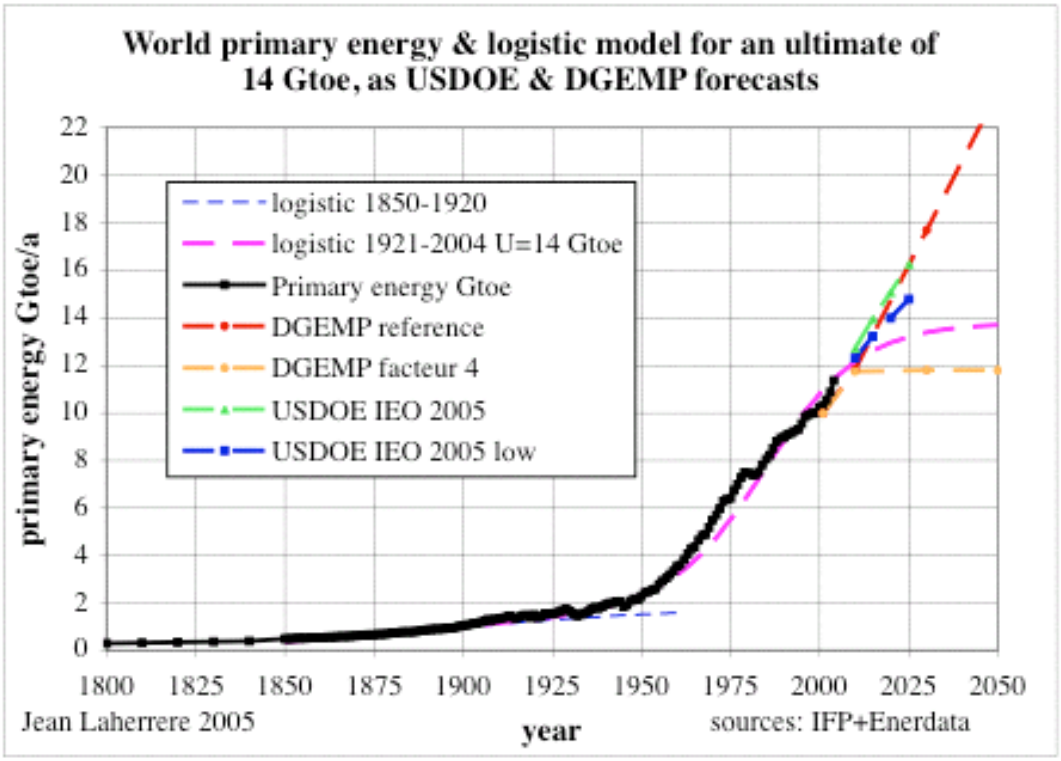


World primary energy per capita is flat for more than 20 years

The primary energy growth versus energy is trending towards 14 Gtoe
Figure 86: **world primary energy annual growth/energy versus energy** giving an extrapolation of 14 Gtoe

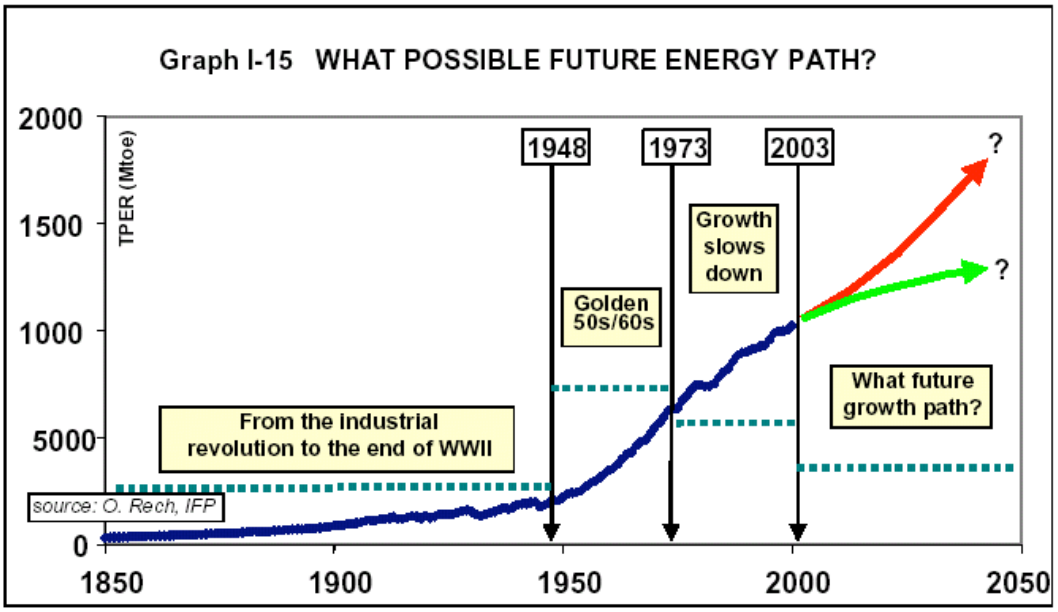


A logistic model with two cycles for this 14 Gtoe ultimate fits well the past data, but diverge strongly to the official USDOE or IEA forecast which are mainly political wishes of constant growth The French DGEMP has two scenarios: a reference one in line with the USDOE and a factor 4 which is assumed to cut human emissions by a factor 4, which in fact aims to flatten at 12 Gtoe.
Figure 87: **World primary energy with logistic to 14 Gtoe and USDOE IEO & DGEMP forecast**



IEO 2005 for 2025 is back to 2003 level, even higher!

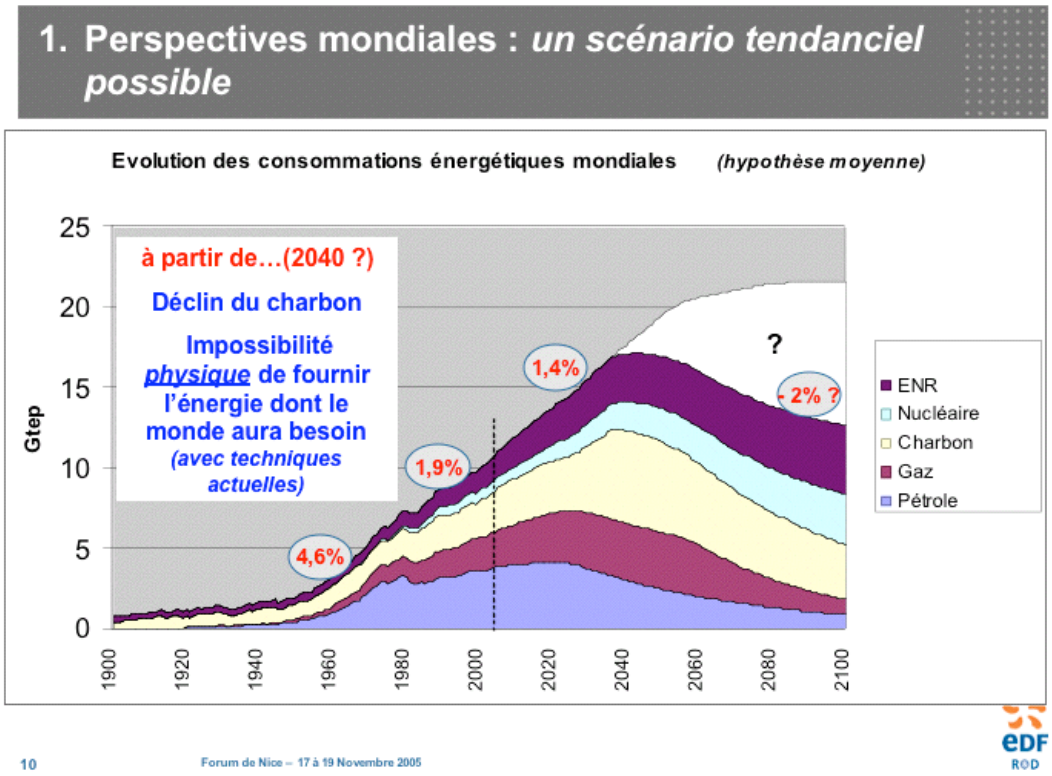
Figure 88: **WEC (World Energy Council) 2003 forecast for world primary energy 1850- 2050**



Scale wrong above 5 000 Gtoe, add one zero 1000 = 10 000 Gtoe

The future depends mainly on the consumer behaviour (US with SUV and China new cars!)

B. Rogeaux (EDF & ASPO France) has shown at Club de Nice 2005 his forecast for primary energy, taking a fossil fuel peak around 2050, a nuclear limited up to 2040 to present uranium reserves (15 Mt), renewables growing slowly, both unable to fill the demand if the growth is 1.4 %/a, uranium and thorium resources have to wait for new advanced reactors planned after 2040 to fill the gap. So if the demand grows at 1.4%/a the demand will not be meet around 2040 = question mark for new progress or energy savings.
Figure 89: **World Energy 1860-2060 from Rogeaux EDF** at Club de Nice 2005 with uranium reserves of 15 Mt (present techniques),

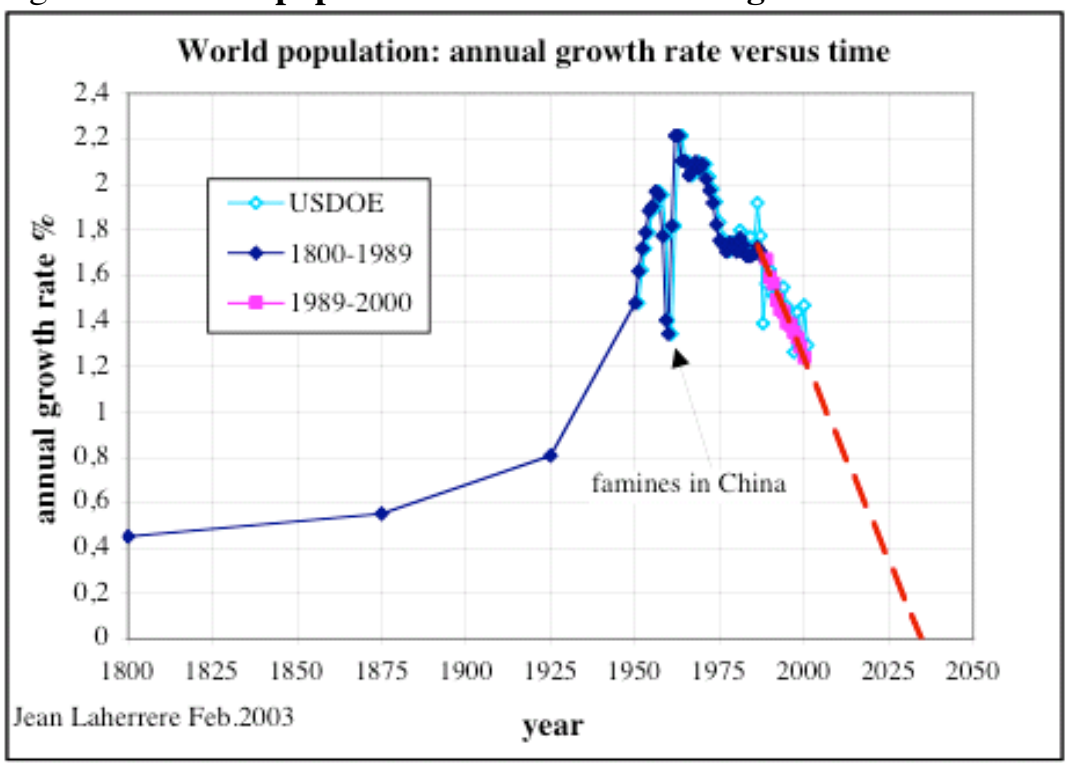


-**Population**

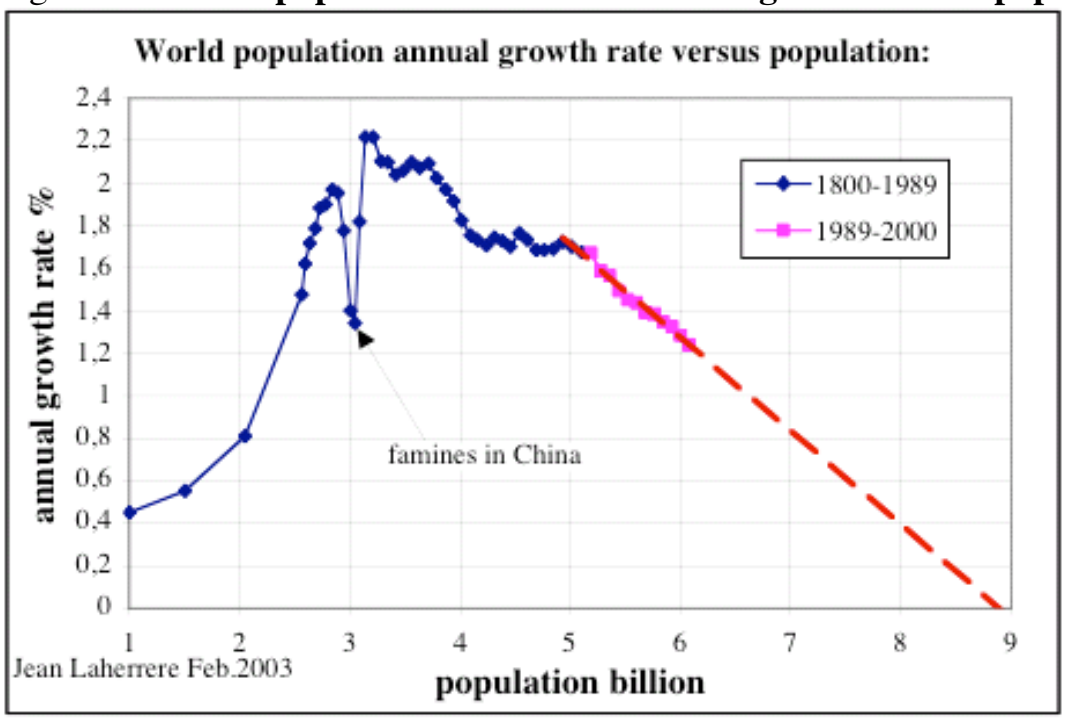
-world

Energy per capita needs population forecast. And energy demand needs also to forecast population. Past forecasts by the UN were always too optimistic. The UN forecasted in 1990 that the annual growth will peak in 1998, in fact it did it in 1988. Population estimates are lousy, because as for reserves it is a political issue. In 1990 Nigeria was reported to be 120 M but a census in 1991 gave a value 30% lower.

Extrapolation of past data provides some possible trend.
Annual growth versus time trends towards zero growth around 2035
Figure 90: **World population 1800-2000 annual growth versus time**

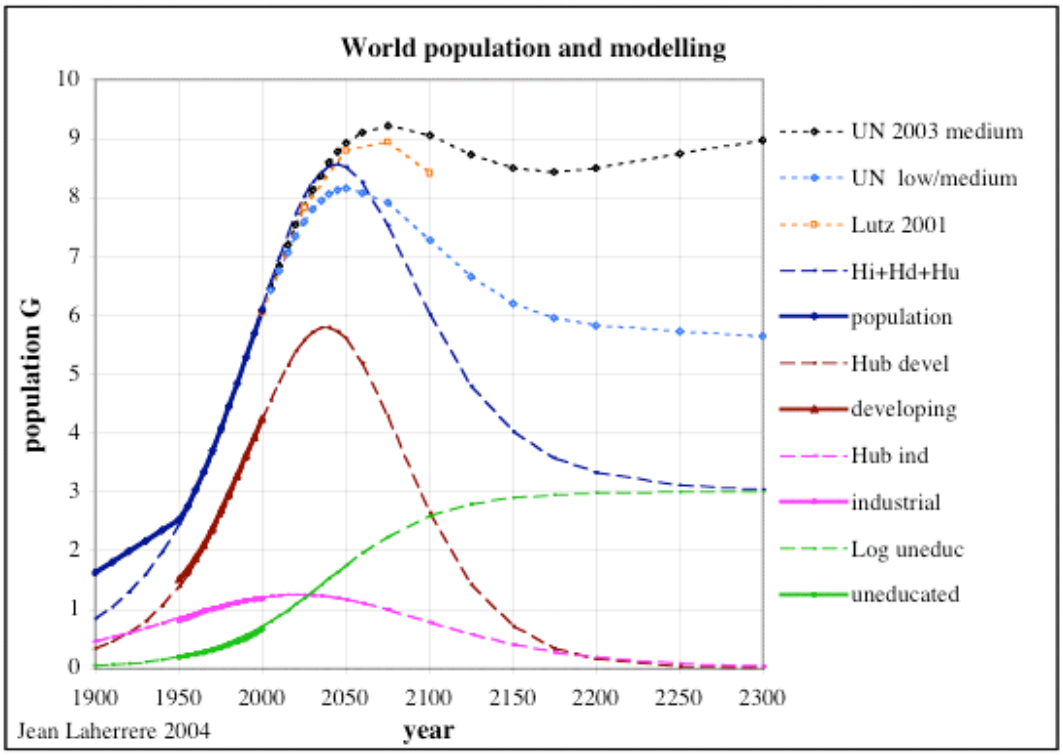


Annual growth versus population trends towards a peak at 9 billion.
Figure 91: **World population 1800-2000: annual growth versus population**



Bourgeois-Pichat, head of INED, has forecasted in 1988 the world population using two bell-shape curve to model developed countries and undeveloped countries. Using three curves (developed, developing and uneducated) the peak could happen in 2040 at less than 9 billions. Lutz (IIASA) 2001 forecasts a peak around 2060 at 9 billions. UN 2003 medium scenario peaks around 2070 and UN low/medium at 2050 at 8.5 billions. The low/medium past scenarios were the closest to the truth in the past.

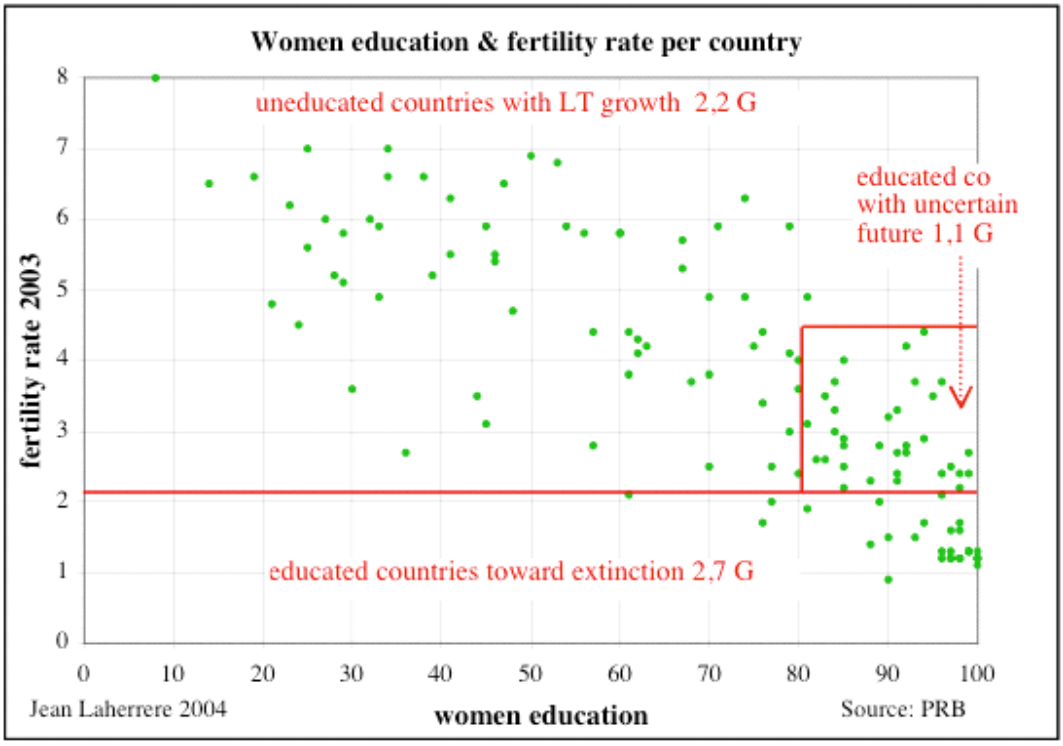
Figure 92: **World population and forecasts**



Every population forecast is based on fertility rate.

The plot in 2003 of fertility rate versus the level of woman education (percentage of girls age 15 at school) is striking. About half (2.7 G) of the world population is below the 2.1 replacement level, and has high woman education rate: it is going towards extinction. Another 1 G has also high woman education and is moving to cross the replacement level in the future. The 2.2 G left has high fertility rate and low woman education. This part will stay in the future.

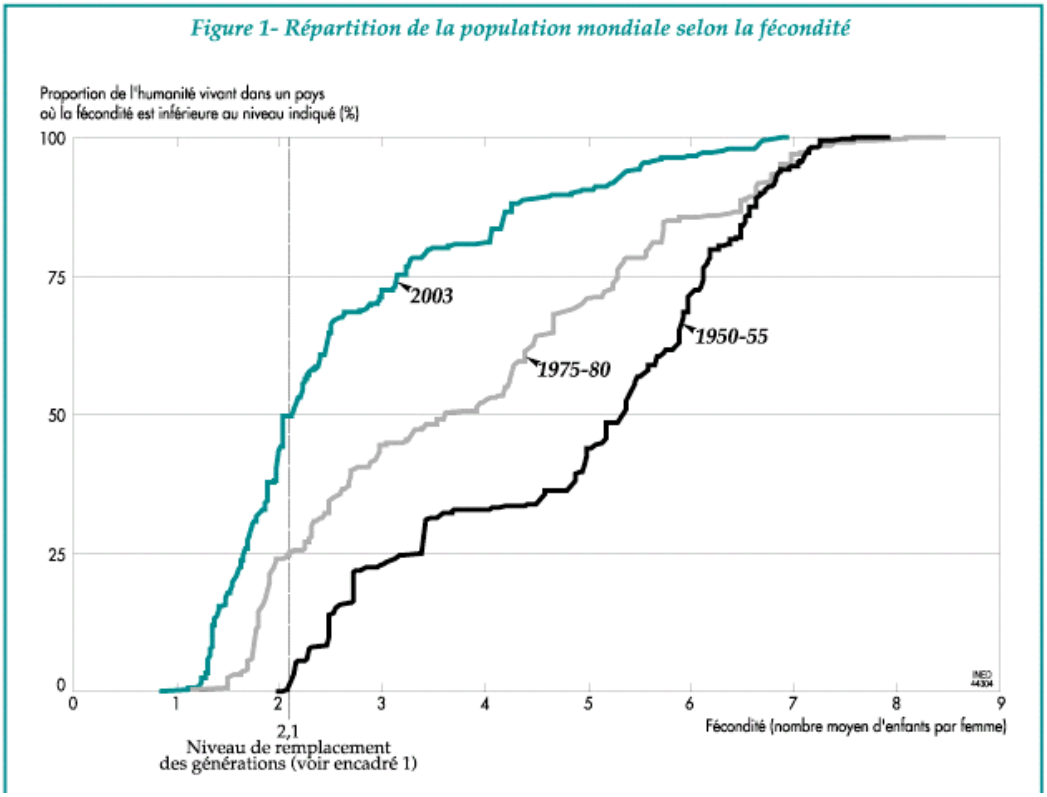
Figure 93: **relationship fertility rate and women education** in 2003



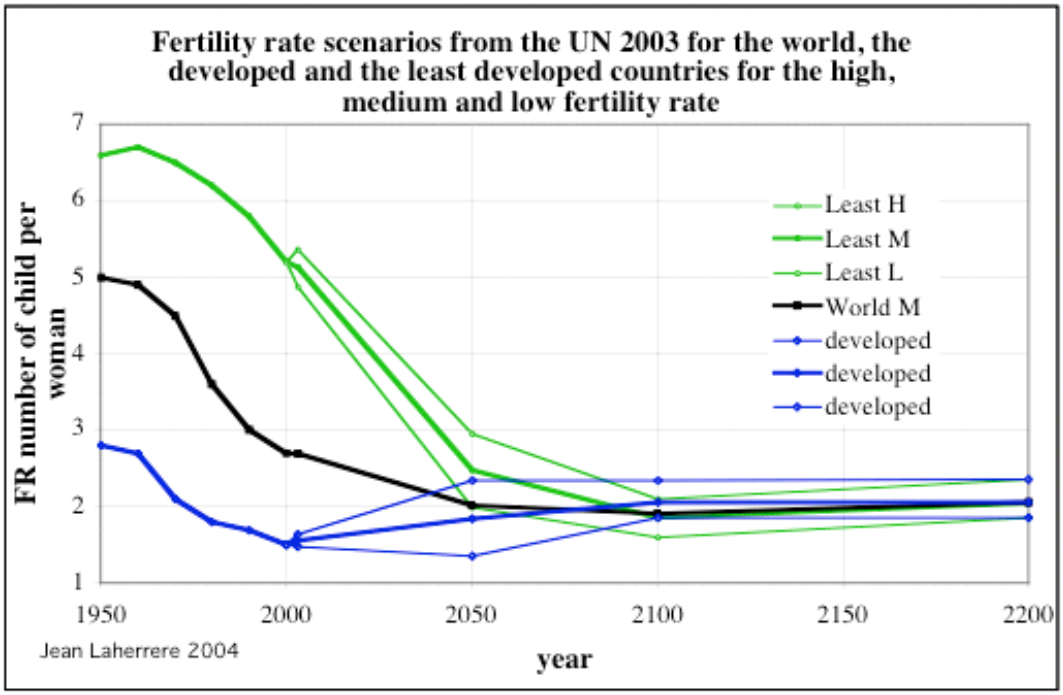
There are two worlds: -countries < 2 child/woman going towards extinction
-countries >5 child/woman with long-term growth

The evolution of the percentage of world population versus the fertility rate is also striking. In 1950 only one country (Luxembourg) has a below replacement rate of 2,1 child per woman. In 1975 one quarter of the world was below 2.1. In 2003 one half of the world was below 2.1. What is striking is that the high level of 7 children per woman is not going down as fast as the 50%!

Figure 94: **Evolution 1950-1975-2003 of the percentage of world population (Y-axis) versus fertility rate (X-axis)** from INED 2004 (P&S 405)



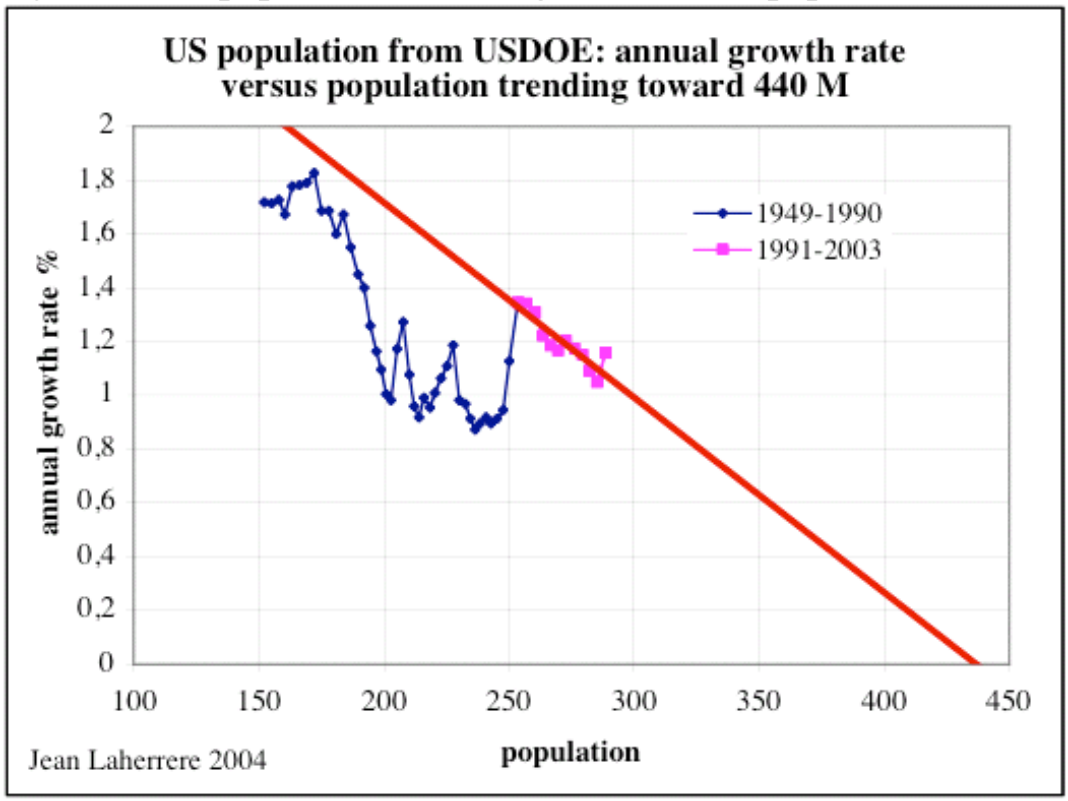
Fertility rate forecasted by the last 2003 UN is a joke. In order to reach the goal of wishful thinking long-term equality, the rate of developed (blue) are planned to increase and to be in 2100 higher than the least developed (green) countries
Figure 95: **UN 2003 scenarios on fertility rate** = political goals (INED Population & Societes n°408)



-**US**

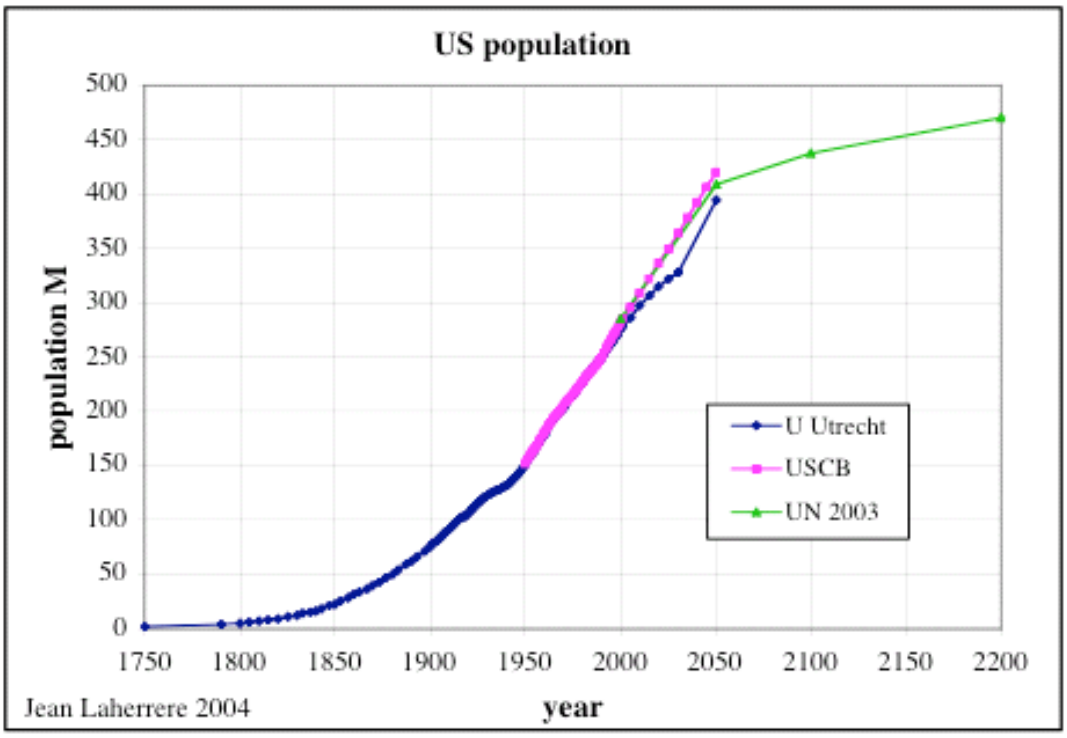
Annual growth versus population trends towards 440 M

Figure 96: **US population: annual growth versus population**



No peak forecasted for the US!

Figure 97: **US population and several forecasts**

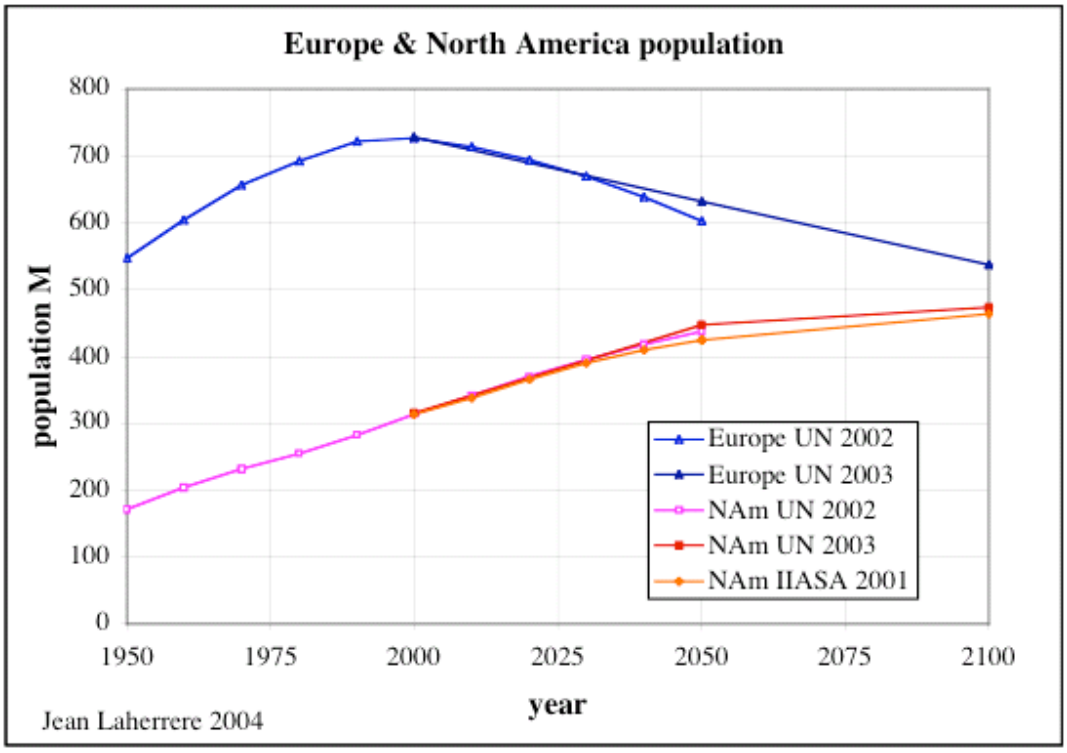


-Europe

Europe has peaked around 2000 and cannot expect continuous economic growth

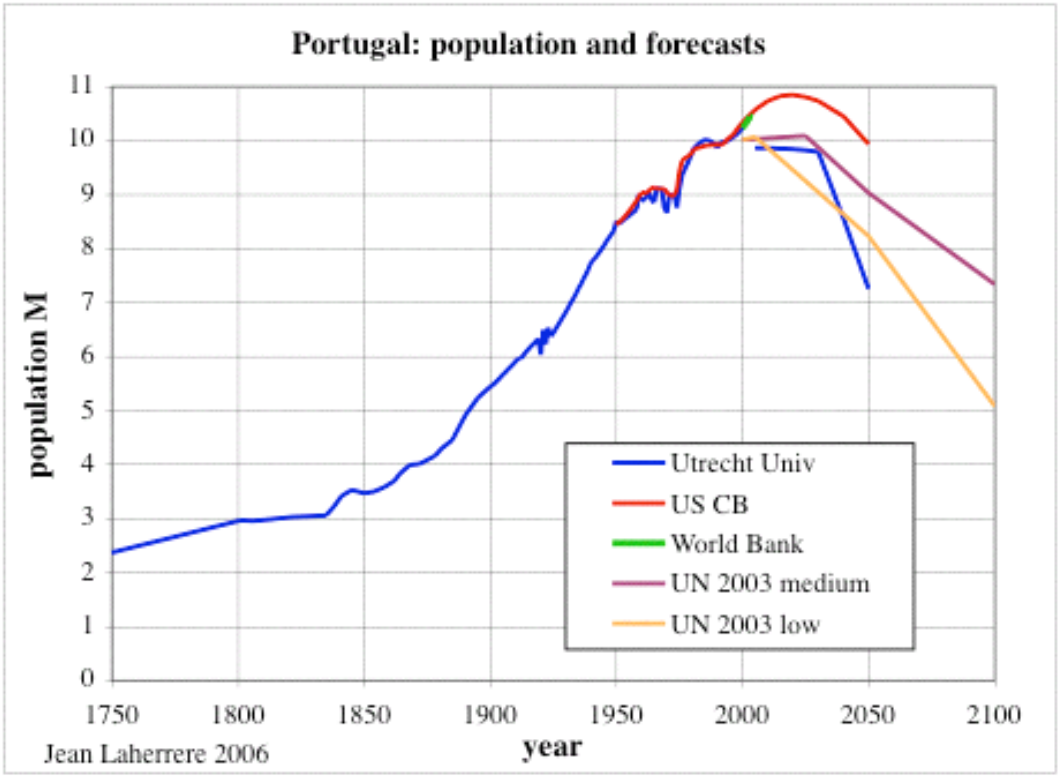
There are two different worlds: North America with growth and Europe with coming decline

Figure 98: **Europe and North America population forecasts**

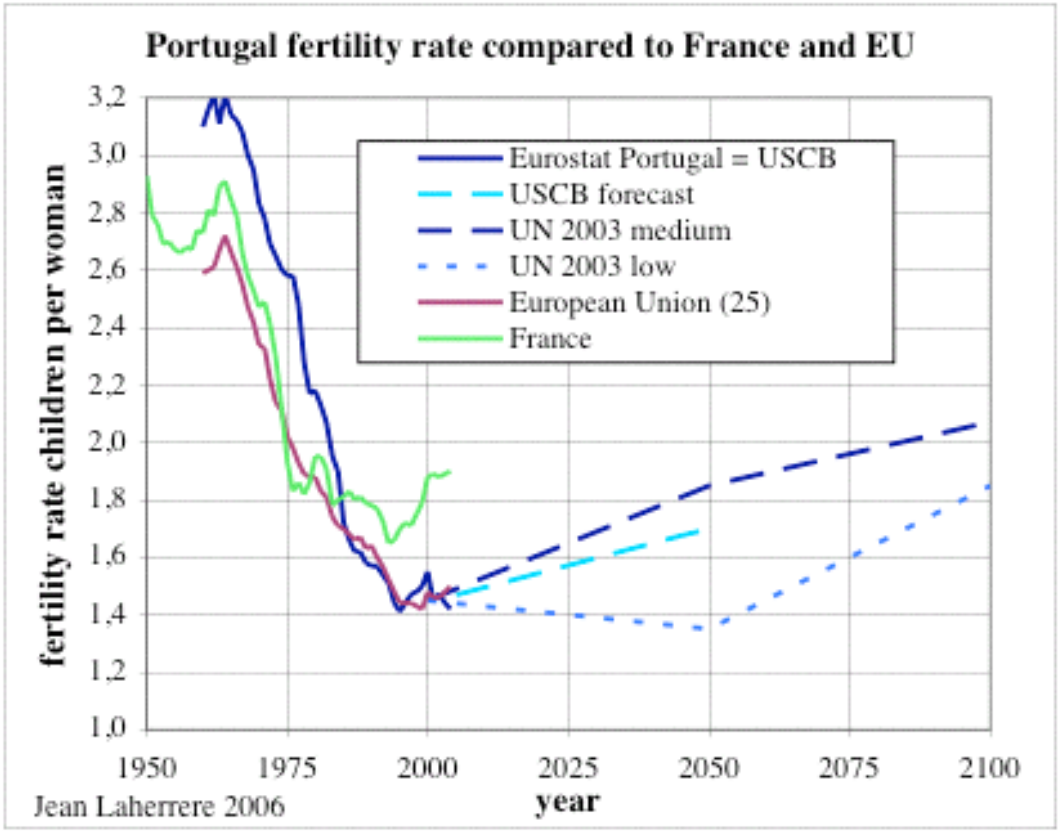


-Portugal

Portugal past population and forecast from different sources shows some discrepancy with USCB (adopted by Eurostat) and World Bank.
Peak is close and decline will be significant in 2050.
Figure 99: Portugal past population and forecasts 1750-2100



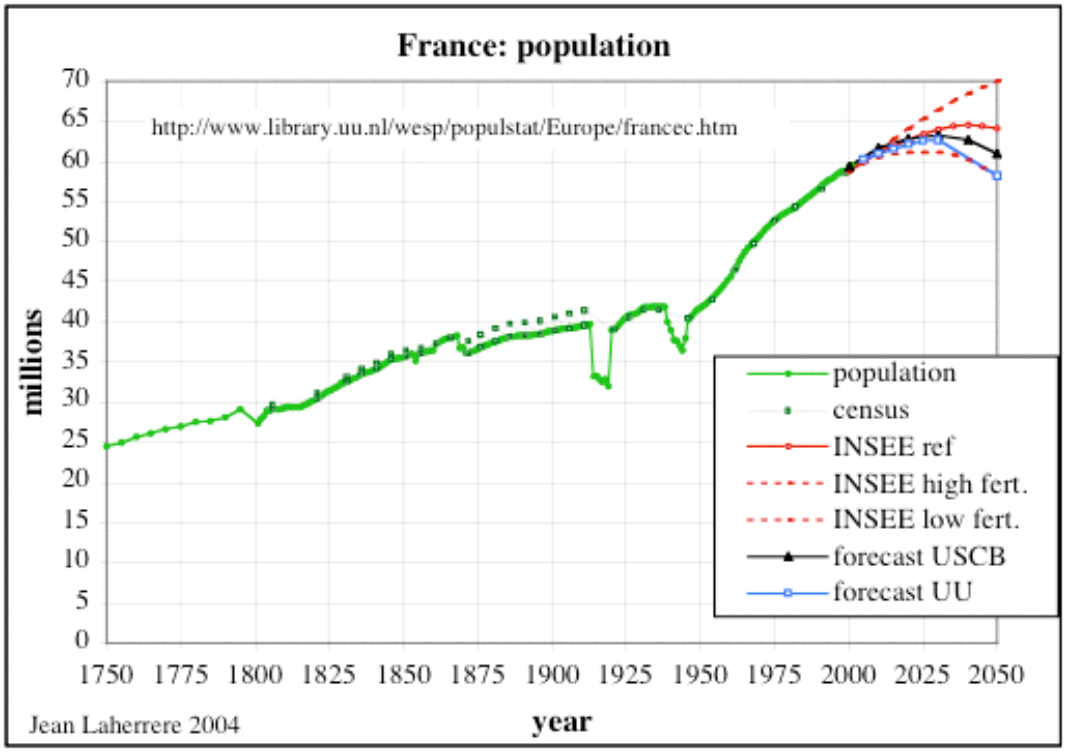
The fertility rate of Portugal is compared to the rate of France and EU.
Portugal rate has been dropping sharply and most forecasts hope for a strong rise in the future, except UN low. I would like to hear the comments of the ladies in attendance!
Figure 100: Portugal fertility rate compared to France and Europe (25)



-France

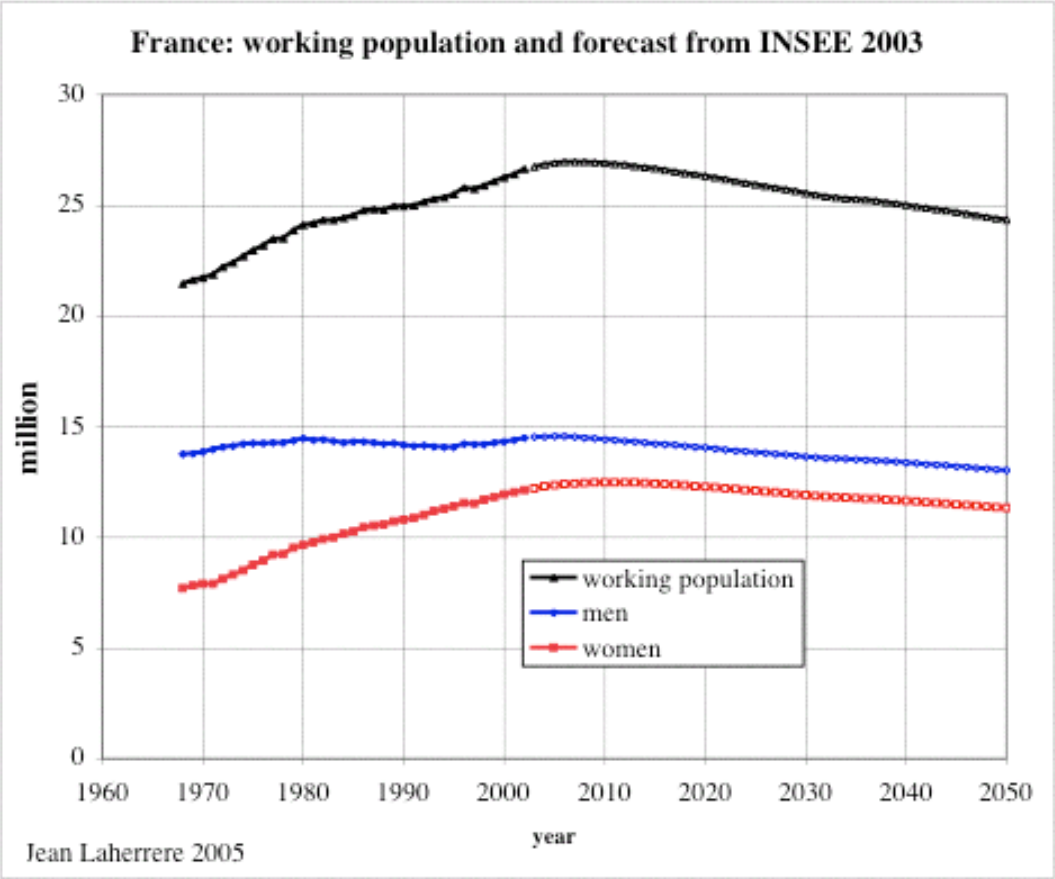
France population will peak around 2025

Figure 101: **France population**



Working population will peak in France this year but economic growth is forecasted at over 2%!

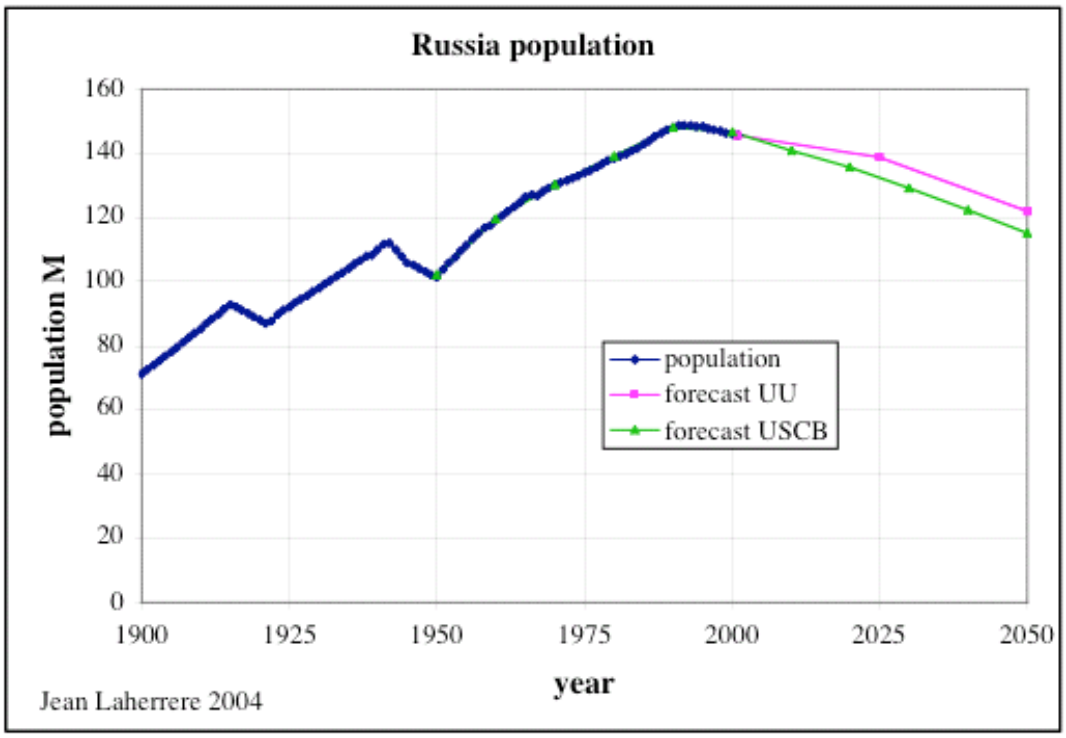
Figure 102: **France: working population & forecast from INSEE 2003**



-Others

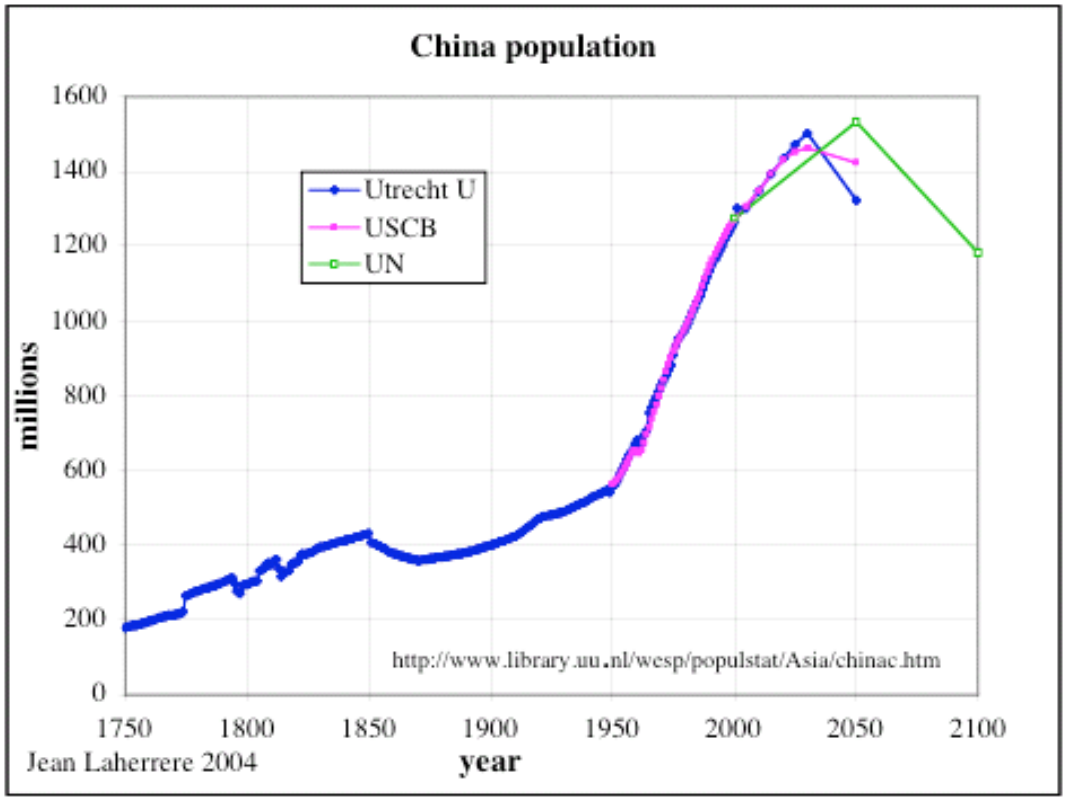
Russia has peaked in 1990 and will lose 30 million by 2050

Figure 103: **Russia population**



China will peak between 2025-2050 and decline by more than 300 M by 2100

Figure 104: **China population**



-**Price**

US whale oil displays an almost perfect symmetrical bell-shaped curve peaking in 1847 followed with a sharp increase in price (2000 $2003/b)in 1855 followed by a decline when oil was discovered in 1859 in US, but still 30 times more expensive than oil in 1875

Figure 105: **US whale oil production** and price compared to oil 1800-1900

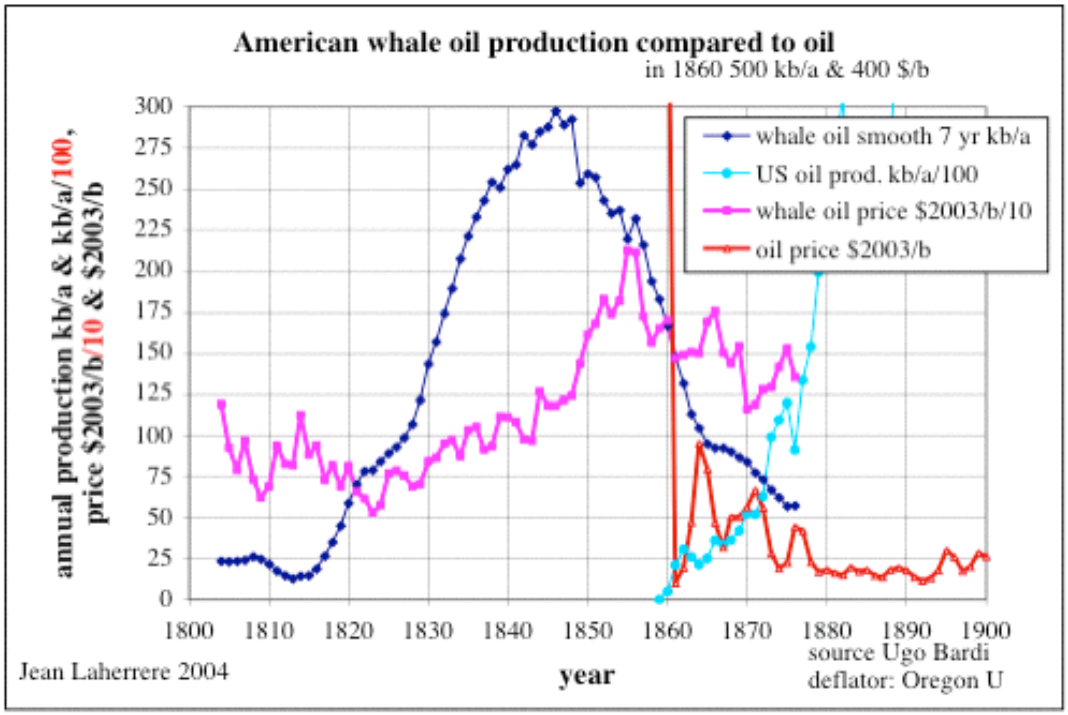
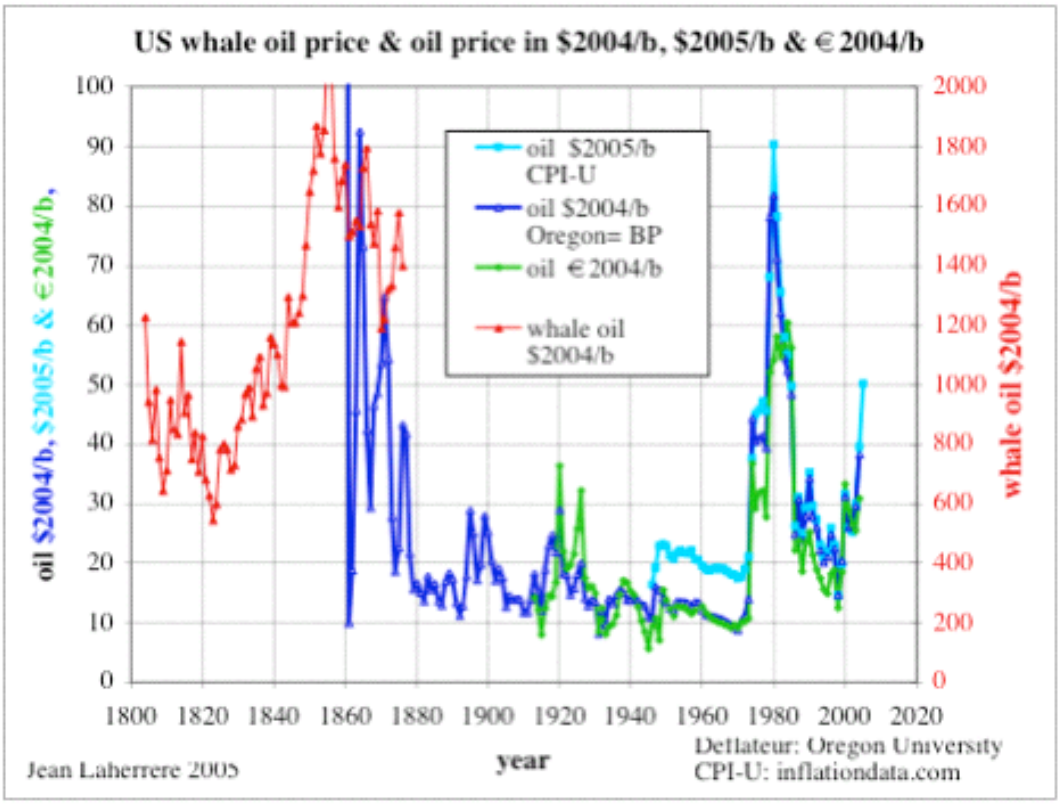


Figure 106: **World whale oil, oil price in today dollar and euro as French minimum wage 1860-2004**

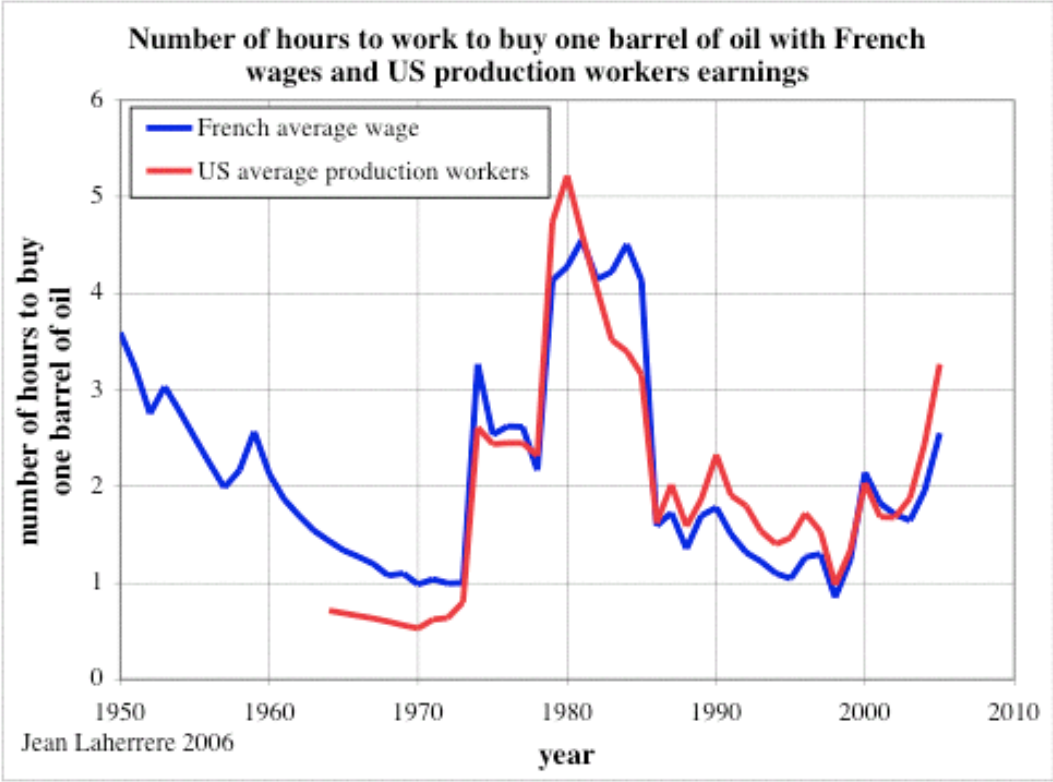


Present oil price is cheap compared to 1860 or 1980

-Working hours/barrel

Instead of comparing constant dollar using an inflation index which is highly manipulated and questionable, it is better to see how many hours of work was needed by an average worker to buy one barrel of oil.

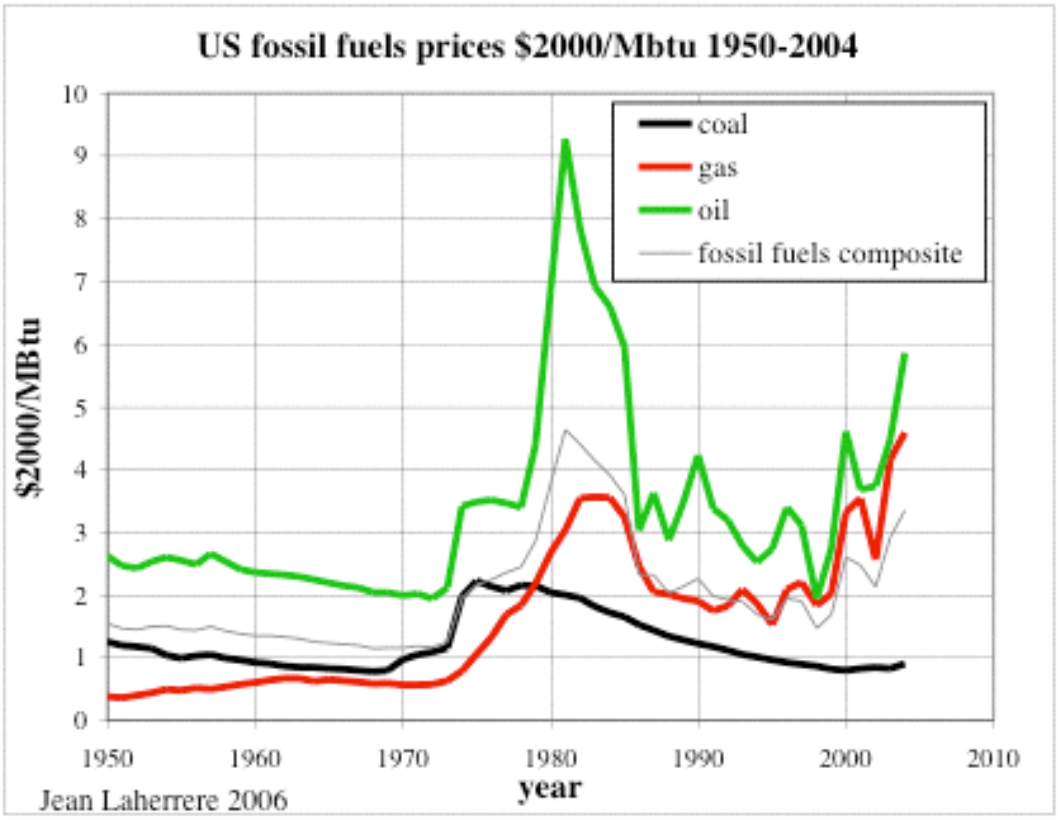
Figure 107: **Number of work hours to buy one barrel of oil with French and US wages**



It was necessary to work (at French minimum wage) to buy one barrel of oil 7 hours in 1950, 3 in 1972, 11 in 1981, but 2 in 1998 and 5 hours in 2005. Today oil has to be at 100 $/b to work as much as in 1981!
Since 1970 these number of hours are about identical for the average French, but the American can buy more barrels as he works 2000 hours per year when the French works only 1600 hours (20 % less!)

-Fossil fuel prices

The US fossil fuel price in $2000/Mbtu shows that gas price was for a long time quite lower than oil price, but now the difference is small, when it is still large between oil (over 5 $/Mbtu) and coal (1 $/Mbtu).
Figure 108: **USDOE/EIA fossil fuel prices**

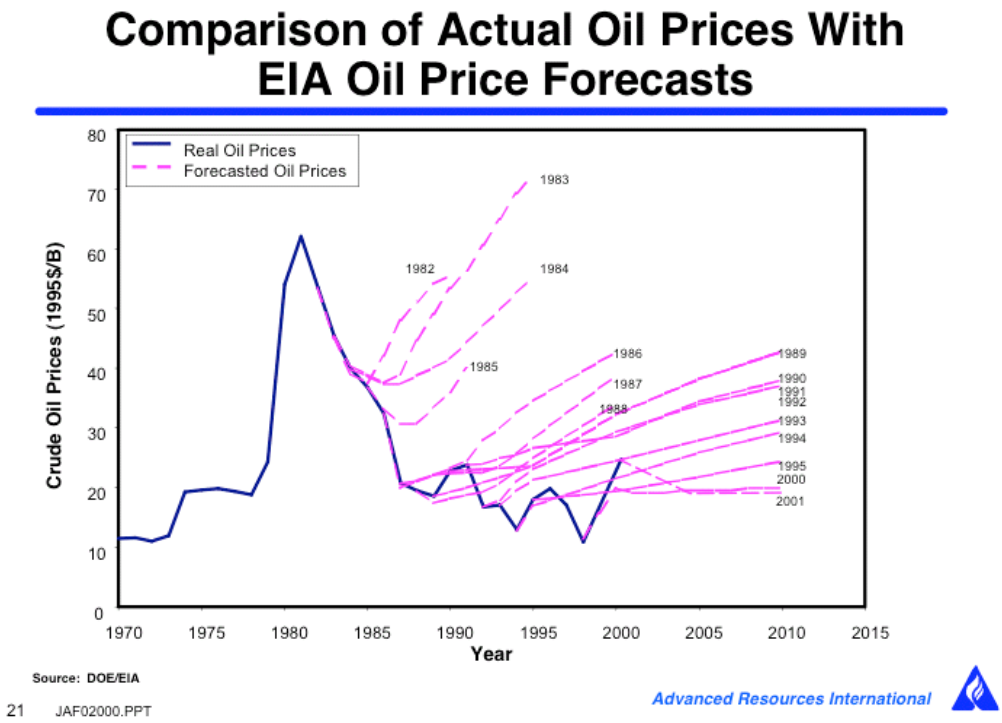


-Price Forecast

I have always refused to forecast oil price (outside forecasting *the end of the cheap oil* in 1998) as the behaviour of the consumer is too irrational.

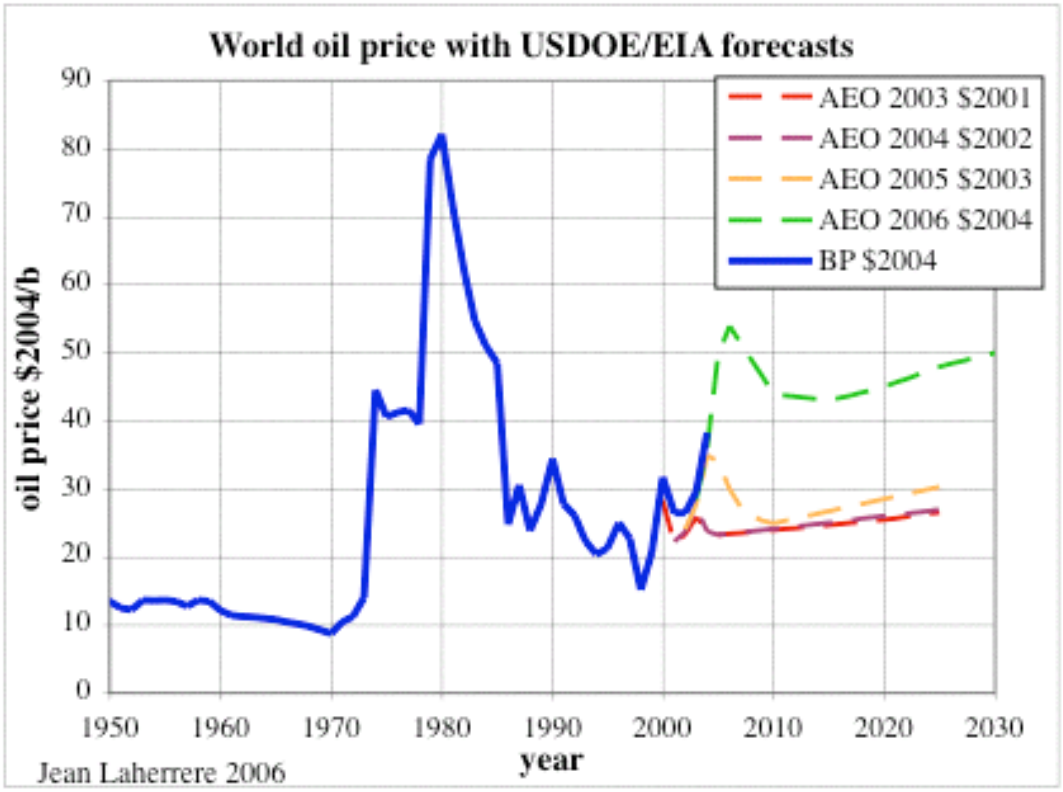
Official forecasts on oil price have been always wrong

Figure 109: **USDOE/EIA oil price forecasts 1982-2001 and actual price**



It is only in 2006 that official oil price forecasts were talking about 50 $/b, which is the new goal of OPEC for a future price target when (?) OPEC could apply prorationing (quotas) with excess capacity.

Figure 110: **USDOE long-term oil price forecasts AEO 2003-2006**



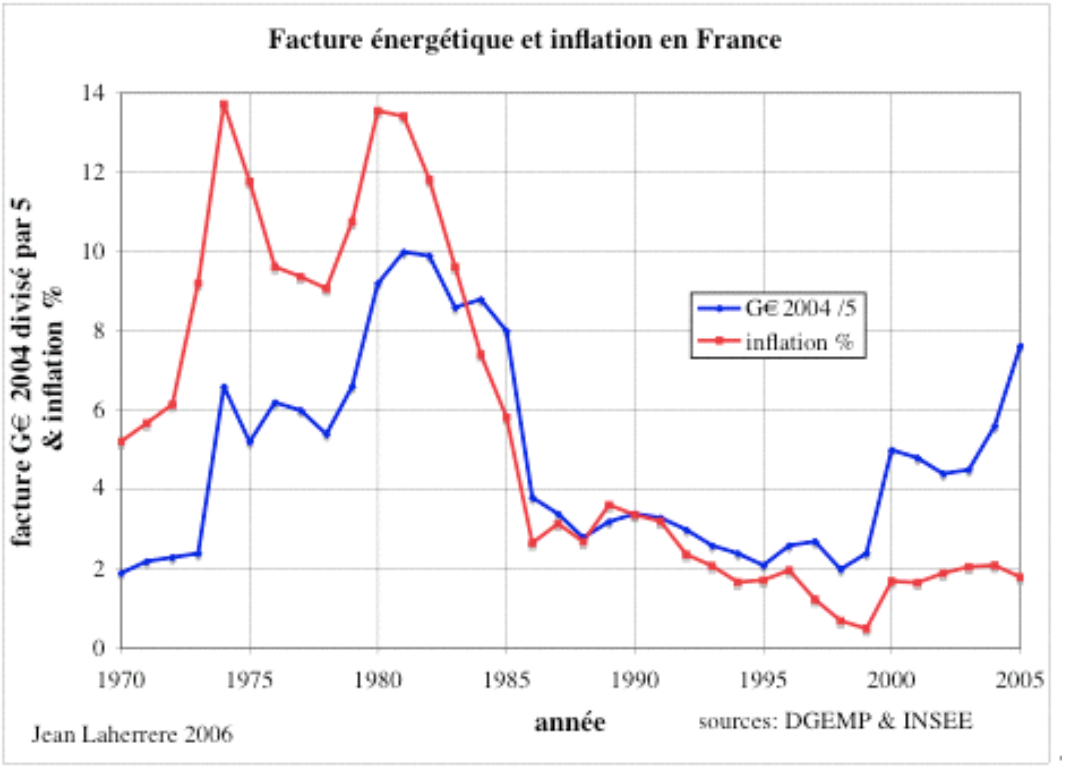
USDOE 2004 forecast was 24 $2002/b in 2010! USDOE 2006 forecast is 45 $2004/b in 2010

It is why no one wanted to invest in energy savings up to now!

-Economy

In France, there is some relationship between inflation and energy bill. Inflation should increase in the near future if the energy bill continues to grow, but it did not in 2005! The answer is that the impact of oil increase is borne by the taxpayer. French farmers and fishermen complaint about the fuel cost and ask for more subsidies, when in fact it is to the consumer to pay and not the taxpayer. Inflation should increase.

Figure 111: **France energy bill and inflation**



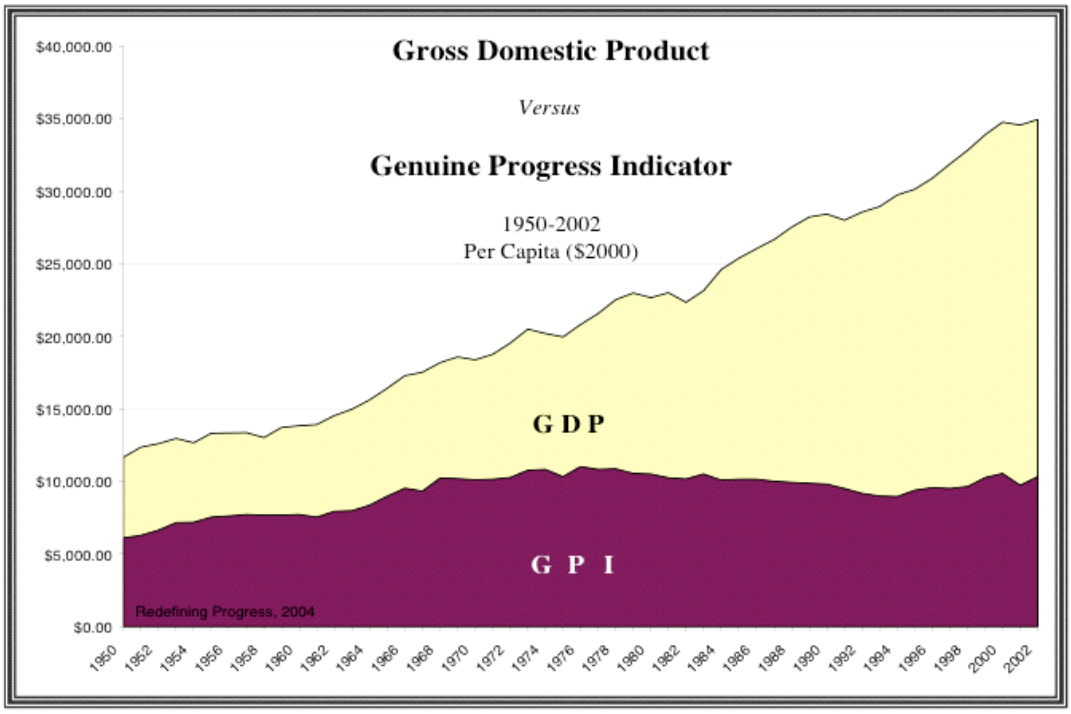
But French energy bill represents about 2% of the GDP and is less than the sole interest paid for the public debt!

-GDP and happiness

GDP is manipulated with several deflators, in particular the hedonic factor adding extra hundred of G$ for computer and software

GDP represent manipulated expenditures and not the wealth of a country.

Figure 112: **US GDP and Genuine Progress Indicator from Redefining Progress** = peak in 1977



Energetic intensity in toe/$GDP is flawed

Figure 113: **Income and happiness in the US**

Richard Layard London School of Economics: peak in US happiness in 1956

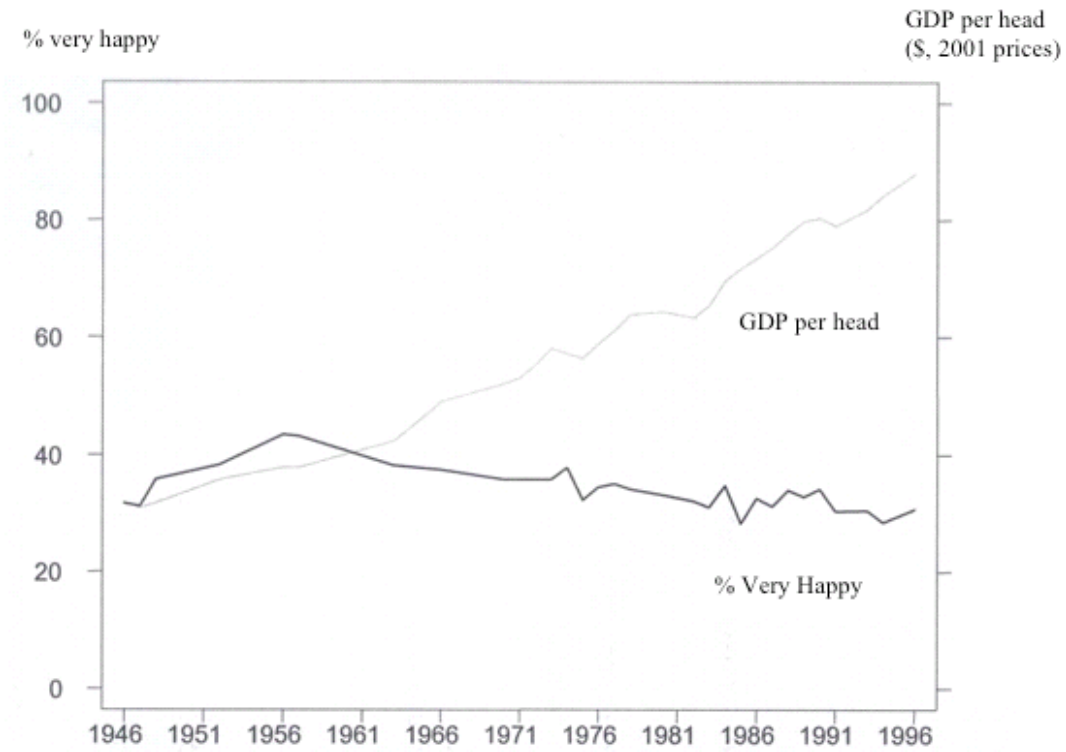
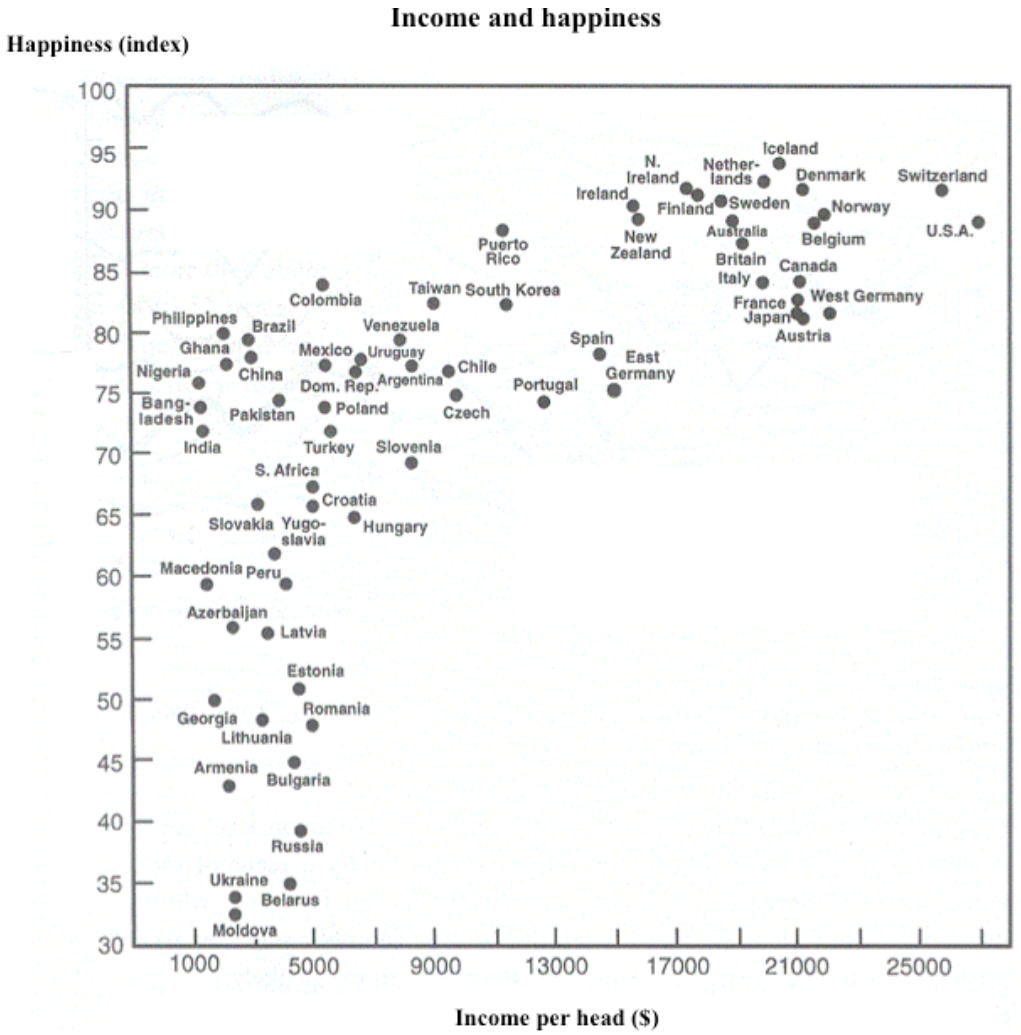


Figure 114: **Income and happiness in the world** from Inglehart & Klingermann 2000



Source: Inglehart and Klingemann (2000), Figure 7.2 and Table 7.1. Latest year (all in 1990s).

First Ireland, last Moldova
-New Scientist (2003):
the most happy countries = Nigeria, Mexico and Venezuela and the least = Russia, Armenia and Romania.
-University Erasmus Rotterdam = Eurobarometer
Ranking of the happiness index = How much people enjoy their life-as-a-whole on scale 0 to 10

top		**bottom**	
Colombia	8,1	Bulgaria	4,5
Denmark	8	Russia	4,4
Malta	8	Belarus	4,3

Switzerland	8	Pakistan	4,3
Iceland	7,8	Georgia	4,1
Ireland	7,8	Armenia	3,7
Ghana	7,7	Ukraine	3,6
Canada	7,6	Moldova	3,5
Guatemala	7,6	Zimbabwe	3,3
Luxembourg	7,6	**Tanzania**	3,2
USA	7,4		
Portugal	6,7		
France	6,6		
Nigeria	6,5		

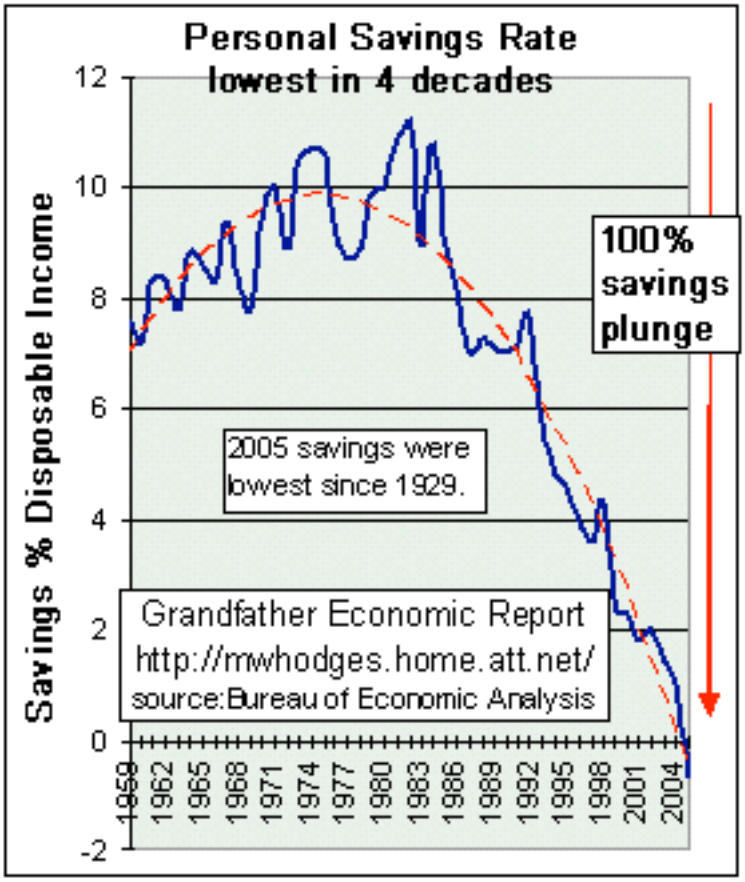
Happiness is hard to measure!

-**US economy**

The US trade in goods and services is falling like a stone!
The 2001 Internet bubble burst stops it a little.
Where is the bottom? US consumers keep buying and borrowing!
The present housing bubble will burst soon.
Figure 115: US trade in goods and services

US consumers do not save anymore and keep borrowing!

Figure 116: **US Personal savings are falling drastically** from Grandfather Economic Report site

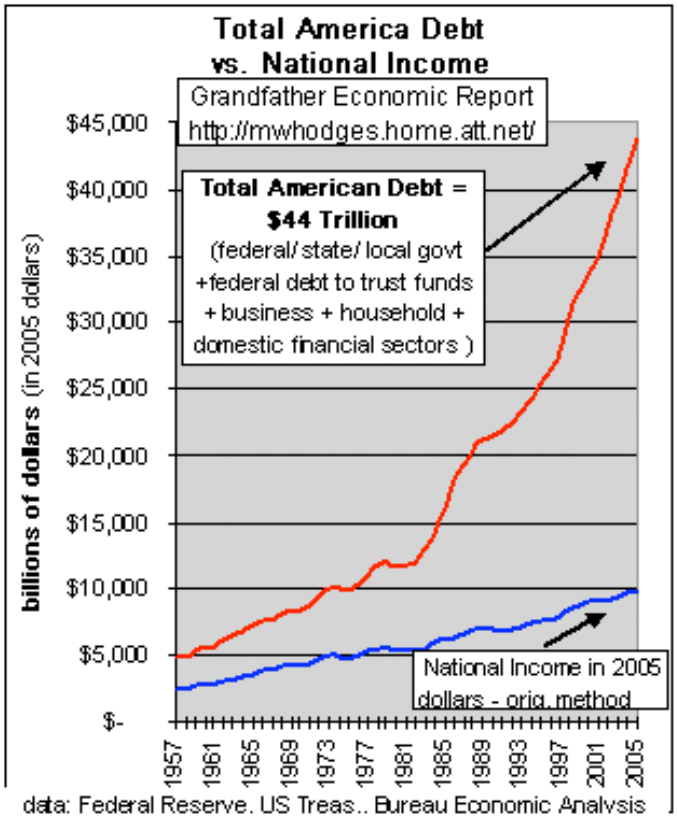


US borrow 80% of the world savings to keep consuming, what about when they reach 100%?

Chinese save 25% of their income and buy US Bonds, but for how long?

Is the US debt sustainable? When is the peak?

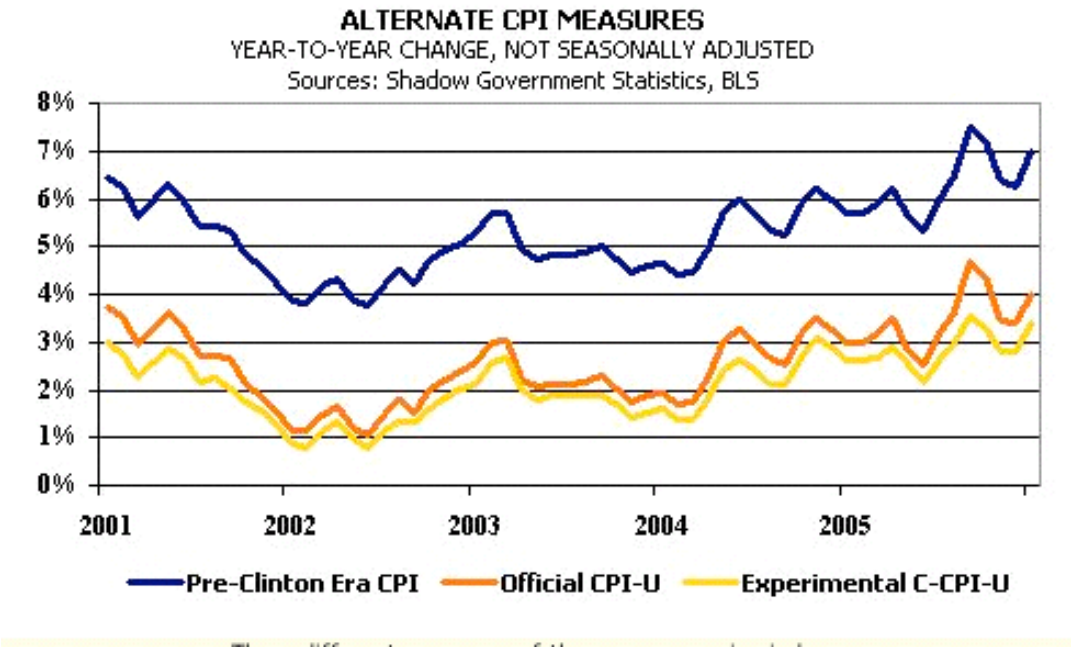
Figure 117: **Total US debt grows much more than income**



General Motors (GM) is close to bankruptcy: but 50 years ago it was said "what is good for GM is good for US"; today, it could be said "what is bad for GM is bad for US"

-Manipulation of data

US CPI, which is supposed to estimate inflation, is also manipulated (as the GDP with the hedonic factor which add artificial hundreds of G$ in the computing). It and was divided by half compared to pre-Clinton era
http://www.europe2020.org/en/section_global/150306.htm
Figure 118: US CPI changes



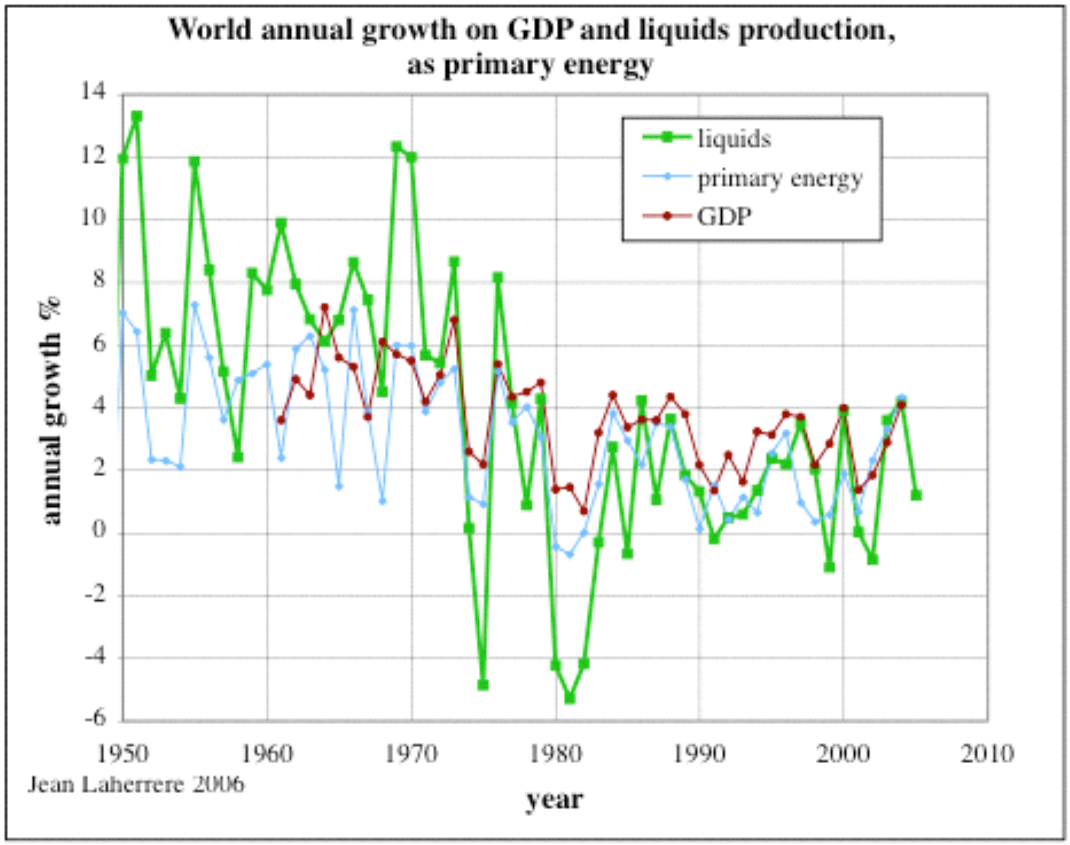
The US core inflation is a joke because it excludes food and energy, it means that the US consumer basically live without food, without heating, without light and without plugging his TV and computer and without gasoline in his car!

But EU countries cheat also on their data as Greece omitting their military expenditures, France and UK omitting civil servant pensions and cares, which almost double their public debt

Public debt in G€	Official	with civil servant pensions and cares
France	1100	1900
UK	645	1800

-World GDP, liquids and energy consumption

Figure 119: world growth of GDP, oil & energy demand 1950-2005



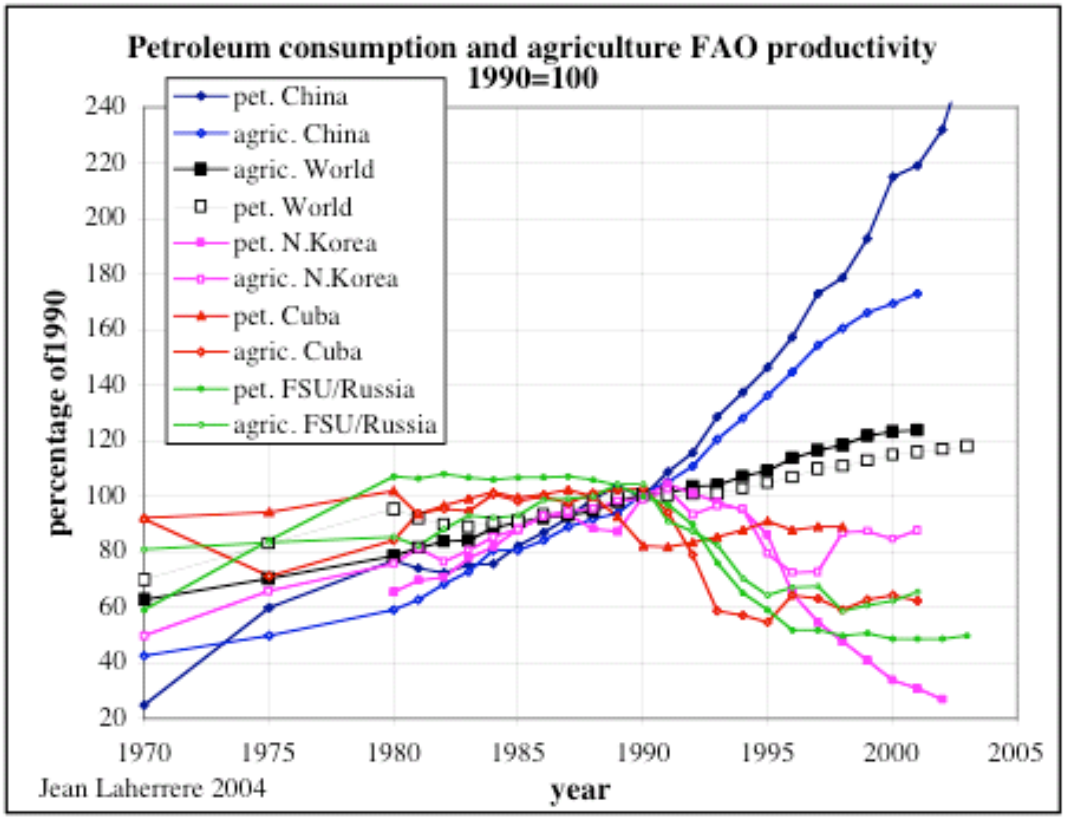
Cost of energy on the last 40 years has been around 5% of the world GDP when experts (Kummel, Ayres) estimate that energy contribution in GDP is around 50%. **Energy is largely under evaluated**.

-Agriculture

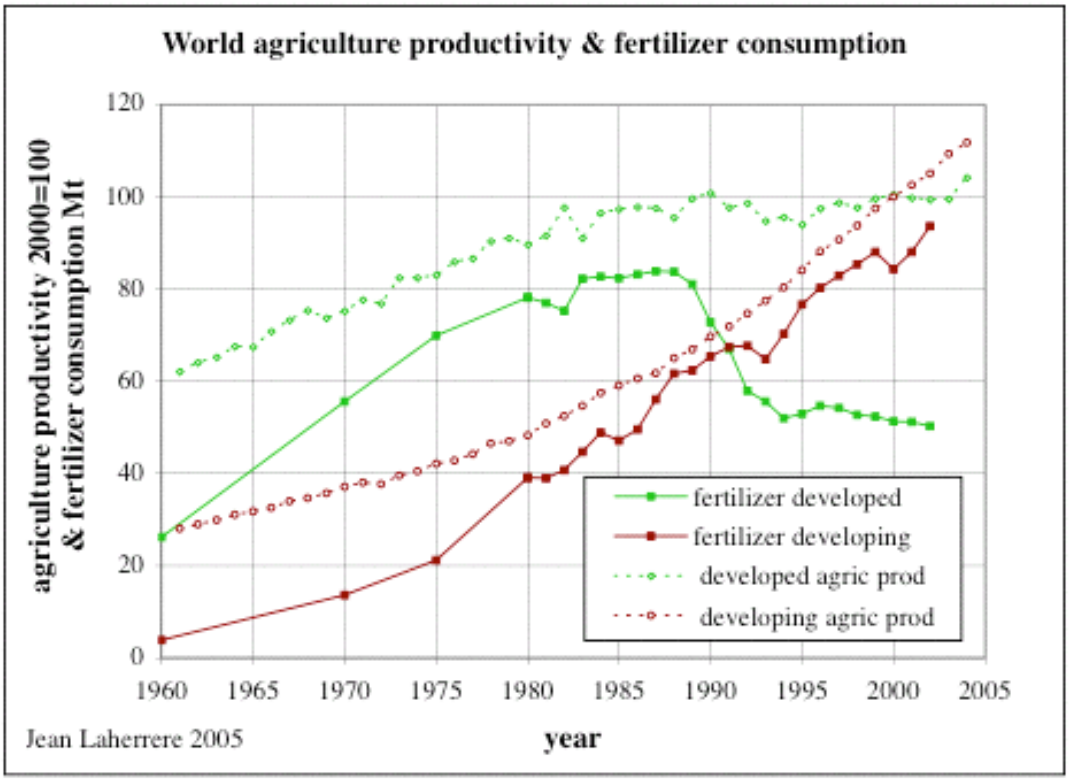
Agriculture productivity varies with petroleum consumption.

Agriculture converts oil into food!

Figure 120: **Petroleum consumption and agriculture productivity** 1990=100

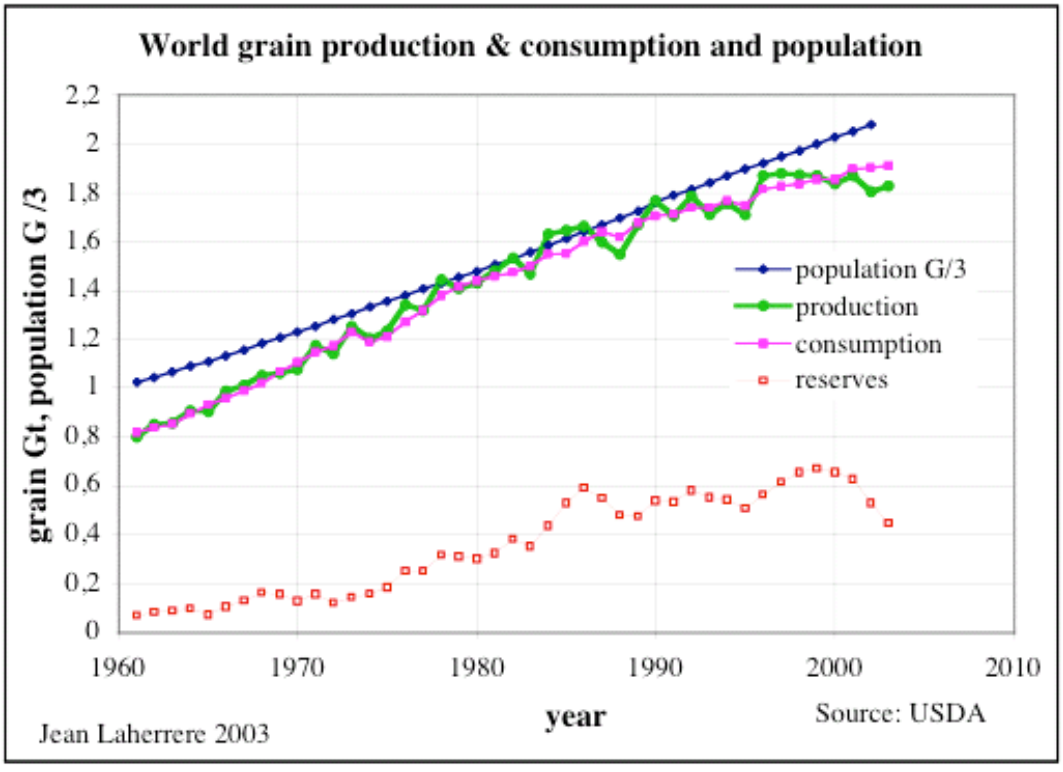


During the 90s developed countries has reduced fertilizer use by 30% without reducing productivity. Developing countries increase their fertilizer consumption but they should reduce it soon.
Figure 121: World agriculture productivity and fertilizer consumption 1960-2004

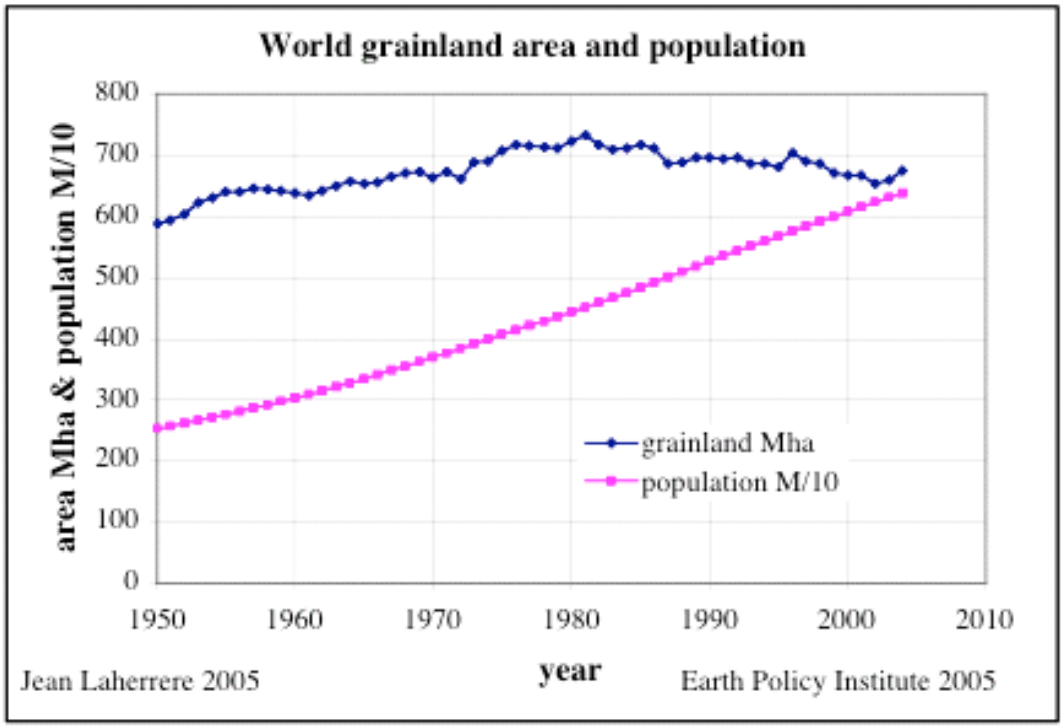


Since 1985 grain production increases less than population and less than consumption, leading to reserves decline

Figure 122: **World grain production, consumption, reserves and population**

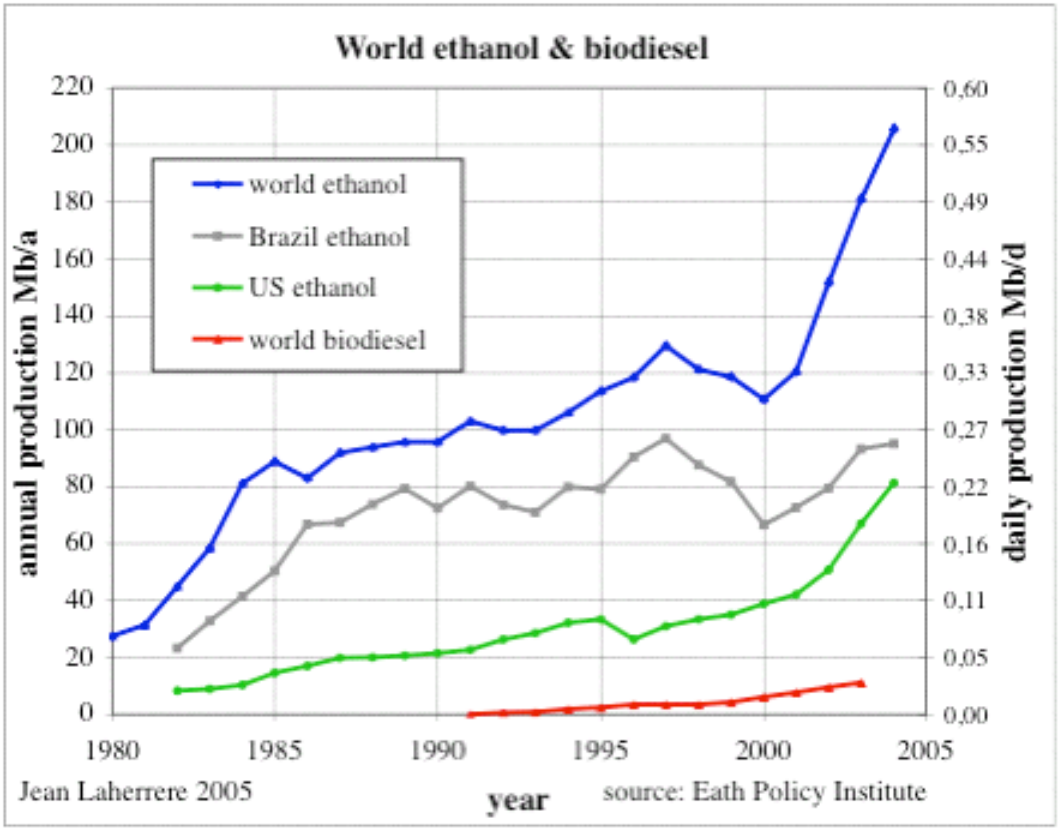


World grain land area has stopped growing since 1980, but not population
Figure 123: **World grain land area and population**



Agriculture cannot feed the world and fill drivers cars, because agriculture has reached the limits of the earth. Deserts cannot be turned into oasis and forests have been already reduced too much.

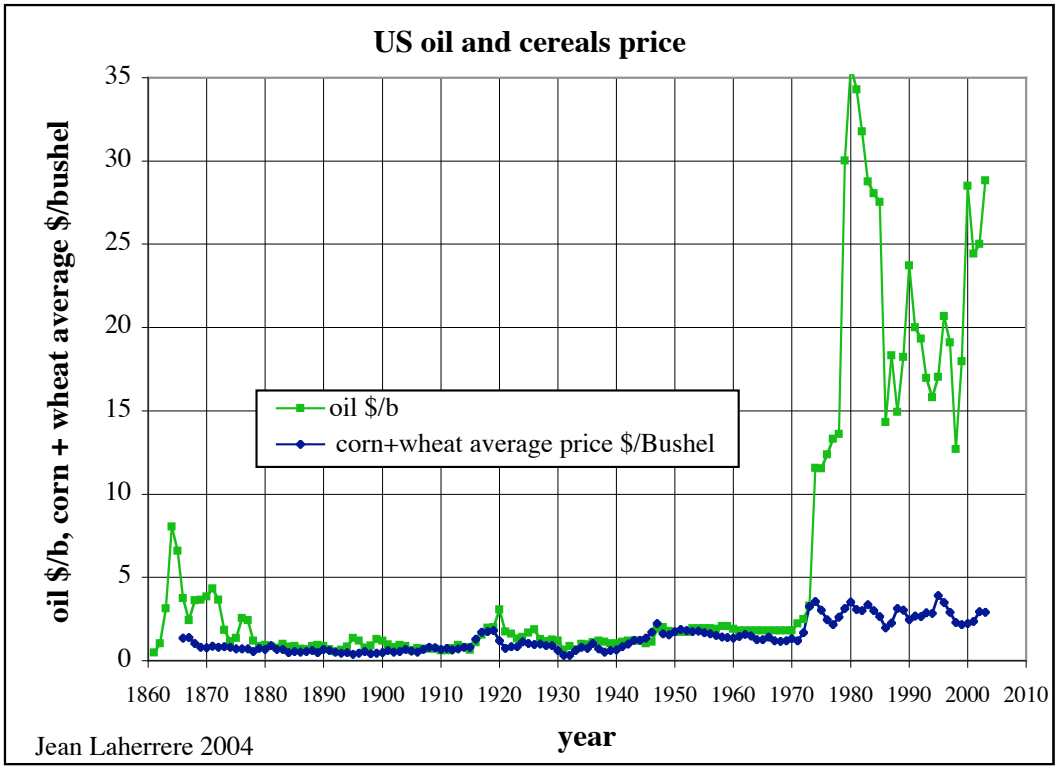
For more than 10 years there is a debate in the US on the energy returned over energy inverted (EROEI) for ethanol from corn where Pimentel & Patzek 2005 estimate that it is less than 1, when USDA estimate tthat it is about 1.3.
Subsidies upset the system. Only Brazil produce ethanol from sugar cane without using fertilizer, irrigation with a good EROEI.
Figure 124: world ethanol and biofuels production



-price comparison oil-grain

The current price of one wheat (or corn) bushel was on the same order as one oil barrel from 1880 to 1973, but since the first oil shock, wheat price has be multiplied by two when oil price by 10.

Figure 125: US price of oil and cereals 1860-2004



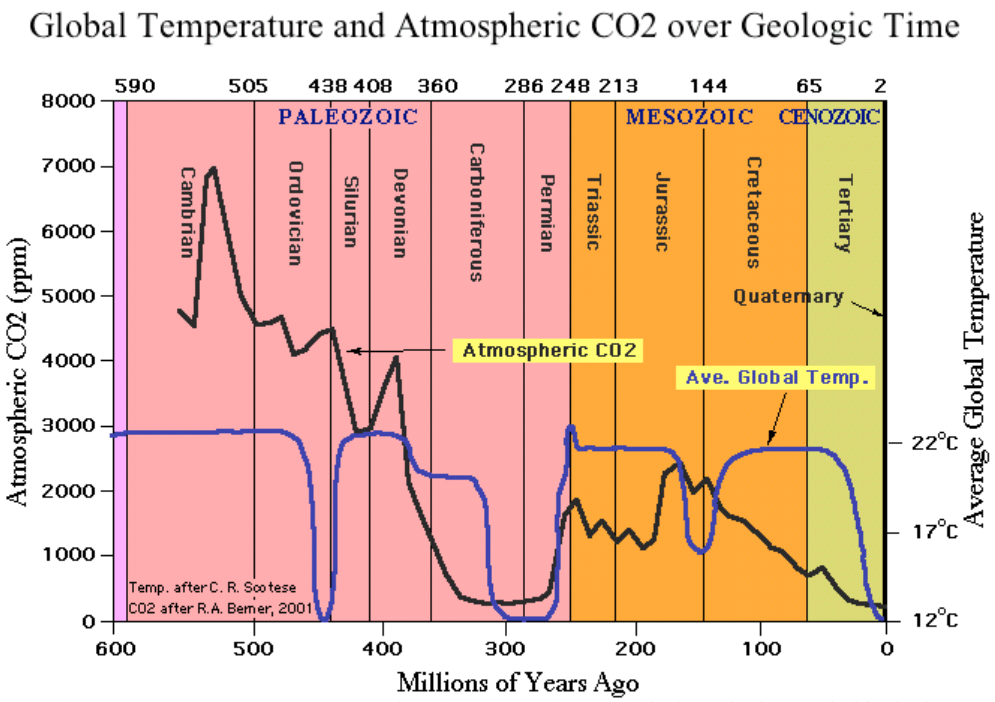
US cereal price is undervalued compared to oil and to the past.
Subsidies have flawed the comparison.

-**Global warming and climate change**

We are presently in an interglacial period within glaciations, which started two million years ago (lands at or around poles due to continent drift). Previous glaciations were 300 Ma ago. Climate changes all the times and geological layers are the best proof!

From the birth of Earth, temperature and CO2 has been most of time warmer than now. On the last 600 millions years warm climate prevail 80%, in the last million only 30%.

Figure 126: Earth temperature for the last 600 Ma from Gerhard 2004

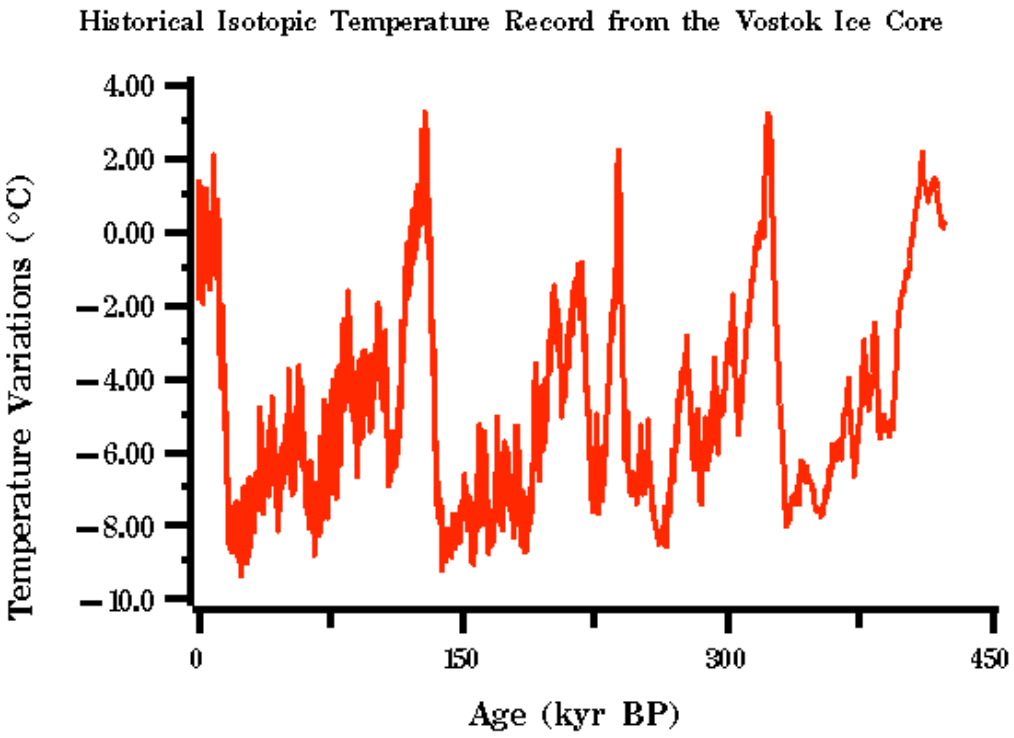


Late Carboniferous to **Early Permian** time (315 mya -- 270 mya) is the only time period in the last 600 million years when **both** atmospheric **CO2** and **temperatures** were as low as they are today **(Quaternary Period).**

Global warming (all earth is warmer) can be different from climate change (locally but no global increase)

Milankovitch has claimed in 1924 that climate changes follow astronomic cycles of the earth around the sun (3 parameters : eccentricity of the earth ellipse, incline of earth axis and precession of equinoxes). Climate comes from the Greek meaning incline. Sun cycles are about 20 000, 40 000 and 100 000 years as it can be seen on the temperatures measured (proxy) from Vostok ice in Antarctica, since 420 000 years, with variations of 10°C between glacial and interglacial (to compare to 0.6 °C increase since 1900).

Figure 127: **temperatures from Vostok ice since 420 000 years**

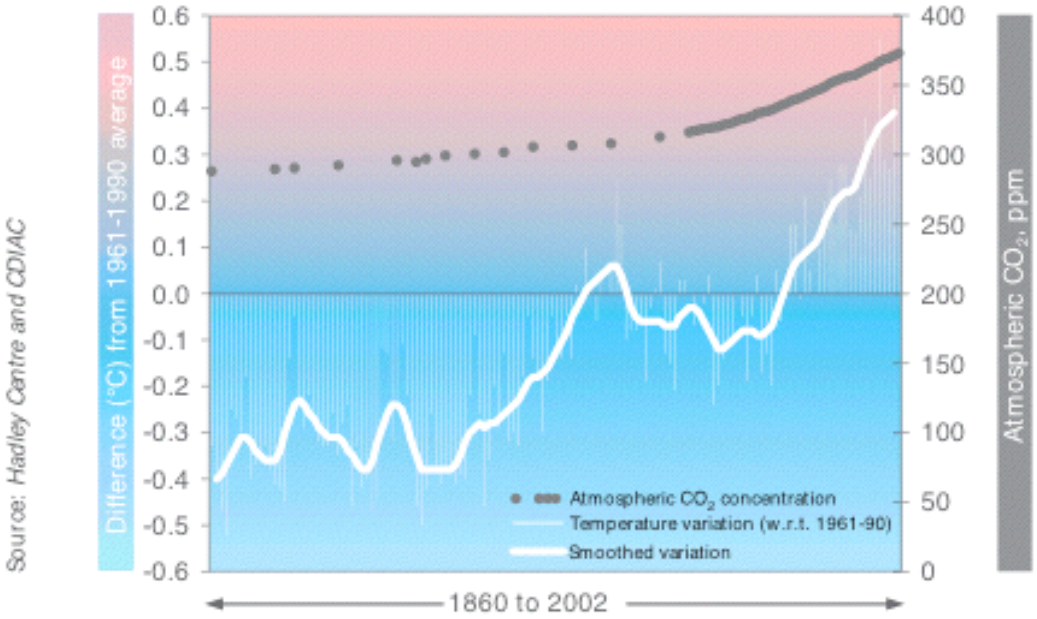


Variation with time of the Vostok isotope temperature record as a difference from the modern surface temperature value of −55.5 °C.

Source: Petit et al.

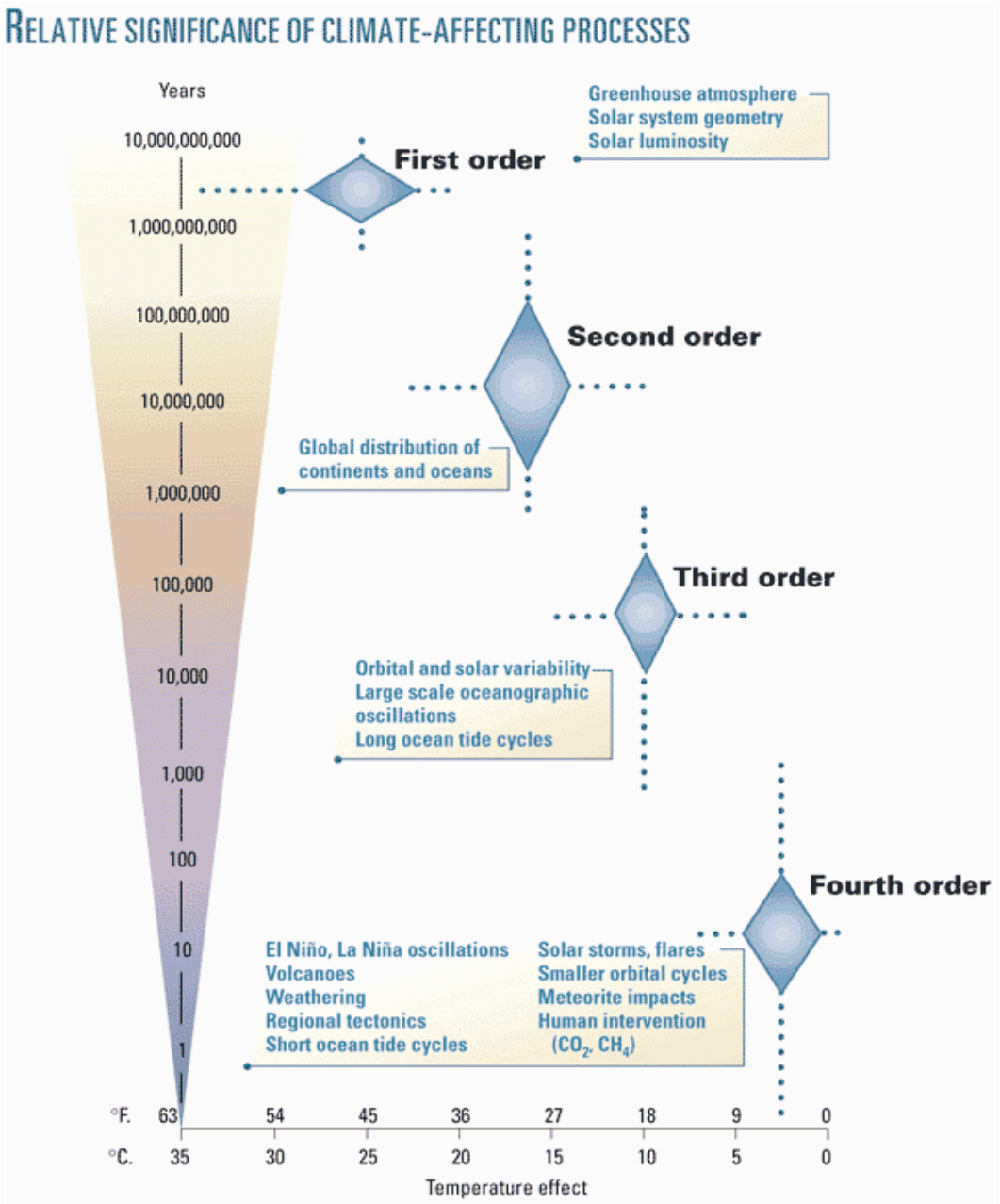
There is now global warming, indeed, because we are getting out of the little Ice Age. On the graph from Hardley Centre the correlation between CO2 and temperature is not obvious! In 1975 everybody was claiming that there was a global cooling because from 1940 to 1970 temperature has decreased when CO2 was increasing. Why?

Figure 128: **world temperature & CO2 1900-2002**

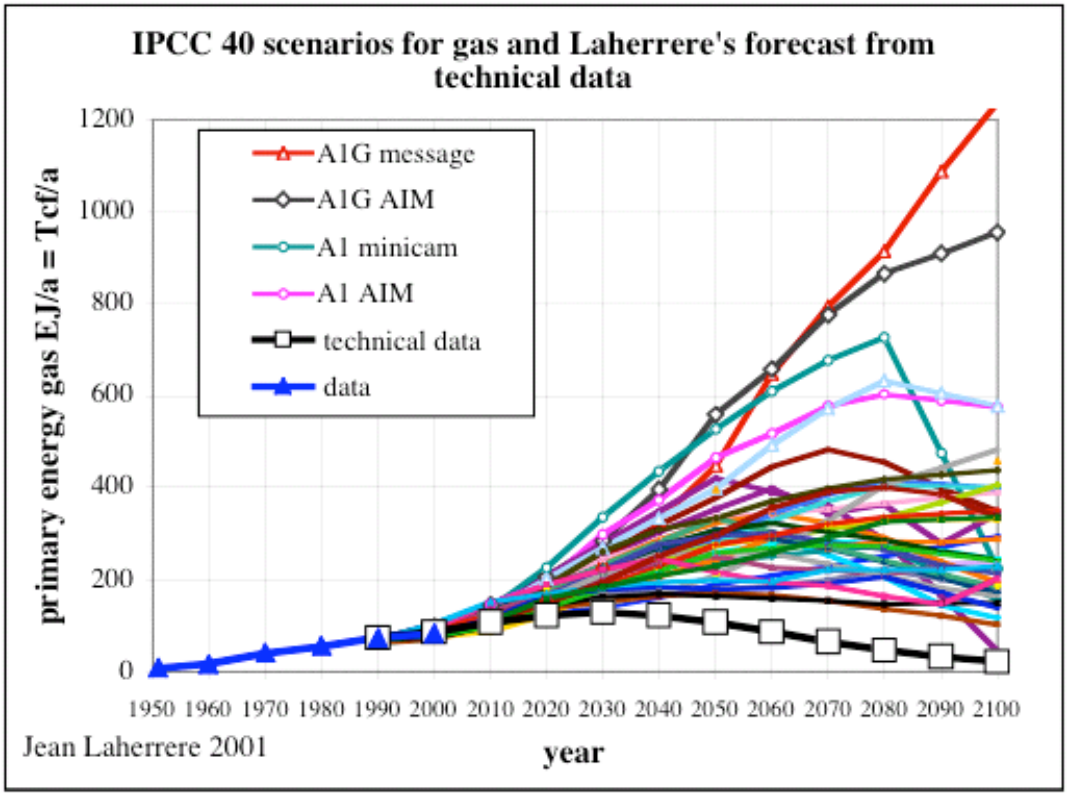


Explanation can be either aerosols (IPCC) or sun.
The main greenhouse gas is not CO2, but steam. Low clouds decrease temperature but high clouds increase it.

Human emissions are at the fourth order compared to solar system geometry being at first order.
Figure 129: relative significance of climate-affecting processes Gerhard 2001 AAPG



The IPCC 2001 report was based on 40 energy scenarios (SRES) which are academic and out of range with reality. The most dismaying is that these scenarios will be used again for the 2007 IPCC report!
Figure 130: IIASA scenarios (IPCC report) for gas consumption compared to technical data



IIASA dreams of a methane hydrate age!

Figure 131: IIASA scenarios (IPCC report) for oil consumption compared to mine

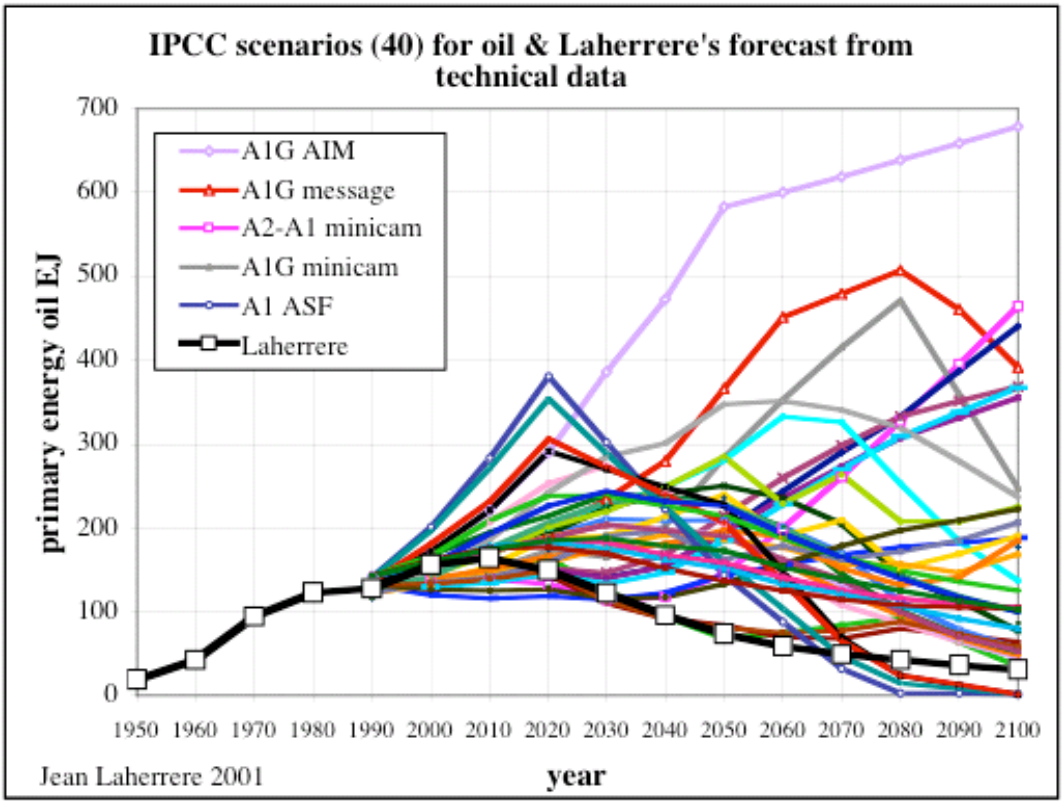


Figure 132: IIASA scenarios (IPCC report) for coal consumption compared to forecast from BGR ultimate

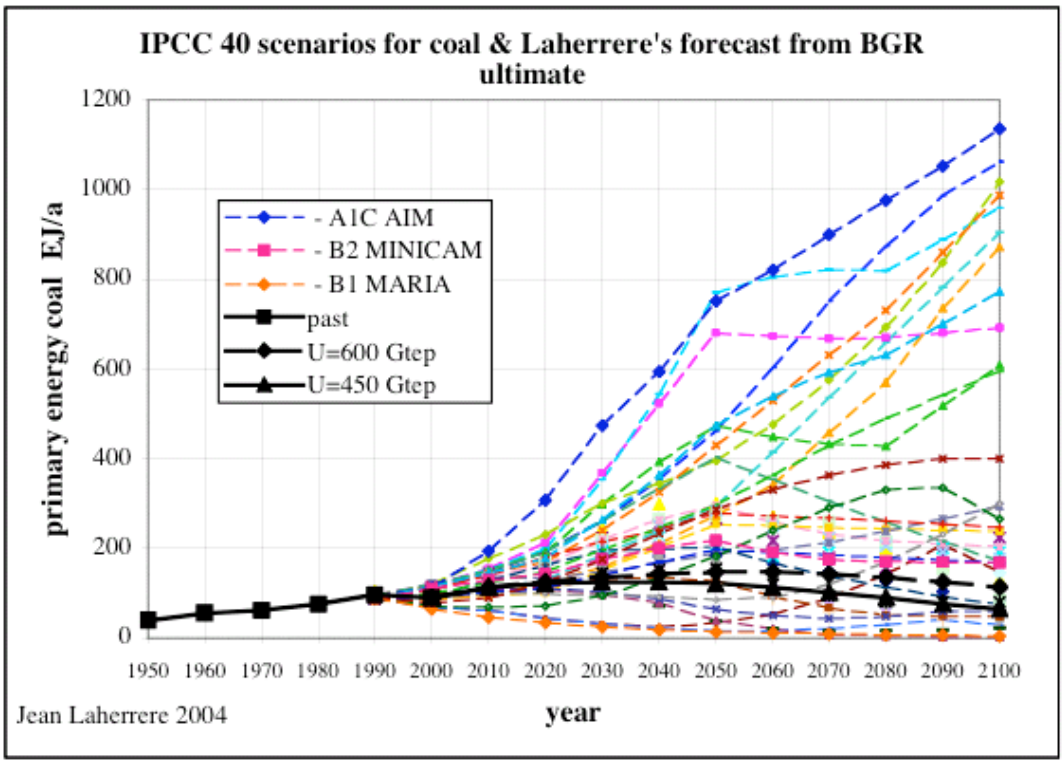
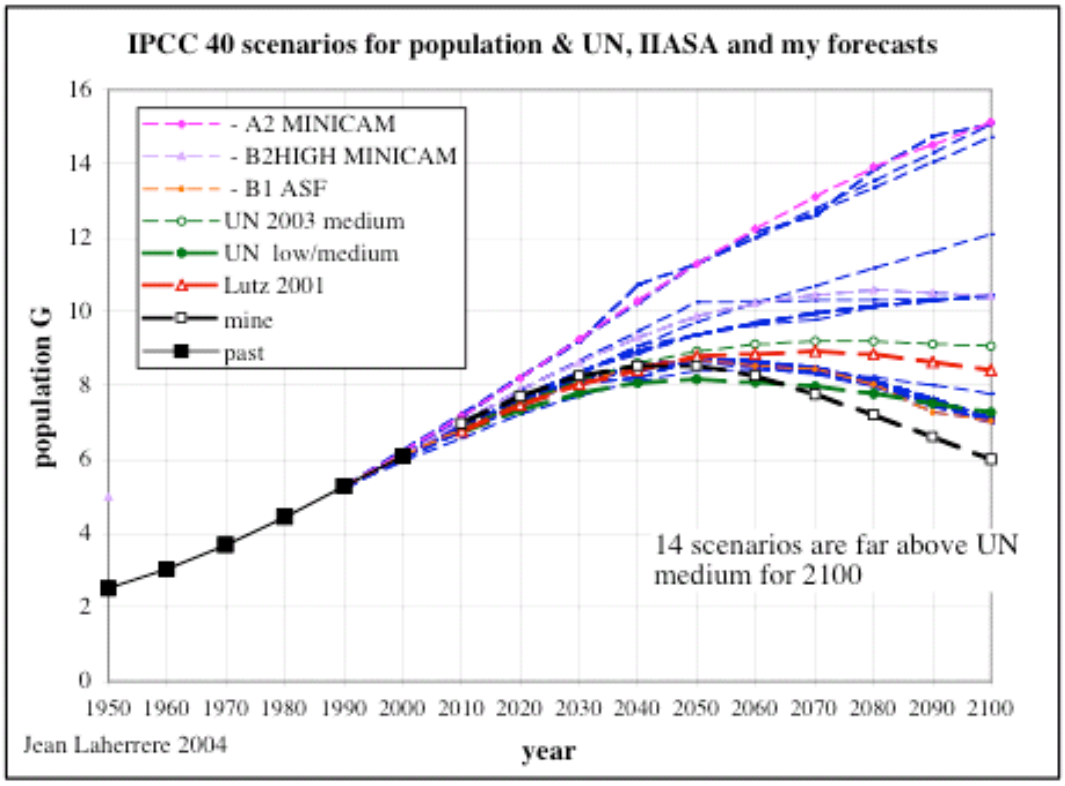


Figure 133: IIASA scenarios (IPCC report) for population compared to UN, IIASA (Lutz) and my forecast



as the Americans say : GIGO: **garbage in, garbage out**

-Conclusions

There are several worlds and not one, but they are confused

-**oil definition**: conventional oil, unconventional oil and all liquids

-oil production: in decline in more than 50 countries (US, North Sea), peaking (China, Russia soon), still growing: deepwater, extra-heavy, some in ME

-**gas markets**: North America, Europe and Asia Pacific

-**gas production**: local in North America and in decline, stranded in Africa

-**reserve definition**: US & OPEC = 1P, FSU = 3P, rest of the world = 2P

-**reserve estimate**: public in UK, Norway, US Federal lands; confidential in the rest of the world

-**population**: educated women countries with low fertility rate going towards extinction, non-educated women countries with high fertility rate growing

-**data**: published data are political or financial, and technical data are confidential because the competition

-experts: economists having only access to political data, believing that money and technology can do anything, but do not listen to technicians; managers or politicians who have to show growth to be well considered; technicians having access to real data and knowing the limits of techniques, but hardly free to speak, only if retired

Many parameters are wrong:
-proved (minimum?) reserves to please bankers (when development are decided on mean reserves) with incorrect aggregation
-R/P, which trends towards 20 years for the world mean reserves and towards 10 years for US proved, reserves since the last 80 years
-GDP, which represents expenditures and not wealth, and is not connected with happiness
Official forecasts are wishes or literary scenarios and not based on any data
Publishing data is a political act and depends upon the image the author wants to give. Published data are flawed (GDP, inflation, debt, production, reserves)
Economists do not think wrong, they think on wrong data
Energy is undervalued, because it represents only 5% of the GDP when its contribution in GDP is about 50%
Nature is more important than thought by most people
-what is born will peak and later die
-constant growth has no future in a limited world
-reserve uncertainty is large because of the geological complexity and the very limited amount of measures
-oil production mimics oil discovery with a certain lag (7 to 50 years), but is constrained also by demand and the first oil peak of 1979 was due to lower demand in front of high oil price expectancy (which was wrong!).
-US discovery peaked in the 30s and US oil production peaked in 1970. World oil discovery peaked in the 60s and production could peak in the next decade or so
-the coming oil peak could be in fact a bumpy plateau if economic depression constraints the demand and delays the peak
-world gas production peak will come later than oil peak, but a gas shortage could occur soon in North America and later in Europe
-coal resources seem to be less than reported by lack of good inventory and good definition; coal could peak much sooner than expected
-fossil fuels production will peak around 2030, but the production per capita, which was flat for the last 25 years, will stay flat for the next 25 years
-primary energy extrapolation of the past (10 Gtoe in 2003) leads to models of either peaking or flattening at 14 Gtoe
-high-energy price is the best solution to save energy and save future demand problems
-shortages in water, agriculture and fishery will likely occur sooner than for fossil fuels
-countries where women are educated are trending towards extinction, with fertility rate less than replacement

-Europe will lose 100 millions people in 2050 when North America will gain 100 millions!
-fossil fuels scenarios used by IPCC reports on climate change are unrealistic and obsolete, making IPCC conclusions unreliable for the report in 2001 and the coming one in 2007 = GIGO
Saint-Exupery has written: "**We do not inherit the Earth from our parents, we borrow it to our children**"

More graphs and papers are on the site www.oilcrisis.com/laherrere

Sorry for the broken English!