

Peak oil and related peaks!

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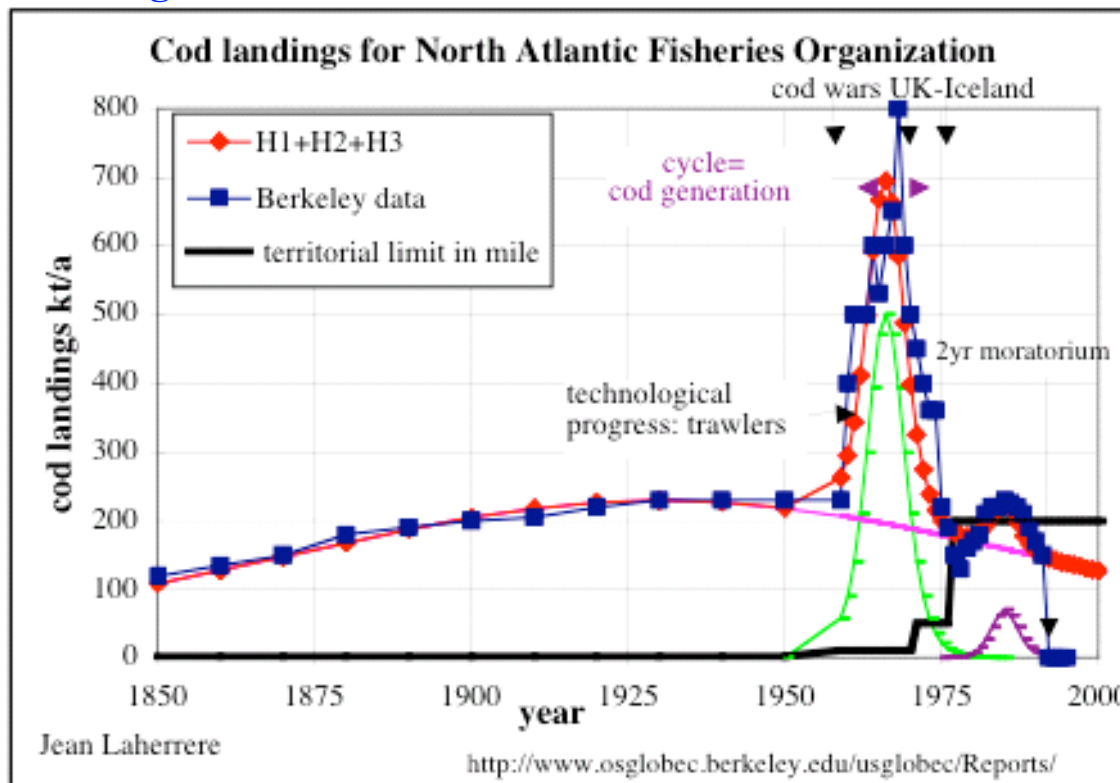
A long paper is available on www.oilcrisis.com/laherrere/Evora-part1.pdf & -part2

Paul Valery wrote: “All that is simple is false and all that complex is useless”

-Present basic facts

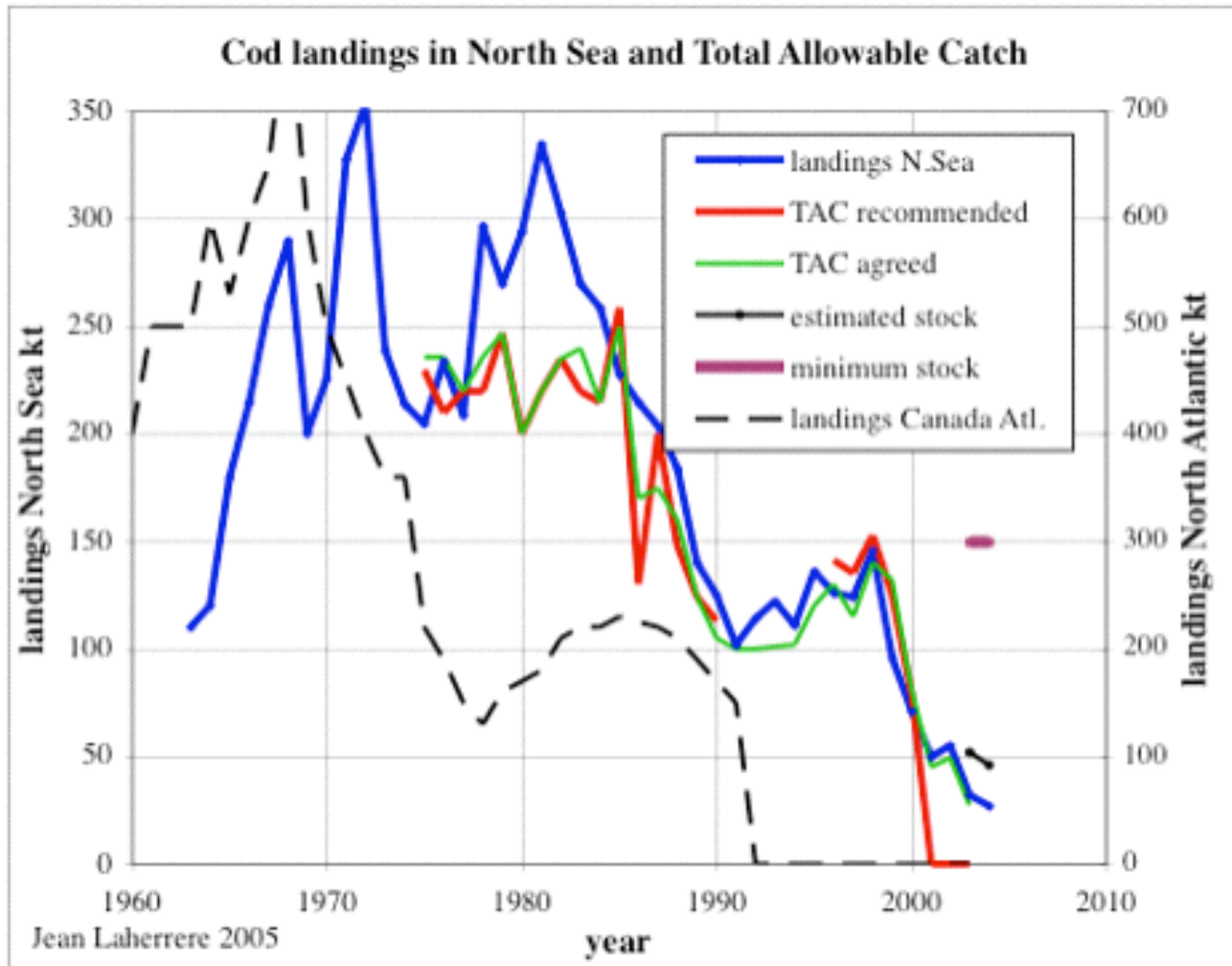
-natural events display several peaks and usually can be modelled with symmetrical cycles (like Fourier analysis)

.Figure 1: **Cod landings in Northern Atlantic**



North Sea cod fishing is going exactly the same way with 15 years delay

Figure 2: **Cod landings in North Sea** and Total Allowable Catch (TAC) compared to North Atlantic



-Problems of wording

Oil is reported for 2005 production varying from **crude oil (71 Mb/d)** to **all liquids (84 Mb/d = oil demand)**

Conventional = primary and secondary recovery **Unconventional** = tertiary recovery (EOR), extra-heavy, synthetic

Peak oil (Google 4 000 000) or **oil peak** (200 000)? **Why such difference? My answer = ASPO**

One peak model (one cycle = Hubbert peak) or **several peaks model?**

Peak by lack of demand or by lack of supply? Peak or bumpy plateau?

-Reporting data

-publishing data is a political act and depends upon the image the author wants to give (rich in front of a banker or for quotas, poor in front of a tax collector).

-OPEC productions are ruled by quotas, but because OPEC members were cheating, OPEC oil productions are flawed and unreliable.

-words such as **energy, oil, reserves, conventional, reasonable, sustainable, dangerous** are badly or **not defined on purpose**

-reporting any data with more than 2 significant digits shows that the author is incompetent

There are **three worlds**:

-economists **having only access to political data, believing that money and technology can do anything**, ignoring 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 when retired.**

-Reserves

Field reserves are confidential in most countries except UK, Norway and US federal lands.

Reserves represent what will be recovered in future

Resource is what is in the ground; reserves are only a small part of resource

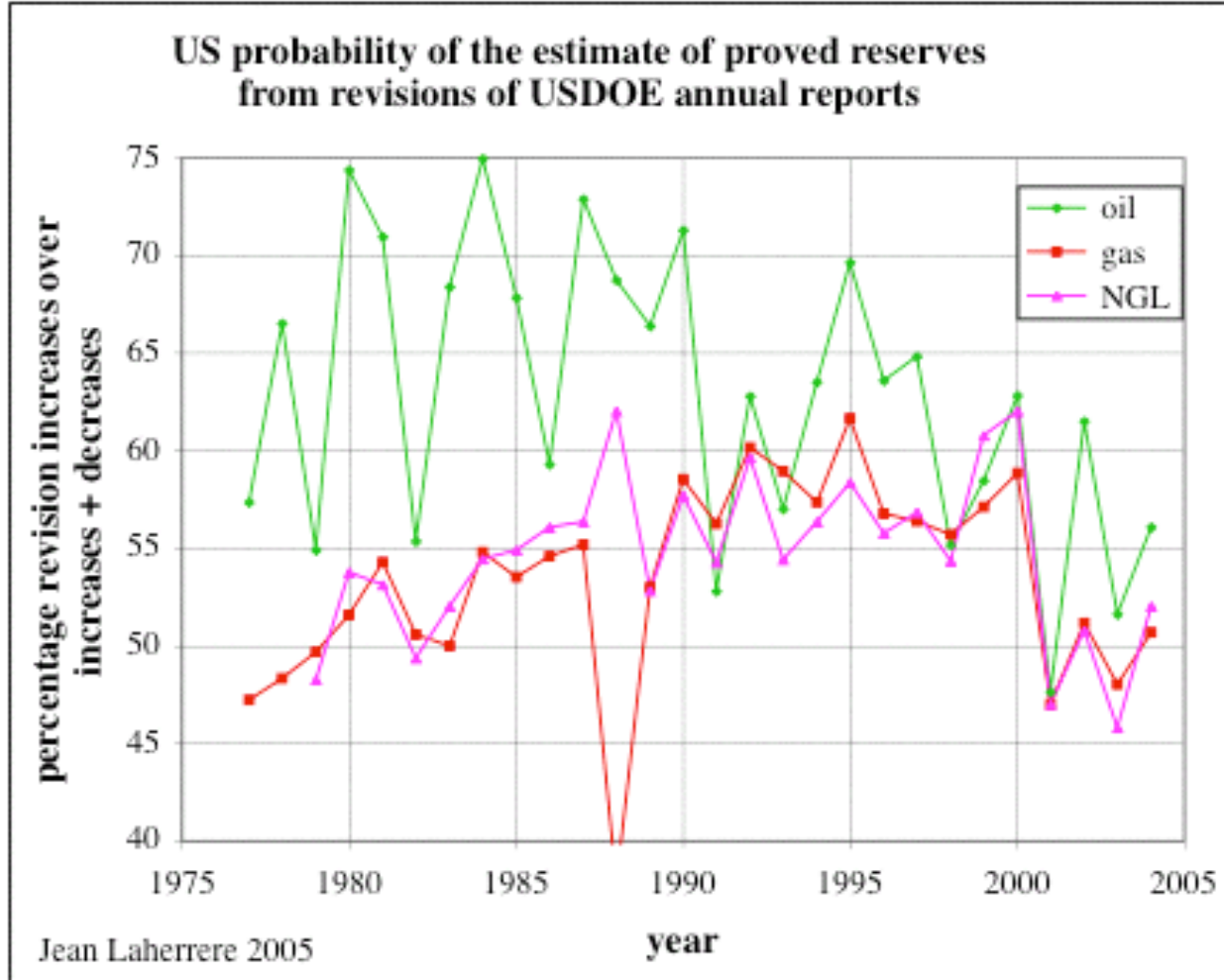
There are several reserve definitions in use:

- US** = all companies listed on the US Stock Market are obliged to report only **proved = 1P** \approx assumed to be the minimum?
- FSU** classification = maximum theoretical recovery \approx **proven + probable + possible = 3P** \approx maximum
- Rest of the world** = SPE/WPC 1997 rules = **proven + probable = 2P** \approx expected value

-Reluctance to change & risk

- world oil industry is dominated by US practices (barrel) and US rules (proved)
- US industry reluctant to adopt the metric system (crash of Mars Climate Orbiter in 1999) and US shops the credit card with a chip
- US banks reluctant to accept uncertainty and probabilistic approach
- US rules oblige companies to omit probable reserves

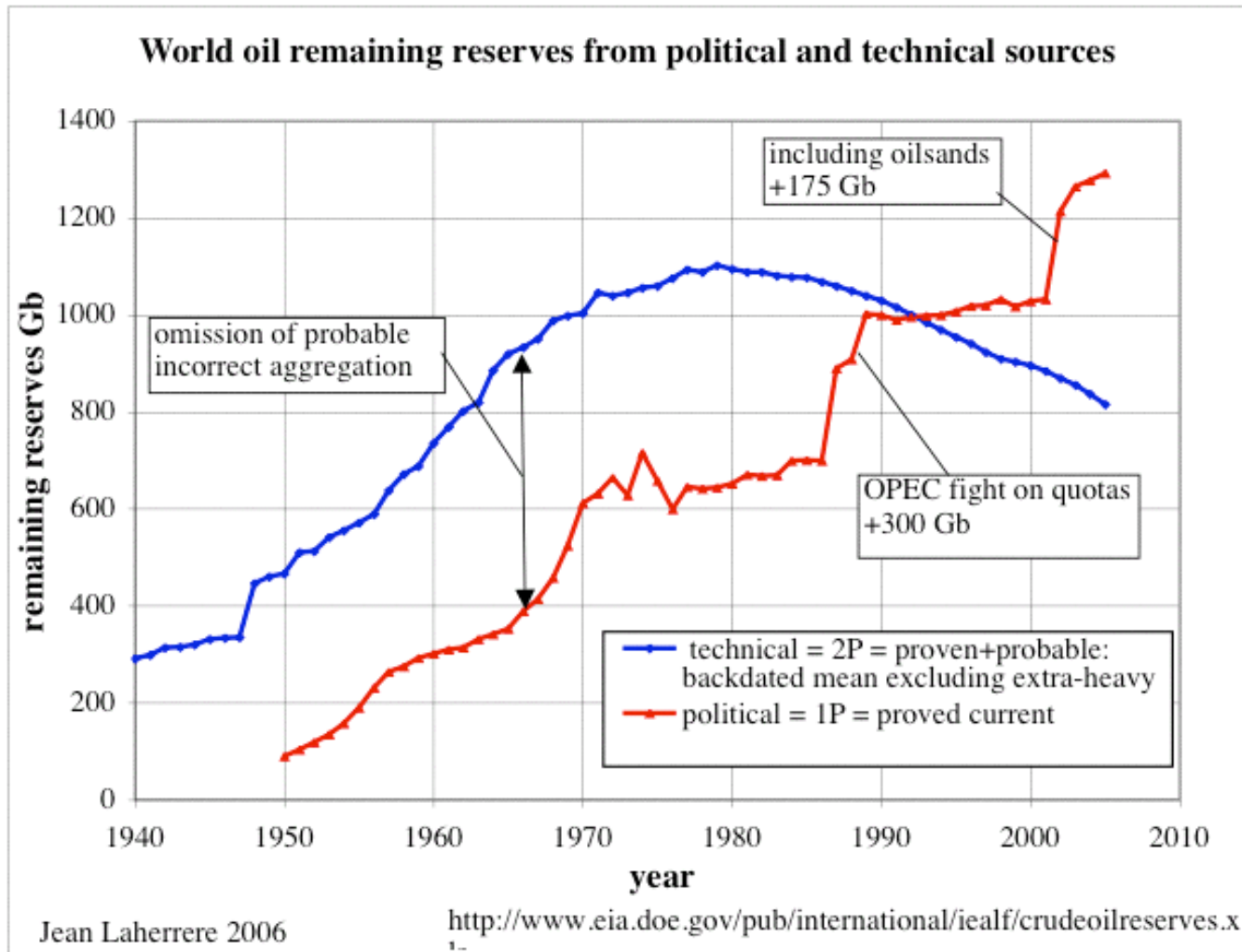
Figure 3: US revisions of proved oil & gas reserves giving the probability of the estimate



Present probability of US proved reserves is about 50%, far from the SPE/WPC definition of proved = 90%.

Oil remaining reserves = cumulative known discoveries minus cumulative production

Figure 4: **World remaining conventional oil & gas reserves from political and technical sources**



From 1950 to 1979 (oil shock) proved reserves were roughly half of the mean value, the difference representing the **omission of the probable reserves and the incorrect aggregation.**

Economists have only access to **political data** (called discoveries when they are not) reported to cheer bankers, but useless for forecasting.

Figure 5: **World cumulative crude oil (less extra-heavy) mean discovery & production and political additions (so-called proved)**

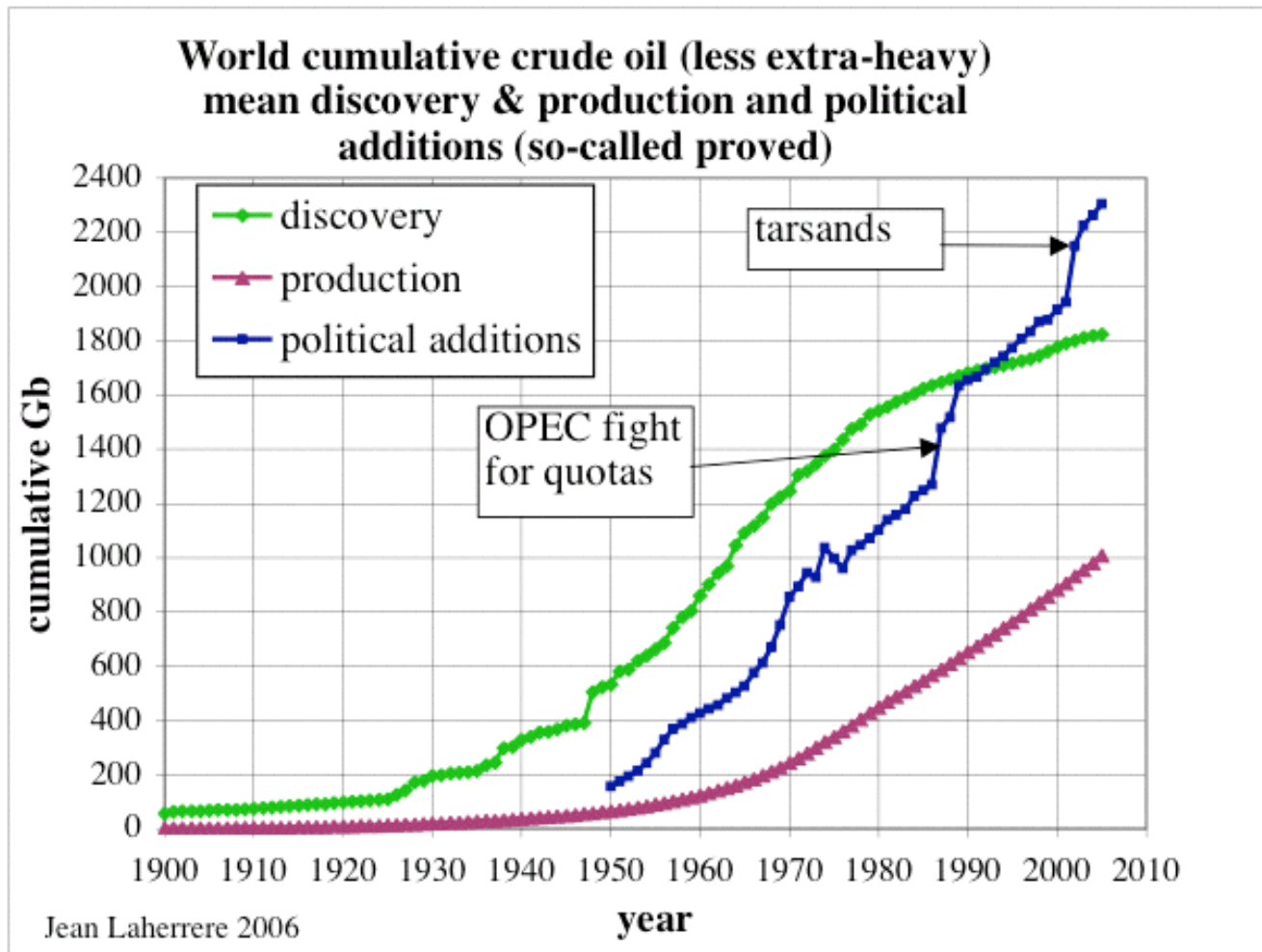
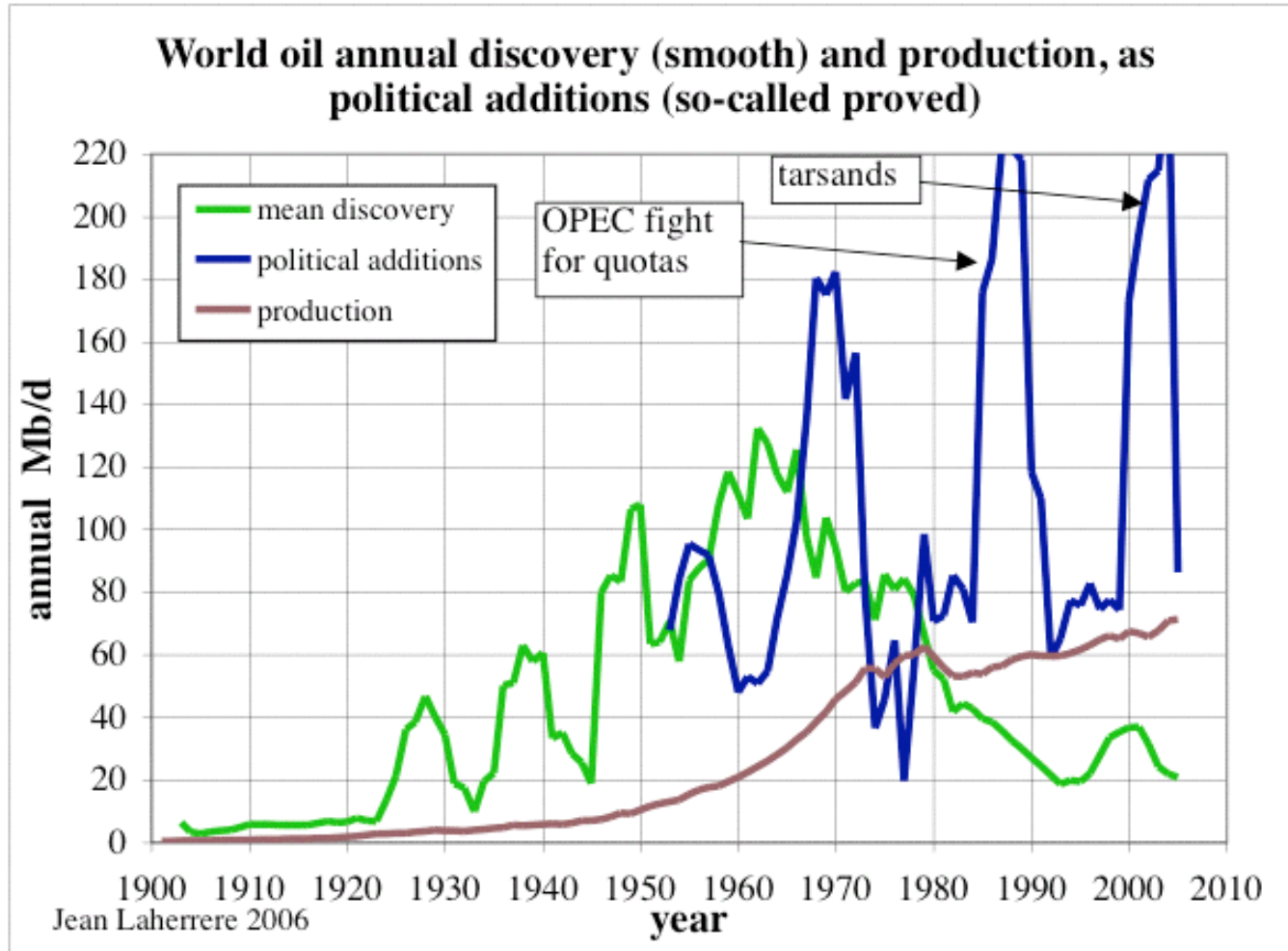
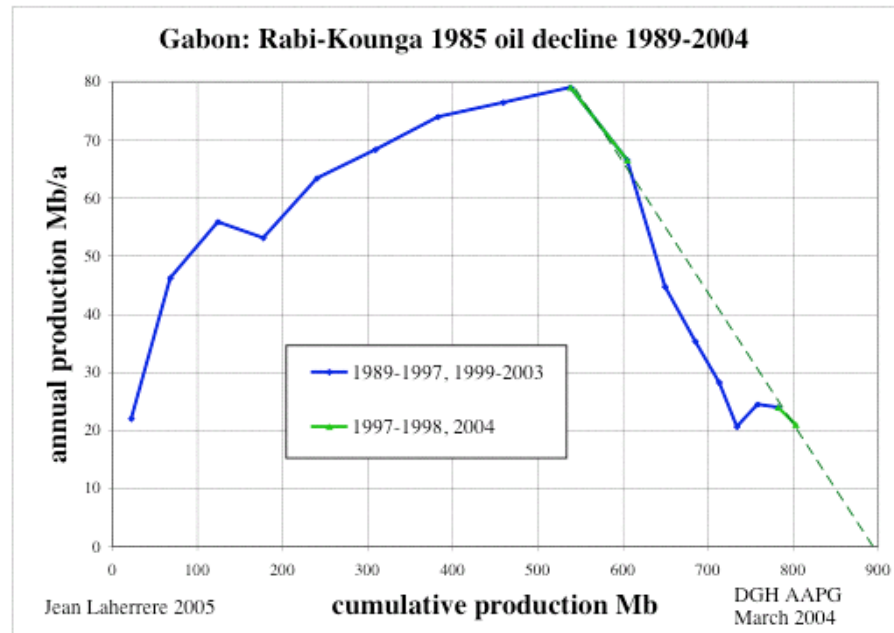
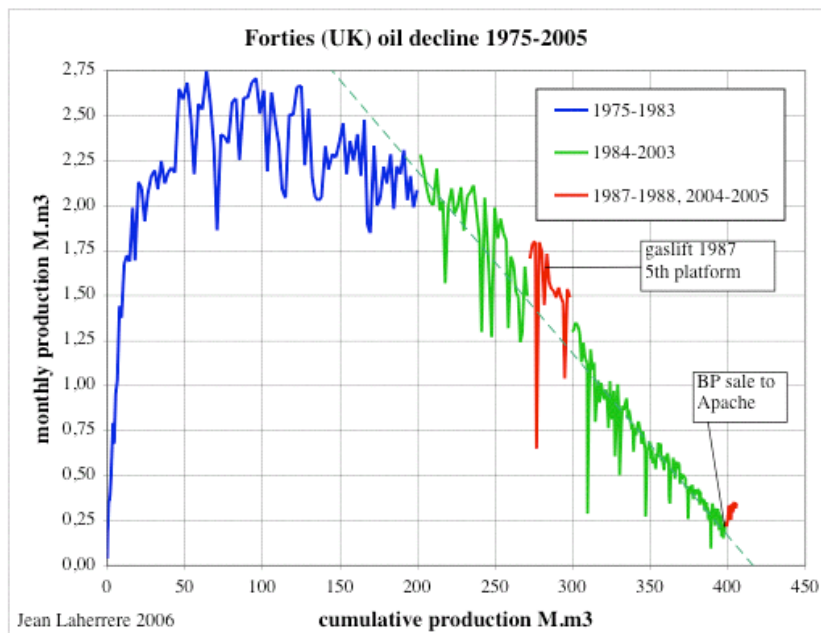
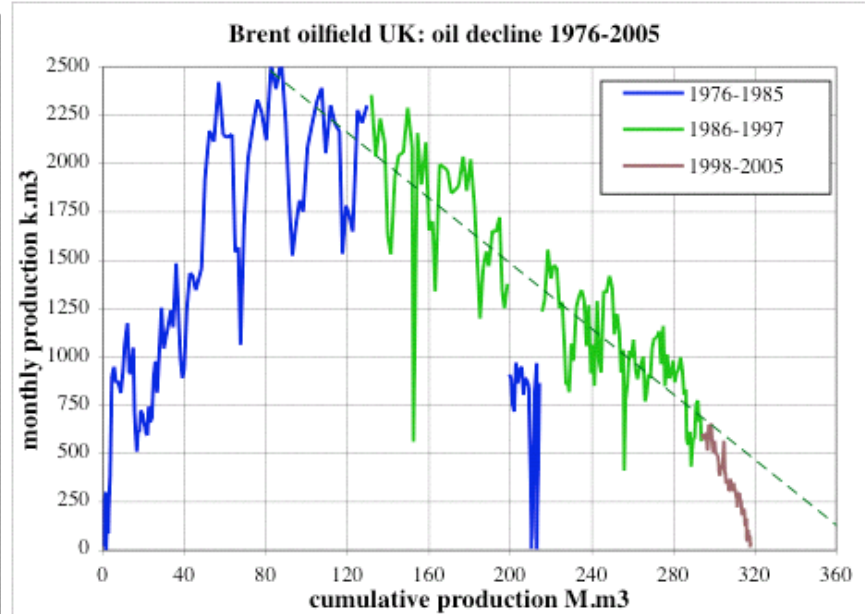
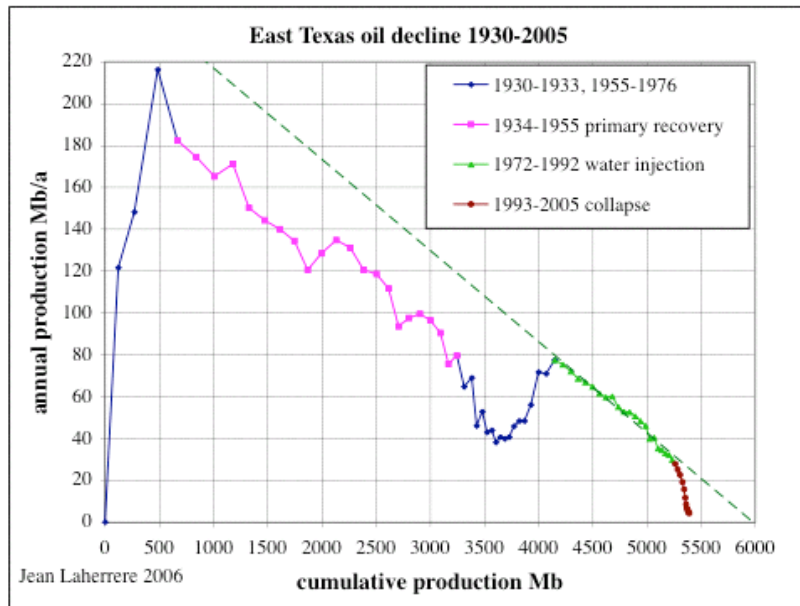


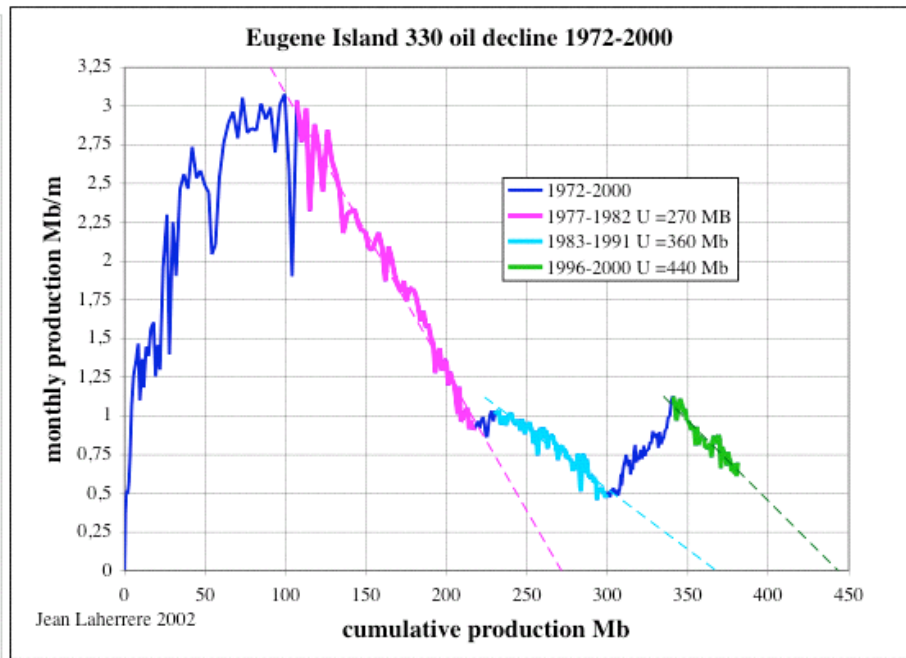
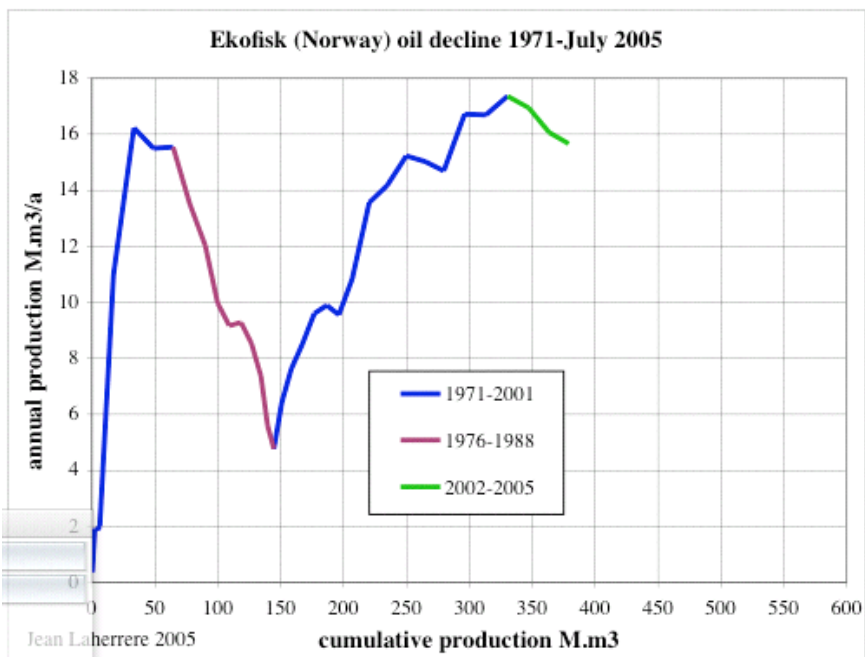
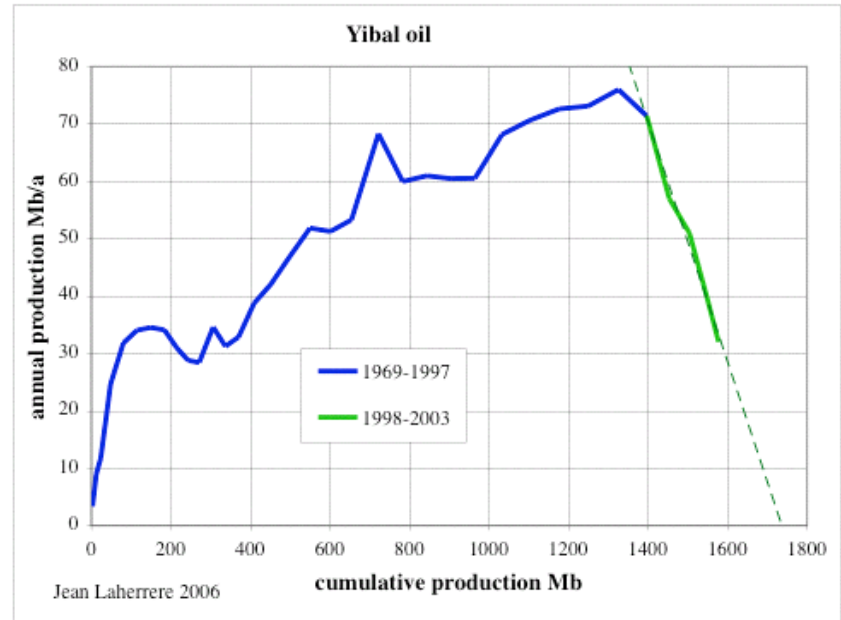
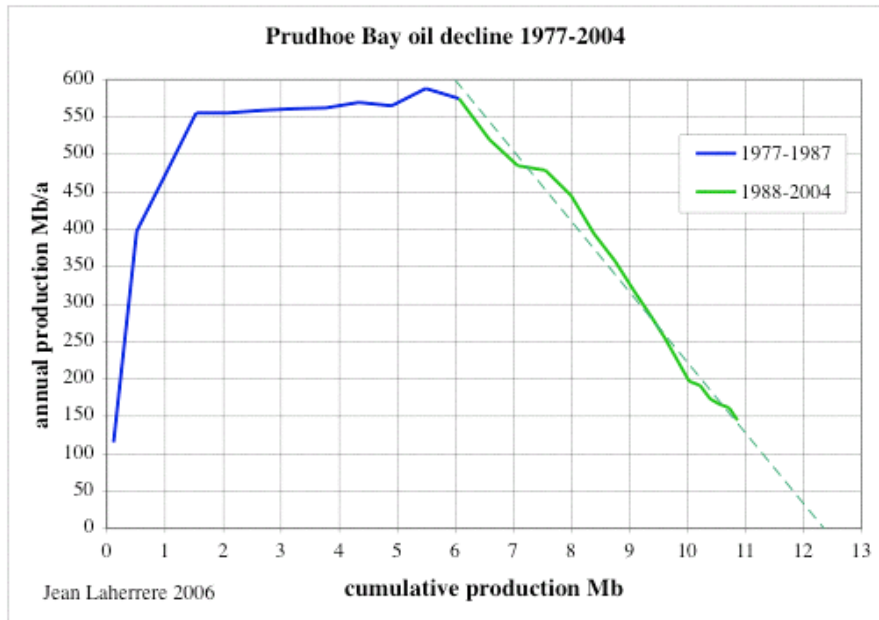
Figure 6: **World annual crude oil (less extra-heavy) mean discovery & production and political additions (so-called proved)**



Any work, study or forecast using **proved reserves has to be discarded as useless, following the GIGO principle: **Garbage In, Garbage Out.****

Reserve growth should be seen on oil decline versus cumulative production





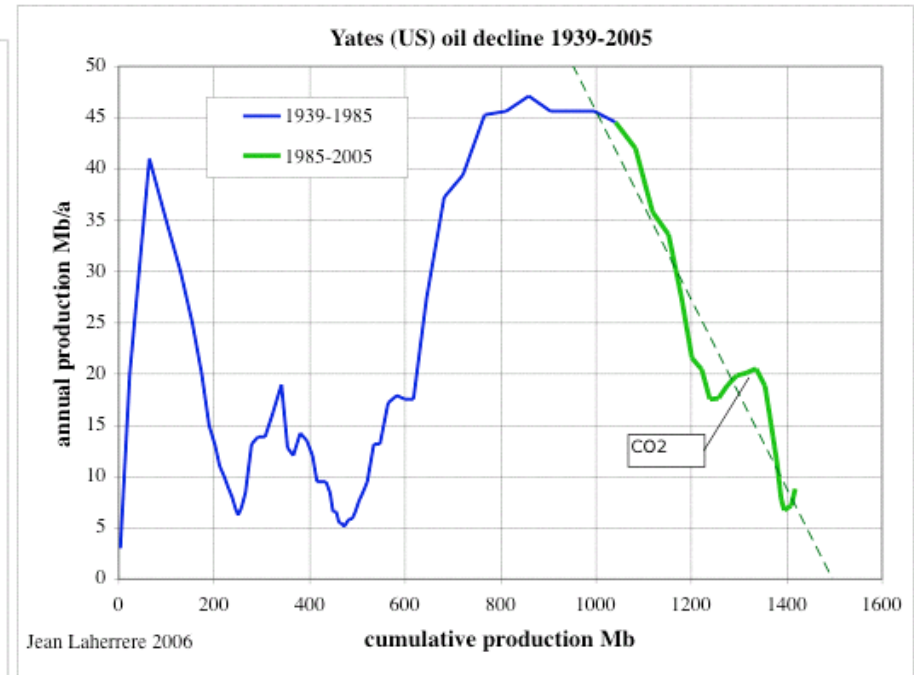
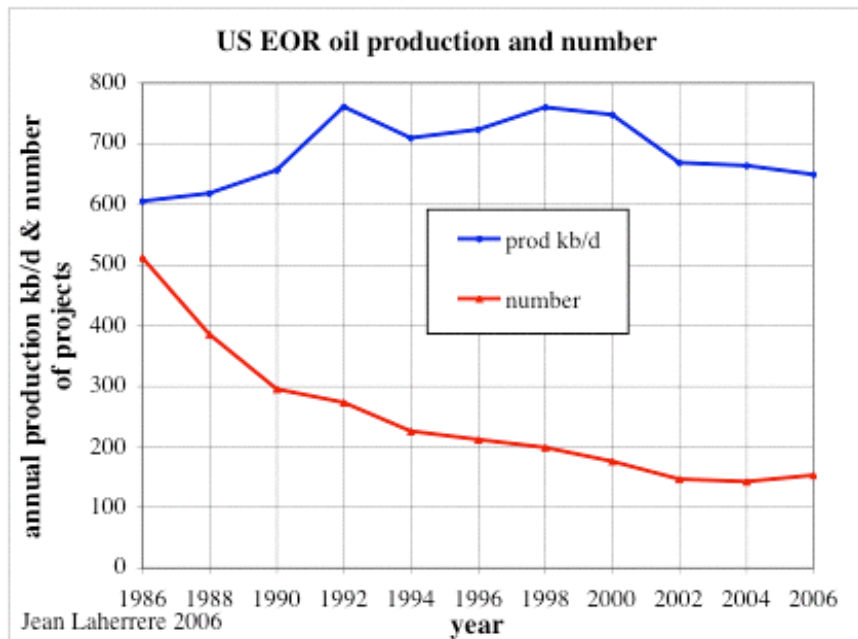
EOR (Enhanced Oil Recovery) = non-conventional

Growth from EOR should not be classified with conventional reserves.

2004 world EOR production = 2.5 Mb/d (60% thermal, 30% gas and 10% chemicals), US = 0,7 Mb/d

US EOR production from OGJ surveys 1986-2006

Yates oil decline 1939-2005



Yates (1939-2005) had chemicals and CO2 since 1985, but minor increase. Marathon sold it en 2004.

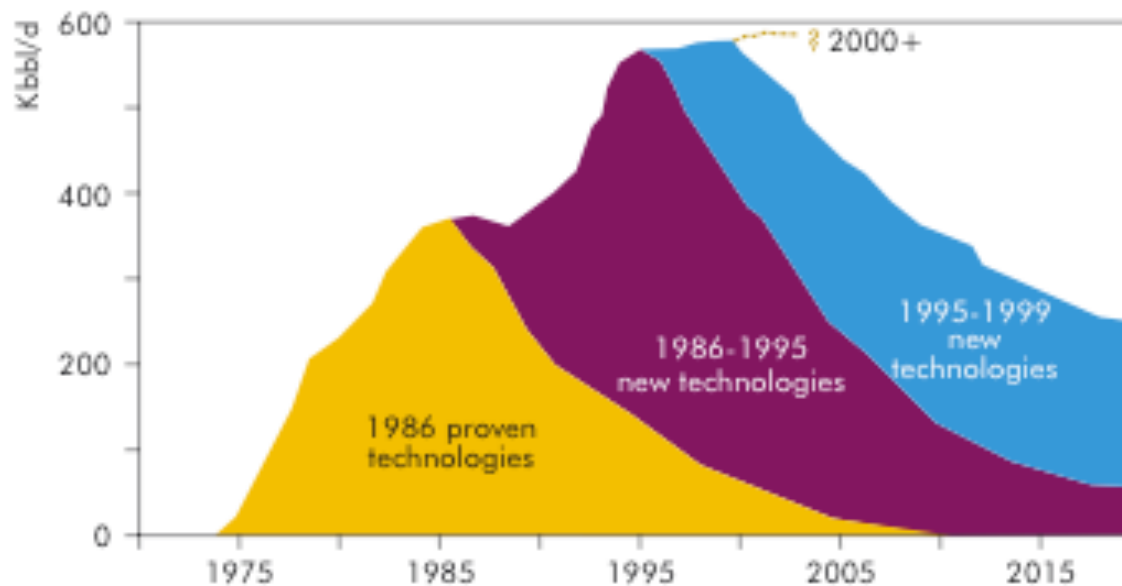
Impact of technology: quoting other work?

Exxon-Mobil 2006 quotes USGS 2000 (10 years old as being at end of 1995), Shell in 2002 quoted EneRG (1999), IEA in 2005 quoted Shell 2002! IFP quotes Wood Mac!

IEA in May 2005 claims that reserve growth is due to technology, justified by Shell 2002 graph coming from EneRG *European Network for Research in Geo-Energy* with a wrong scale: 0.6 Mb/d instead of 6 Mb/d

Figure 24: May 2005 IEA *Impact of technology on production from the North Sea quoting Shell*

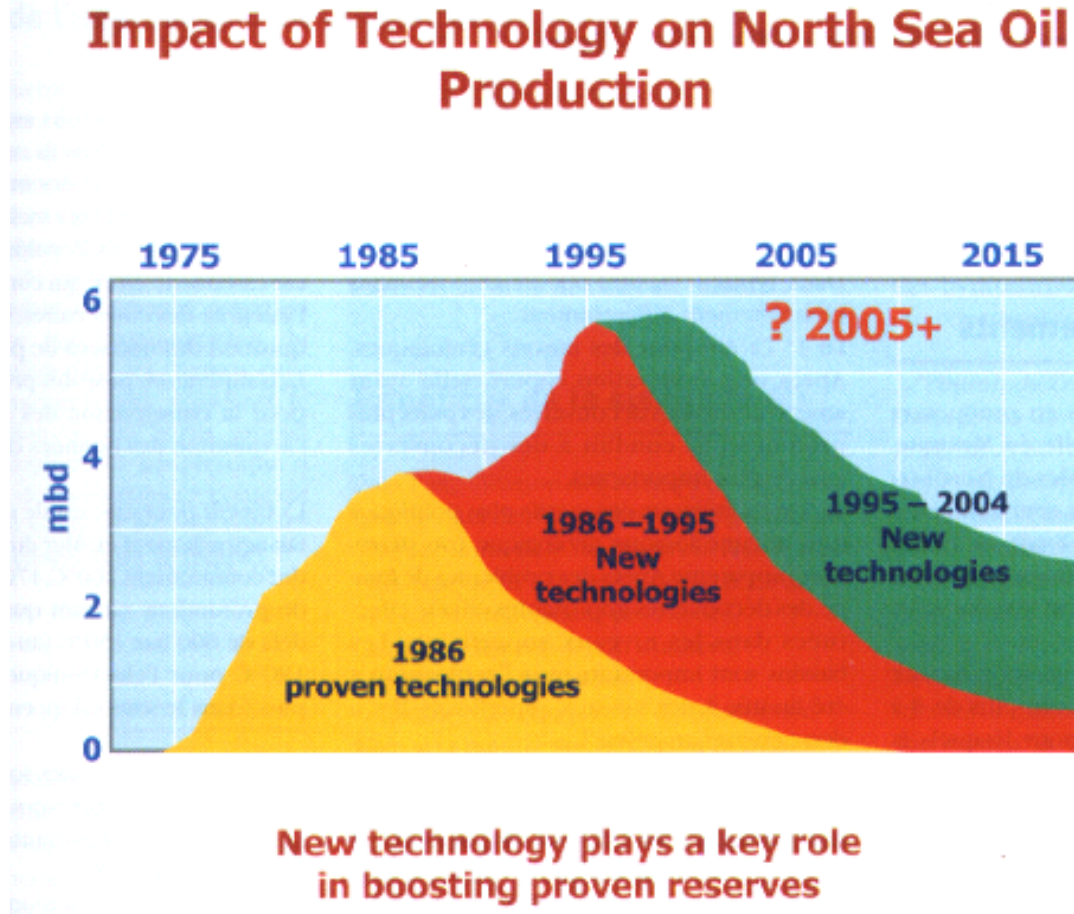
Figure 1.20 • Impact of technology on production from the North Sea, in thousand barrels per day



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

IEA shows in October 2005 (*Jan. 2006 Petrole & Gaz Information p.19*) the same May 2005 graph but redrafted **by replacing 1999 by 2004 !!** and suggesting a good surprise thanks to 2005+?

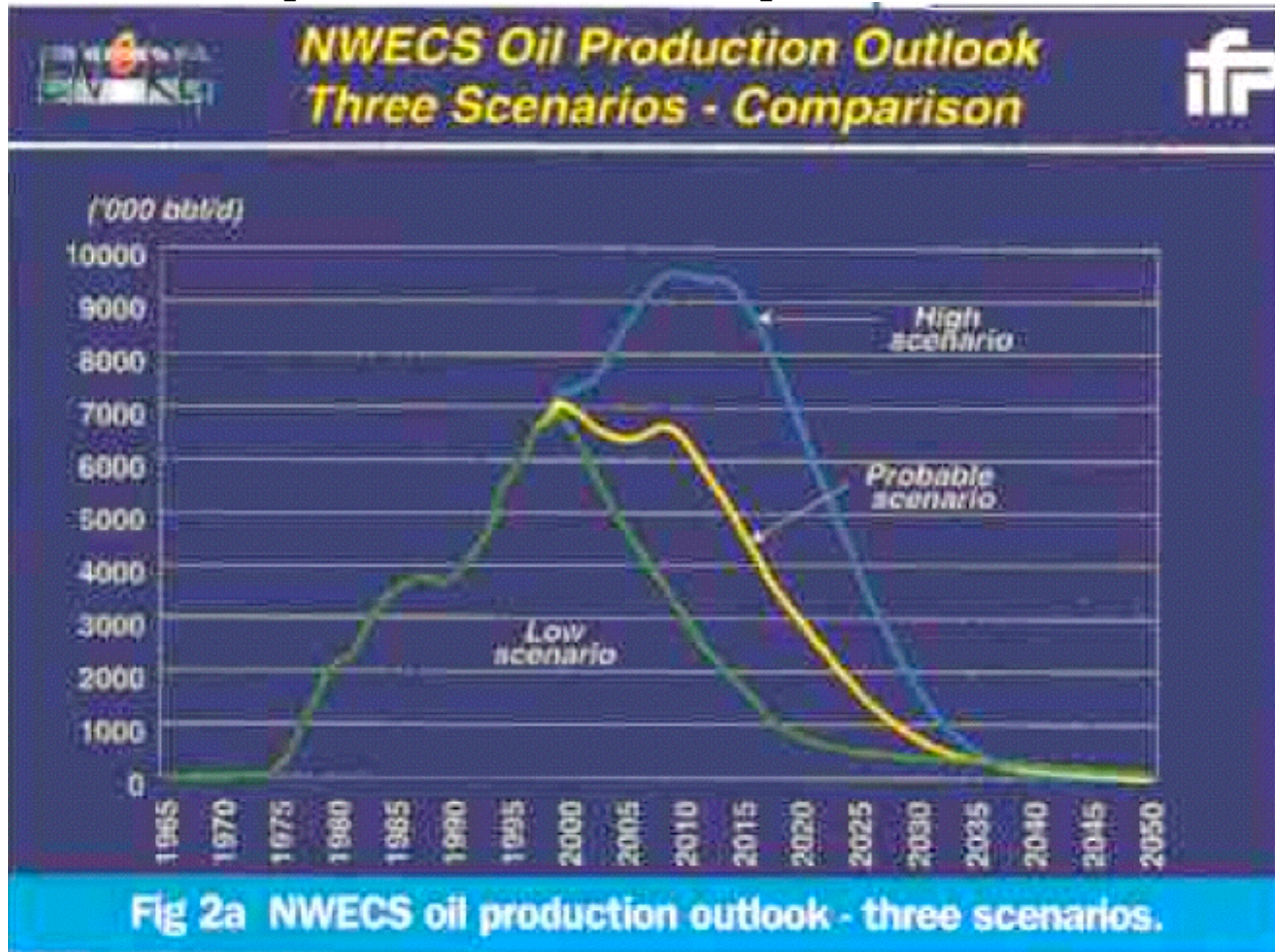
Figure 26: **October 2005 IEA (Pochettino)** without quoting Shell



In the same bulletin p.84, Shell (Rodriguez) displays exactly the same graph as IEA, but without the IEA change of 1999 by 2004 and 2000 by 2005. It is amazing to see such obvious manipulation!

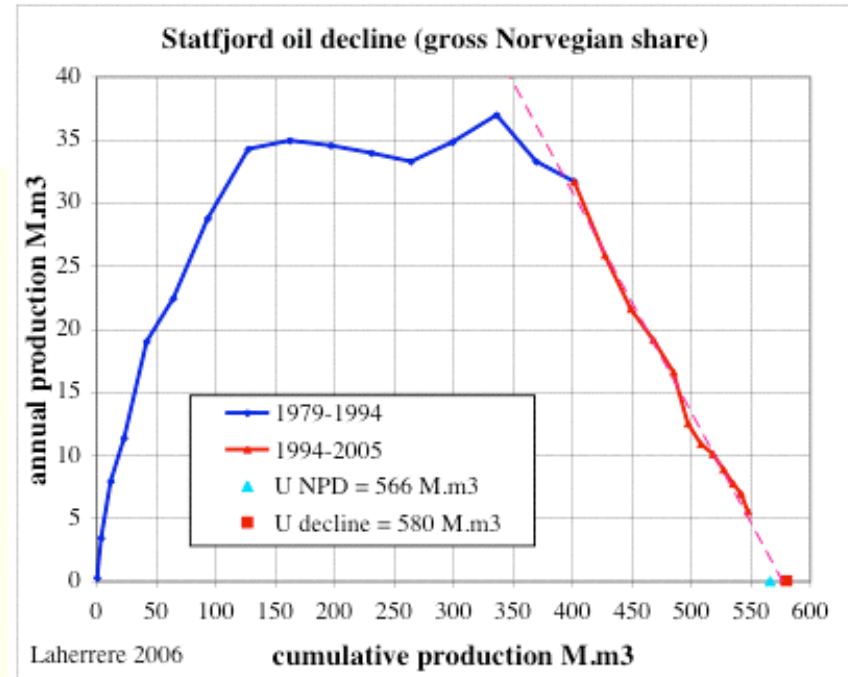
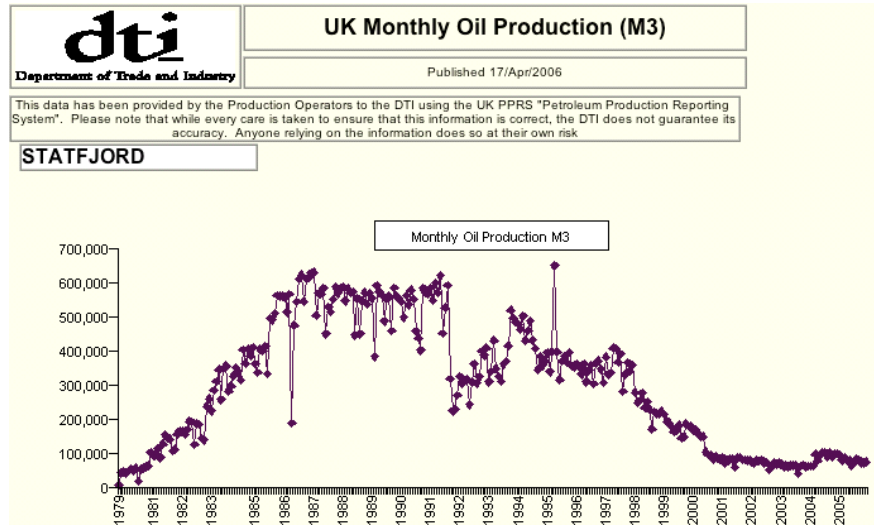
European Network for Research in Geo-Energy newsletter Feb 1998 claims that North Sea production decline will be delayed by 10 years

Figure 27: North West European Continental shelf oil production with 3 scenarios by IFP 1998



The real data up to 2005 follows the 1998 low scenario (green curve) and the 1998 probable scenario (yellow) was pure wishful thinking!

Statfjord is shared between UK and Norway, but operated by Statoil.



CEO Statoil Overvik stated that Statfjord has recovered:

-in World Oil December 2005: **64 %** of **8 Gb OIP** (oil in place), compared to 48 % in 1979, hoping to reach 70% in ultimate

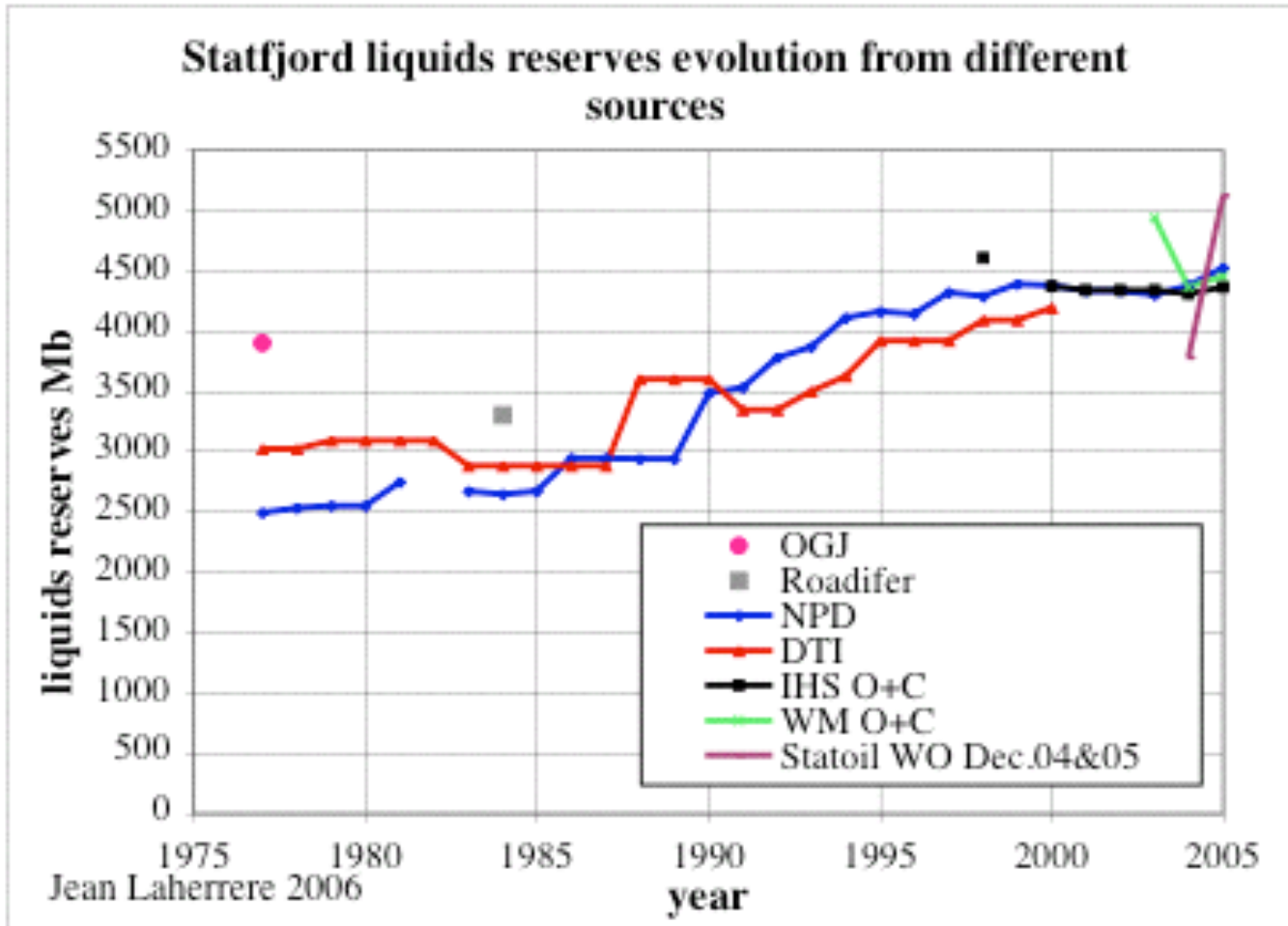
-in World Oil December 2004: **63 %** of **6 Gb OIP**.

Is the change of OIP a typing mistake or is OIP a wild guess?

IHS reported, in 1998, an **OIP** of **6.3 Gb** with oil+condensate (O+C) 2P= 4,60 Gb giving a recovery factor of 73 % and, in 2005, an **OIP** of **6.1 Gb** with O+C 2P=4,36 Gb giving a RF of 72 %.

IHS does not see any improvement in recovery factor, being already very high in 1998!

Figure 31: **Statfjord liquids reserves evolution** from different sources 1977-2005



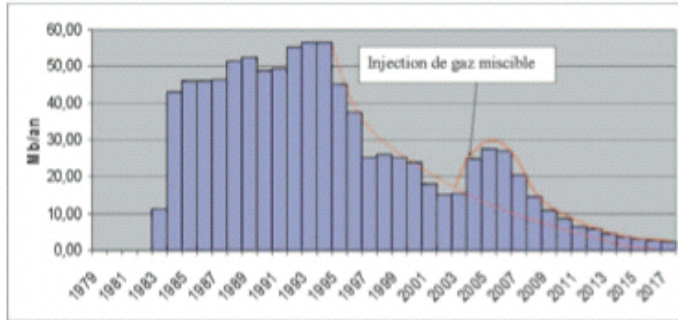
Magnus IFP press conference 31 Mai 2005 claims that Magnus will increase production in 2005



EOR : un exemple

- Magnus en mer du Nord (UK)

Augmentation de 15 % des réserves
Augmentation de 5 % du coût moyen par baril



Conférence de presse mai 2005

Source : D'après WoodMacKenzie

© IFP 2005

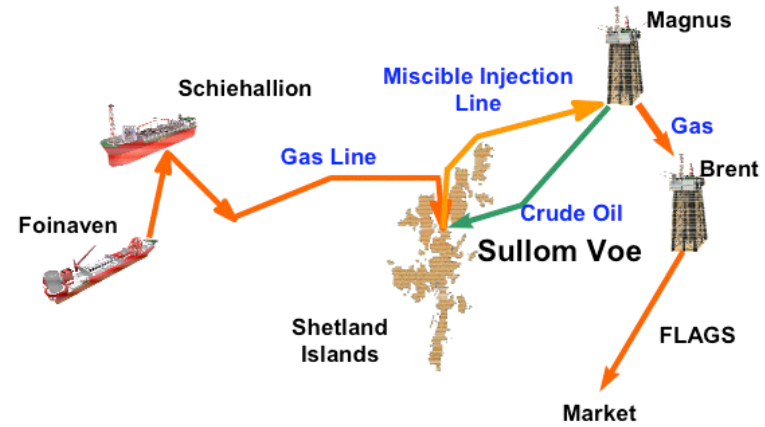
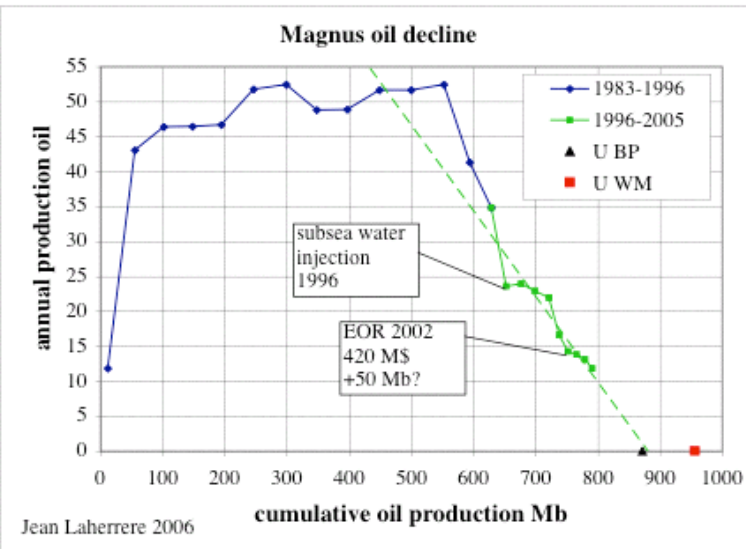
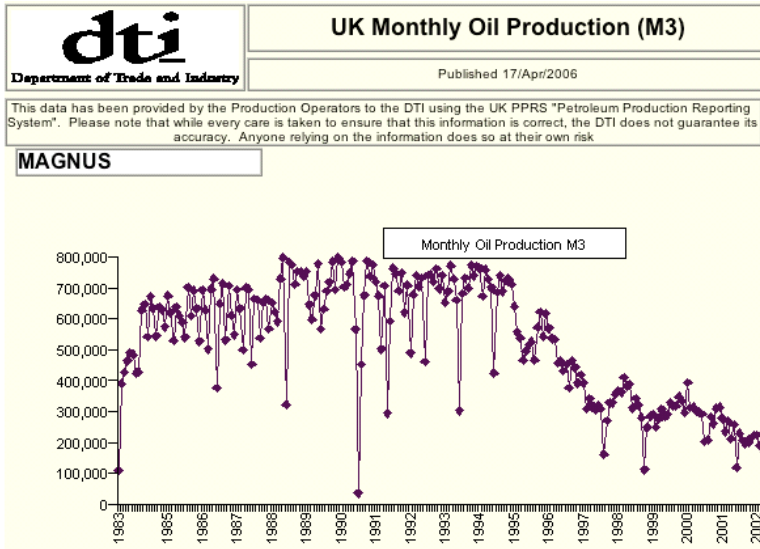


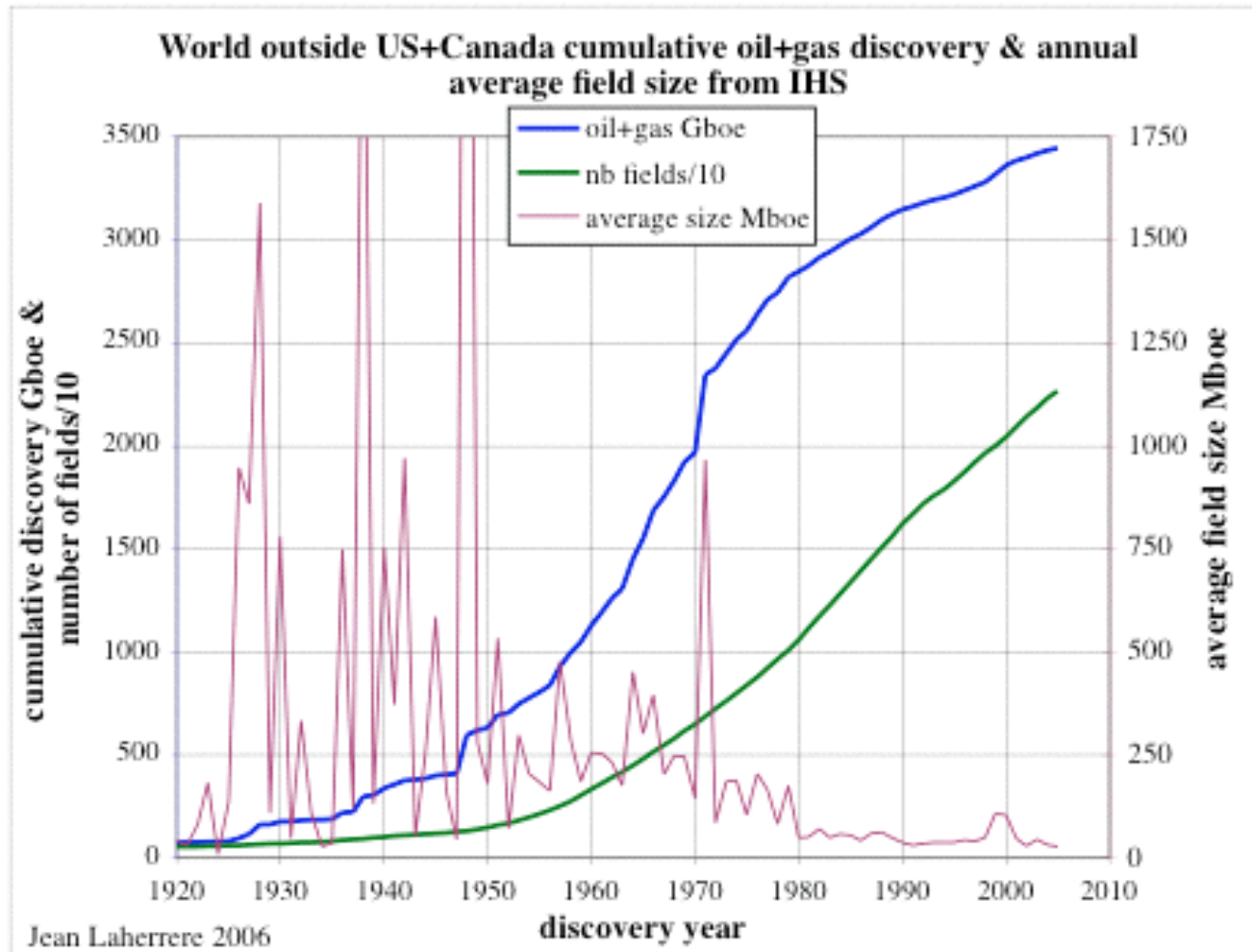
Figure 20: Schematic of Magnus EOR project.



Jean Laherrere 2006

Field size decrease

Figure 38: World outside US + Canada cumulative oil+gas discovery and average field size from IHS



-Personal motives:

Change of only the head of IEA long-term analysis changes drastically the message

Figure 40: **IEA 1998 forecast by JM Bourdaire: there is a problem**

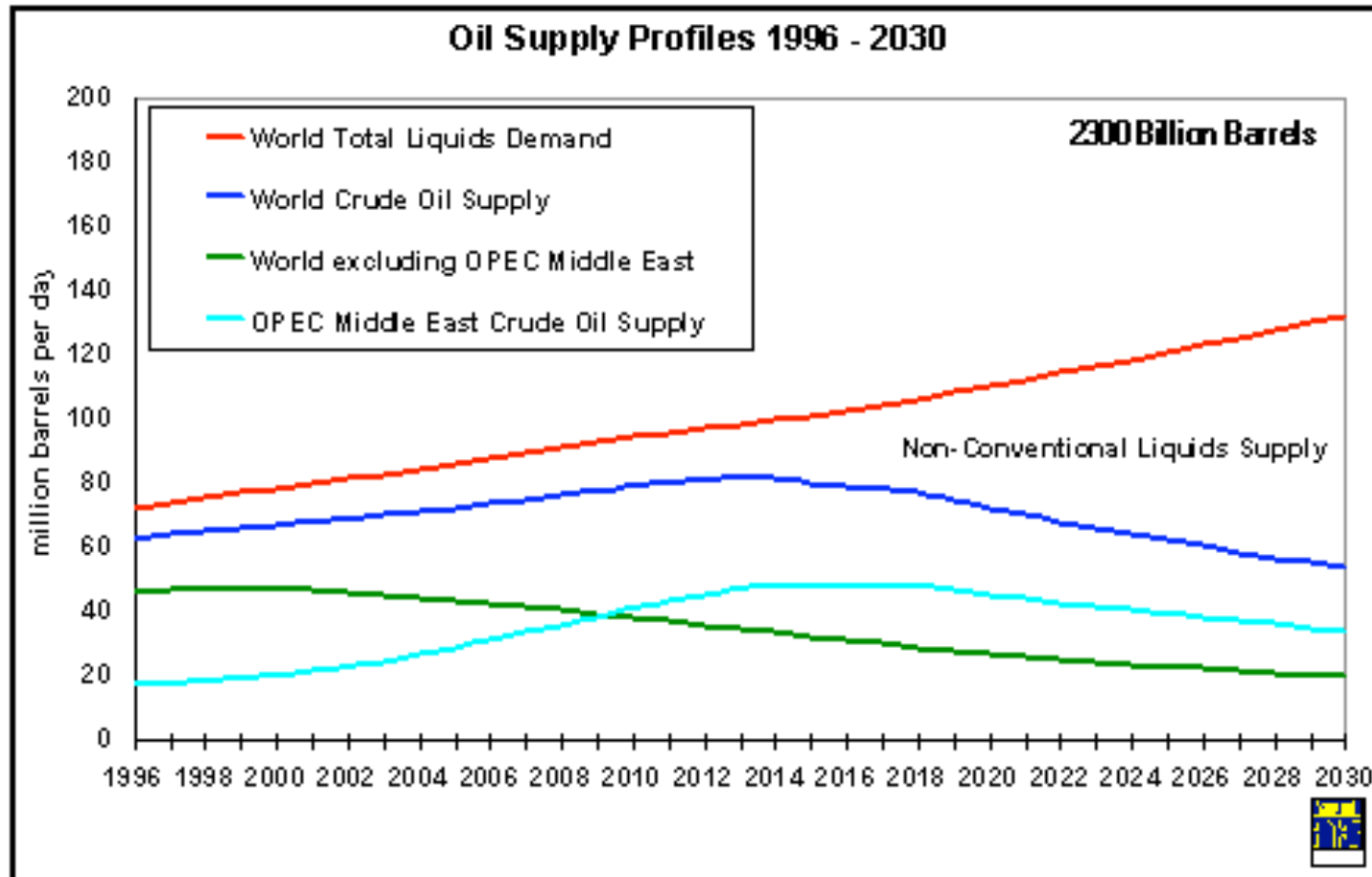


Figure 41: IEA 2002 forecast by O. Appert: there is no problem,

Figure 3.3: World Oil Production

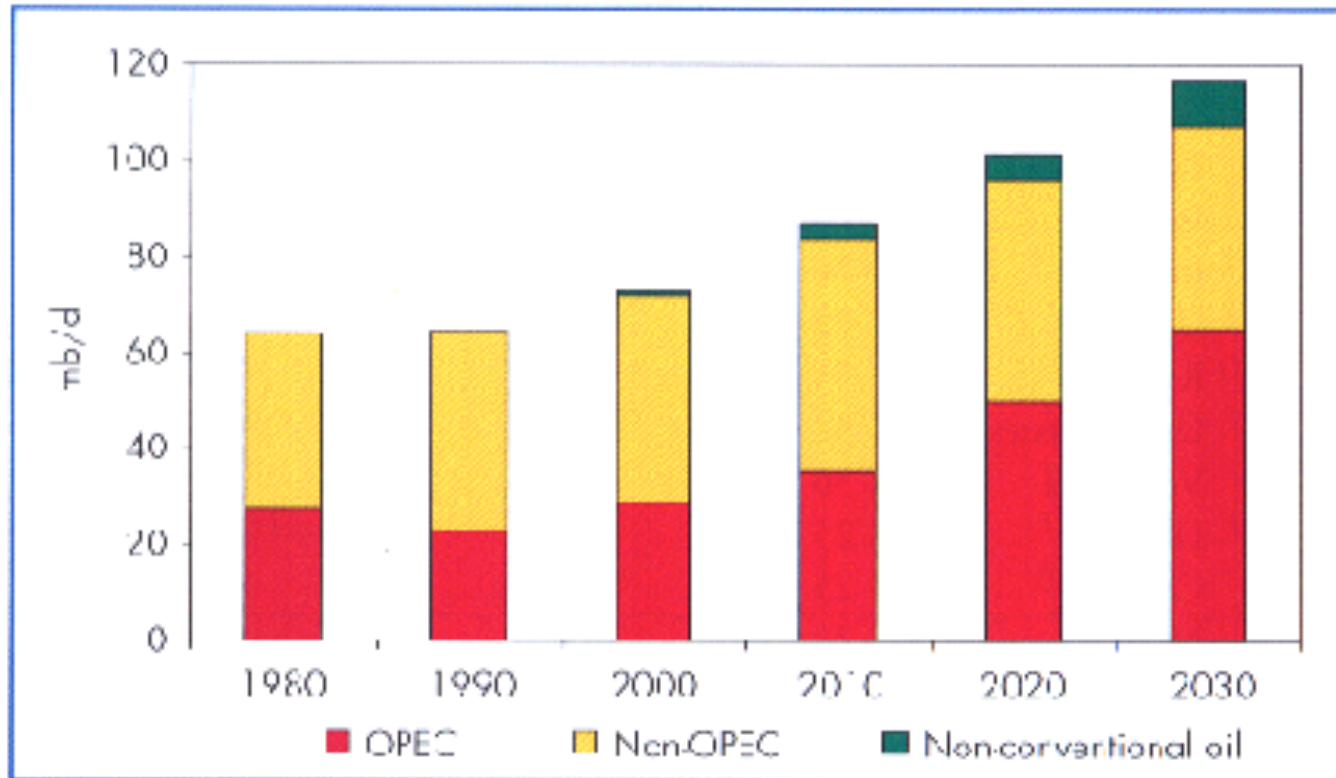
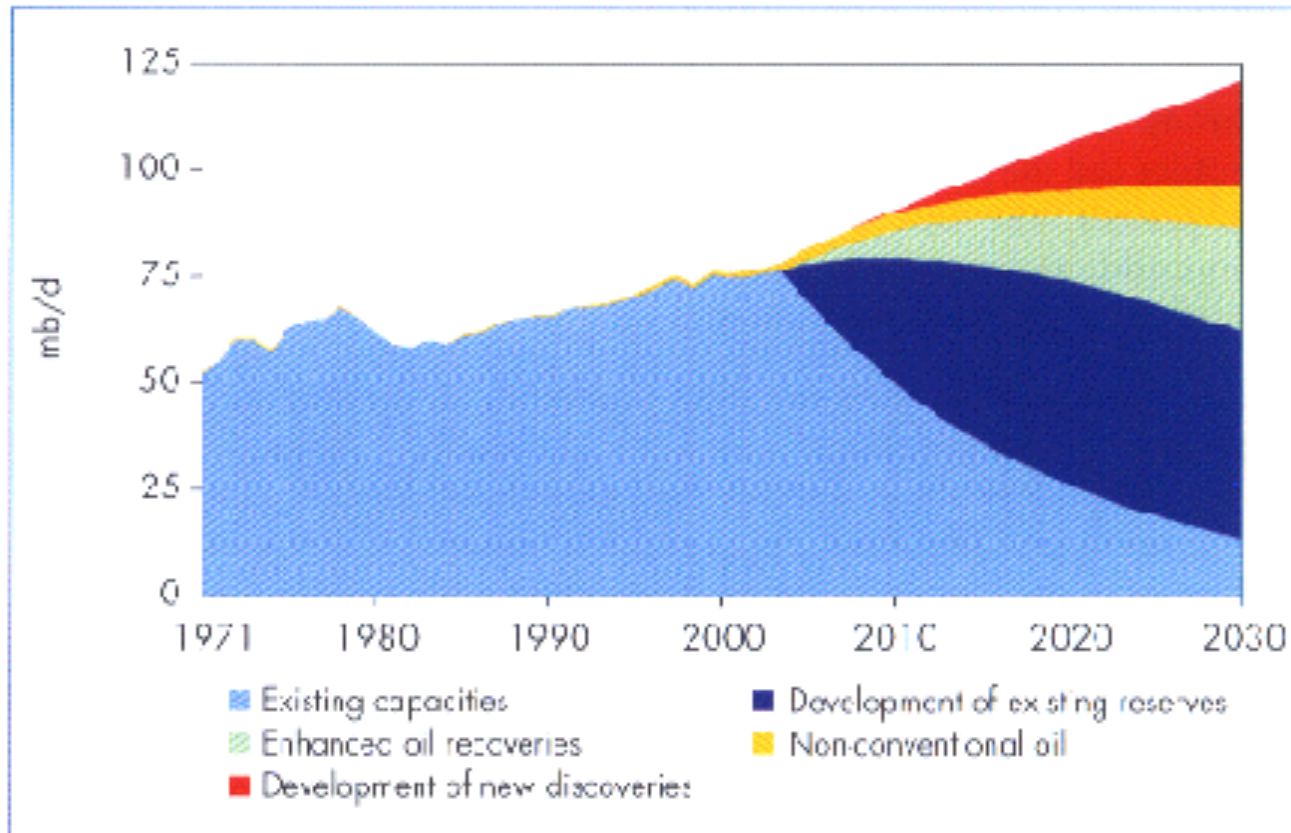


Figure 42: IEA 2004 forecast by F.Birol: there could be problem

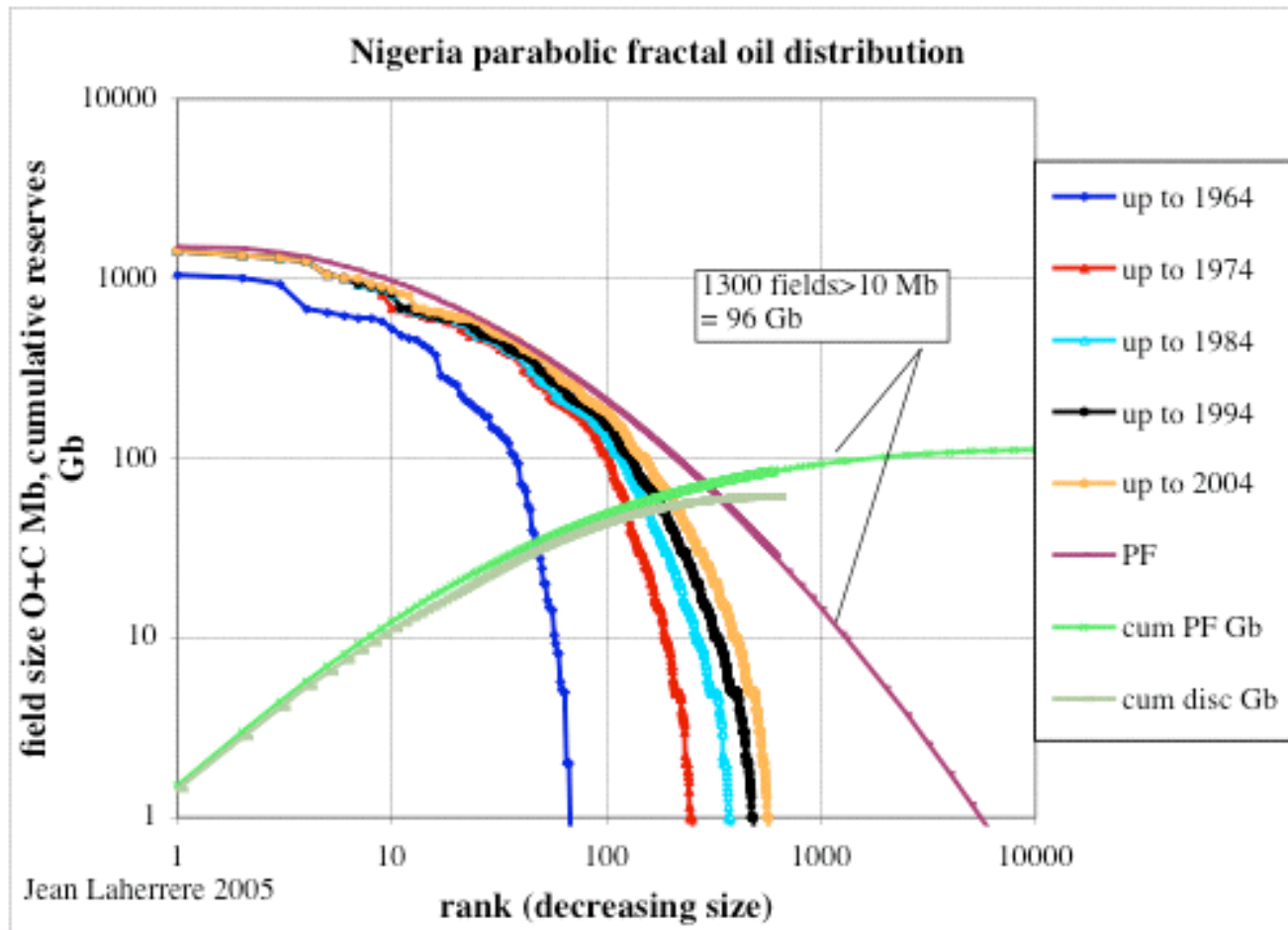
Figure 3.20: World Oil Production by Source



-Oil Reserves distribution

Oil reserves gather in fields as human beings in urban agglomerations or stars in galaxies or earthquakes. It is not, in a size-rang log-log graph, a power law (straight line) as reported by many, but a parabolic fractal as shown by the distribution in the Niger delta :

Figure 43: Niger Delta Petroleum System parabolic fractal distribution



-Creaming curves = cumulative discovery versus cumulative number of pure exploratory wells = New Field Wildcat (NFW)

Figure 44: **Africa oil creaming curve 1907-2003** easily modelled with two hyperbolas

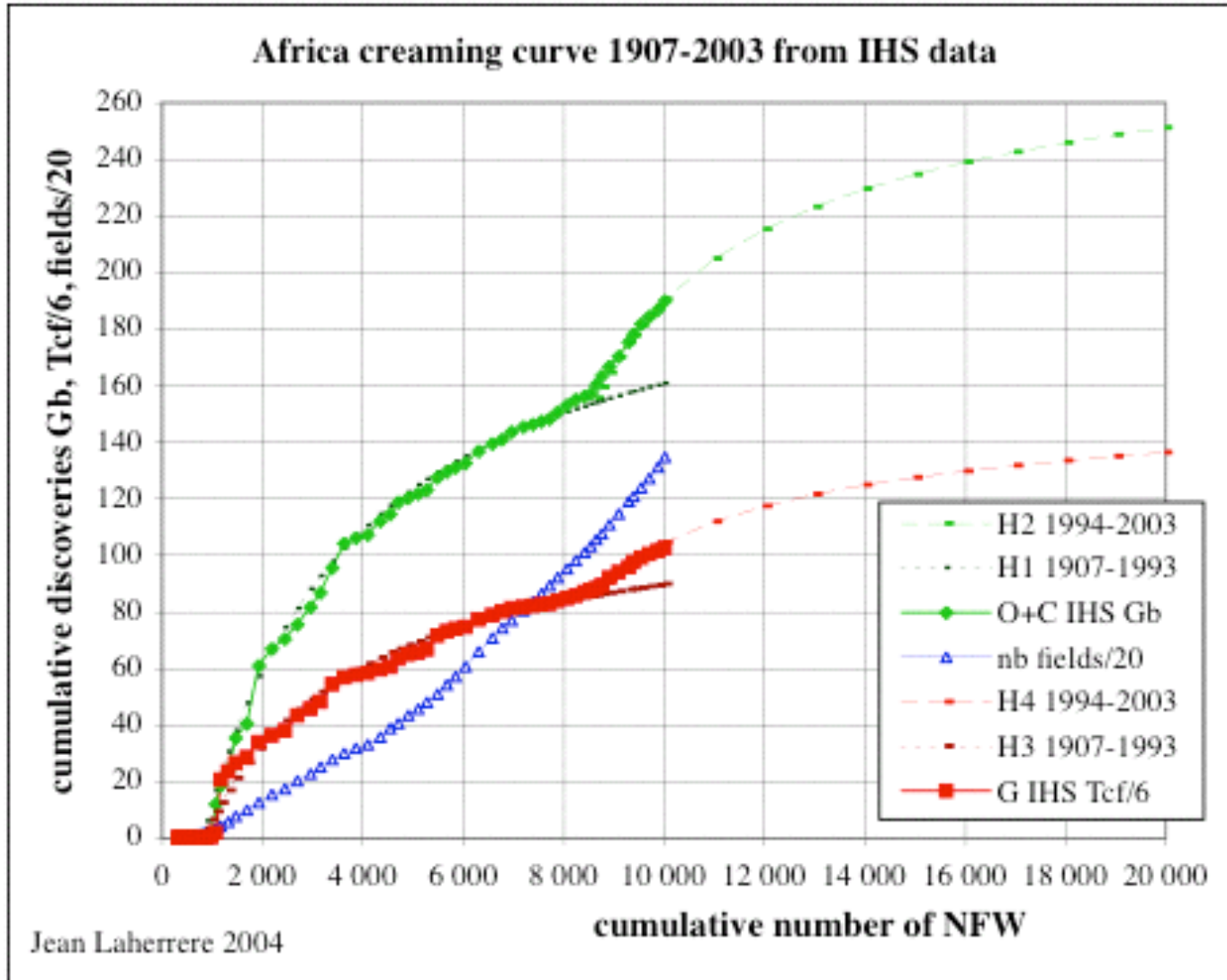
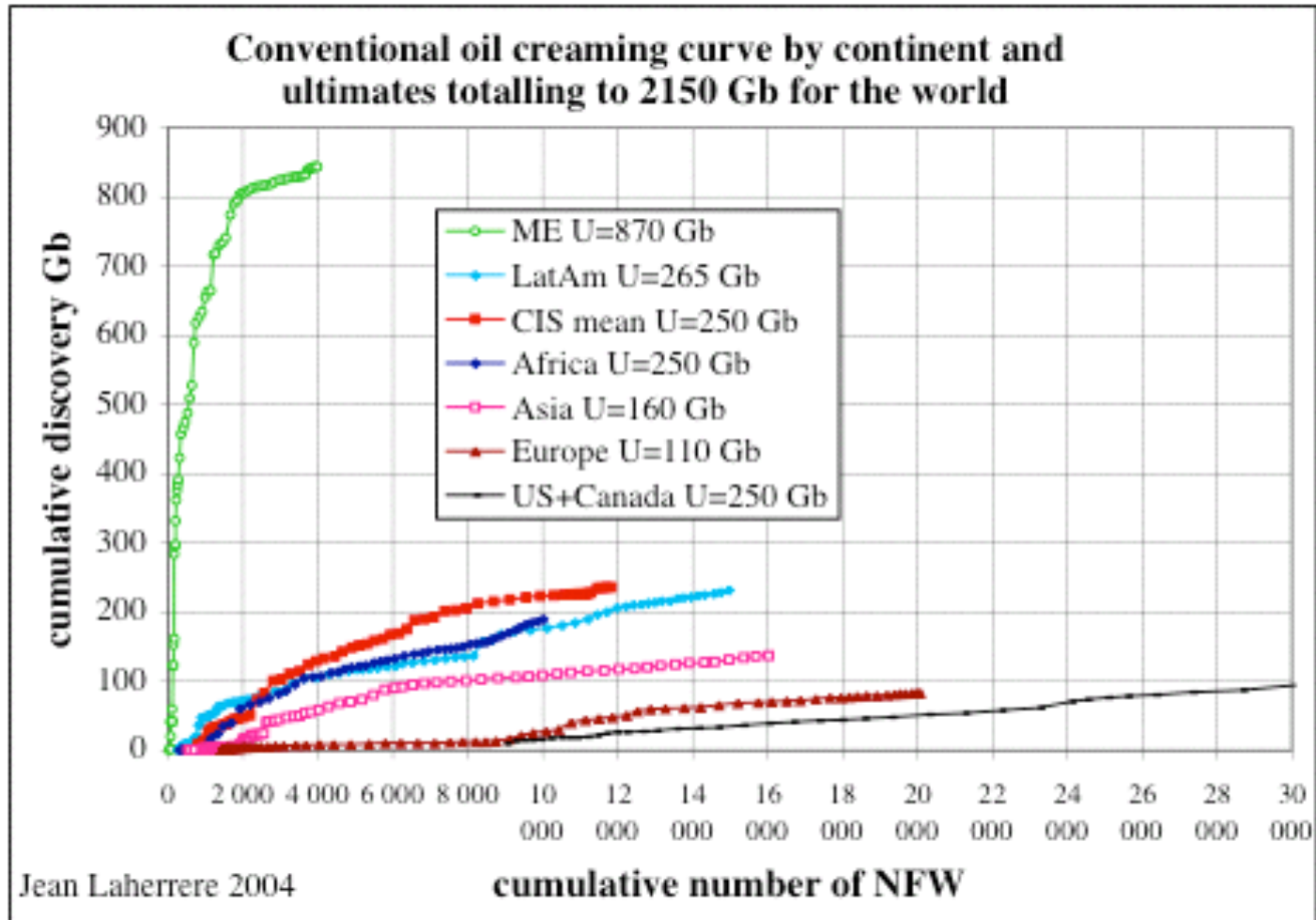


Figure 45: **Conventional oil creaming curve by continent**

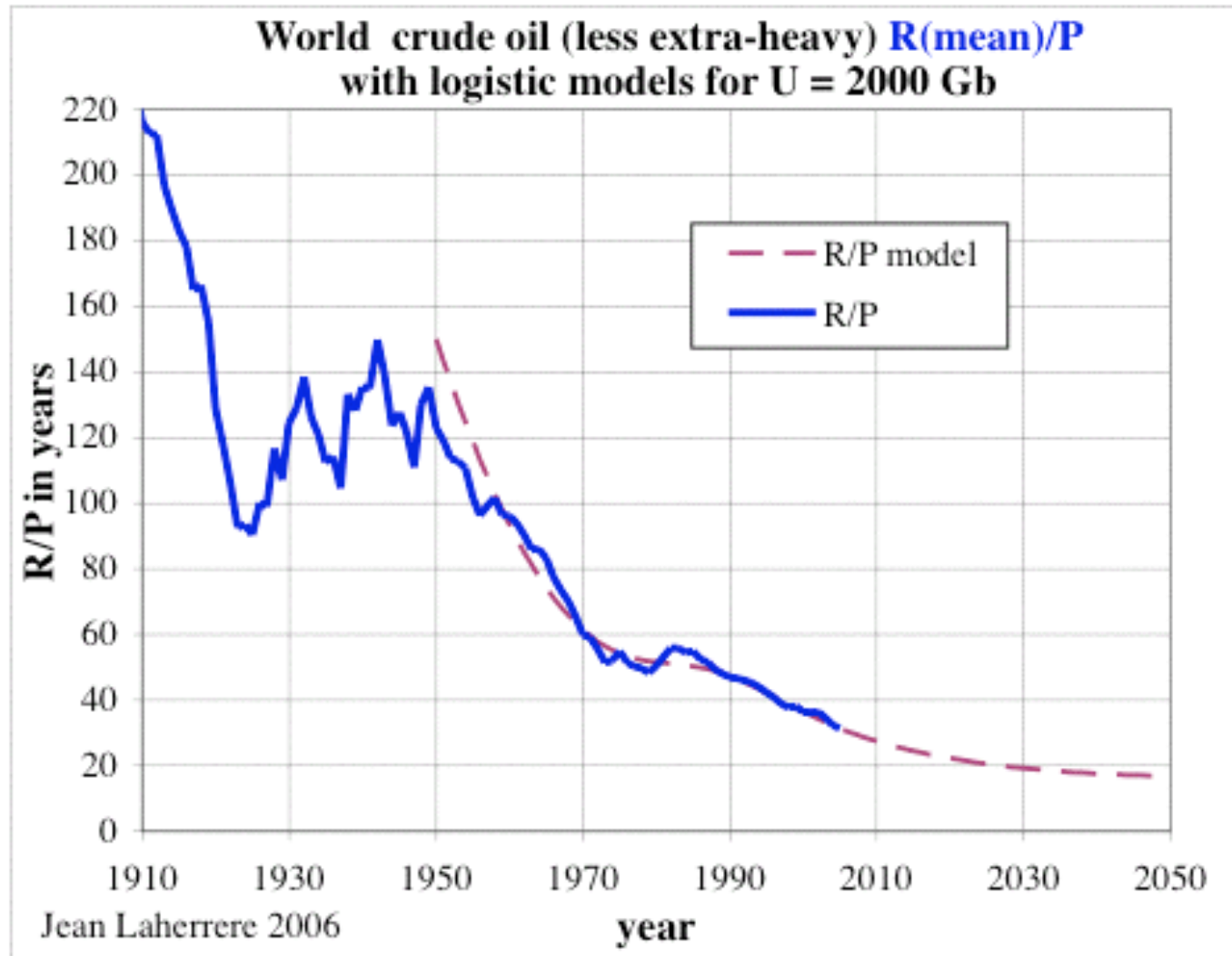


Creaming curves are rarely used in estimating ultimate because few has the data on historical NFW.

-Oil production forecast R/P

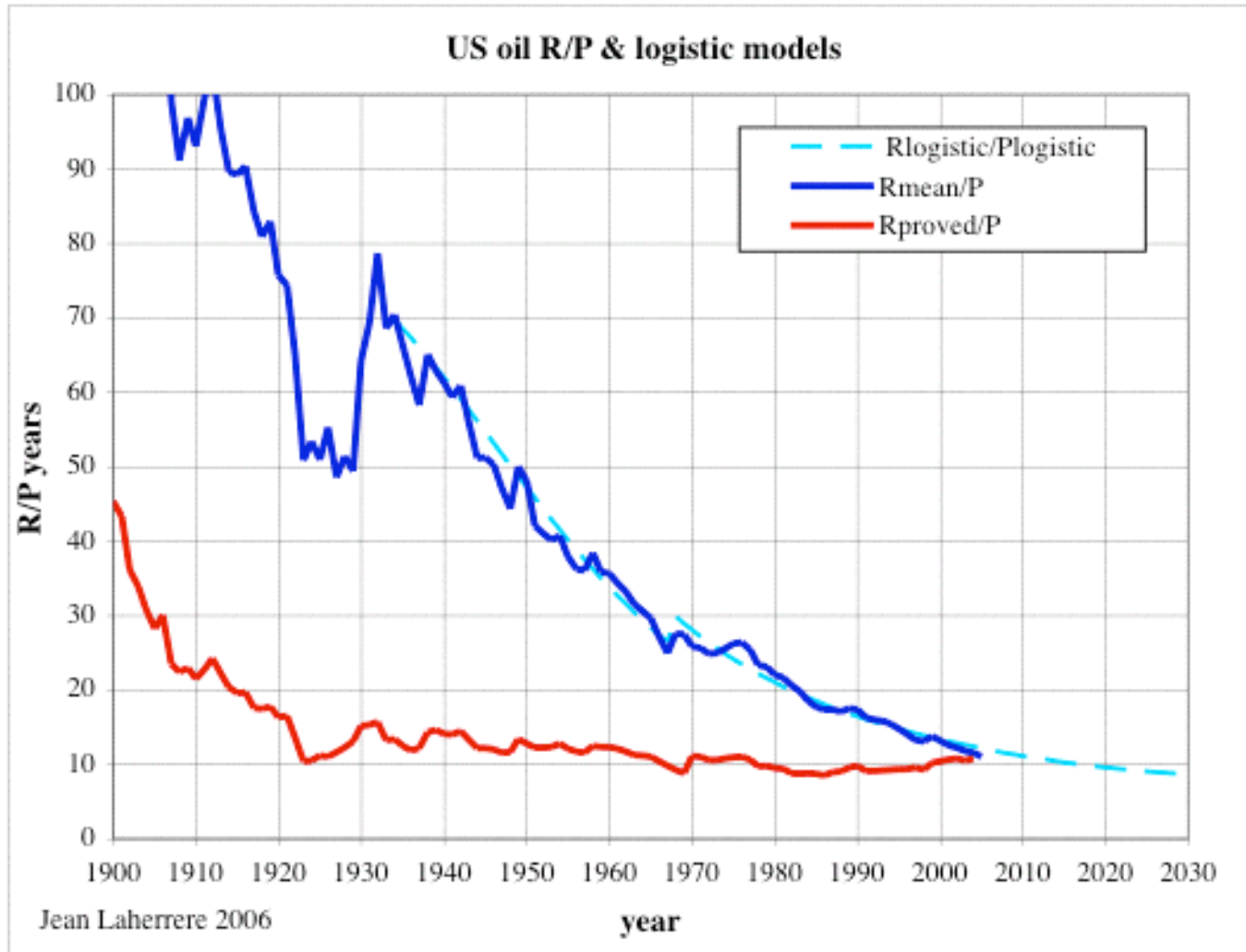
Medias and politicians claimed that there is oil for the next 40 years and gas for 60 years, R/P trends towards an asymptote of about 20 years

Figure 46: **World R/P from technical sources**



R/P from US proved reserves is about 10 years since the last 80 years! Useless for forecasting!

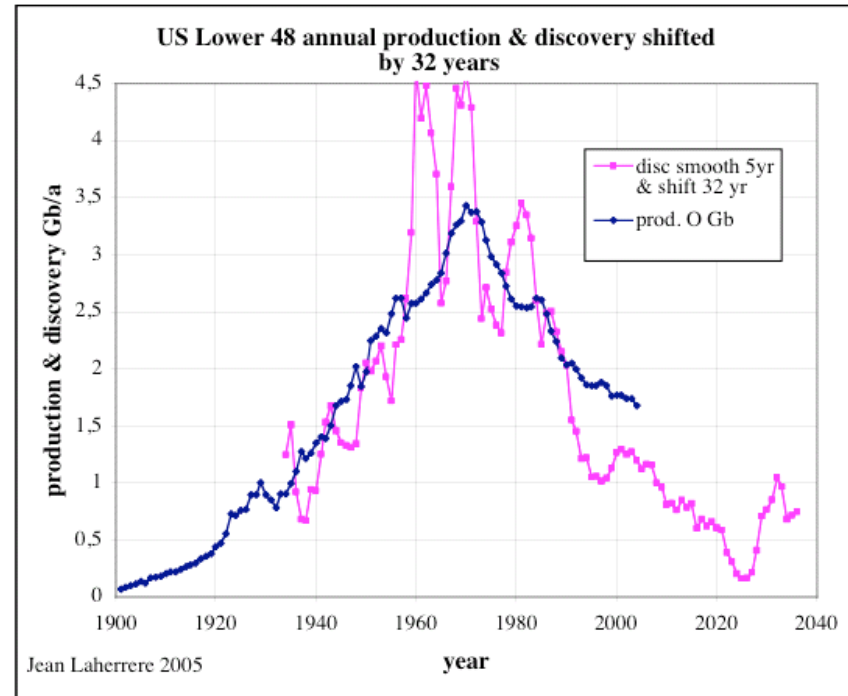
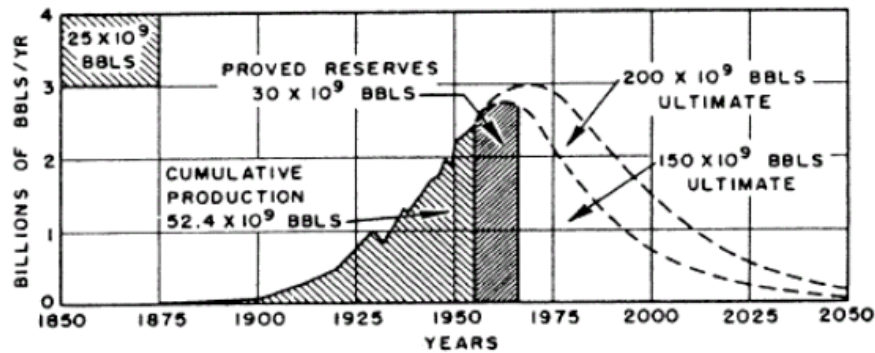
Figure 47: US R/P from mean backdated reserves and from proved current



The last US barrel will be produced with still 9 barrels reserves in the ground, which will be then going back to resource status. **R/P is a very poor parameter, but used by all!**

-Future production Forecasting using ultimate

Figure 49: King Hubbert forecast the US oil production in 1956



Production mimics discovery. US lower 48 = one main cycle because many basins and 40 000 fields

Figure 51: France oil production and shifted discovery: 2 discovery cycles & 2 production cycles

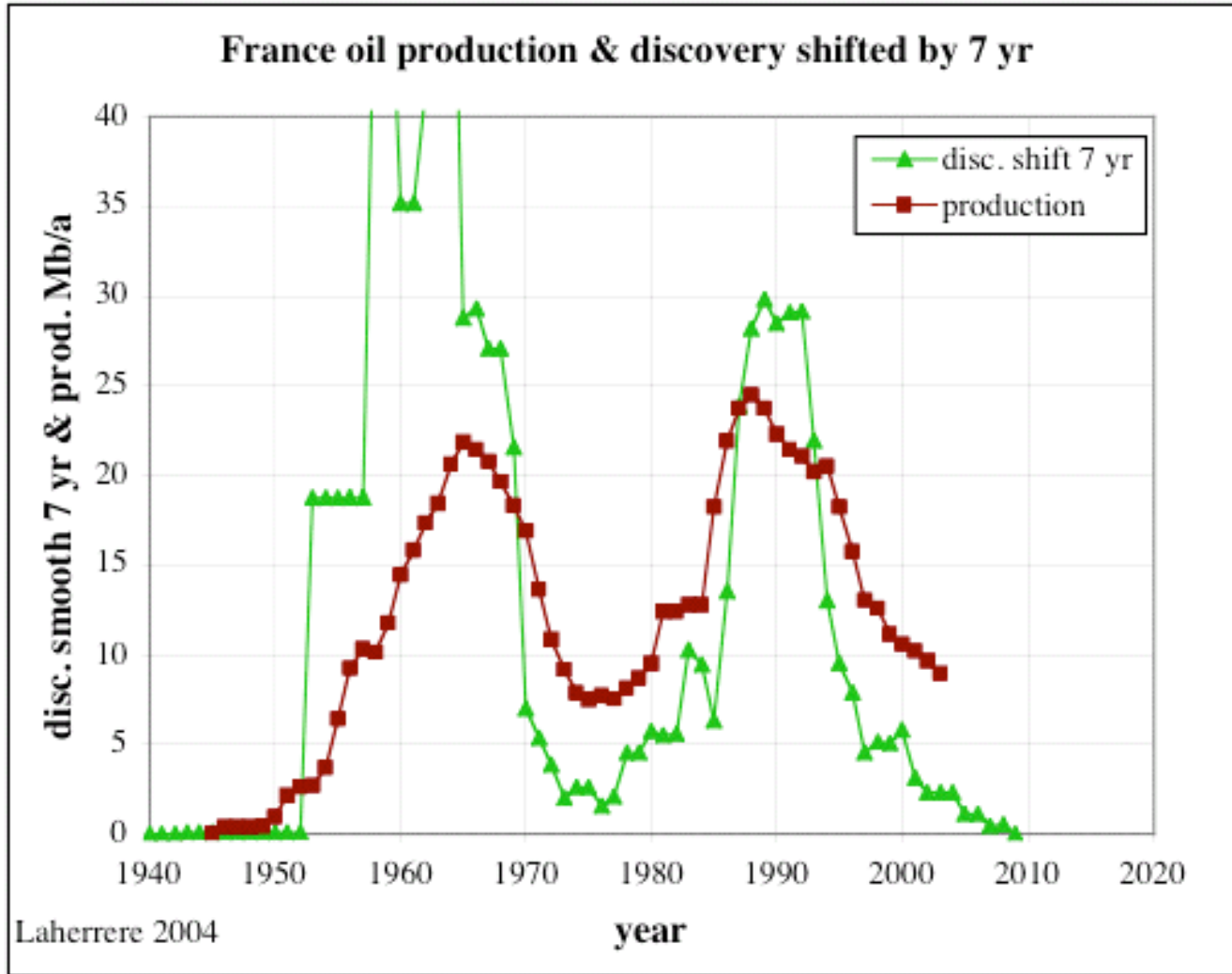
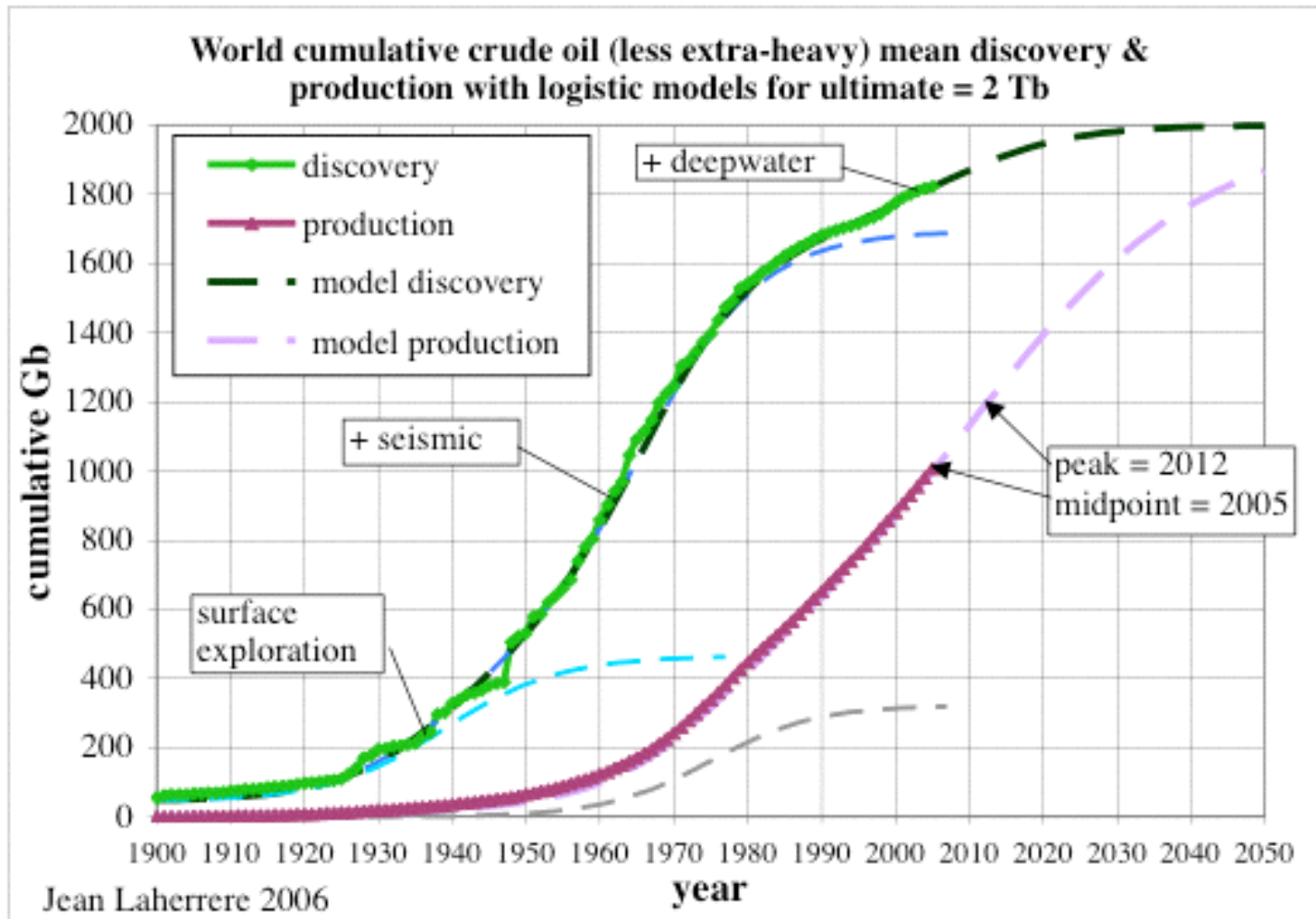
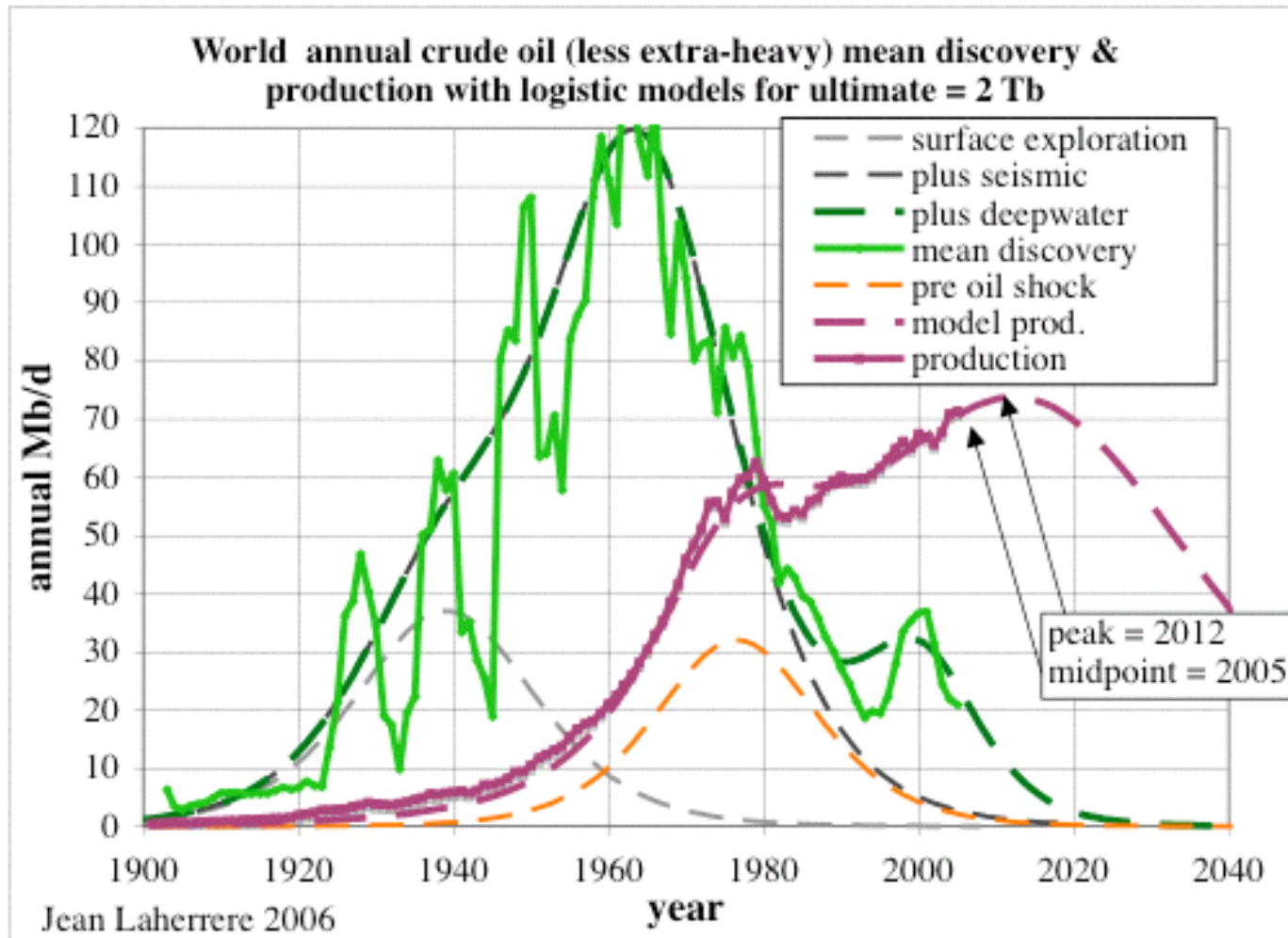


Figure 53: World **cumulative** crude less extra-heavy oil mean discoveries and production with logistic models at $U = 2000 \text{ Gb} = 2 \text{ Tb}$



Oil peak 2012 does not coincide with mid-point 2005!

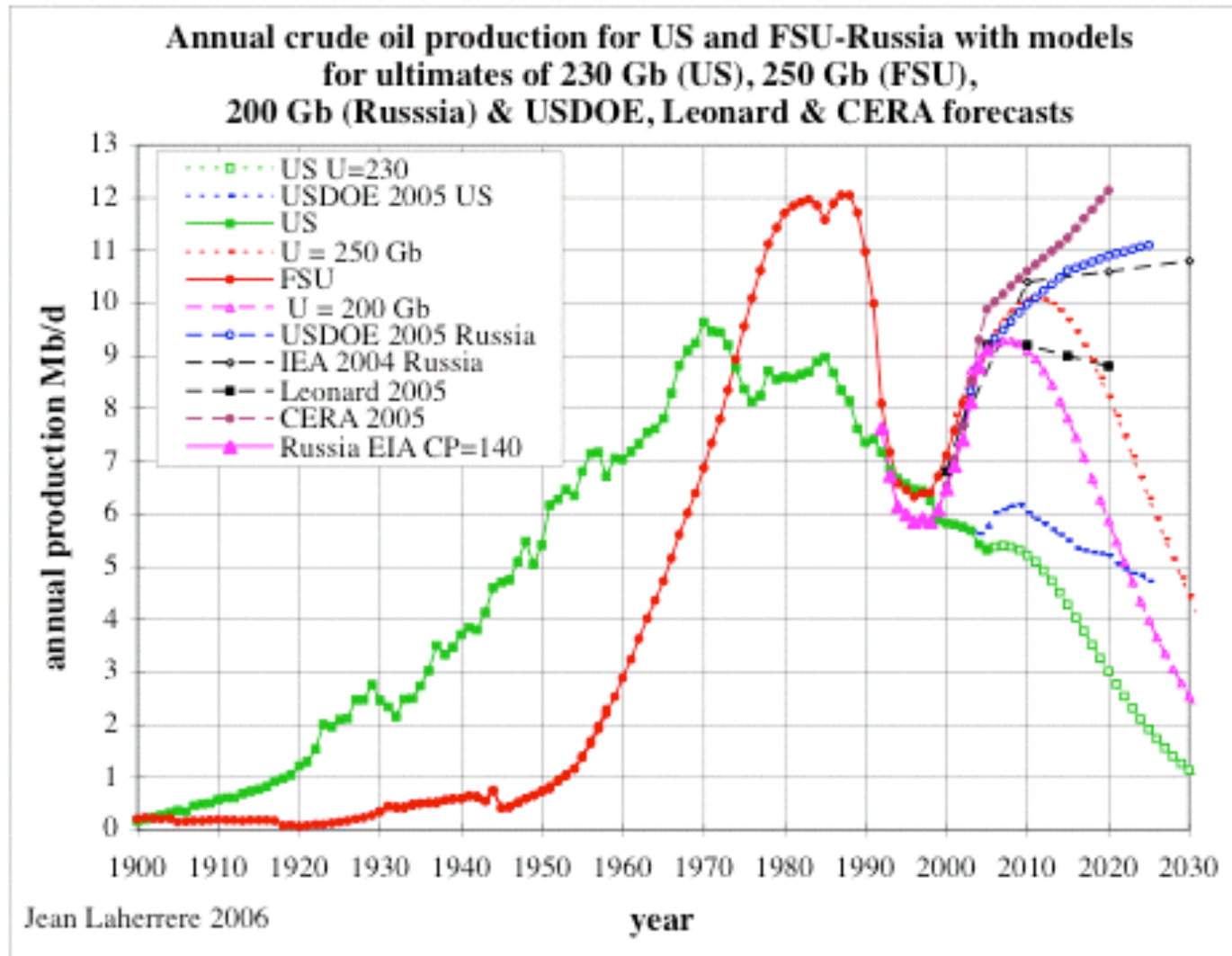
Figure 54: World **annual** crude less extra-heavy oil mean discovery and production with logistic models for $U = 2000 \text{ Gb}$



The last minor oil discovery peak in 2000 was due to deepwater
 Oil peak 2012 does not coincide with mid-point 2005!

-US-FSU

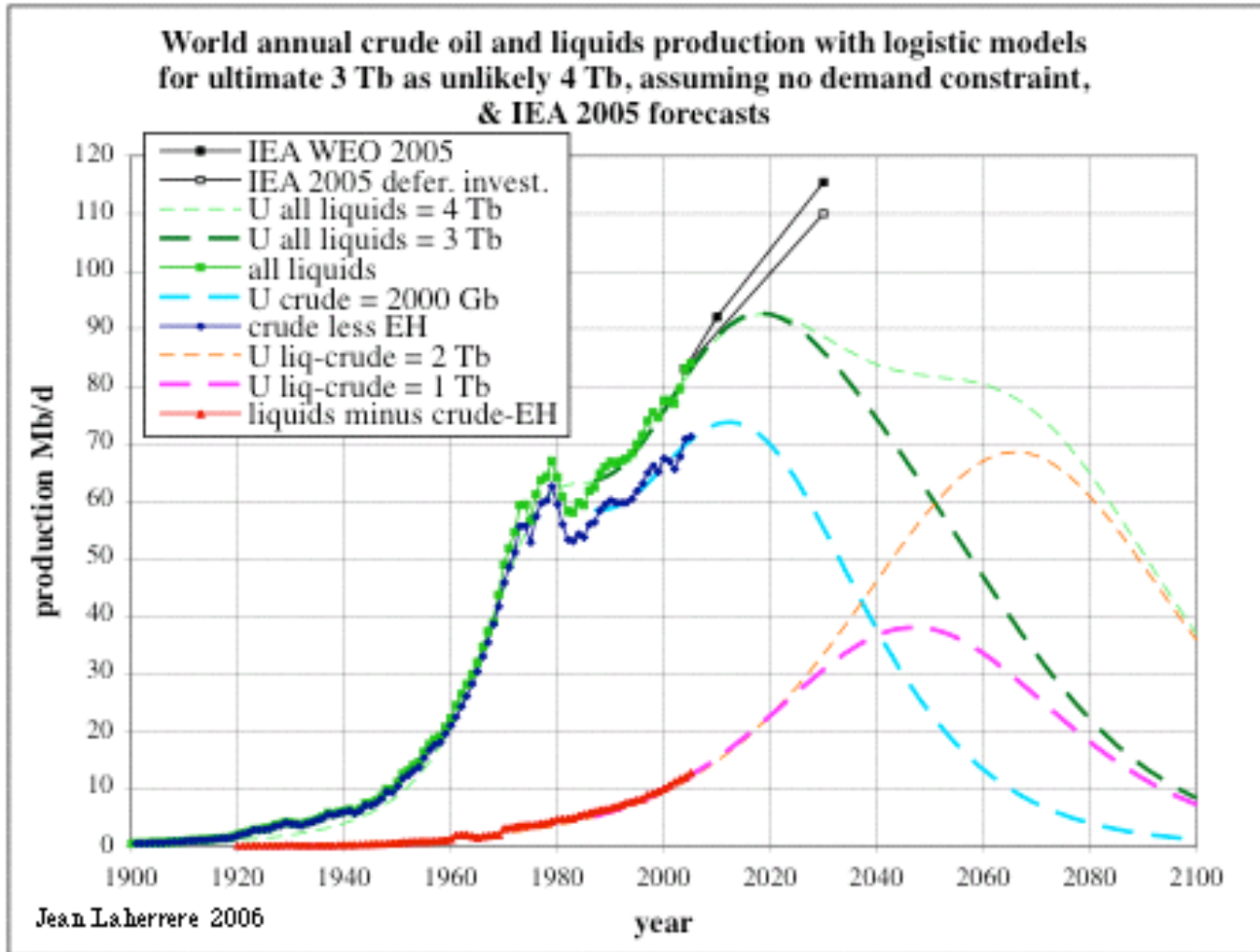
Figure 57: US & FSU annual oil production and forecasts



-World oil production

Ultimate liquids = 3 Tb is the sum of 2000 Gb for crude less extra-heavy +500 Gb for extra-heavy +250 Gb for natural gas liquids & GTL + 250 Gb for synthetic (CTL, BTL) & refinery gains.

Figure 58: **World liquids production (no demand constraint)**

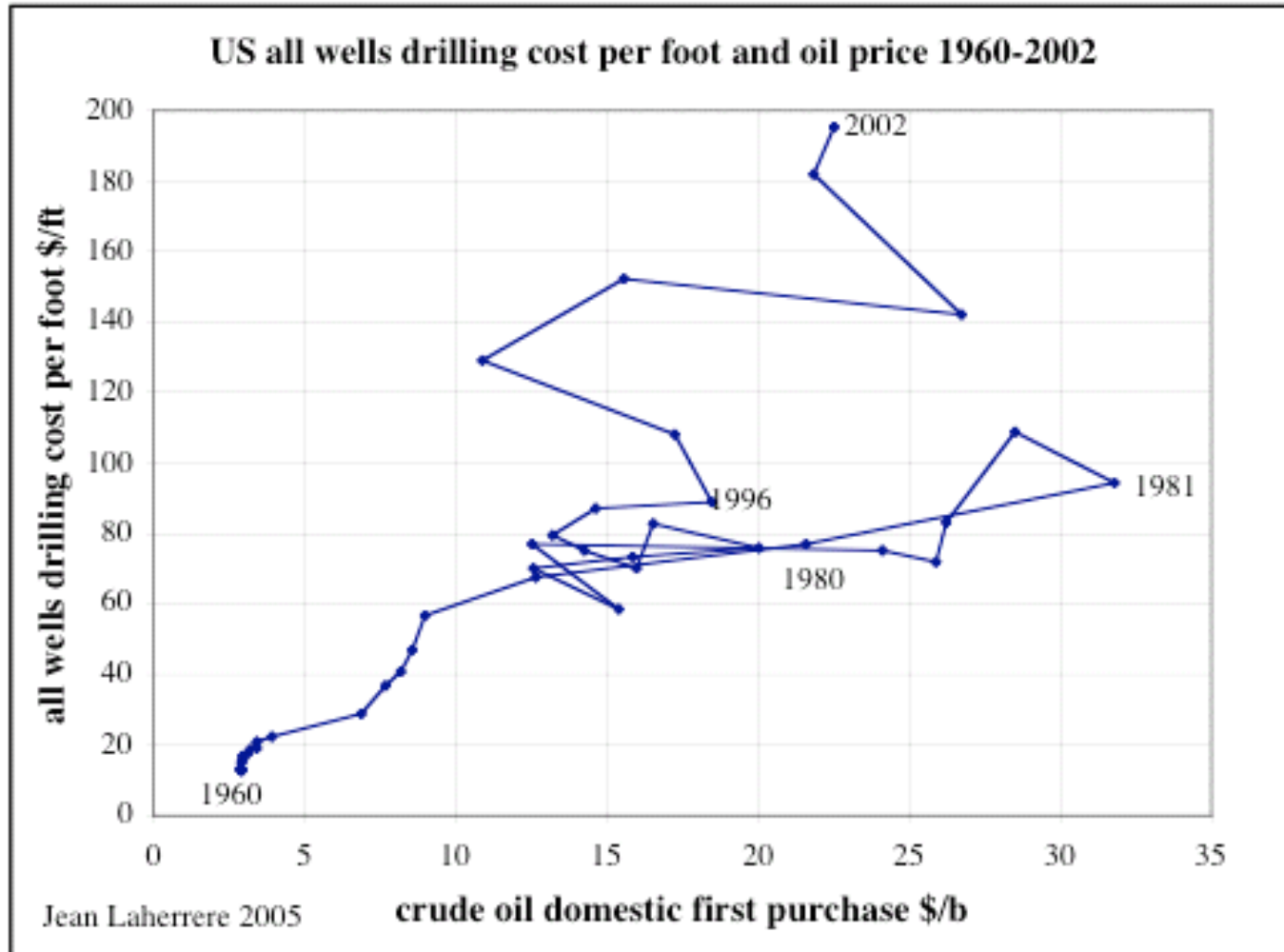


Adding 1 Tb to expensive oil does not change the peak, only the slope

-Finding or operating cost and reality

Some claim that costs are down with technology, but facts are different.

Figure 61: US drilling cost versus oil price



-Natural gas (NG)

If there is only one oil market, because natural gas (NG) cost 10 times more to transport, **there are three NG markets: North American, Europe and Asia Pacific.**

Figure 62: **world remaining NG reserves** from different sources.

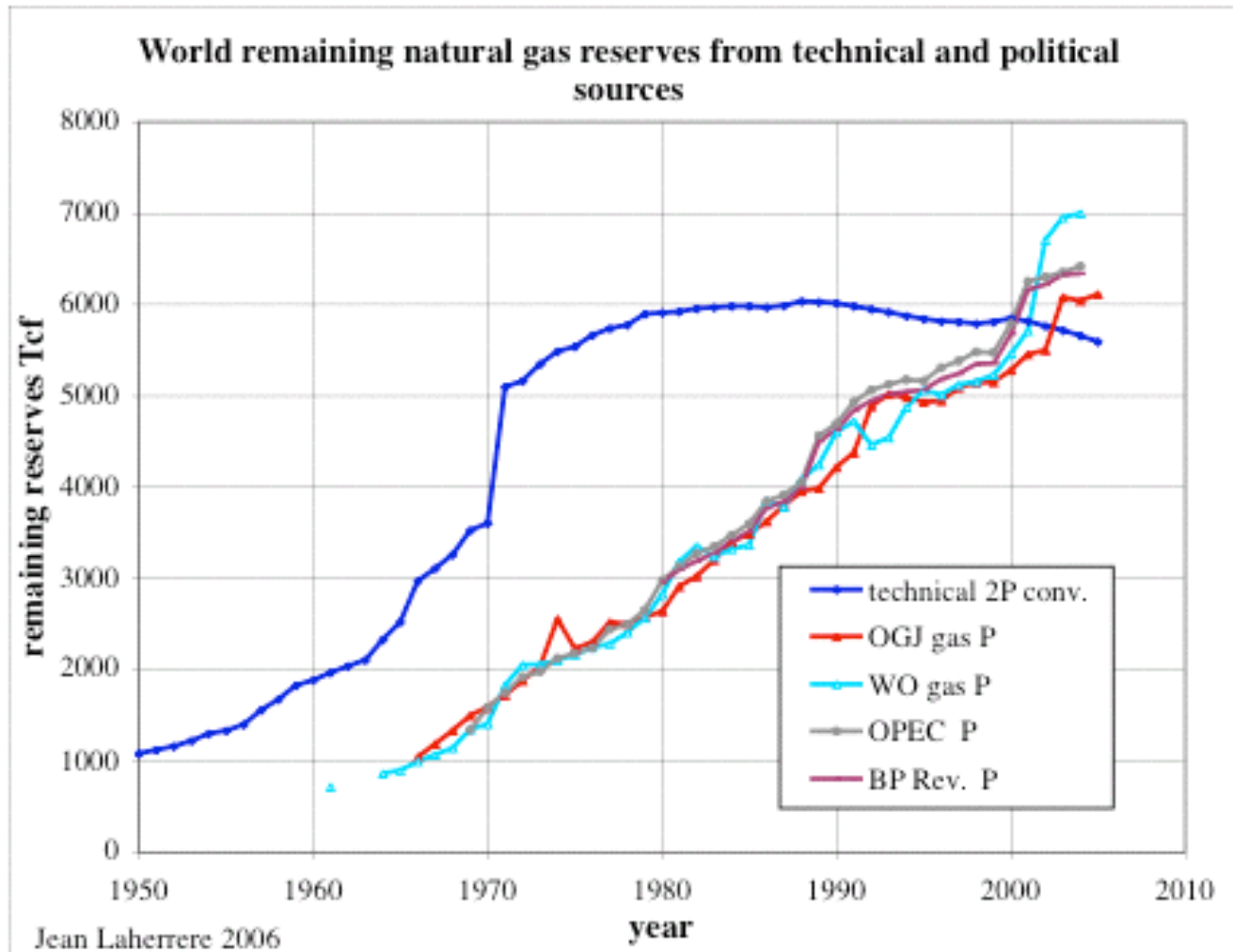


Figure 63: Conventional gas creaming curve by continent

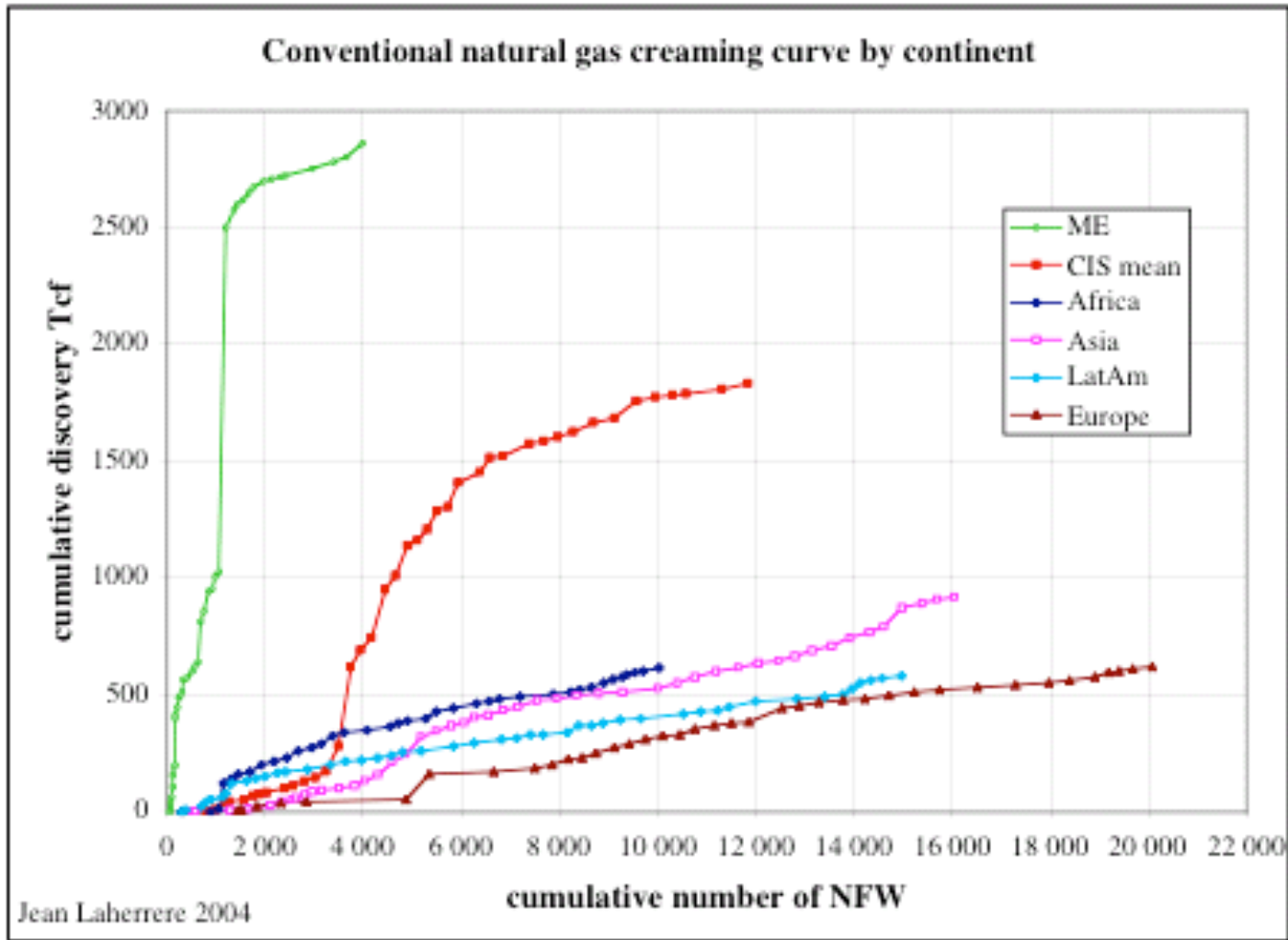


Figure 64: 2006 forecast: World conventional cumulative gas conventional discoveries and production with logistic models

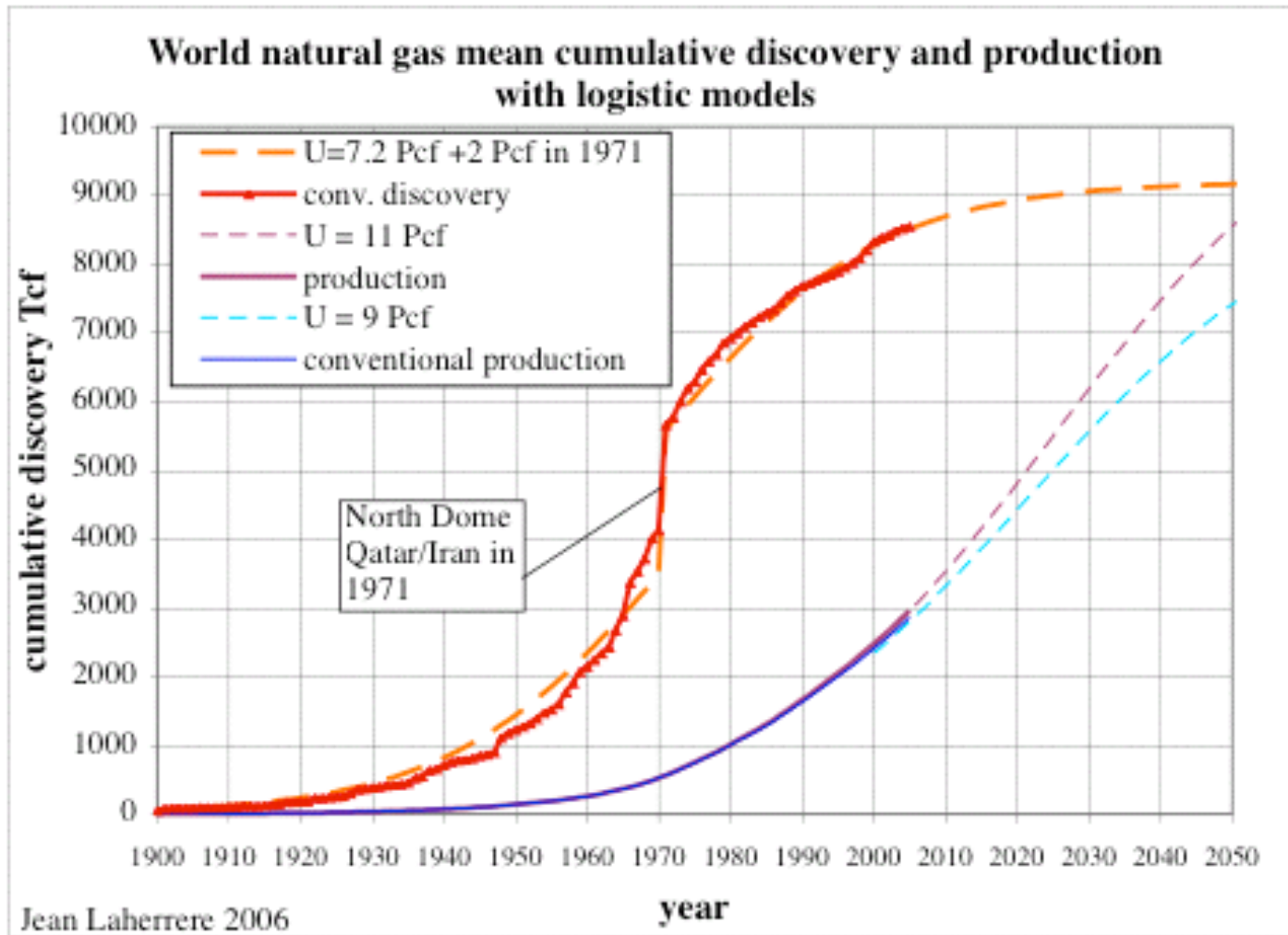


Figure 65: World annual gas discovery & production as forecasts

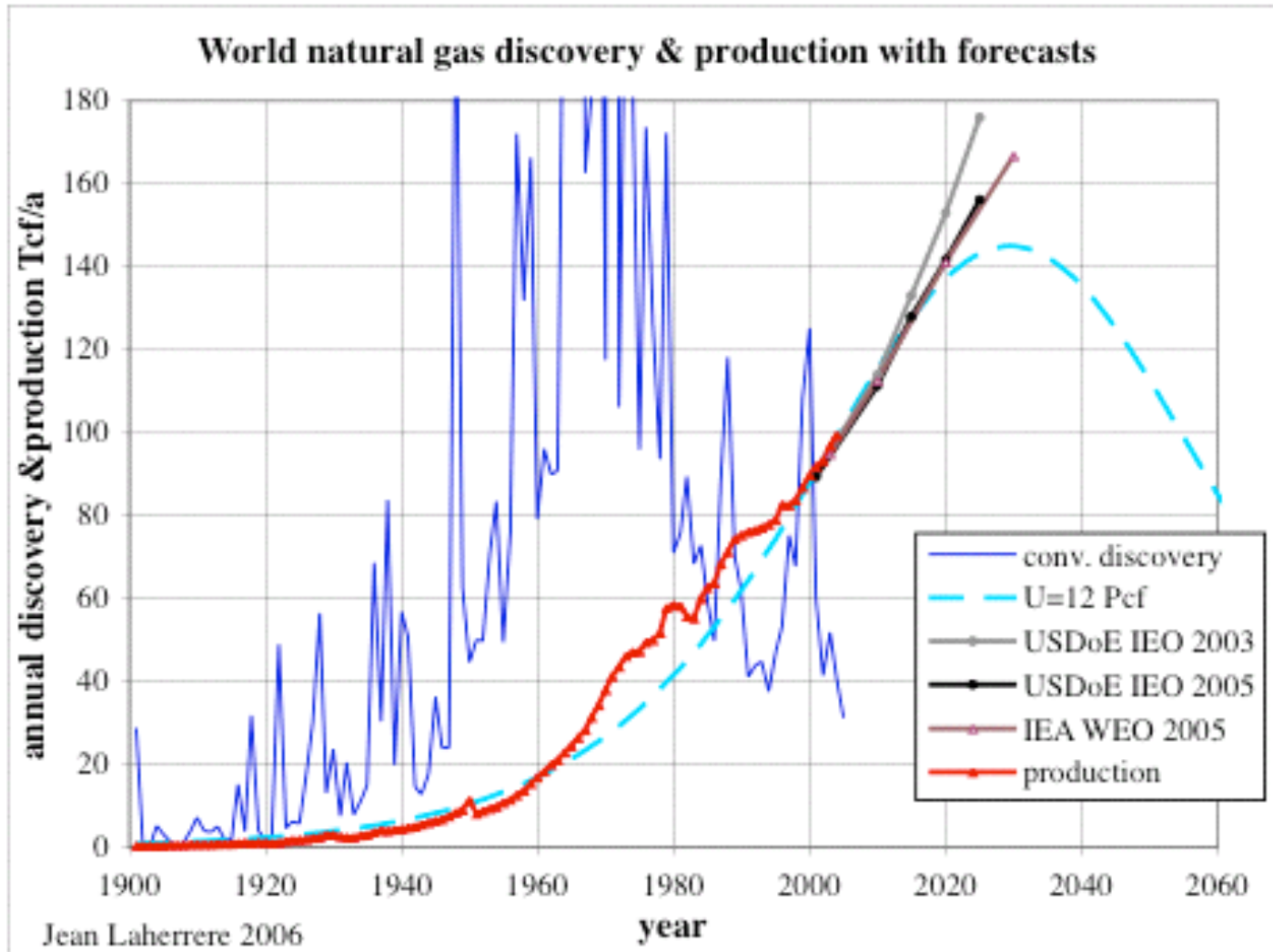
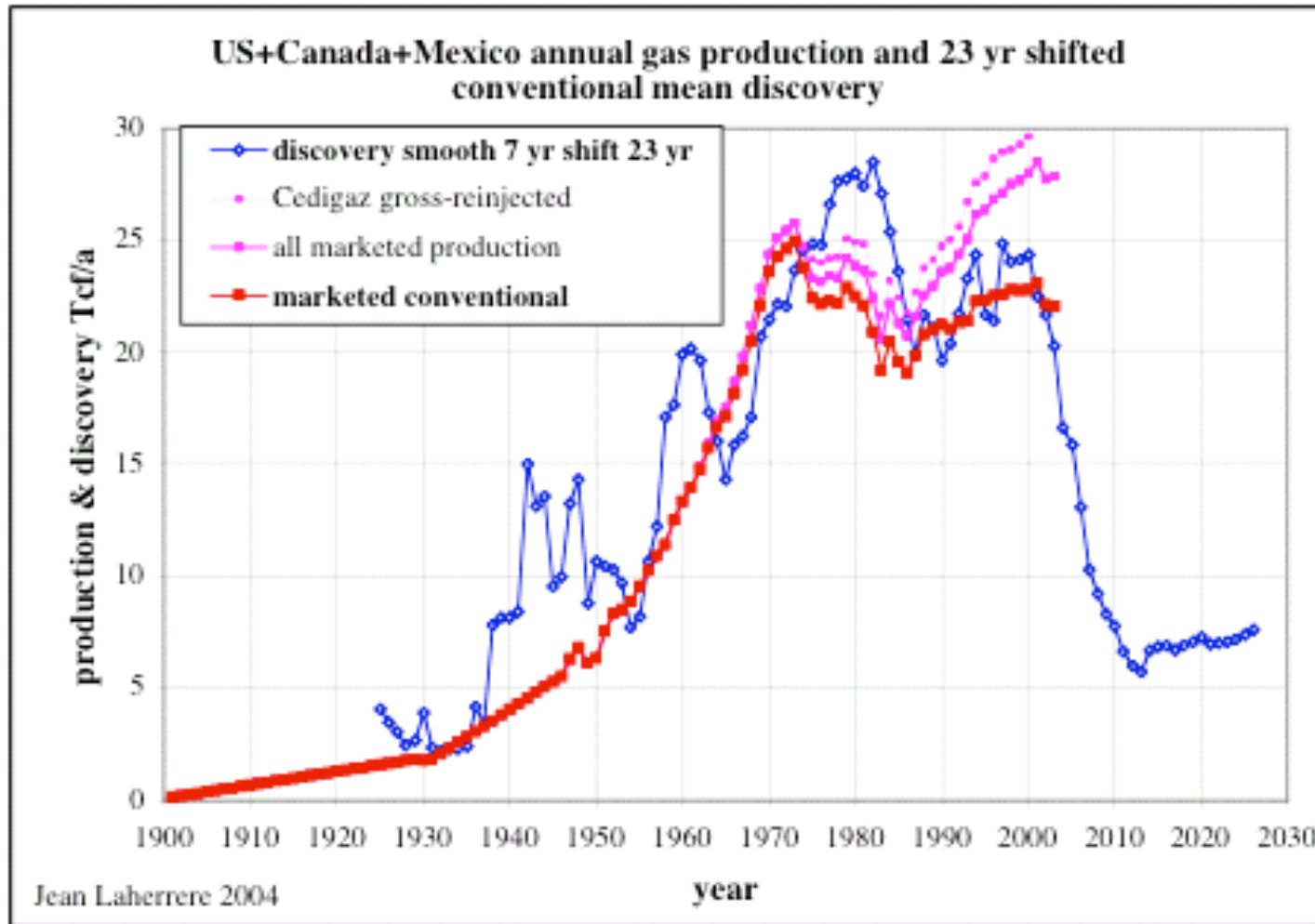
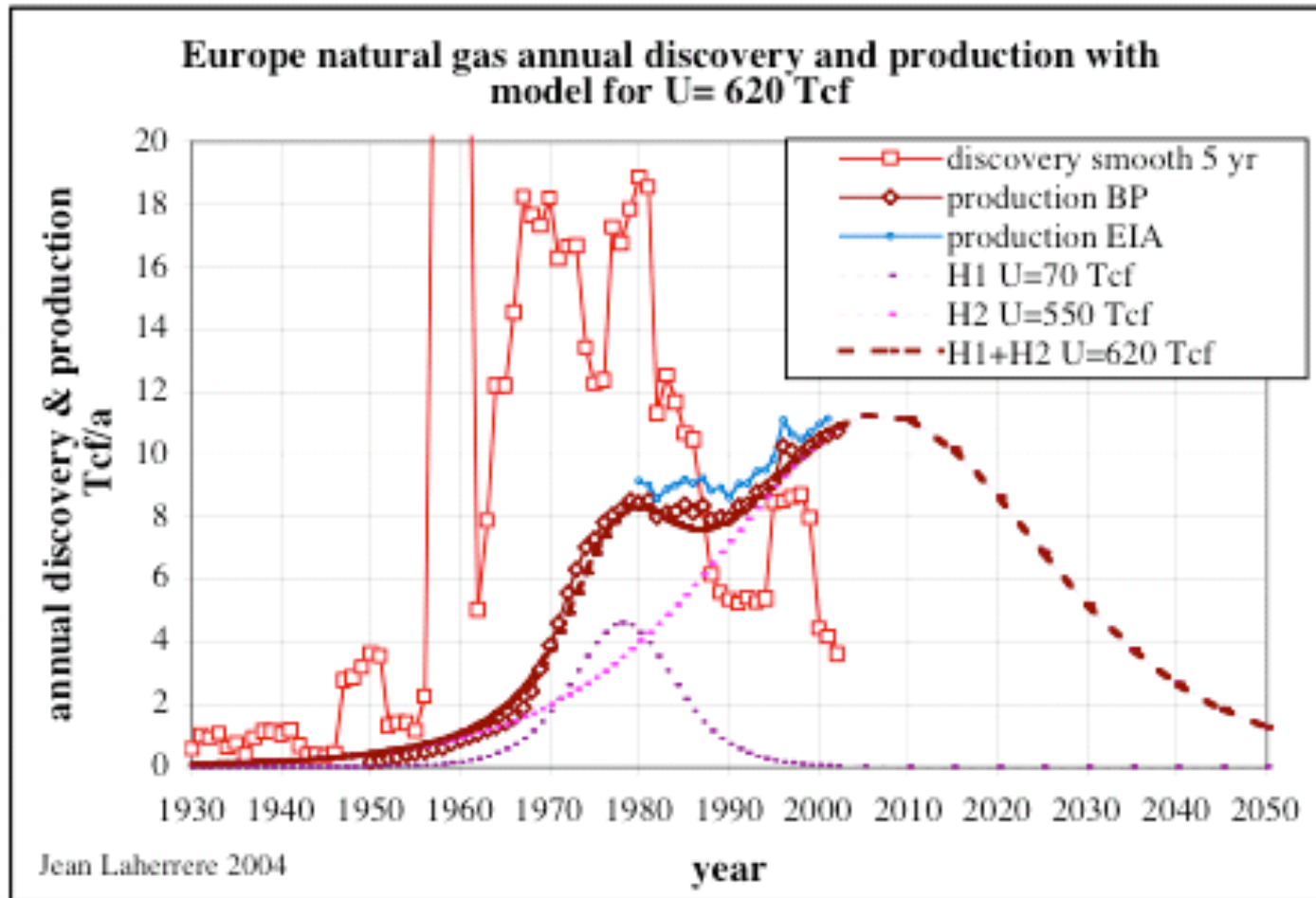


Figure 67: US + Canada + Mexico annual conventional gas production and shifted discovery



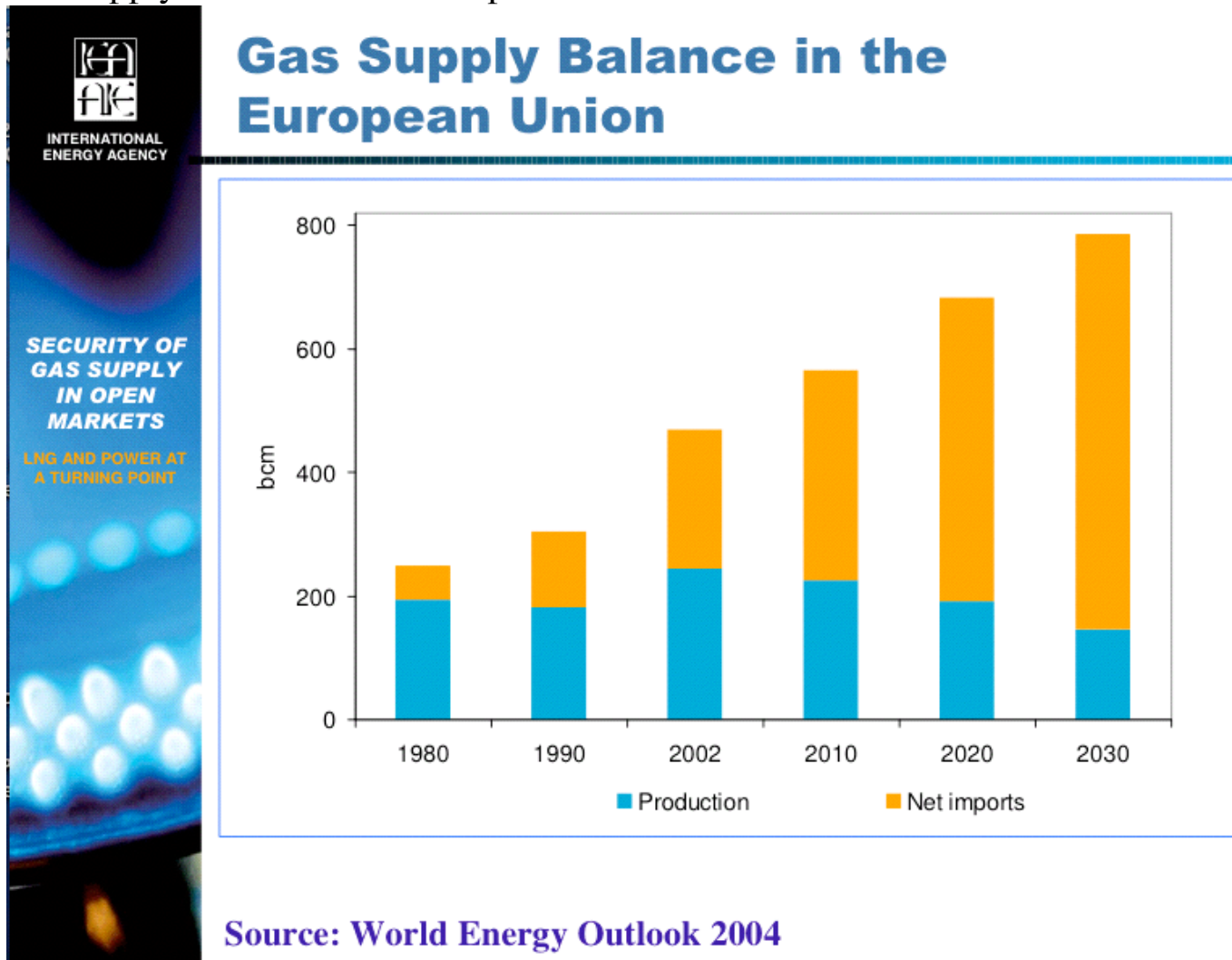
North America gas production is peaking and will decline sharply following the correlation between production and mean discovery shifted by 23 years.

Figure 69: Europe annual gas production and discovery



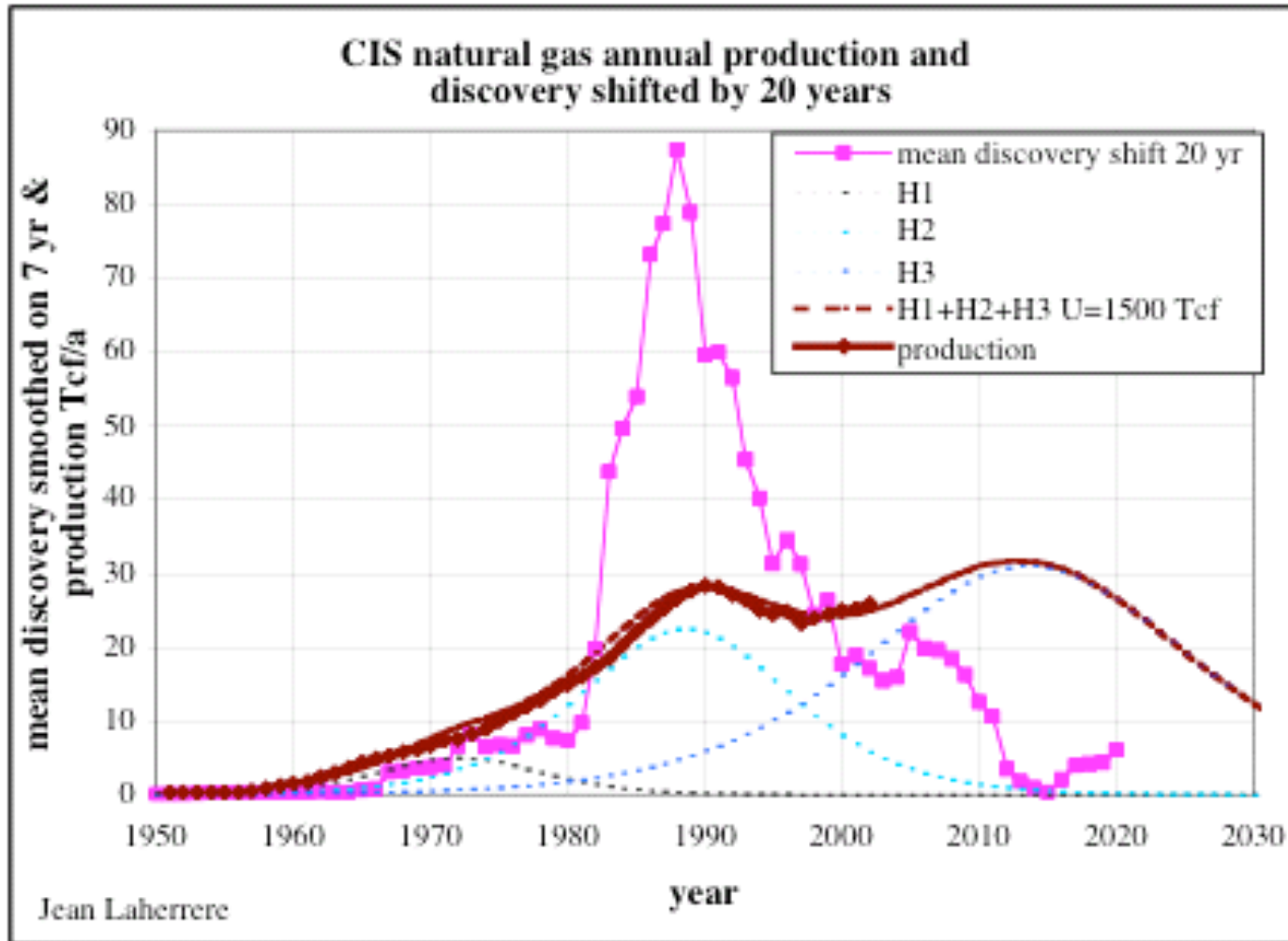
Europe gas production will peak soon as reported by the IEA for European Union

Figure 70: Gas supply balance in the European Union 1980-2030



Europe is counting too much on Russian gas supply, which is overestimated

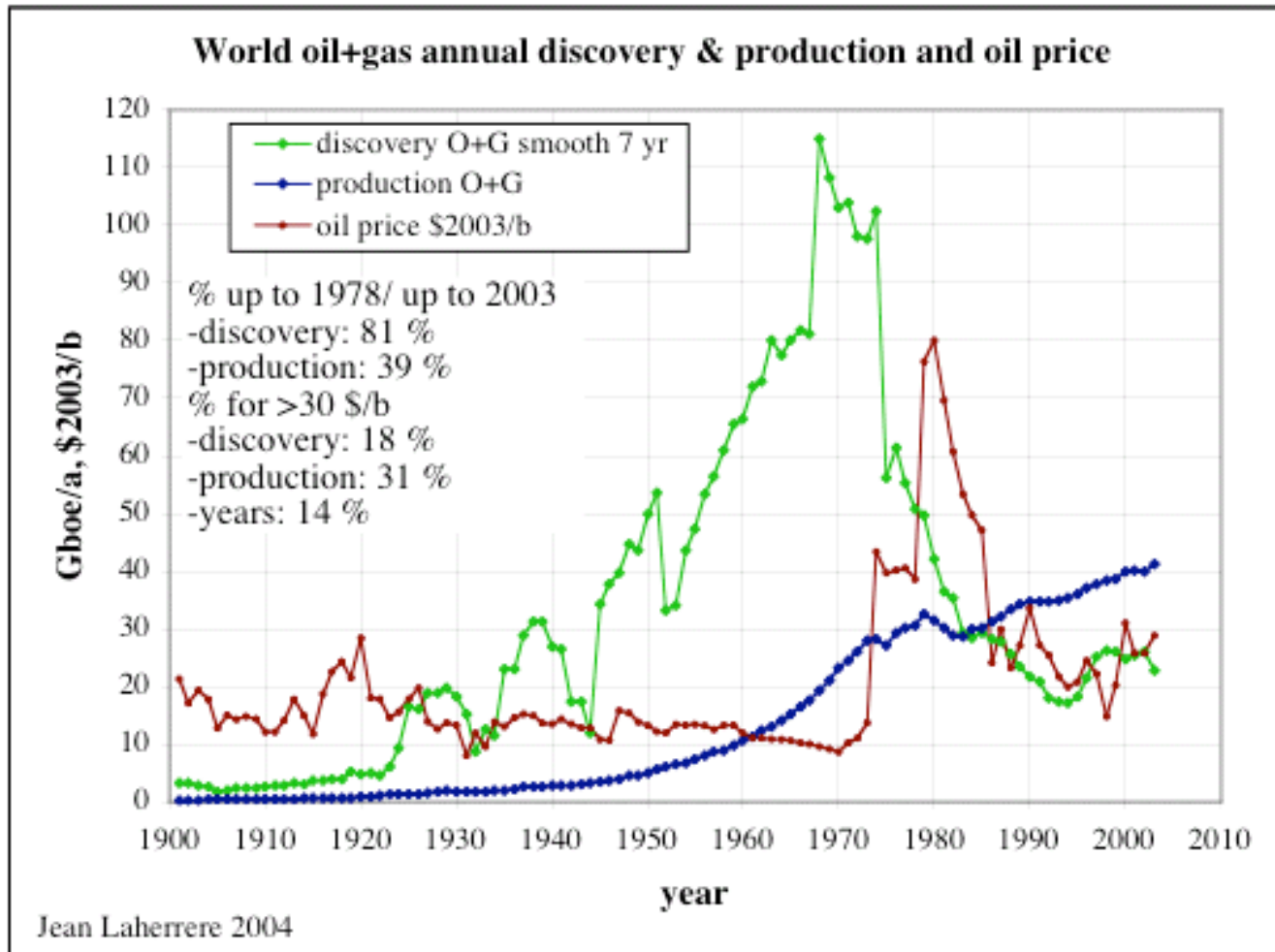
Figure 71: FSU gas production and shifted discovery



Russia gas production will peak soon and will not fill Europe needs!

-Discovery does not increase with oil price

Figure 72: World oil+gas production & discovery and oil price



Oil price increase did not increase discovery, in contrary, it only decreased production for a while!

-Resources assessment

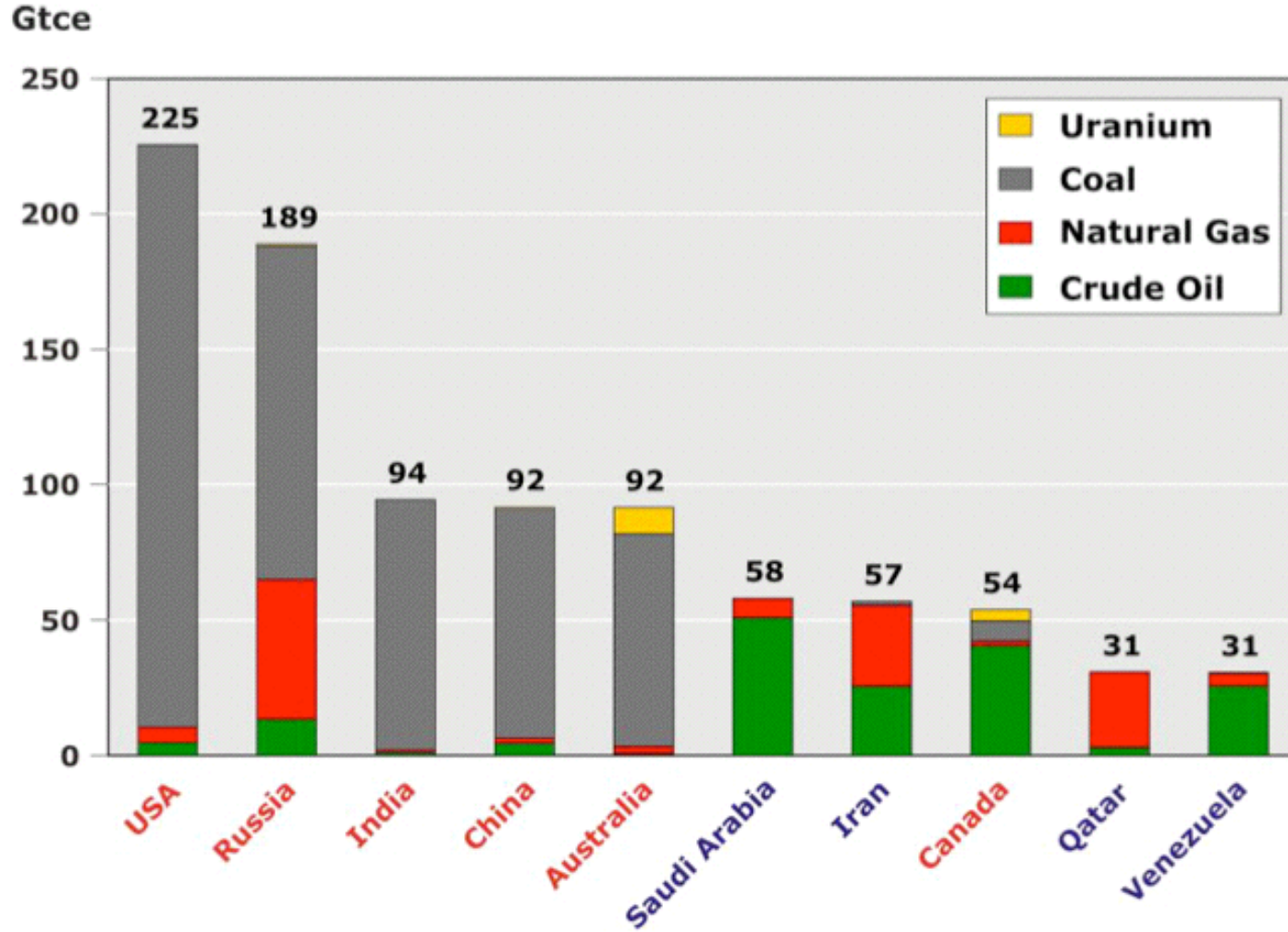
The BGR in Germany is the only one organism in the world making complete and reliable assessment of world energy reserves and resources. The study is updated every 4 years.

The WEC (World energy Council) is just gathering heterogeneous national reports, but is reluctant to add them for a global estimate.

Remaining reserves & resources 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

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

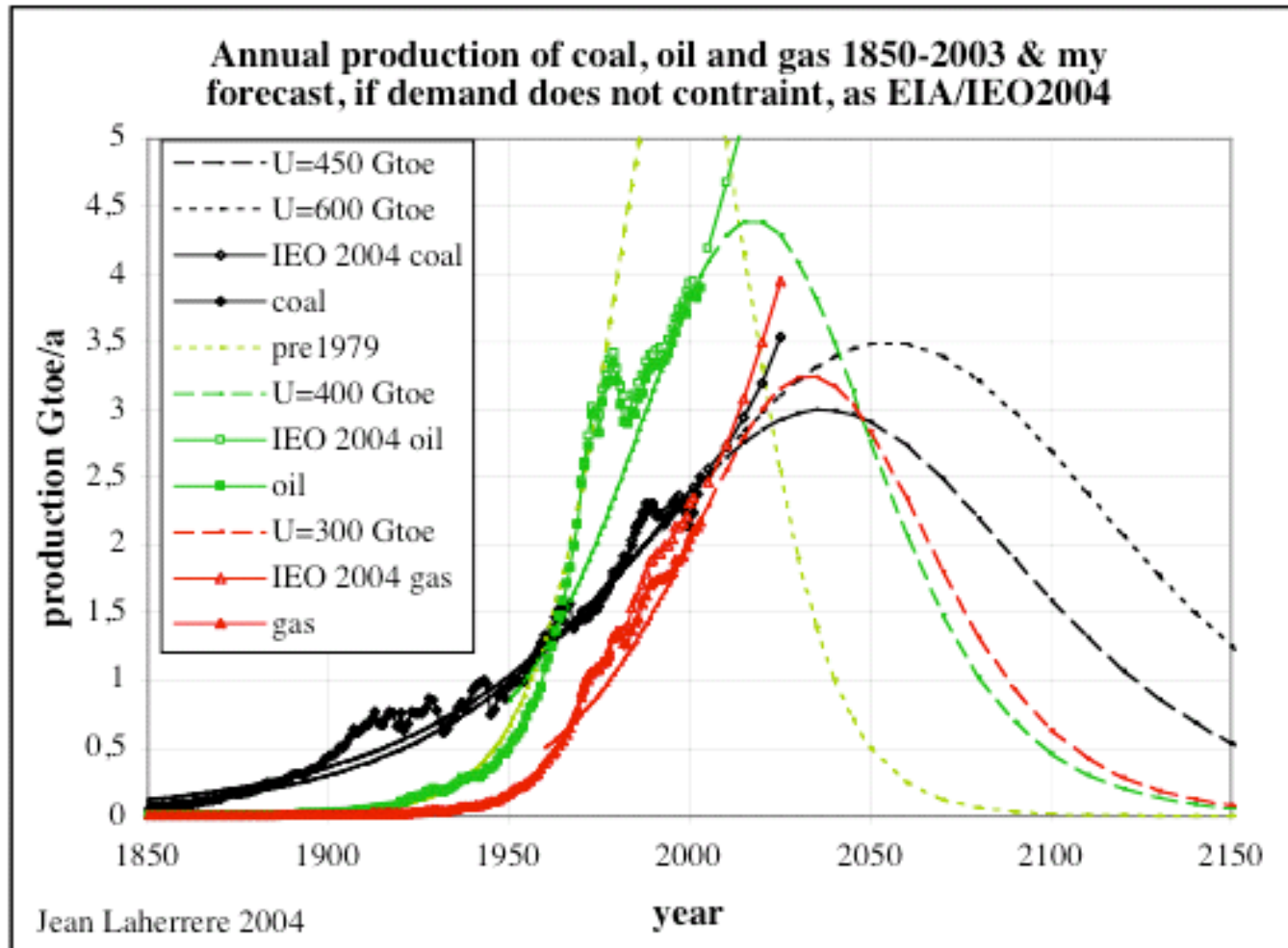


-Fossil Fuels

Fossil fuels production can be modelled with ultimates giving peak (if no demand constraint):

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

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



-Primary energy

As each energy is different, it is necessary when aggregation energy to get an energy mix to make arbitrary assumptions, one MWh can be converted either into 0,083 toe or 0,2606 toe

Figure 82: energy flow in France en 2005 from 285 Mtoe to 176 Mtoe

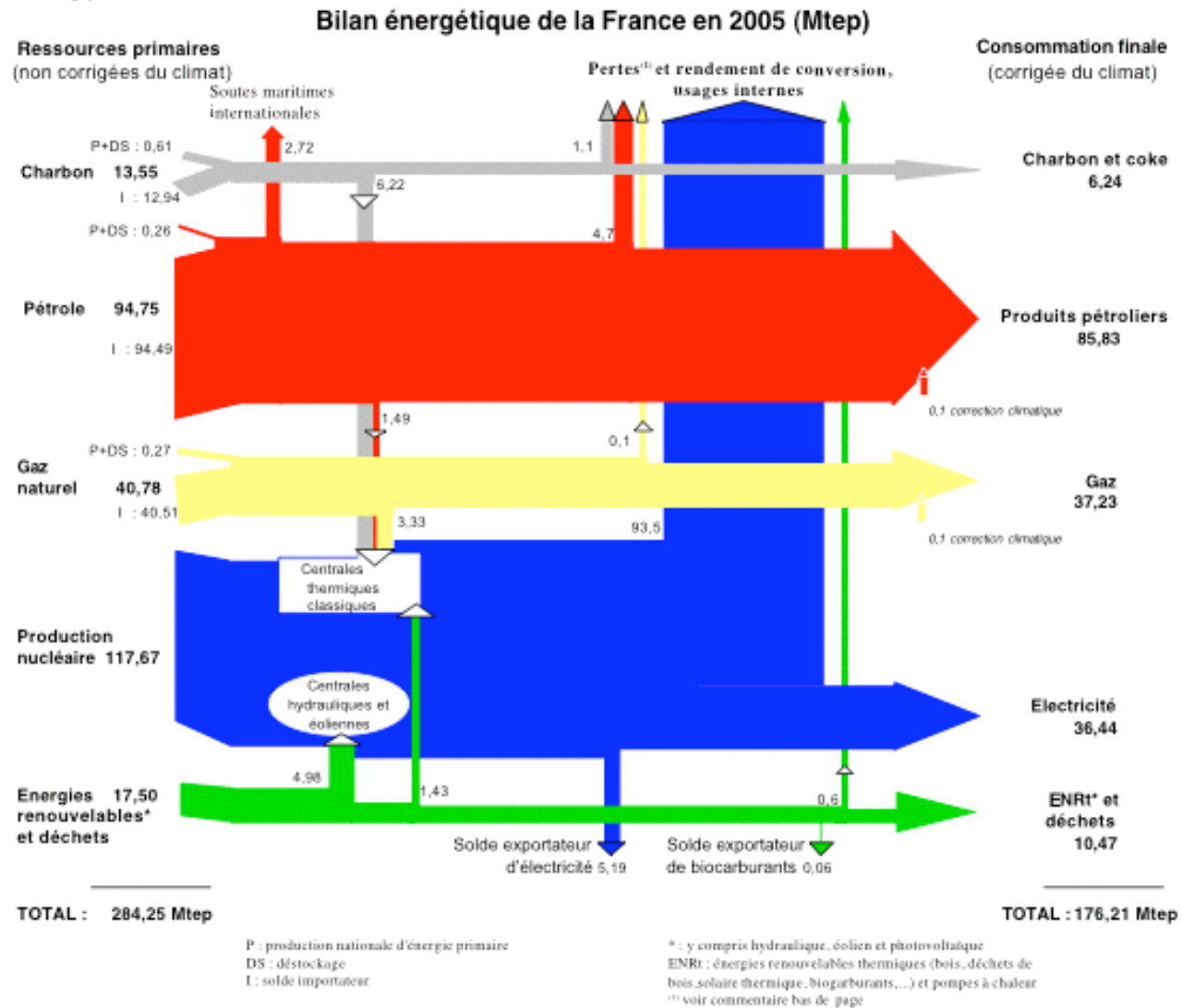
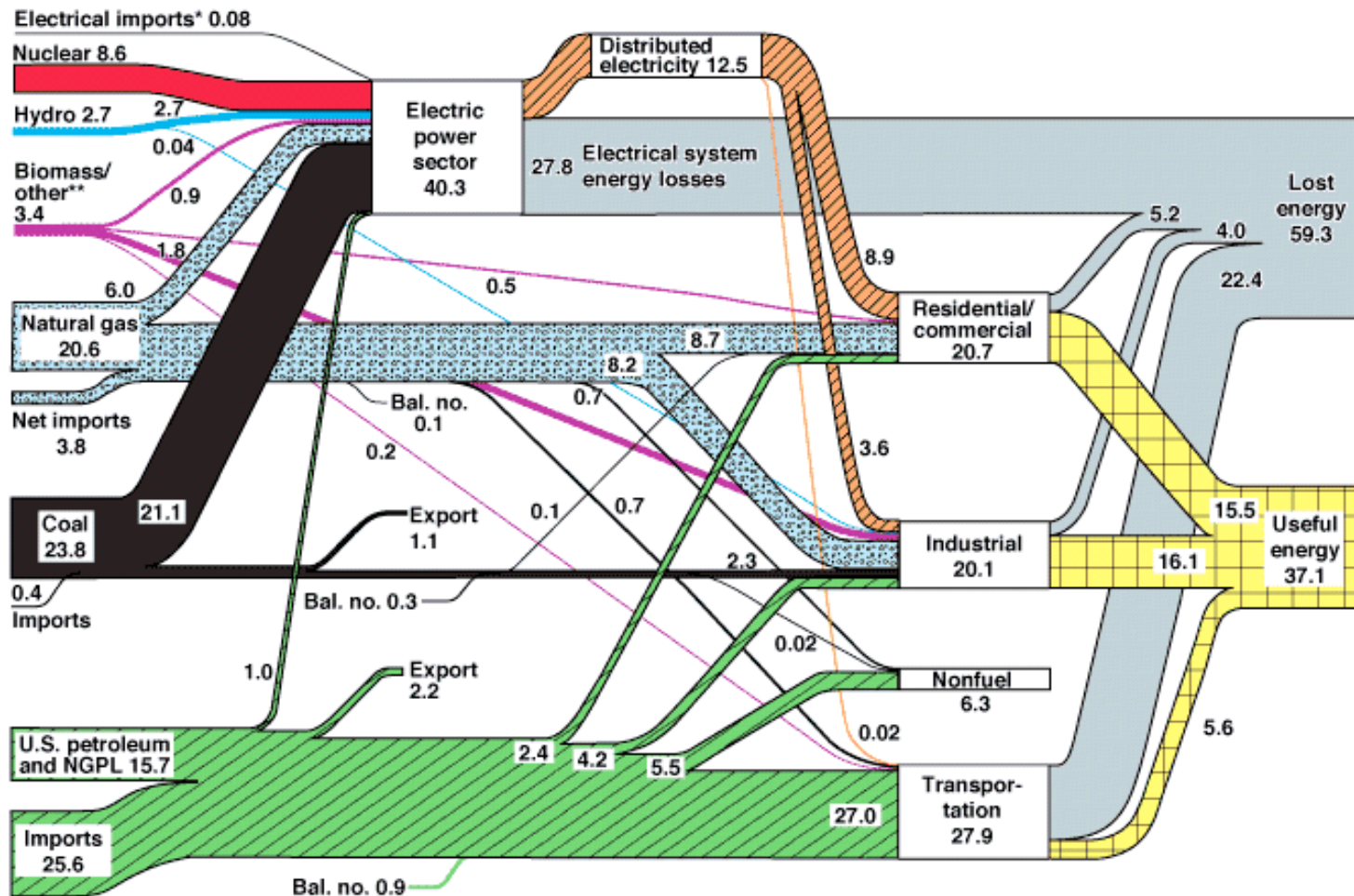


Figure 83: US energy flow for 2002: **61% of the energy is lost!**

U.S. Energy Flow Trends – 2002

Net Primary Resource Consumption ~103 Exajoules



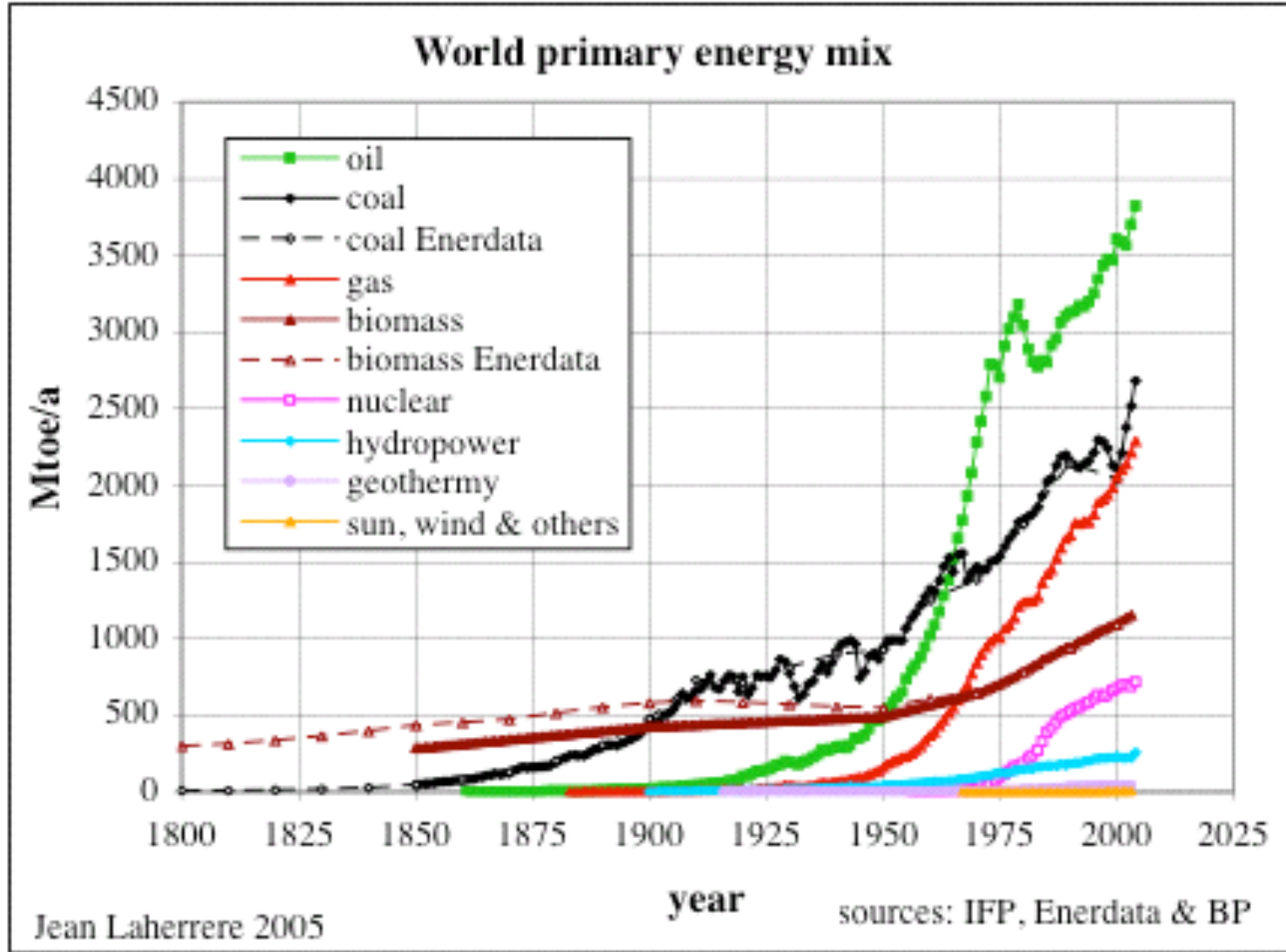
Source: Production and end-use data from Energy Information Administration, *Annual Energy Review 2002*.

*Net fossil-fuel electrical imports.

**Biomass/other includes wood, waste, alcohol, geothermal, solar, and wind.

June 2004
Lawrence Livermore
National Laboratory
<http://eed.llnl.gov/flow>

Figure 84: **World primary energy mix 1850-2004**



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 as a peak

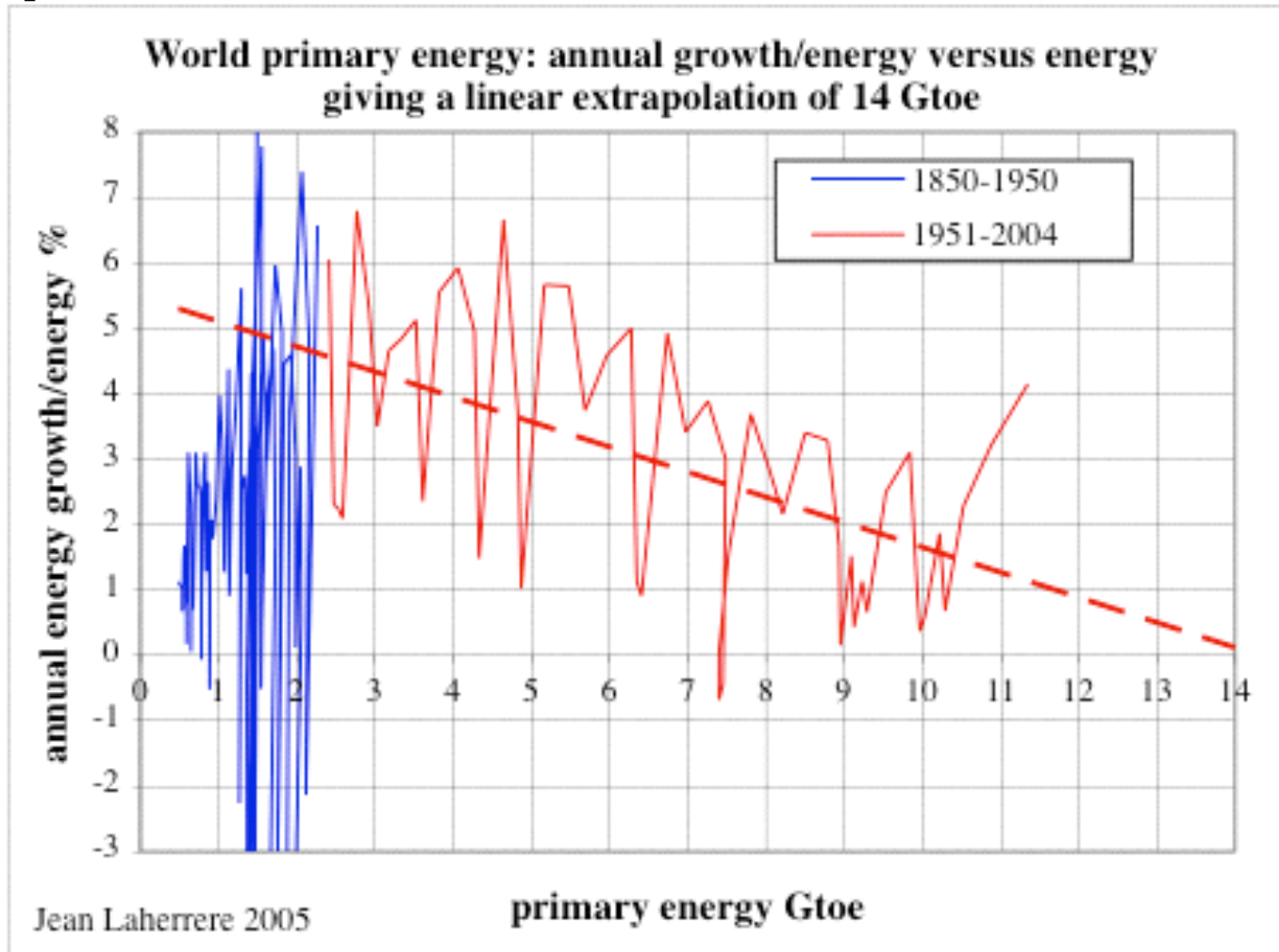


Figure 87: World primary energy with logistic to 14 Gtoe and USDOE IEO & DGEMP forecast

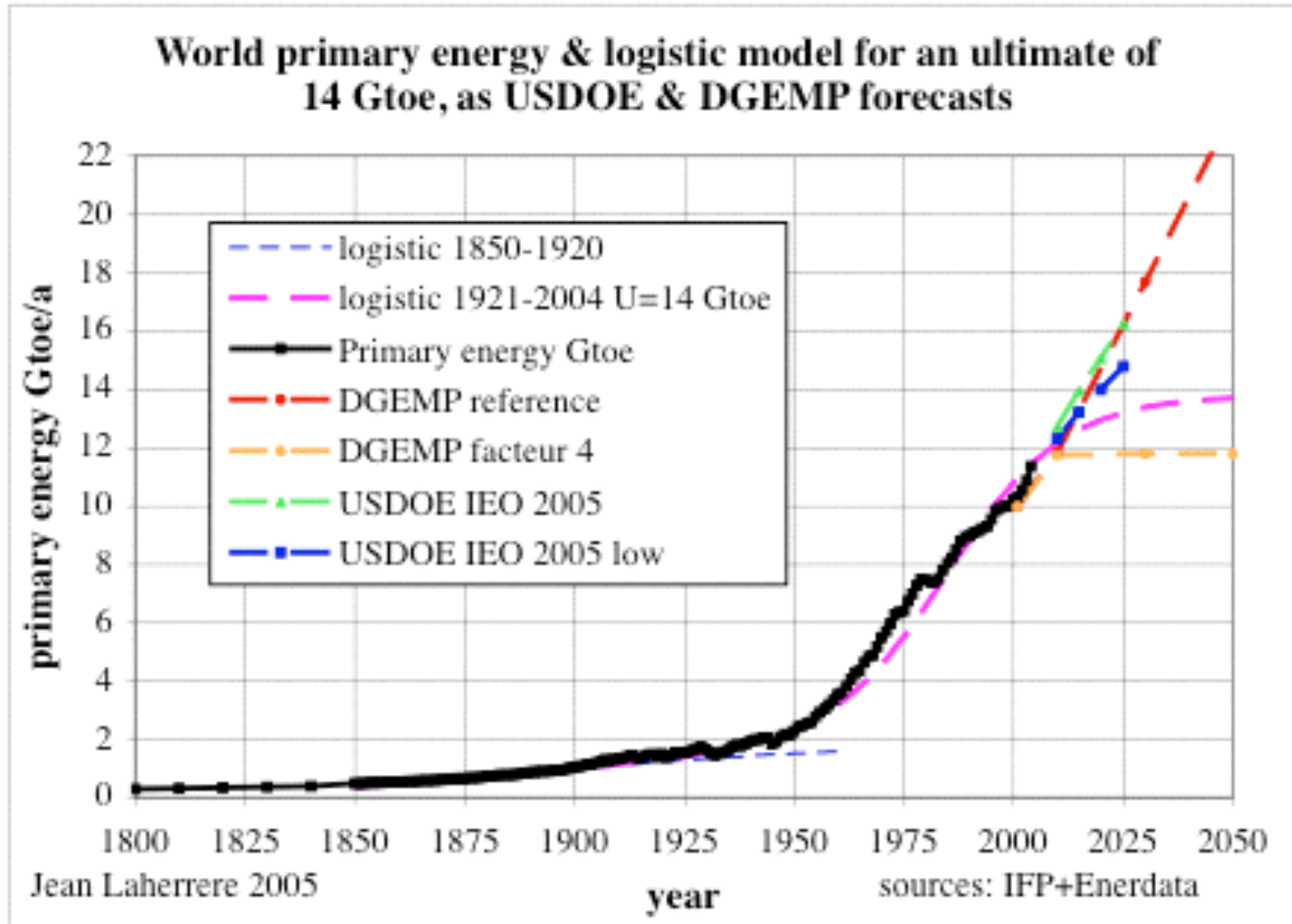
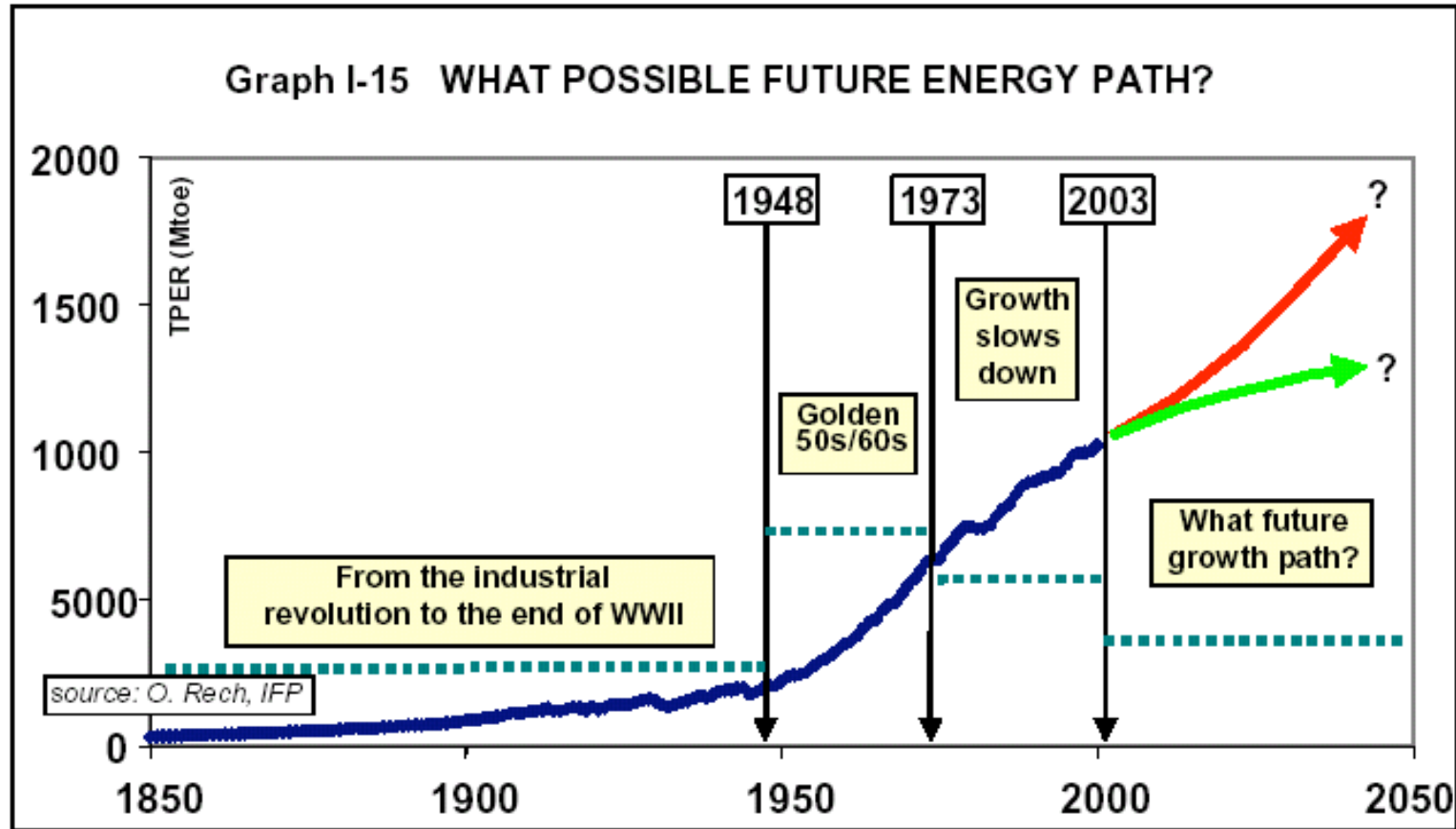


Figure 88: WEC (World Energy Council) 2003 forecast for world primary energy 1850- 2050

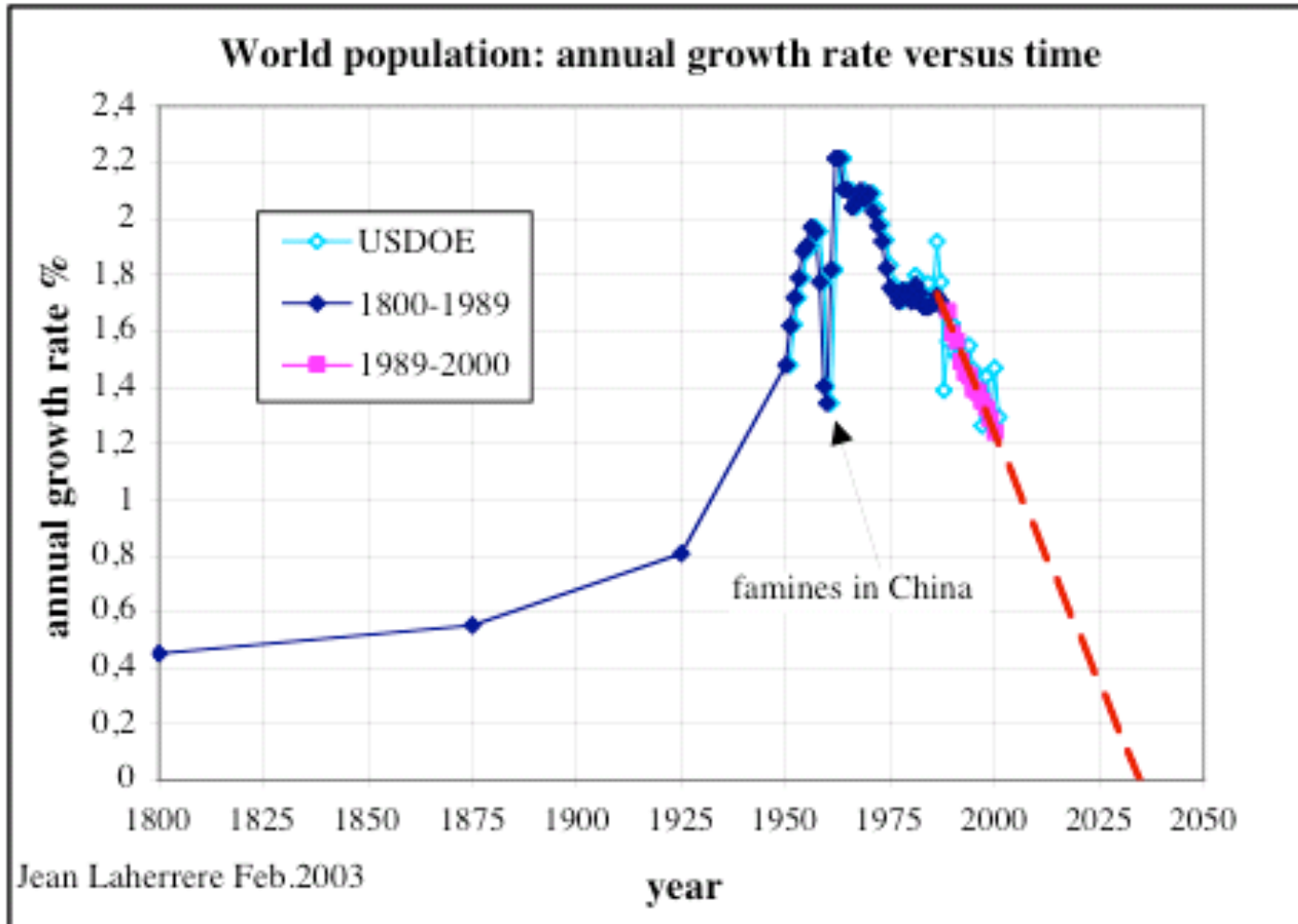


Scale wrong above 5 000 Gtoe, add one zero 1000 = 10 000 Gtoe

-Population

Energy per capita needs population forecast. And energy demand needs also to forecast population.
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**

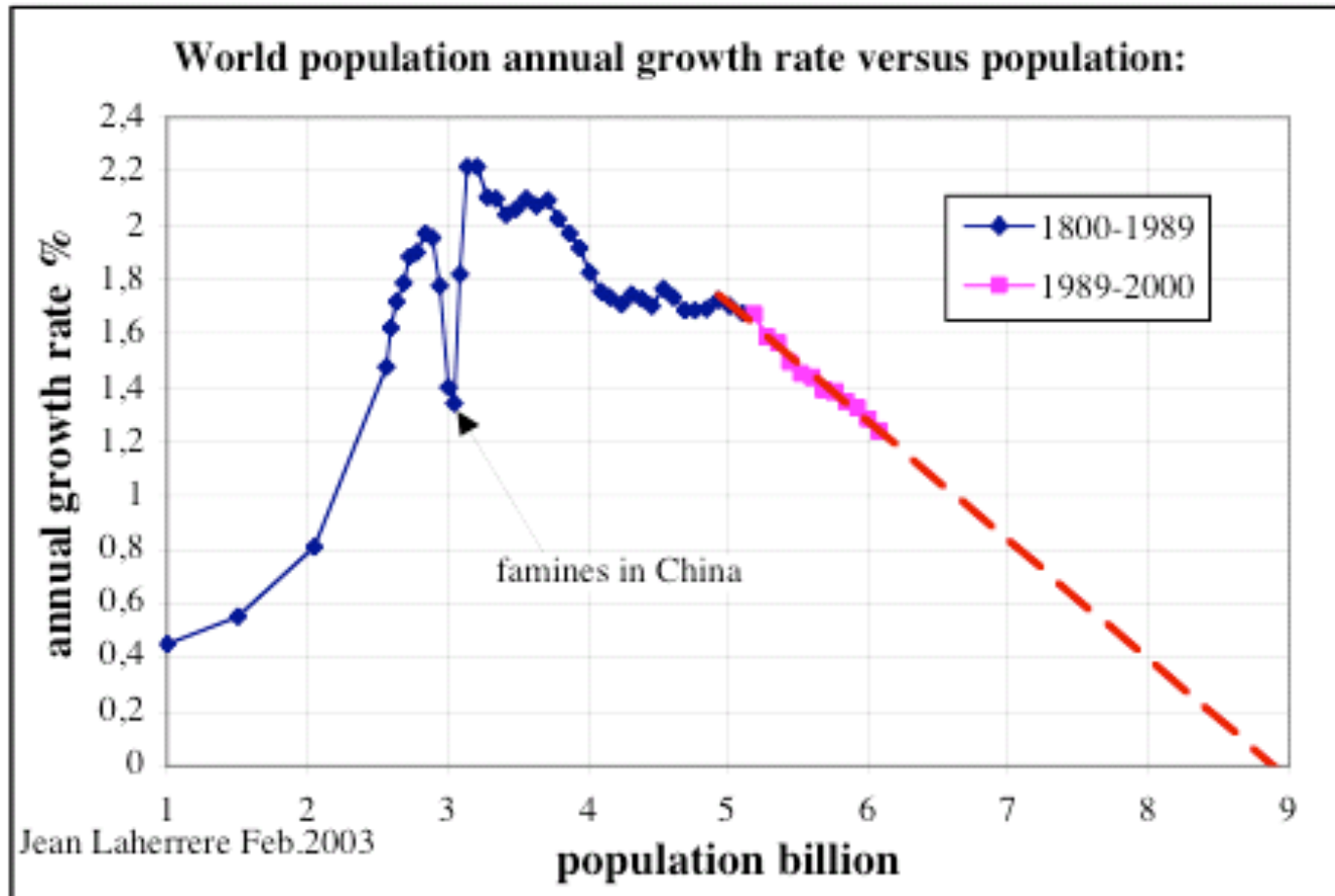
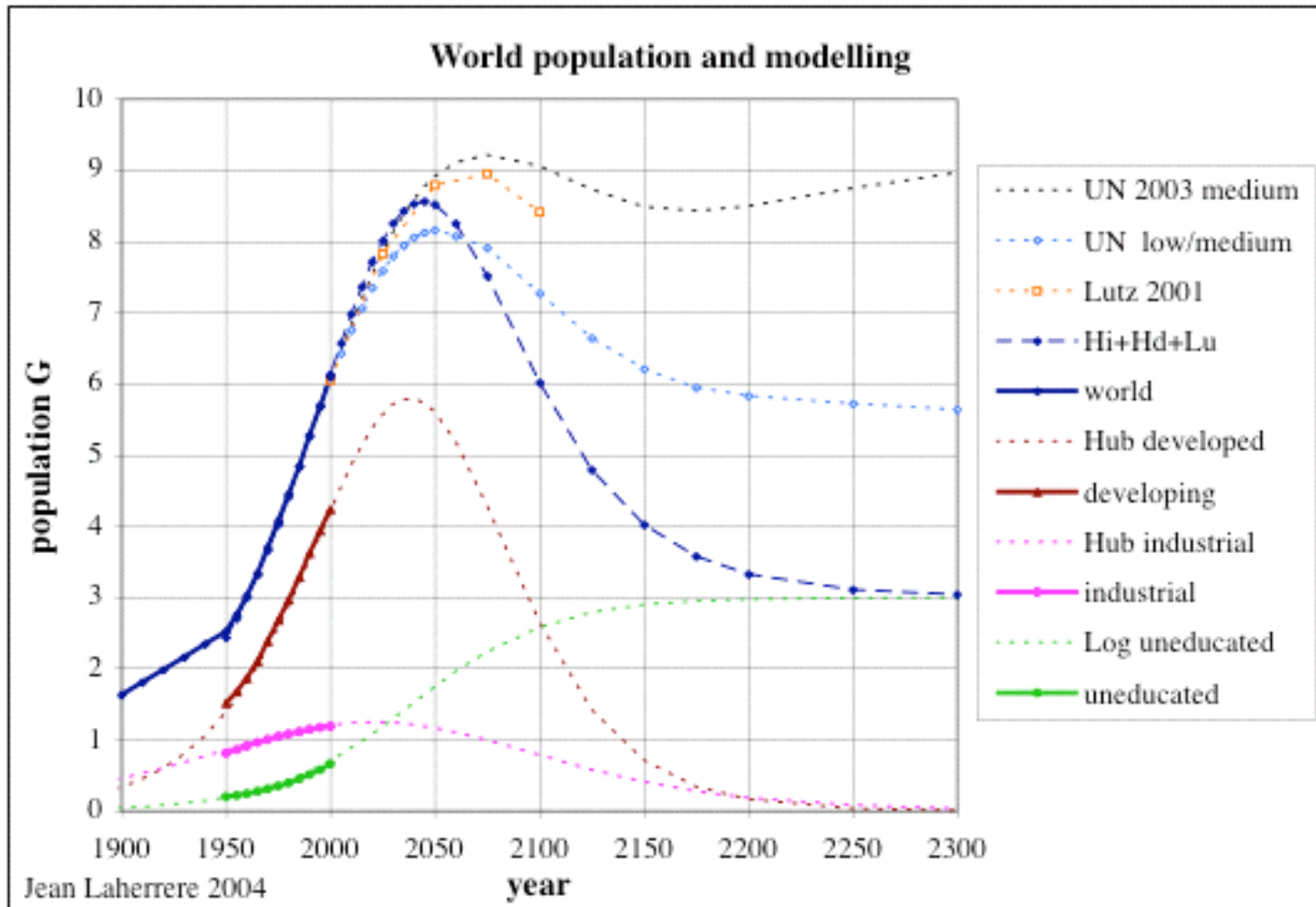
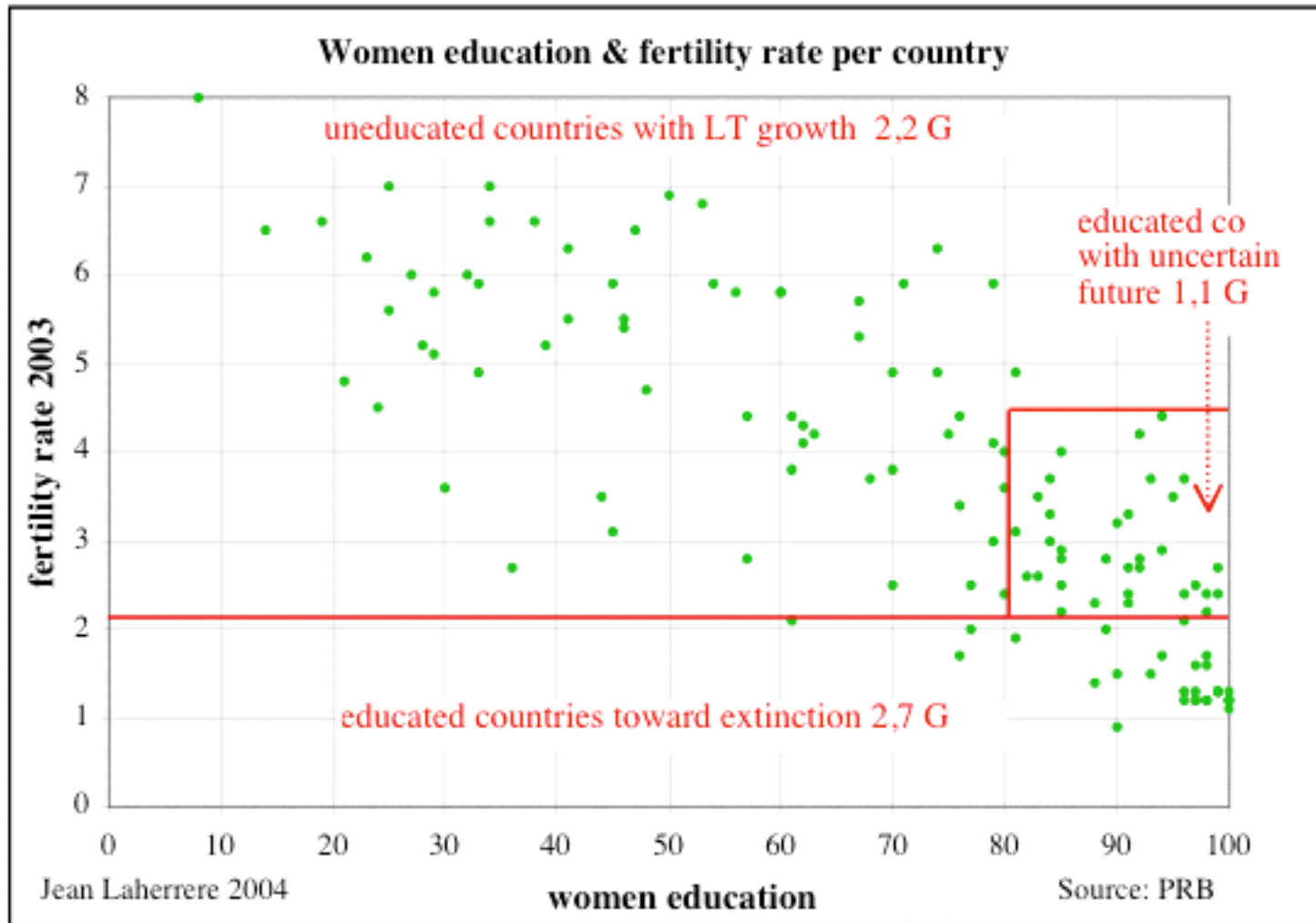


Figure 92: World population and forecasts



Every population forecast is based on fertility rate.

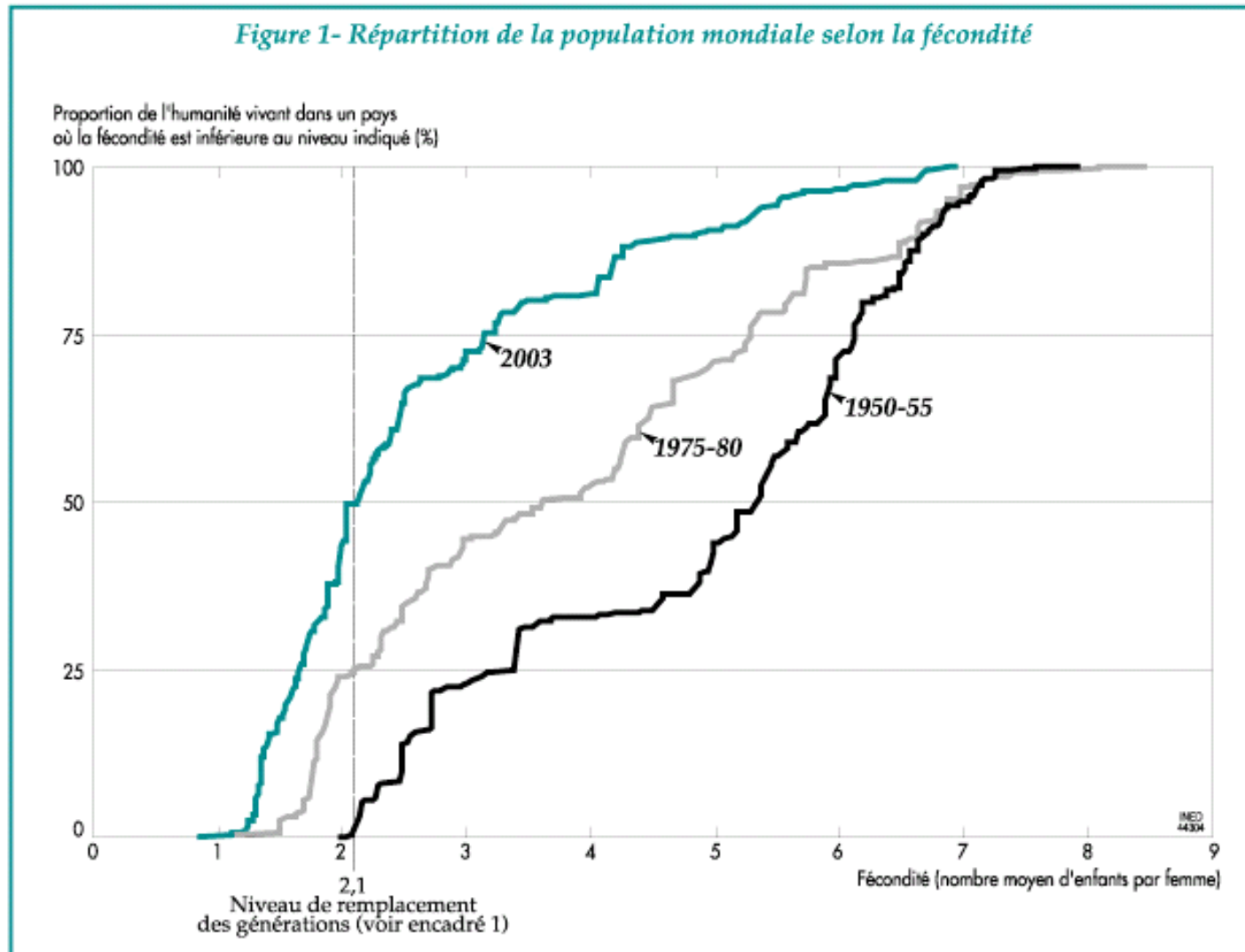
Figure 93: **relationship fertility rate and women education** in 2003



There are two worlds:

- countries < 2 child/woman going towards extinction
- countries >5 child/woman with long-term growth

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)



-Europe and North America

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

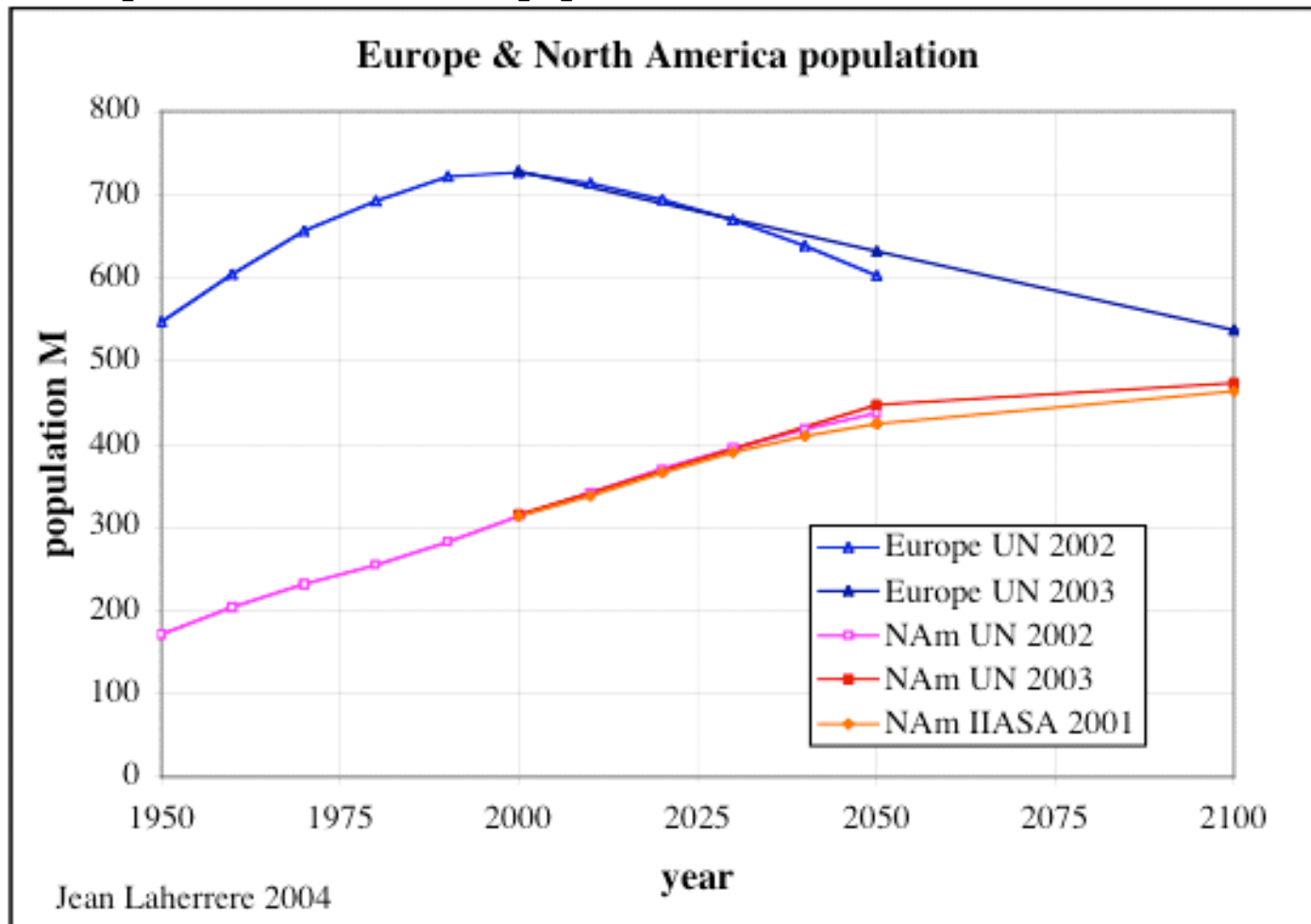
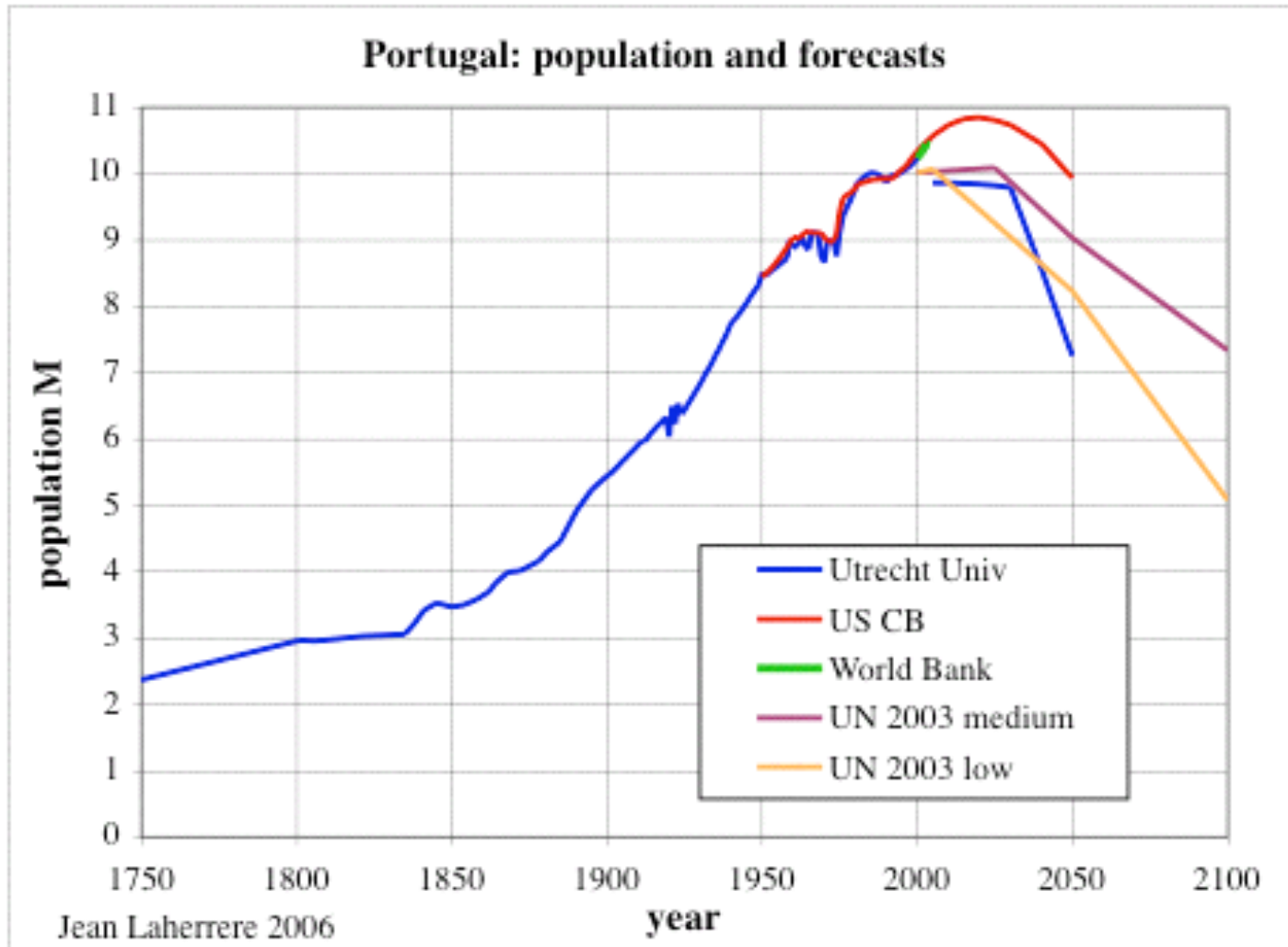
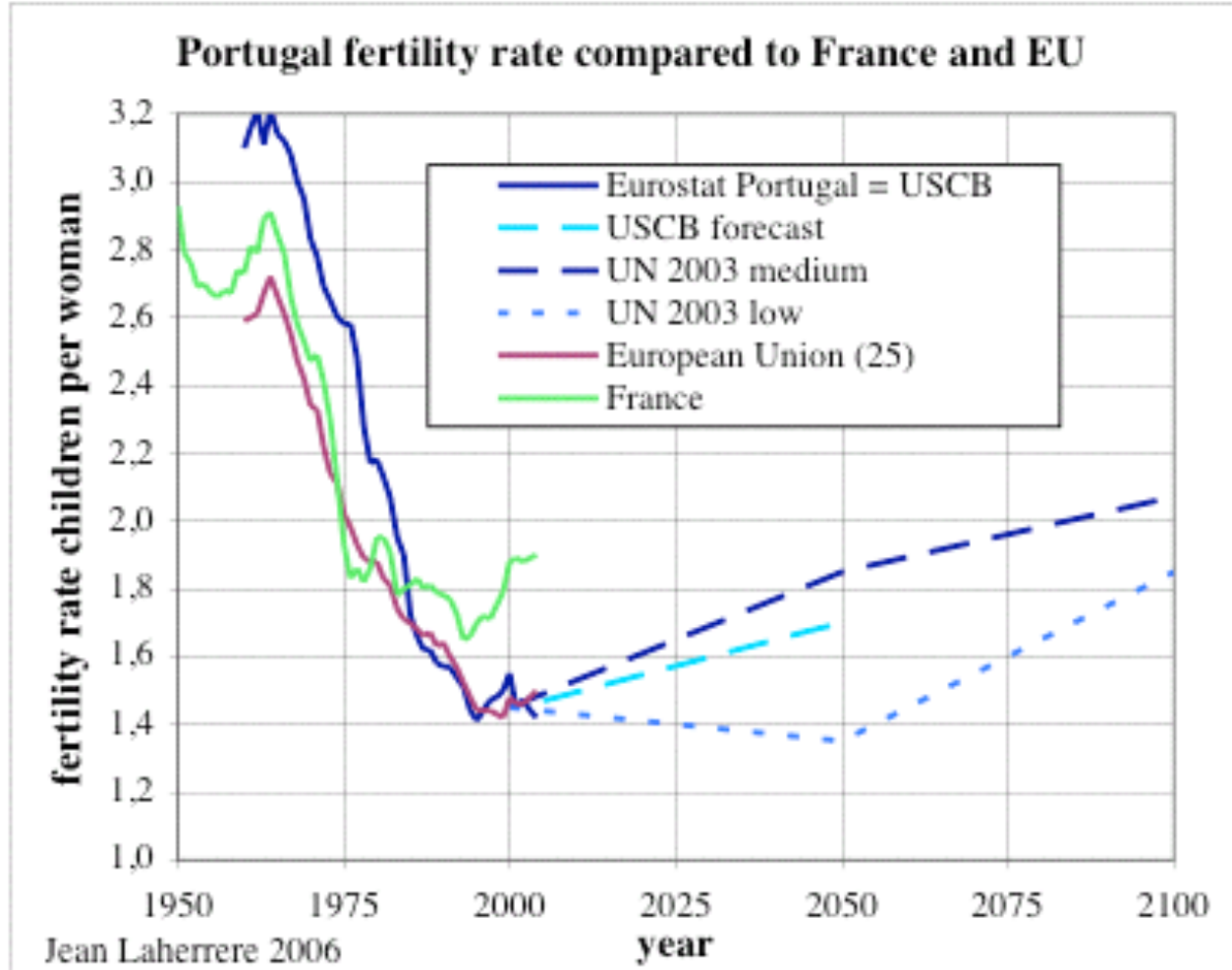


Figure 99: **Portugal past population** and forecasts 1750-2100



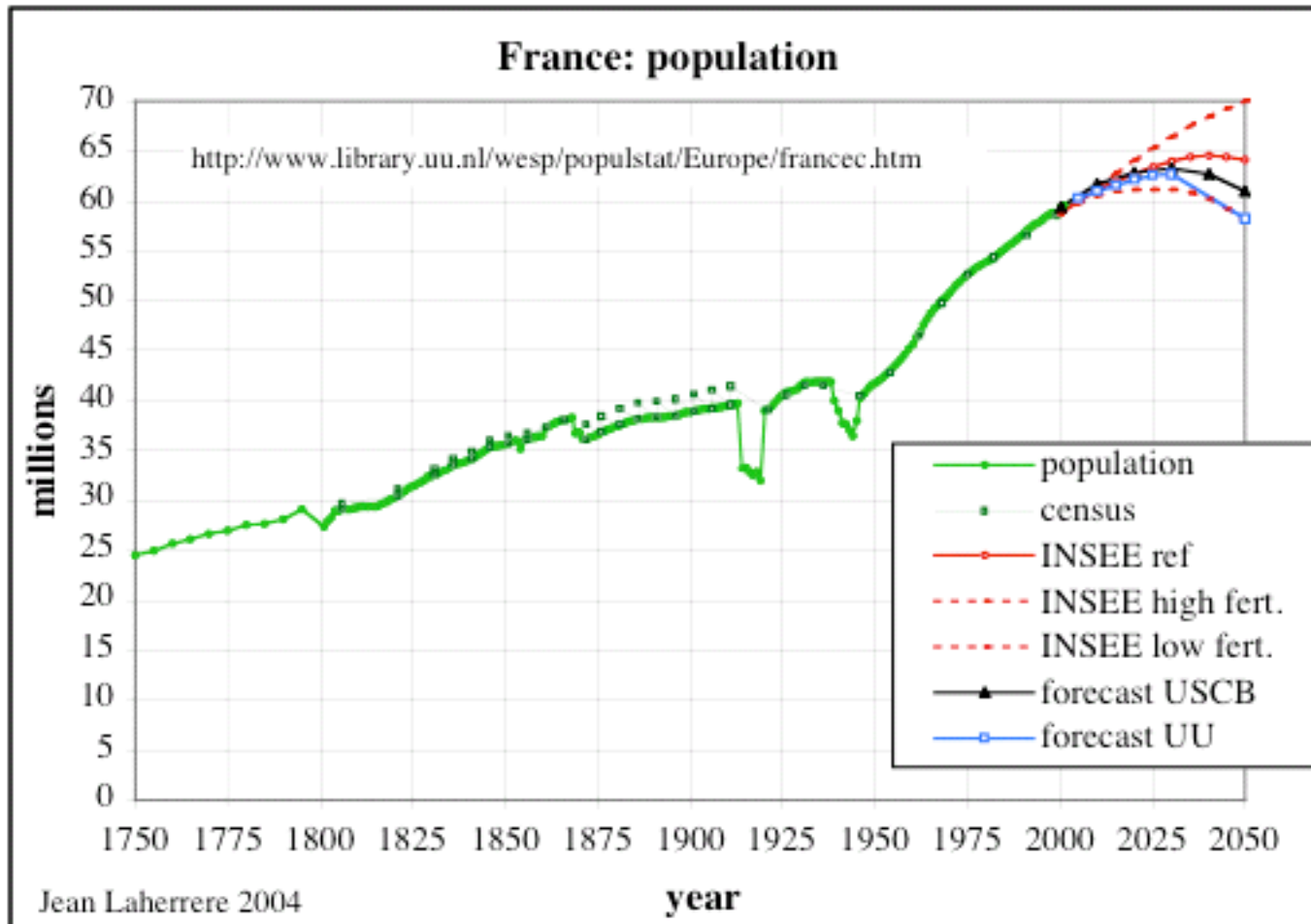
Portugal past population and forecast from different sources shows some discrepancy with USCB (adopted by Eurostat) and World Bank. Peak is now or close!

Figure 100: **Portugal fertility rate** with forecasts and comparison to **France and Europe (25)**



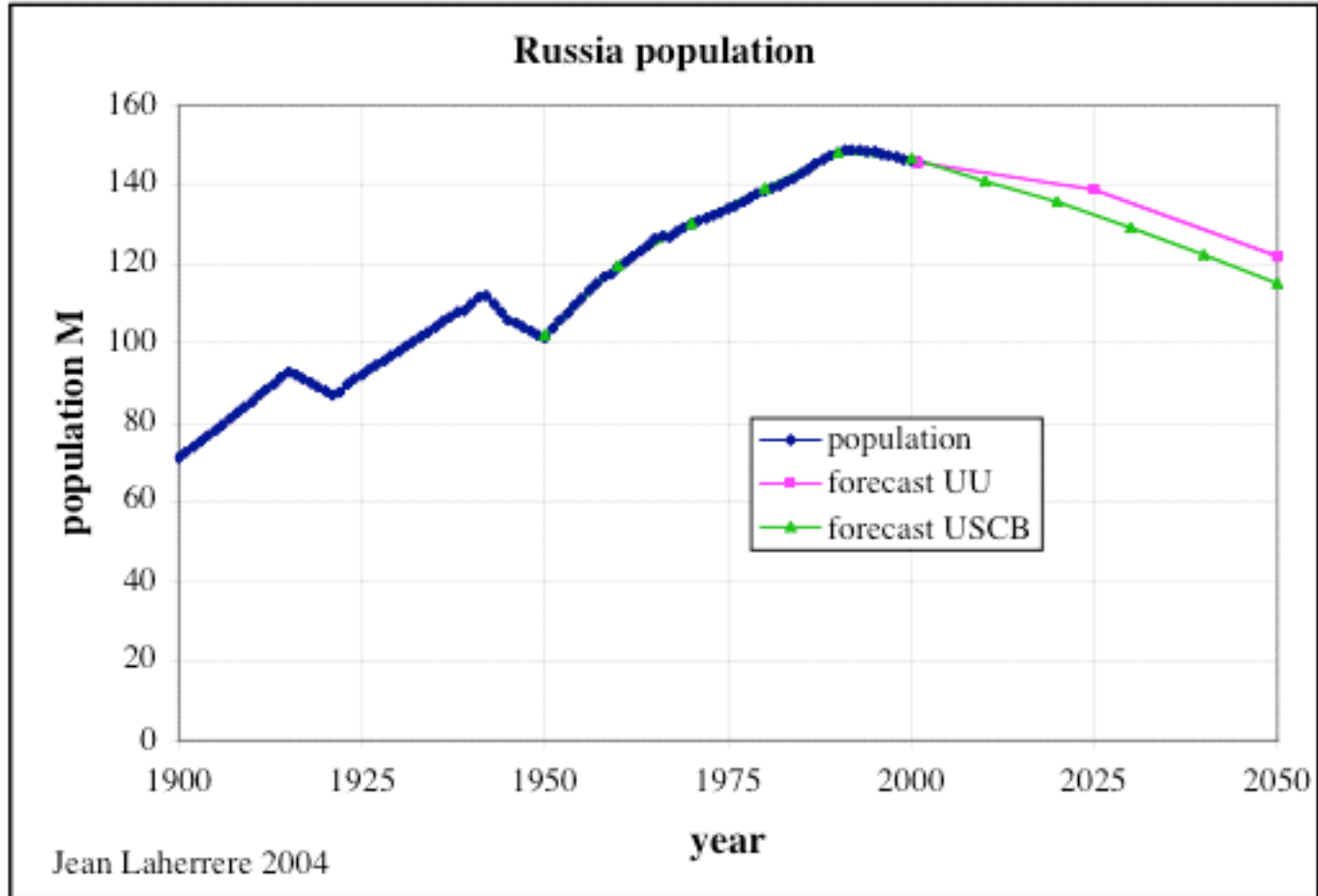
Portugal rate has been dropping sharply and most forecasts hope for a strong rise starting now. I would like to hear the comments of the ladies in attendance!

Figure 101: France population



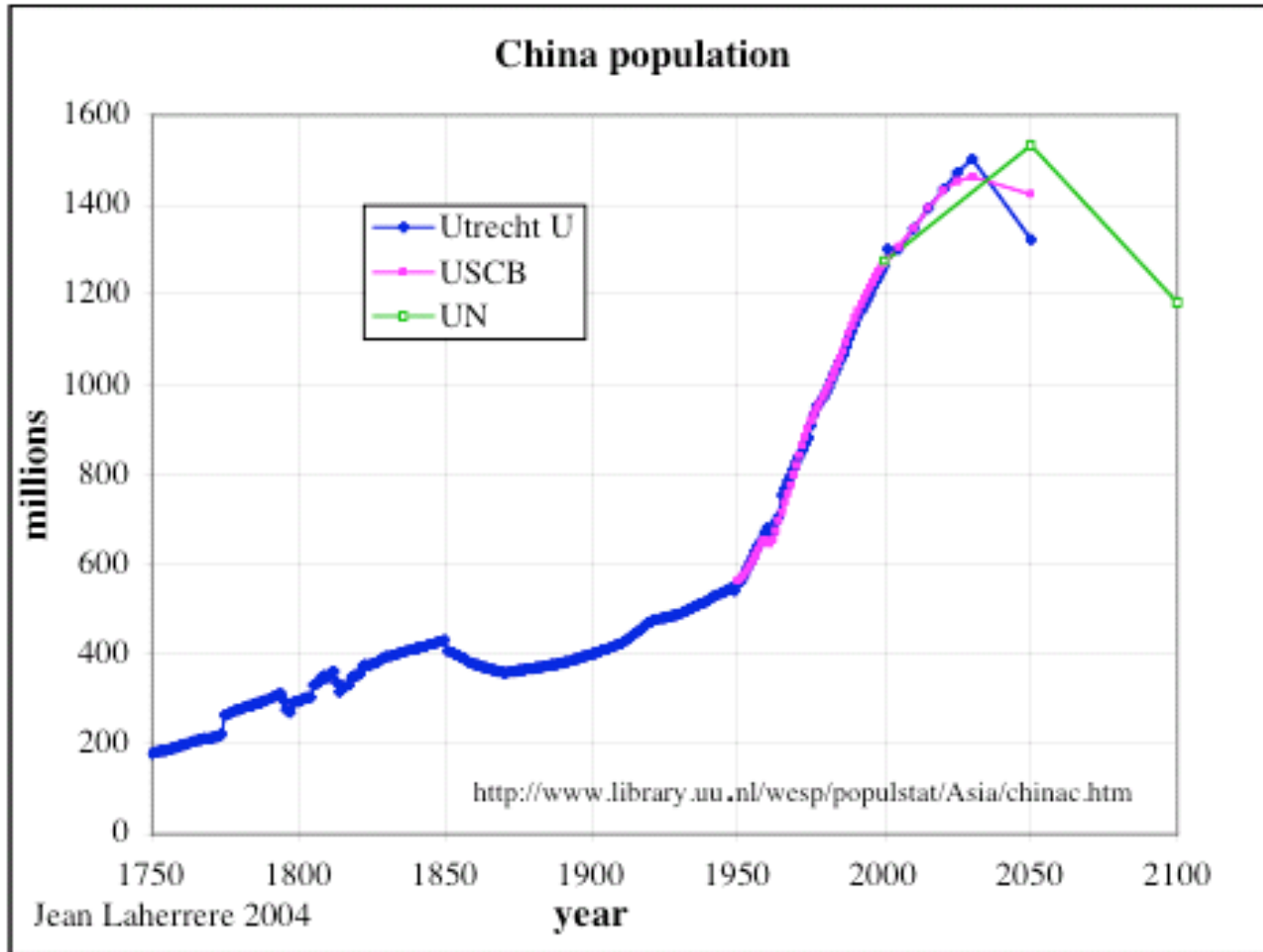
France population will peak around 2025

Figure 103: **Russia population**



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

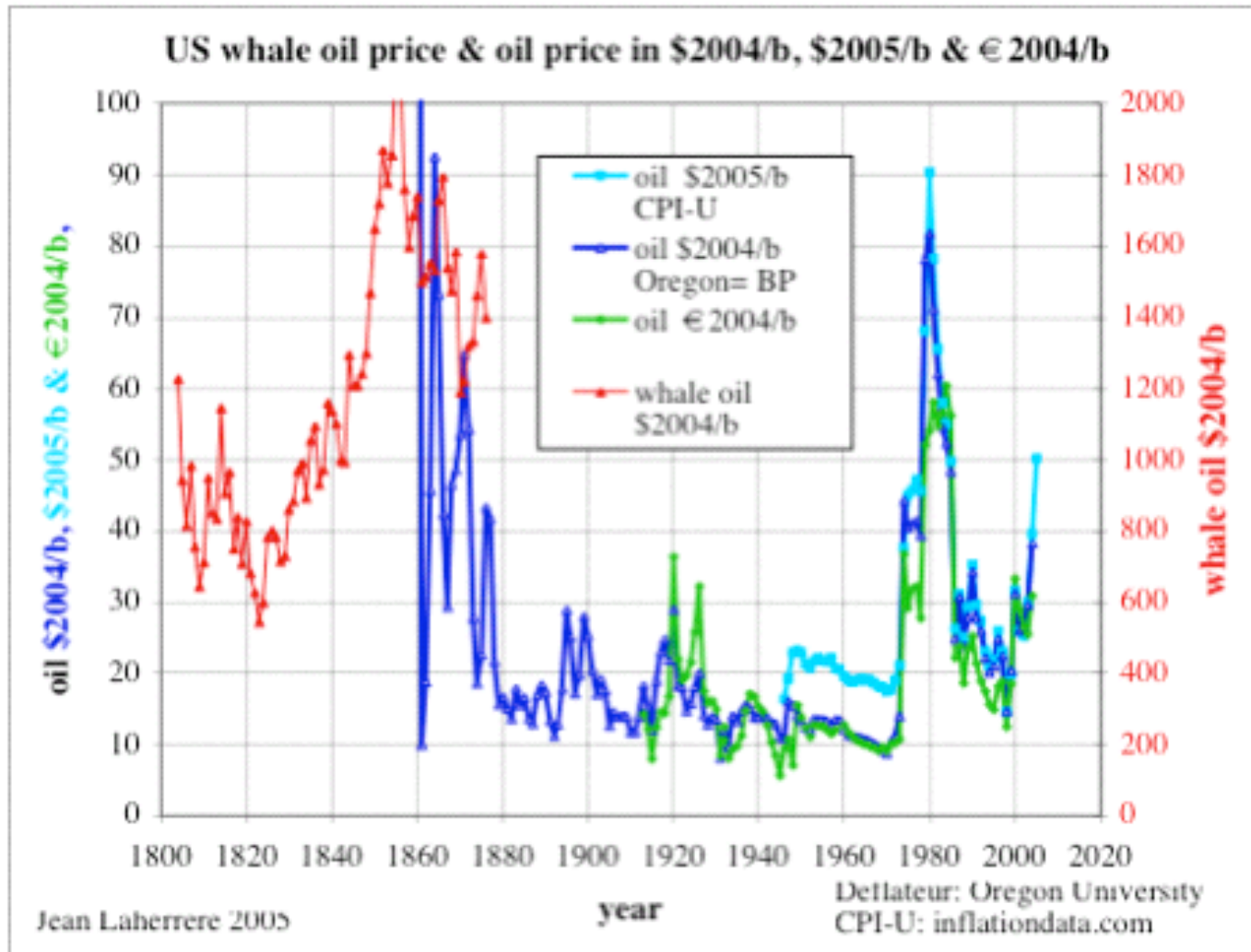
Figure 104: **China population**



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

-Price

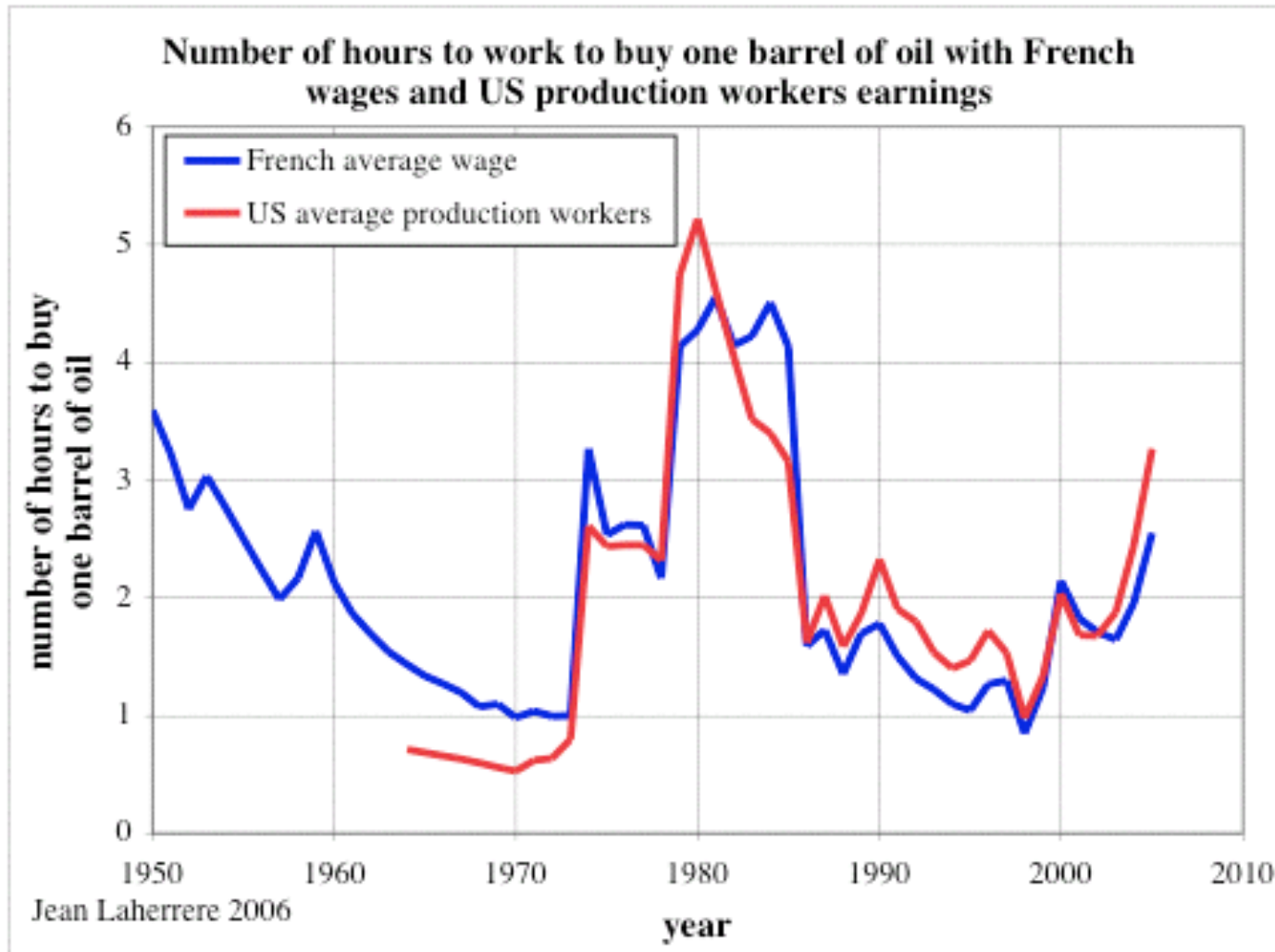
Figure 106: World whale oil price, oil price in today dollar and euro 1860-2004



Present oil price is cheap compared to 1860 or 1980

-Working hours/barrel

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

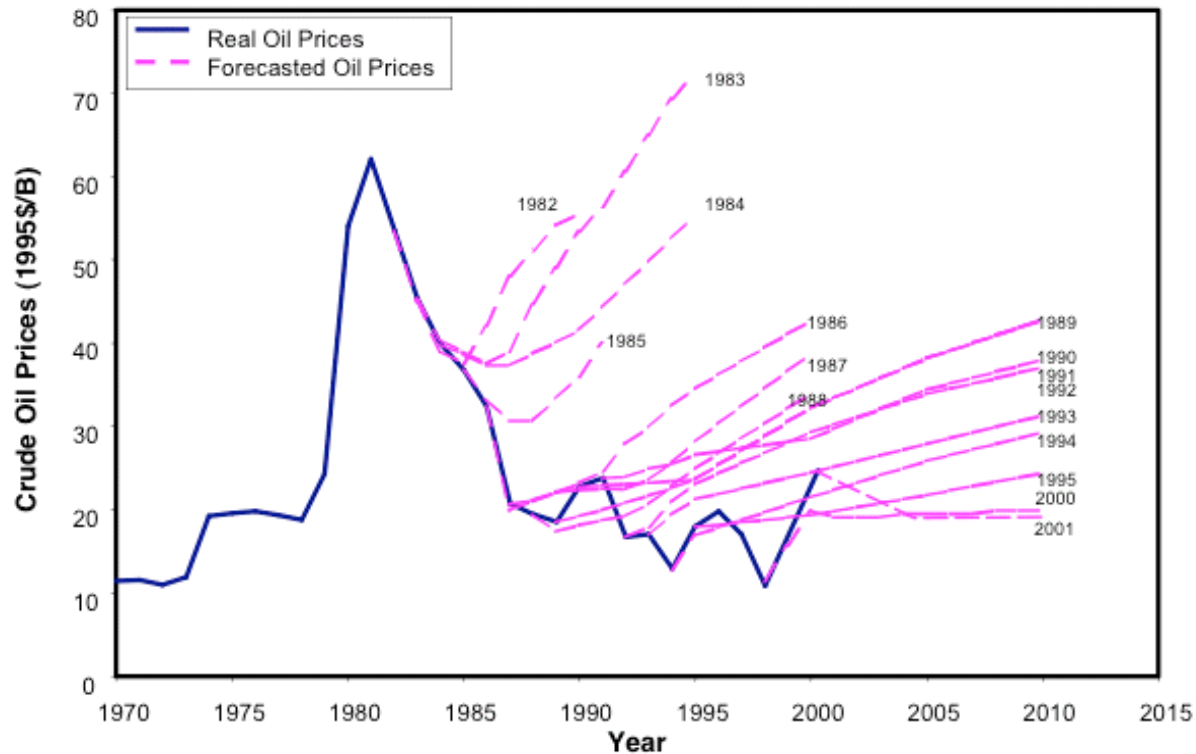


Since 1970 these number of hours are about identical for Frenchs and Americans, but the American can buy more barrels as he works 2000 hours per year when the French works only 1600 hours!

-Price Forecast

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

Comparison of Actual Oil Prices With EIA Oil Price Forecasts



Source: DOE/EIA

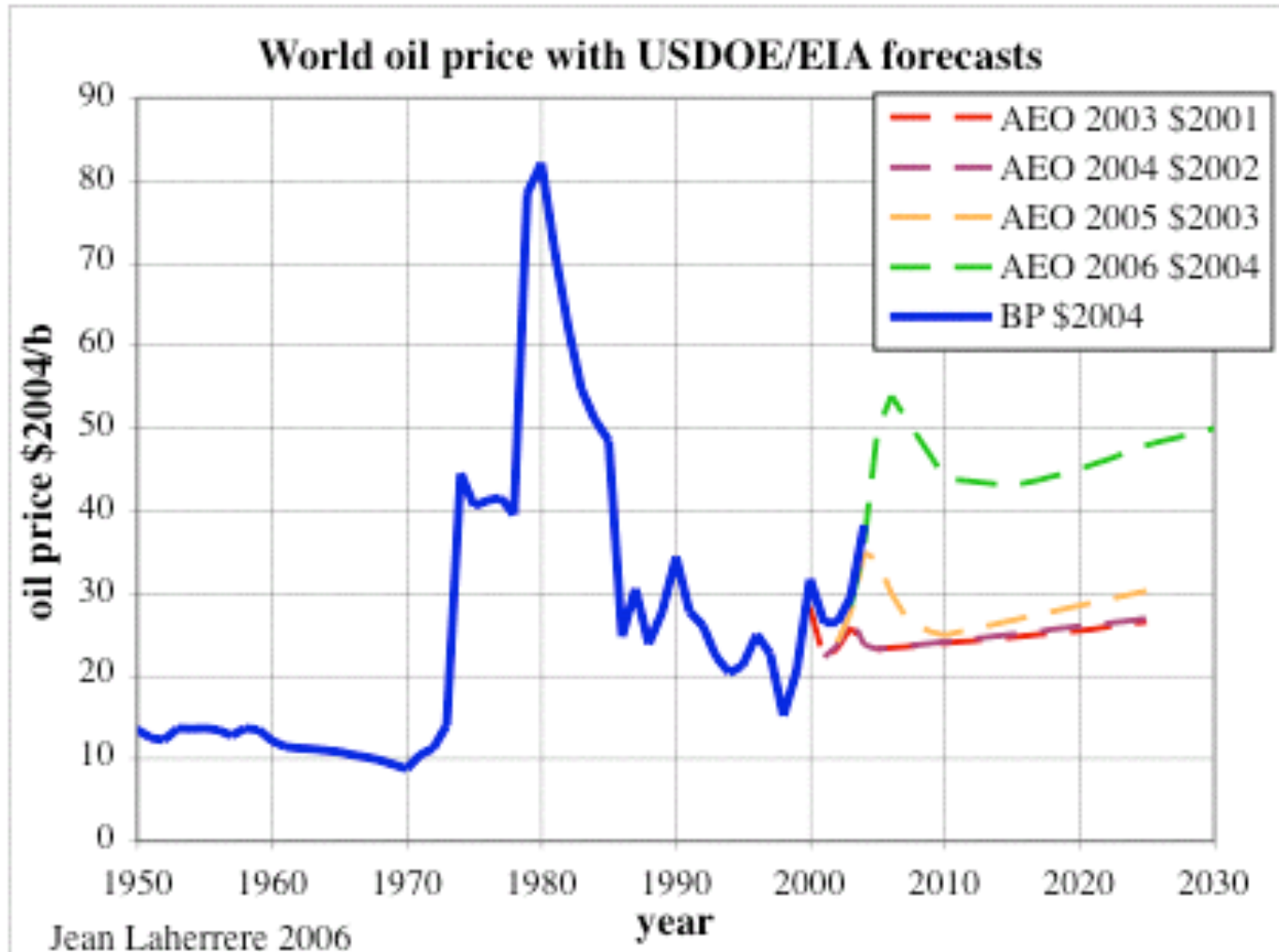
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Advanced Resources International



Official forecasts on oil price have been always wrong

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

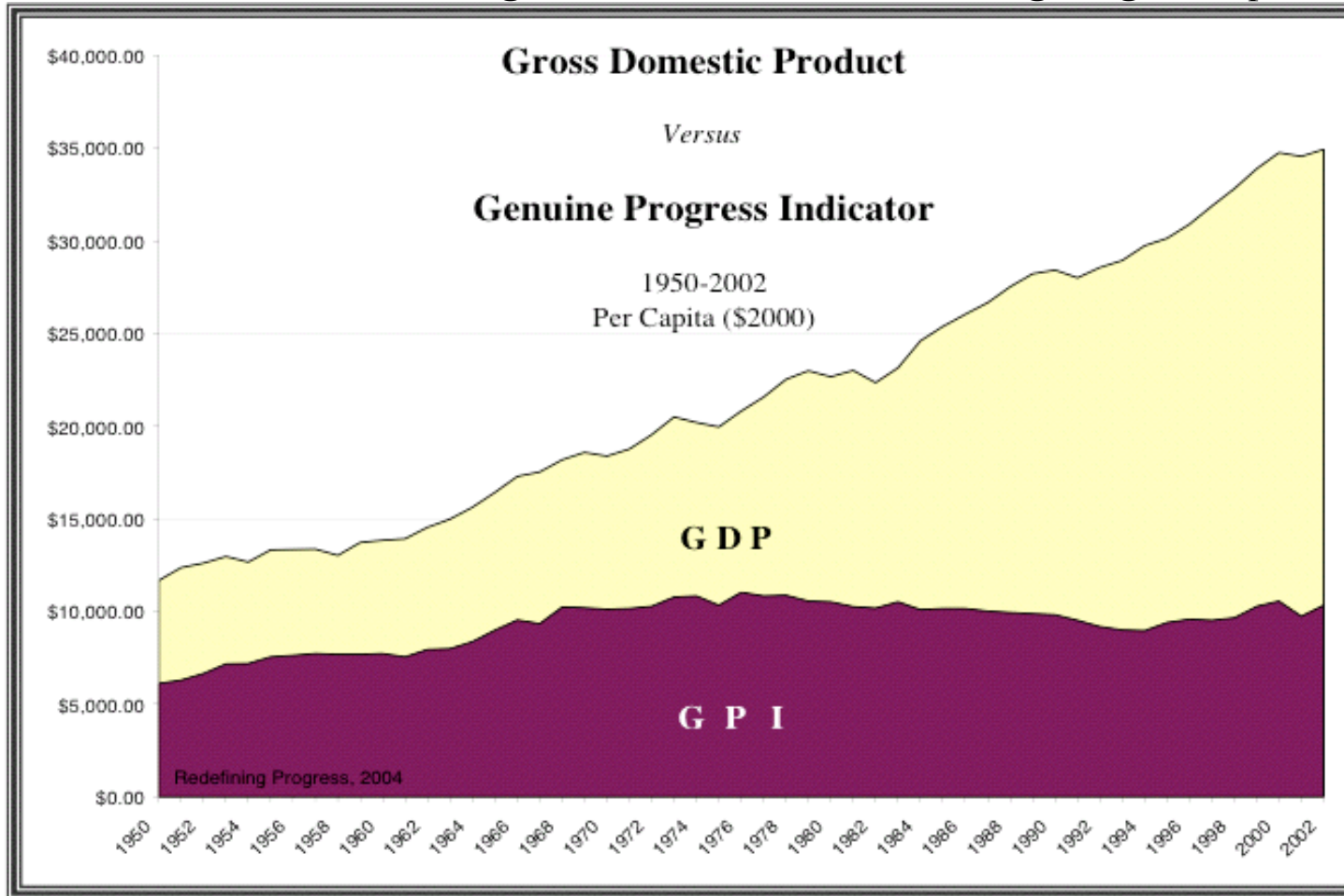


USDOE foresees only in 2006 that high oil price is there to stay, but less than the new OPEC goal of 50 \$/b!

-GDP and happiness

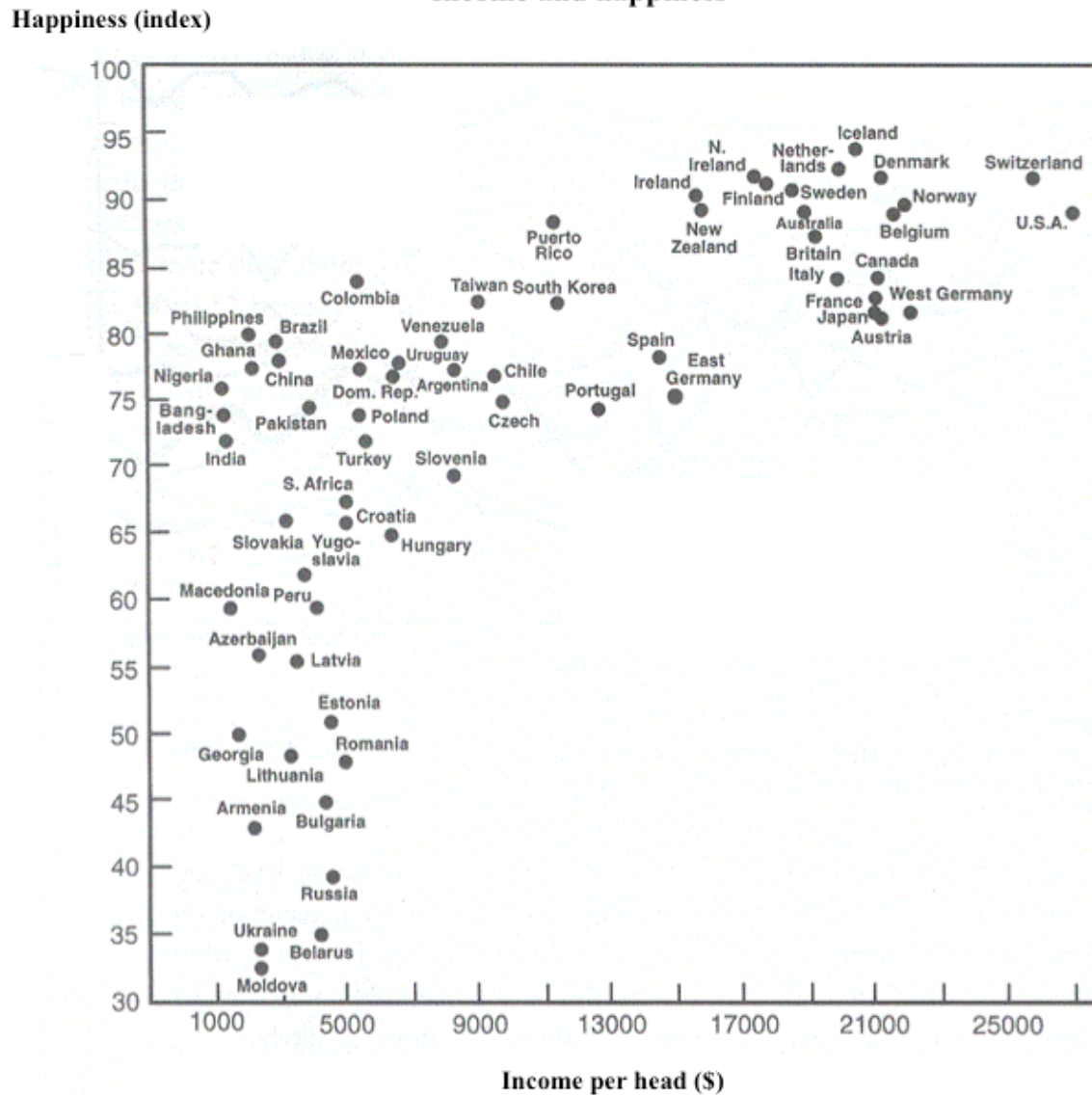
GDP represent manipulated expenditures and not the wealth of a country.

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



Energetic intensity in toe/\$GDP is flawed and of little use.

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).

-New Scientist (2003):

the **most happy countries** = **Nigeria**, Mexico and Venezuela
and the least = Russia, Armenia and Romania.

-University Erasmus Rotterdam = Eurobarometer period 1990-2000

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! But it does not correlate with GDP

-US economy

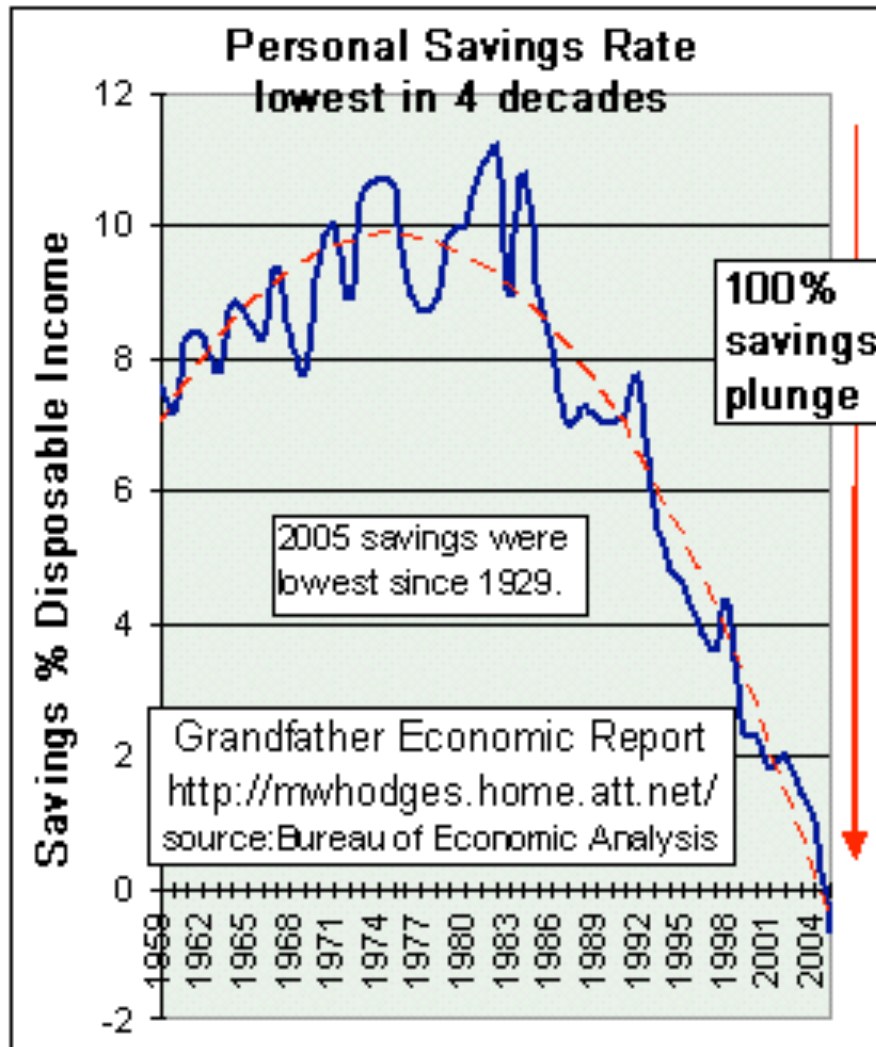
Figure 115: US trade in goods and services



When will the cliff be stopped and when returned to zero? To 900 G\$ or beyond?
900 G\$ \approx Chinese \$ reserves \approx Chinese banks bad debts

US consumers do not save anymore and keep borrowing!

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

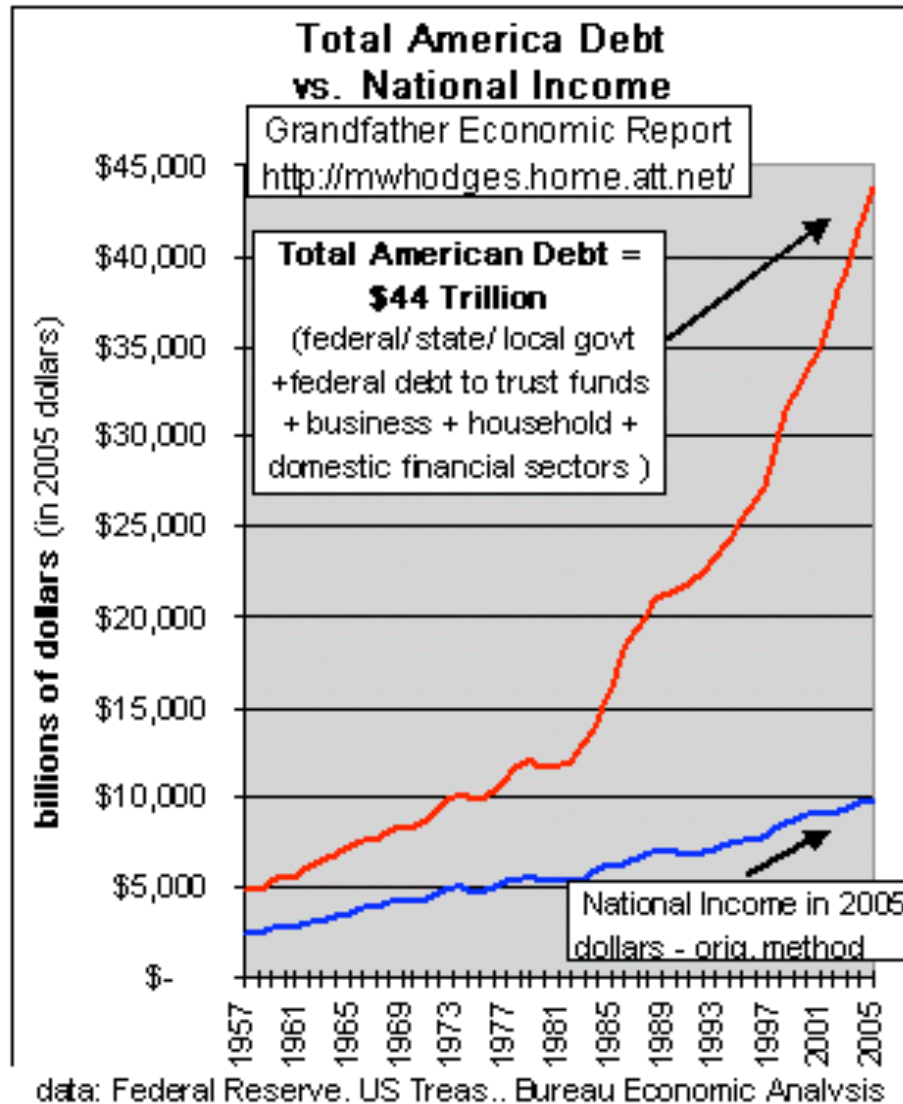


US borrow 80% of the world savings to keep consuming, what about when they reach 100%?

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

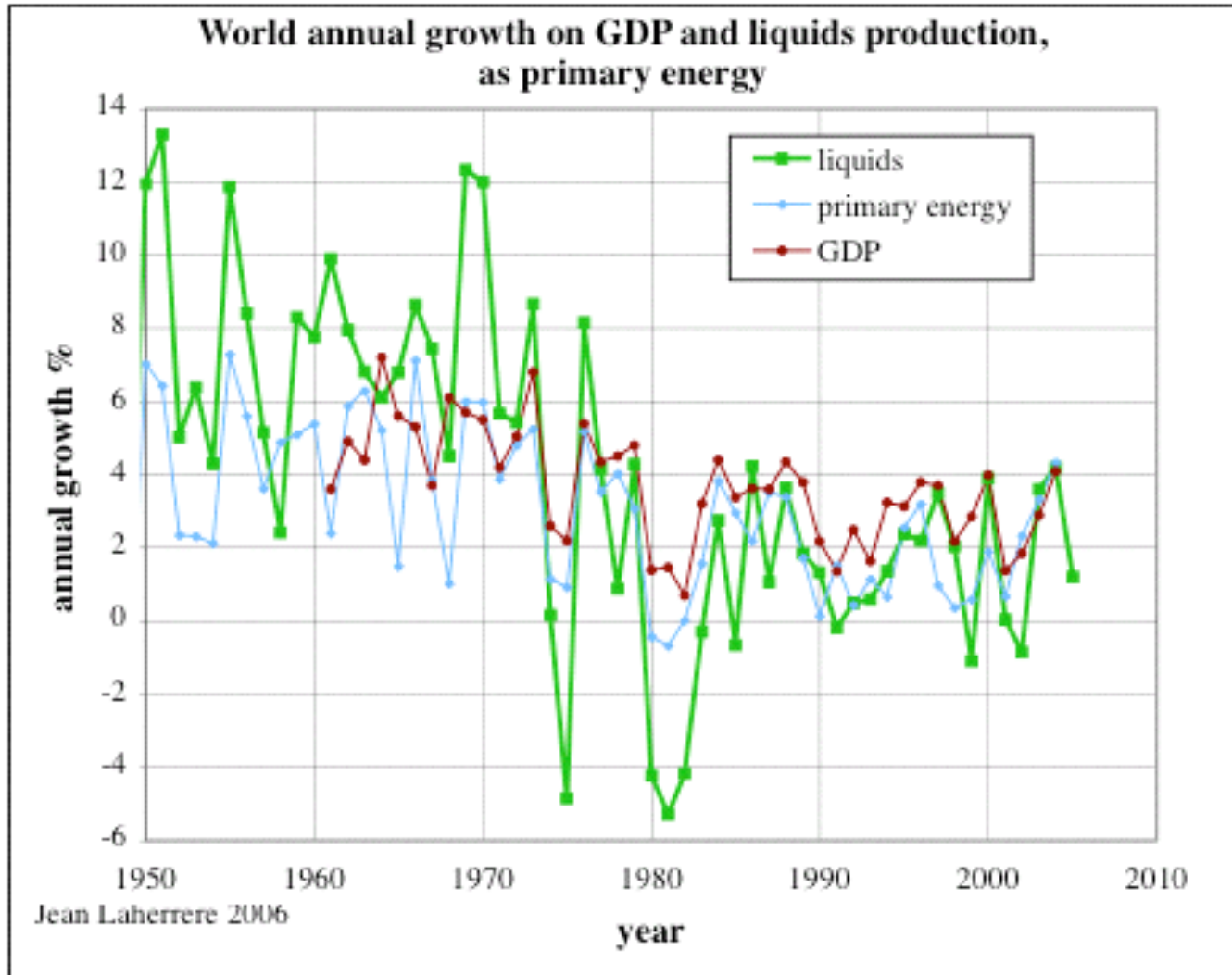
Is the US debt sustainable? When is the peak?

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



General Motors (GM) is close to bankruptcy: 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”

Figure 119: World growth of GDP, liquids & energy demand 1950-2005



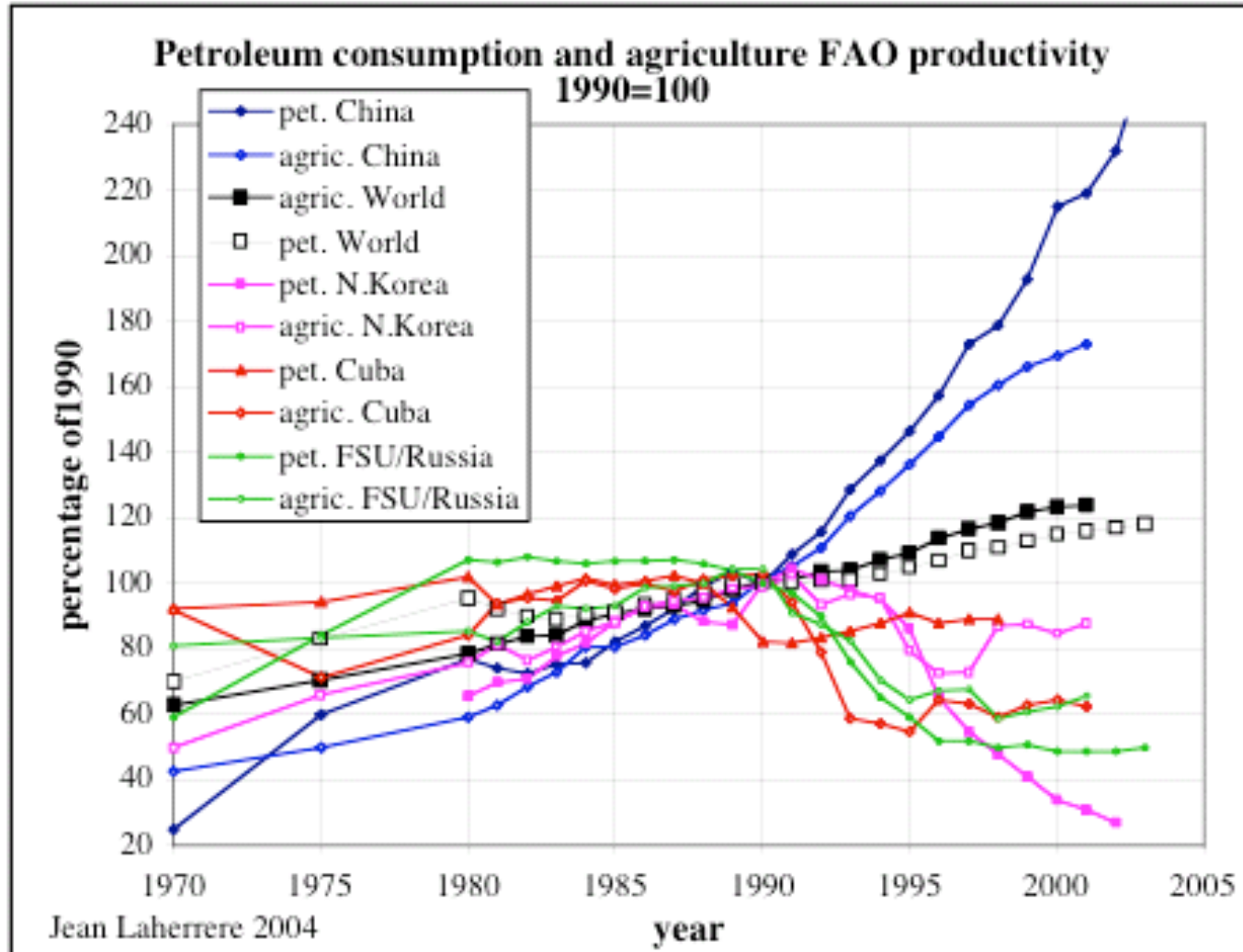
Cost of energy on the last 40 years has been around 5% of the world GDP when experts (Kummel, Ayres) estimate that energy contribution in GDP is around 50%.

Energy is largely undervalued.

-Agriculture

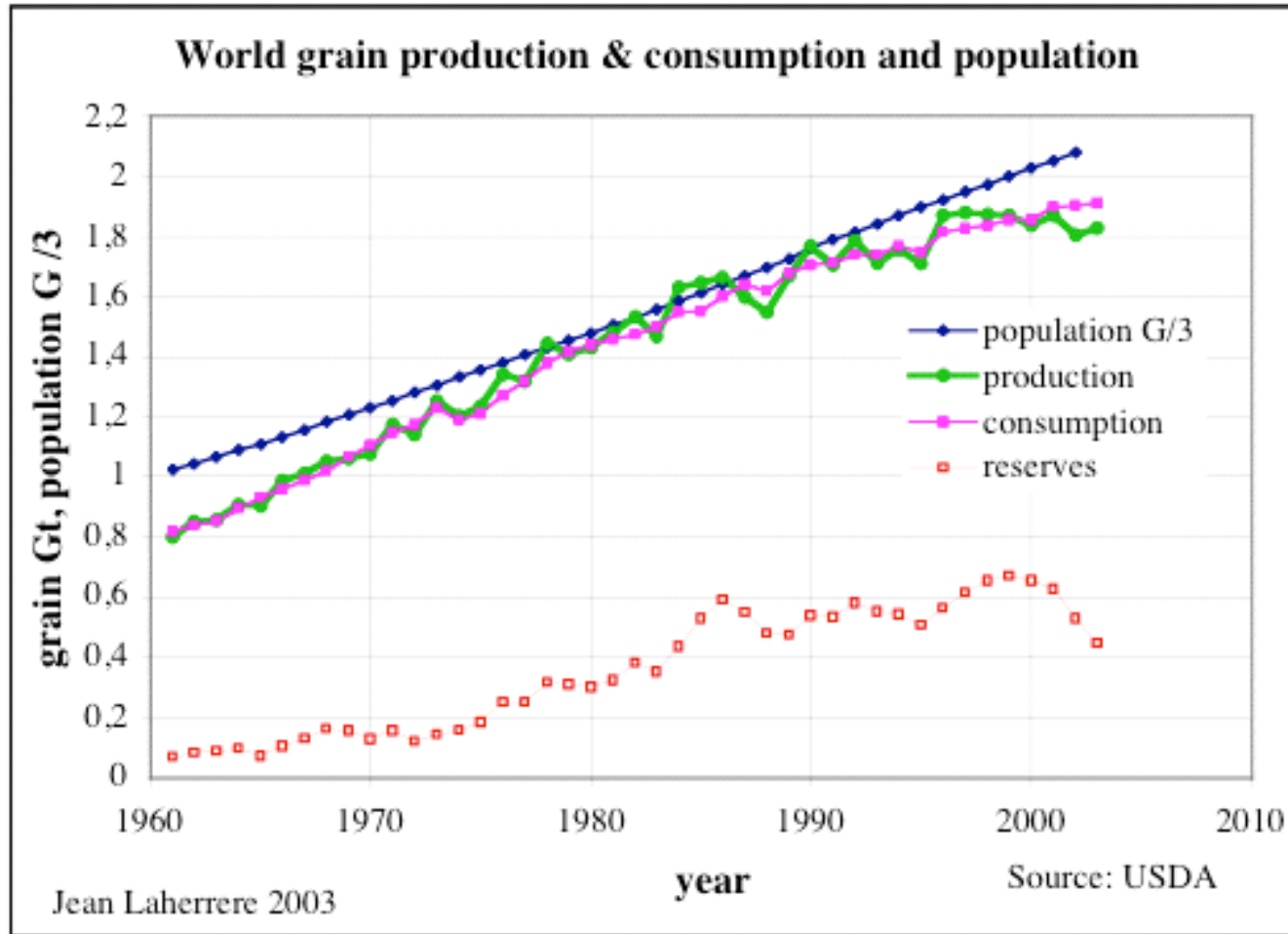
Agriculture productivity varies with petroleum consumption. Agriculture converts oil into food!

Figure 120: Petroleum consumption and agriculture productivity 1990=100



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**



Agriculture cannot feed the world and fill drivers cars

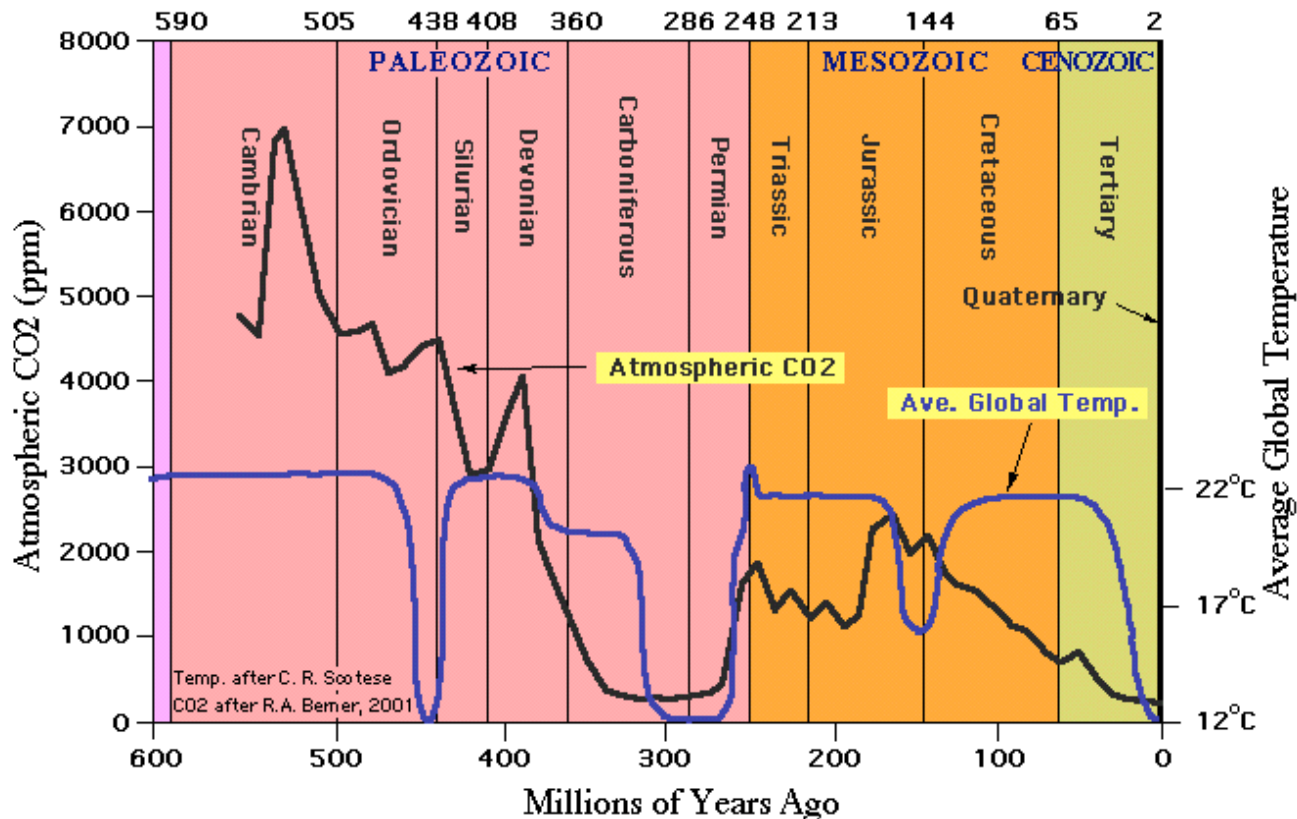
-Global warming and climate change

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 prevails 80%, in the last million only 30%.

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

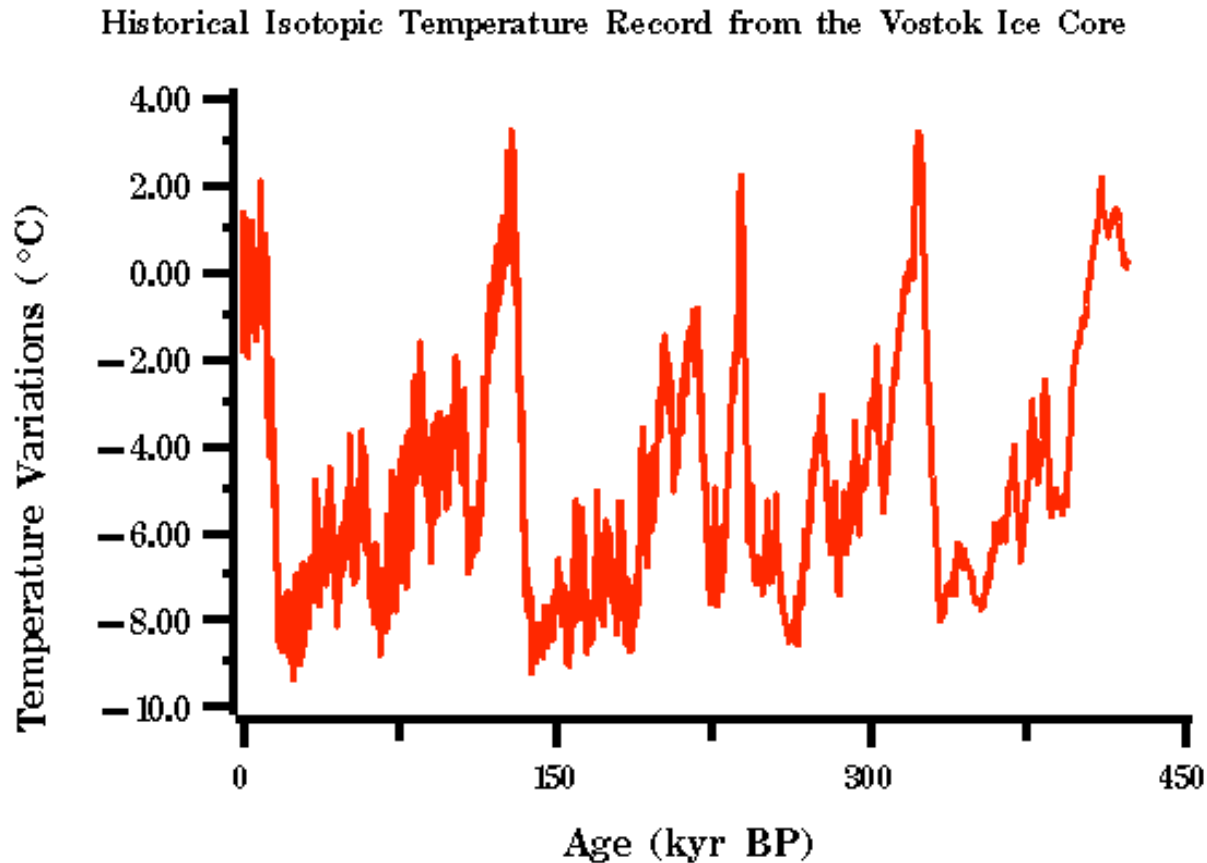
Global Temperature and Atmospheric CO₂ over Geologic Time



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).

Milankovitch has claimed in 1924 that climate changes follow astronomic cycles of the earth around the sun, which are about 20 000, 40 000 and 100 000 years.

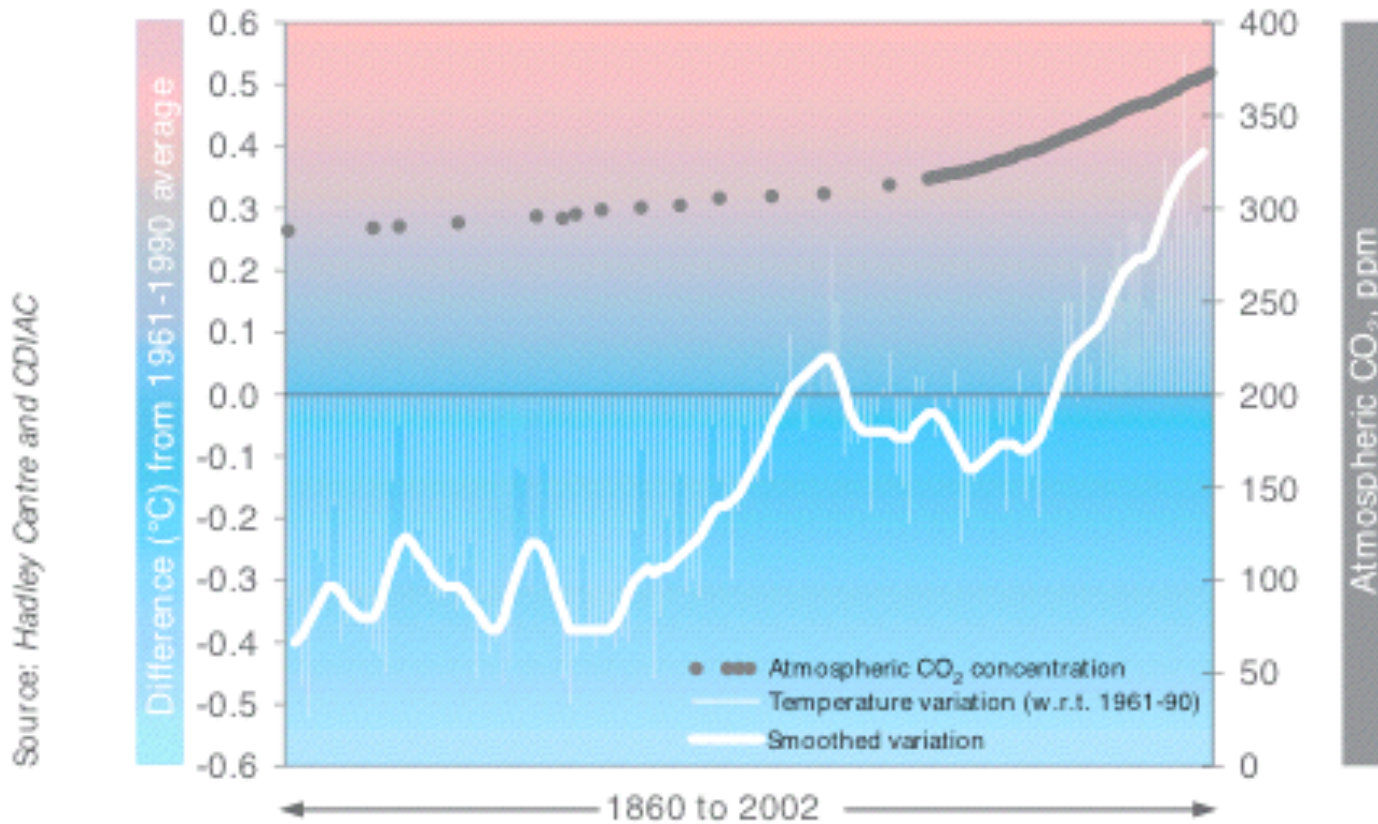
Figure 127: **temperatures from Vostok ice since 420 000 years**



Source: Petit et al.

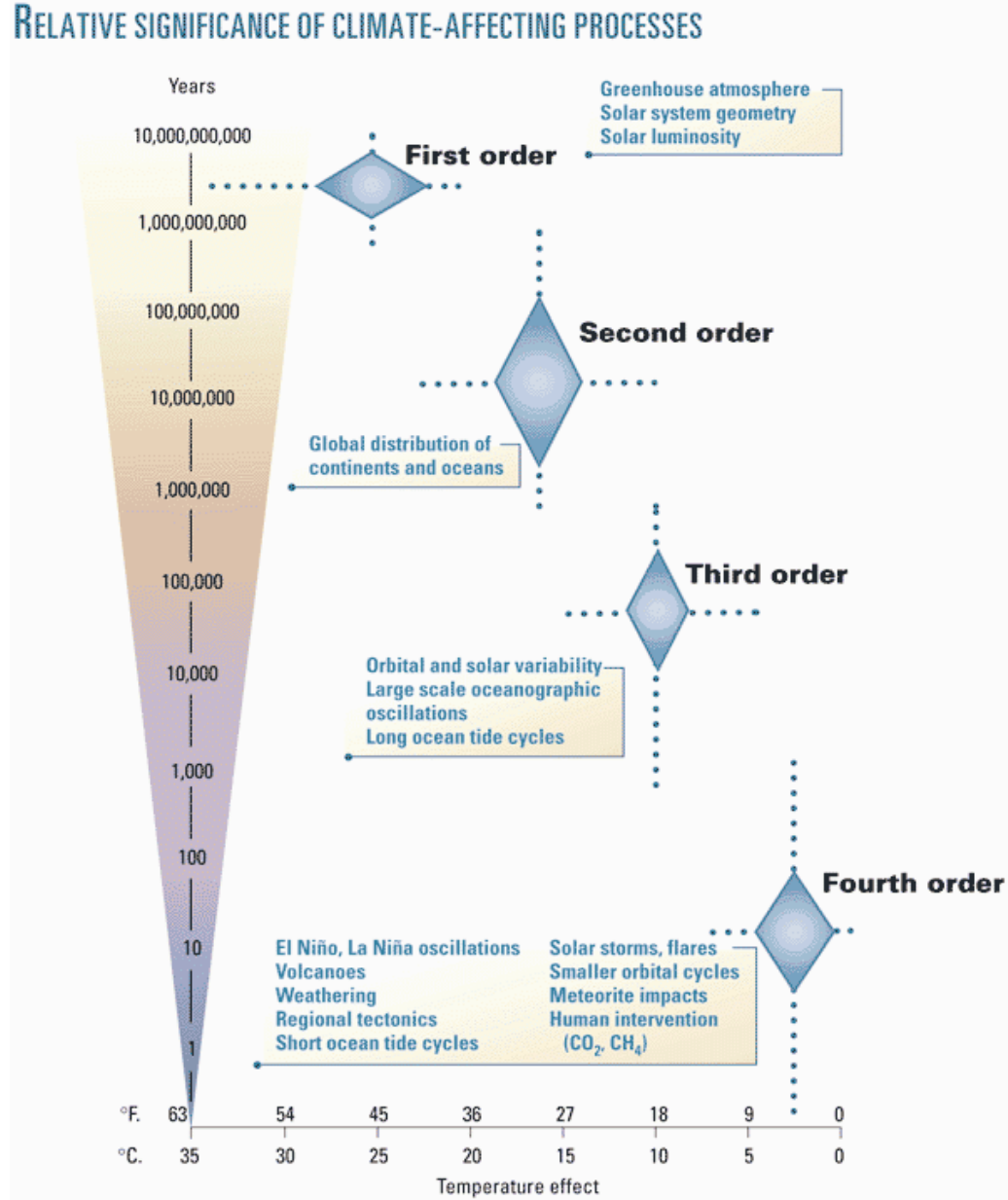
There is now global warming, indeed, because we are getting out of the little Ice Age.

Figure 128: world temperature & CO2 1900-2002

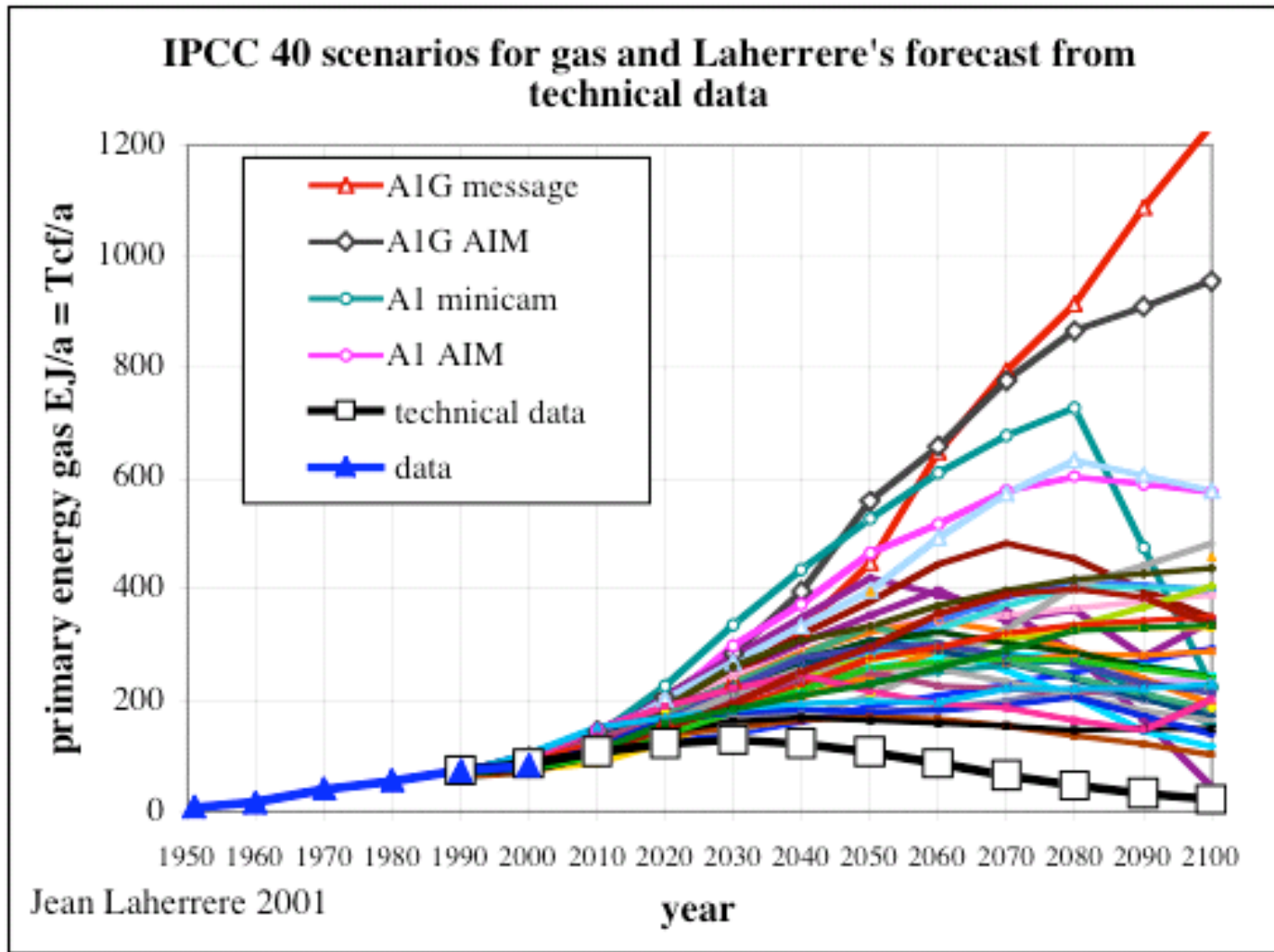


On this graph from Hardley Centre, why cooling from 1940 to 1970 when CO2 increases?

Figure 129: Gerhard 2001 AAPG human emissions 4th order when solar 1st order



The IPCC 2001 report was based on 40 energy scenarios (SRES) which are wishful thinking!
 Figure 130: **IIASA scenarios (IPCC report) for gas consumption** compared to technical data



These scenarios will be used again for the 2007 IPCC report!
GIGO: garbage in, garbage out

-Conclusions

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

-**oil definition & production**: cheap; expensive;

-**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; non-educated women countries with high fertility rate;

-**data**: published data = political or financial; technical data = confidential

-**experts**: **economists** having only access to political data; **managers or politicians** who have to show growth; **technicians** having access to real data and knowing the limits of techniques, but hardly free to speak, only when retired.

Many parameters are wrong and should be discarded:

-**so-called proved**, which are political and useless for forecasting

-**R/P**, which trends towards 20 years for the world and towards 10 years for US

-**GDP**, which represents expenditures and not wealth, not connected with happiness

Official forecasts are plain wishes or literary scenarios, not based on any data

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

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: technology cannot change the geology of reservoirs

Oil production mimics oil discovery with a certain lag, but is also constrained by demand

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

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

Fossil fuels production will peak around 2030,

Primary energy extrapolation of the past (10 Gtoe in 2003) leads to model 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 are 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