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**Comments on NPC Draft** «Facing hard truths about energy» July 18, 2007

I was pleased by the first call conference in February and now I am pleased to see the NPC approach asking again participants their views after the release of the Draft (as in a Delphi enquiry). NPC is using the right approach, asking the right people, but, despite many good points, the Draft did not deliver completely the hard truths and what I was hoping for a right balance between the many opinions.
ASPO US called the Draft a dry hole, but it is good to see NPC drilling again.
What is wrong in the Draft?
Since the Draft was written, the Minneapolis bridge collapsed and I was almost as shocked as the September 11.
What was wrong? I thought that this kind of collapse should not happen in such modern and rich country.
What was missing in this case?
Lack of data ? no, the problem was known, lack of funds and staff? maybe.
I feel that the US does not want to change, to evolve keeping obsolete practices and obsolete units, when the rest of the world has dropped them.
The Draft shows such desire of not to change the old practices.
I will try to show some examples of obsolete items, as missing items

**-A Obsolete items**
-A1-Reserve and resource definition
The Draft displays this very old 1972 graph:
Figure 1: NPC figure S2-1

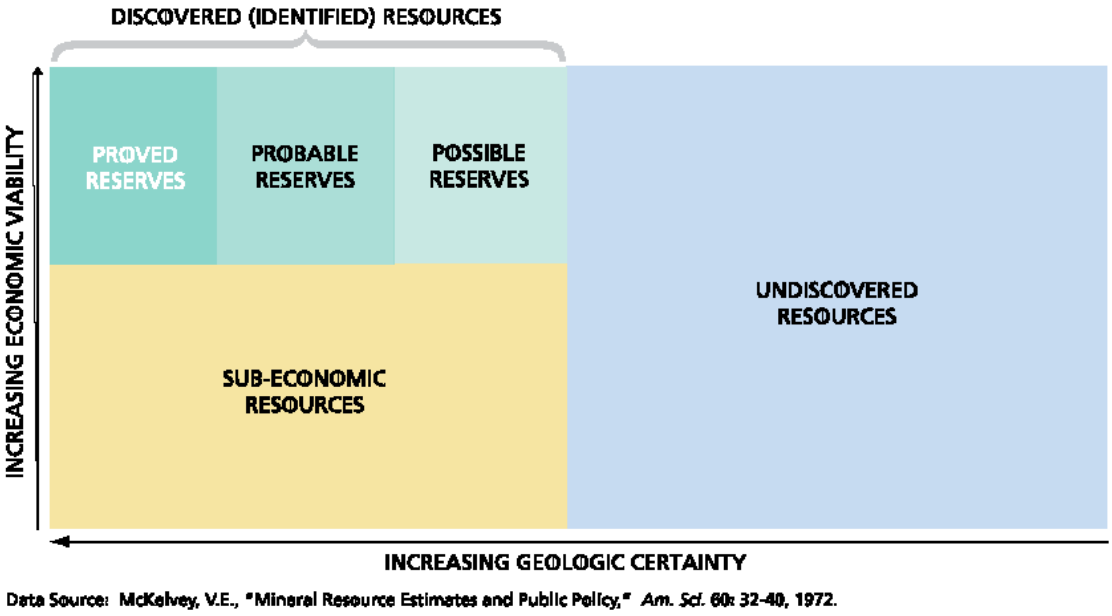



*Figure S2-1. Example of a McKelvey[iii] diagram, used to illustrate the technical distinction between resources and reserves (modified from McKelvey, 1972).*

It should be replaced by the 2007 SPE definition for reserves and resources, where 2P = proved plus probable is the best estimate and proved is the low estimate.

Figure 2: SPE 2007 reserve and resource definition

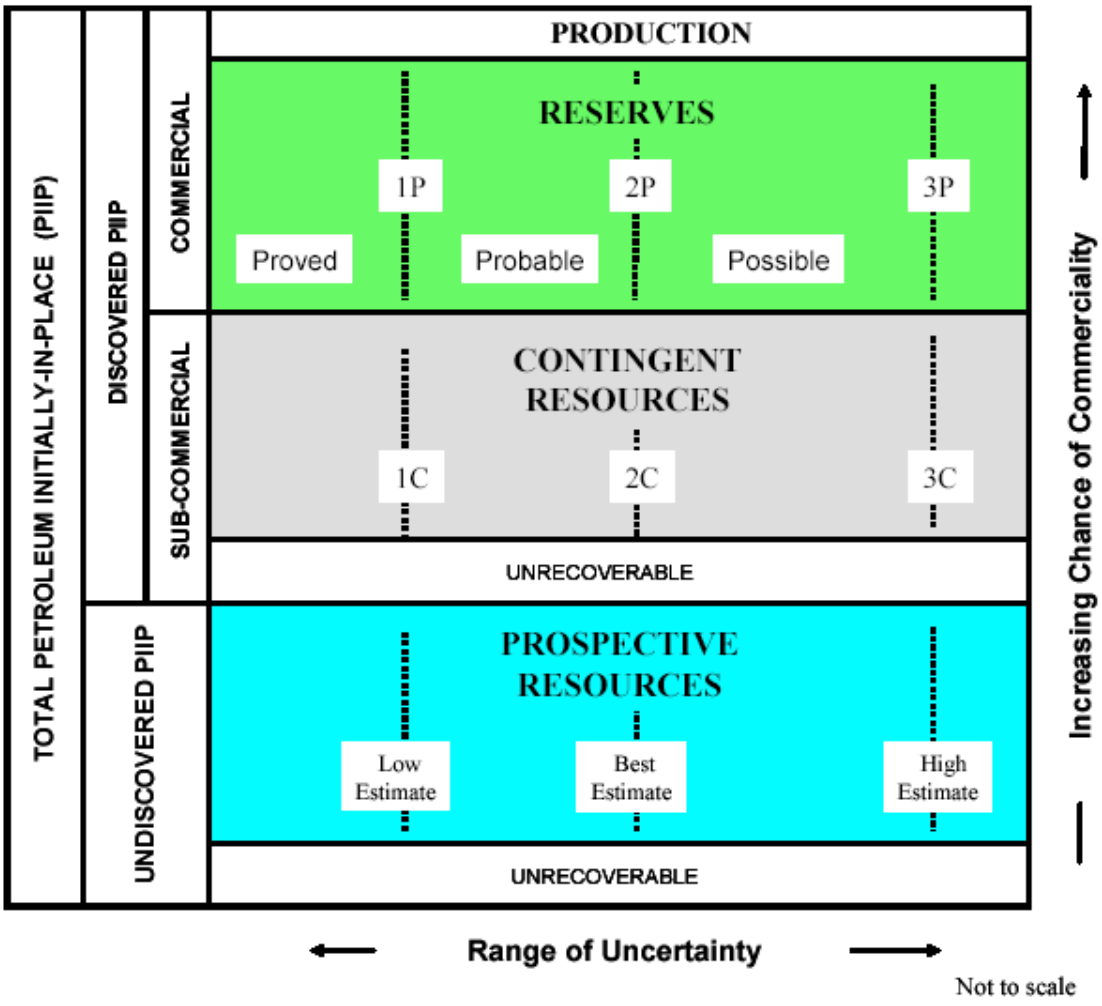



Figure 1-1: Resources Classification Framework.

The definition of resources page 135 out of 422 is too large, covering only *contingent resources* and *prospective resources,* but not all resources, because some resources are unrecoverable or will be unrecovered!

-A2-Proved reserves and reserve growth
The Draft states:
*The importance of reserves growth to estimating available future oil is the subject of considerable debate. One challenge stems from the fact that not all countries report reserves in the same way. For example, the percentage and rate of conversion of reserves, and, therefore, the predicted amount of field growth, depends significantly on the reference point. In some cases, the reference point is proved reserves (often referred to as P1). In other cases, the basis is proved plus probable reserves (P1 + P2). The different reference points yield different results for reserves growth.*
This paragraph is the only place where probable reserves are mentioned.

In the SPE definition the best estimate is proved plus probable, meaning that all studies should be based on 2P and that all studies based on 1P (low estimate) should be rejected as not the most likely to occur.
Unfortunately 2P and in particular updated 2P seems to be ignored in this Draft:
*Reserve Growth and Undiscovered Resources are two categories of the USGS 2000 assessment with greatest uncertainty. Reserve Growth refers to the increase in reserves in oilfields. Reserve Growth typically occurs through improved knowledge about the field's productive potential and application of new technology. Reserve Growth accounted for 0.7 trillion barrels of the USGS mean estimated URR at the beginning of 1996*
Reserve growth occurs in the US because omission of probable reserves following the SEC rules and because incorrect arithmetic aggregation of proved reserves.
Reserve growth occurs in the so-called proved non audited OPEC reserves because of the fight on quotas, as the 300 Gb increase during 1985-1990.
Reserve growth occurs mainly in unconventional fields (heavy oil as Midway-Sunset which peaked in 1997 more than 100 years after first production and with over 10 000 wells) and very old fields. It is incorrect to compare old heavy oilfields (about 10 b/d/w) with new deepwater prolific oilfields (20 000 b/d/w).
Negative reserve growth has occurred for the largest conventional oil fields in the USL48 i.e. East Texas oilfield (from 6 Gb to 5.4 Gb).
The 700 Gb of reserve growth forecasted by USGS 2000 is based on a wrong extrapolation of US proved reserve growth to the rest of the world proved plus probable reserves. It is as comparing the degree temperature in New York and Paris without bothering to check that the first is in Fahrenheit and the second in Celsius !
In USGS study 2000 chapter "Estimating potential reserve growth of known (discovered) fields" J.W.Schmoker & T.R.Klett wrote
*For most areas outside the United States and Canada, however, Attanasi and Root (1993) and Root and Attanasi (1993) concluded that* ***successive field-size estimates were not sufficiently reliable and consistent to develop world-level reserve-growth functions****. At the time of the World Petroleum Assessment 2000,* ***available world field-size estimates still appear to be inadequate****—in terms of completeness, quality, and internal consistency—****to construct a credible world reserve-growth function****. That is to say, the preferred approach outlined above to developing a world reserve-growth function cannot be implemented because of data limitations. Given this conclusion, three reserve-growth options were considered for the World Petroleum Assessment 2000:* ***1. Defer the forecasting of world potential reserve growth to some future assessment****. 2. Forecast potential reserve growth for those relatively few areas of the world where field-size estimates are adequate to establish local reserve-growth functions. 3. Forecast potential reserve growth at the world level by using an analog model that incorporates the reserve-growth experience of the United States. The third*

*option is the one that has been pursued, on the reasoning that, although the resulting preliminary forecast of world potential reserve growth carries much uncertainty, a greater error would be to not consider world-level reserve growth at all.*
USGS admitted that the worth reserve growth study had to be done: they should have done it by now! What they did was worse than doing nothing i.e. assuming as their predecessor Chuck Masters that world reserve growth was nil when using inferred values.
When reporting best estimate, reserve growth does not occur statistically on conventional (primary and secondary recovery) fields, but does occur on unconventional field (including EOR= tertiary recovery) where the problem is not the size of the tank(reserves), but the size of the tap (annual production depending upon investments).
Reserve growth can occur in scout reports when they accept political estimates from OPEC members instead of staying with geological and technical values or when their past files were incomplete.

As long as obsolete SEC proved reserves rules will be used, reserves studies will be flawed.
SEC rules were designed in 1978 in line with 1978 SPE rules, but SPE rules have been changed several times since, last time being 2007.
In fact IOCs and NOCS reports proved but also proven+probable=2P and 3P

| For 2006 | | proved | 2P | 3P |
|---|---|---|---|---|
| Pemex | Gb | 15,5 | 30,8 | 45,4 |
| Lukoil | Gb | 15,9 | 25 | 29 |
| | Tcf | 26,6 | 48 | 58,5 |
| Total | Gboe | 11,1 | 20,5 | |
| Exxon Mobil | Gboe | 22 | 72 | |
| Shell Canada | Gb | 1,1 | 1,5 | |

(probable is now stated by Exxon as *other quantities of oil and gas that will likely be produced in the future* and 2P is called *resource base)*
When Shell and Exxon sold their assets, it is reported in *boe of proved-plus-probable reserves* News in brief - Petroleum Economist July 2007

-A3-Past production
The most important graph of the Draft reports past production up to 2000, but it should have been up to 2006 or at least 2005
Figure 3: NPC figure ES-5 on total liquid supply

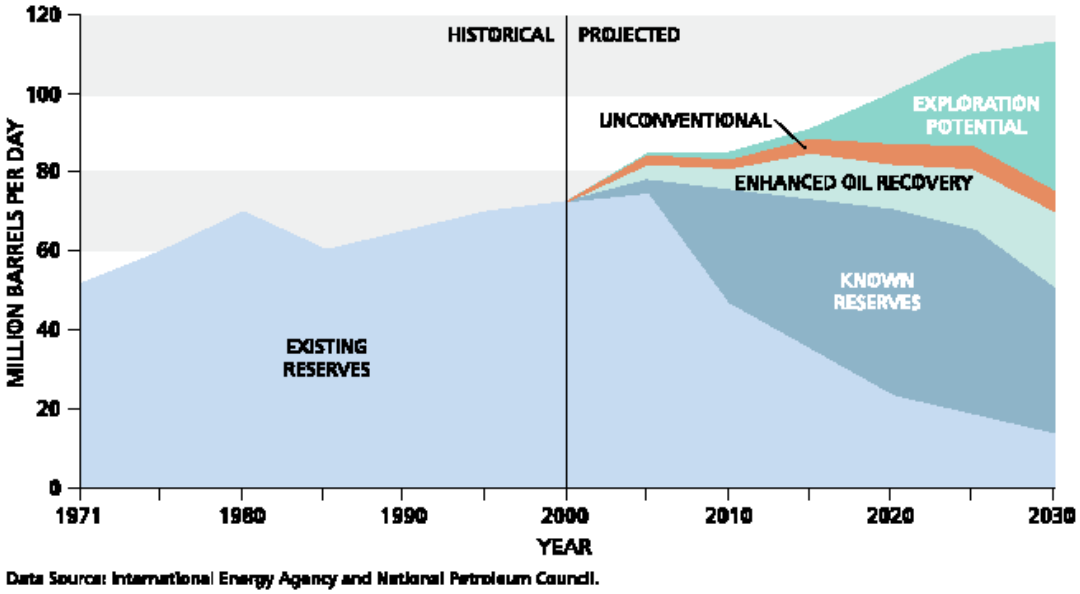
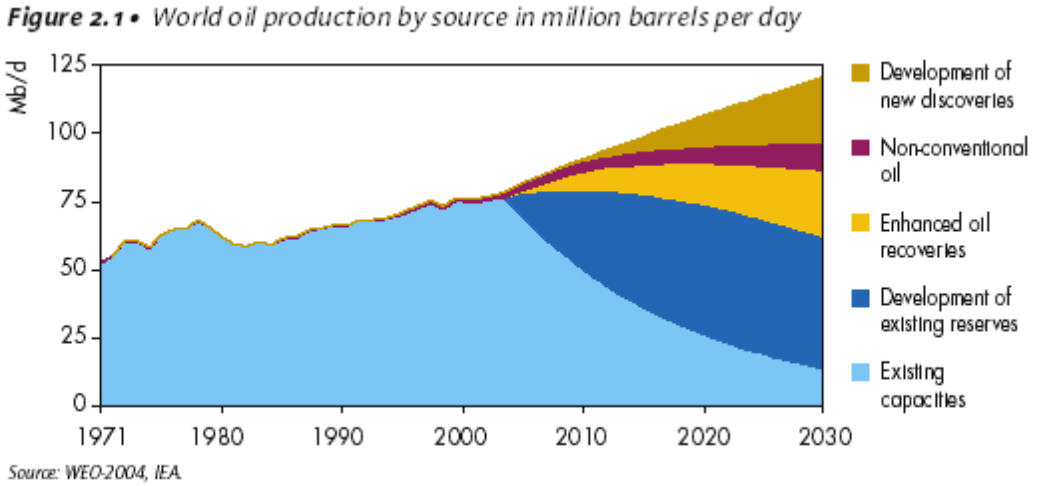



*Figure ES–5. Illustrative Total Liquid Supply*

Known reserves is not defined and should distinguished into undeveloped fields (known) and wildly speculative reserve growth.
EOR and unconventional should be reported in the past and presently EOR is smaller than unconventional (extra-heavy), when in fact EOR is unconventional !
Exploration potential is not in line with past recent discovery where deepwater is on decline
It looks to be a copy of an IEA WWEO 2005 graph where the past was put back from 2004 to 2000, values only every 5 years and some definitions changed!
What improvement!
Figure 4: IEA graph from 2005"Resources to reserves"



-A4-Unconventional oil and gas
Table II.2 (page 138 out of 422) quotes BGR 1998 for unconventional, but BGR has published a study in 2001 and another in 2004 on non-conventional, the table is obsolete by two surveys and furthermore non-conventional oil reserves were reduced by BGR from 5 605 EJ in 1978 to 2 761 EJ in 2004 a decrease of 51%, and the resources from 23 975 EJ to 10 460 EJ a decrease of 56%! Non-conventional gas resources decreases also by more than half! I suspect it is the reason to quote 1998!
Figure T-IX.1 (page 273 out of 422) US unconventional natural gas production and future projection reports values at 5.5 Tcf for 2005 and 7.5 Tcf for 2030 much lower than EIA/AEO 2007 (Table A14) at 8 Tcf for 2005 and 10.2 Tcf for 2030. Why such discrepancy?

-A5–US reports
Most of US reports are obsolete or late to be published
-USGS 2000 world inventory is as end 1995 and we are in 2007.
Previous USGS world inventories were carried out every 4 years, using ***inferred*** estimates assuming no reserve growth (Ch.Masters).
-USDOE published reserves inventory is now obsolete and should be updated:
-Report-0557 1992, "Geologic distributions of US oil and gas" as end 1990
-Report 0534 1990 "US oil and gas reserves by year of field discovery" as end 1988
All my US graphs using backdated mean estimates are based on these old reports plus new discoveries from recent annual reports, because current proved reserves are useless for forecasting.
The updated data exists (I have seen one good EIA confidential l graph in 1998 in Denver) but it is kept confidential, as far as I know, contrary to the rule that all what is paid by the taxpayer should be public.
-MMS reserves and production of the Gulf of Mexico
This very important and reliable published last database is dated as end 2003, it should be as end 2005.

-A6-Units: SI and “Imperial” units
I remind that every country in the world is using by law the SI units except US, Liberia and Bangladesh.
However since 1993 US federal agencies are obliged to use SI, but it does not show up much !. The crash in 1999 of the Mars Climate Orbiter occurs because NASA sent instructions approaching Mars in SI to the spacecraft built by Lockheed in *imperial* units !
This SI rule is ignored in every US federal report, except maybe on one page!.

US Customary is not the best system as indicated by
http://www.ilpi.com/msds/ref/volumeunits.html
*-The U.S. has two definitions of the pint and quart called the dry and wet measures. Each has a different size, something most Americans probably don't even realize.*
*-The U.S. system has an ounce which refers to a fluid volume, but also an ounce that refers to mass; these are not interchangeable. In general, an ounce of liquid does not weigh an ounce!*
*-The British Imperial system of liquid and dry measure uses only one ounce, pint and quart, but these differ from any of the U.S. measures as does the British Imperial gallon, peck and bushel.*

The barrel of oil is not an official unit anywhere and USDOE is obliged every time after barrels to write (42 US gallons). The official liquid barrel in US is 31.5 US gallons (http://www.unc.edu/~rowlett/units/dictB.html), but 31 US gallons only for beer. Even the origin of the symbol bbl is unknown!

I remind the Guide for the Use of the International System of Units (SI) by the National Institute of Standards and Technology
*10.5.3 Grouping digits*
*Because the comma is widely used as the decimal marker outside the United States, it should not be used to separate digits into groups of three. Instead, digits should be separated into groups of three, counting from the decimal marker towards the left and right, by the use of a thin, fixed space.*
*However, this practice is not usually followed for numbers having only four digits on either side of the decimal marker except when uniformity in a table is desired.*
This rule of using a space instead of a comma is completely ignored.
UK, Australia and Canada have moved to the SI to follow the majority, as in democracy, why not the US? Is it that Americans are unable to change?

**-B-Missing items**
-B1-SEC reserves rules
The big omission is that the Draft ignores completely the obsolete SEC rules obliging oil & gas companies listed on the US stock market to omit probable reserves, leading to the US reserve growth bad practice.
Exxon Mobil subsidiary Imperial said that the SEC rules prevent good practice of reporting.
Imperial wrote in their 2006 report :
*The United States Securities and Exchange Commission regulations preclude the company from showing in the Financial section of this document the*

*reserves that are calculated in a manner which is consistent with the basis that the company uses to make its investment decisions*
CERA (press release Feb.7 , 2005) said bluntly that the SEC rules have to be changed to be in line with modern practices :
*The SEC rules are in urgent need of modernization for three primary reasons:*
** Advances in technology over the last three decades which have enabled earlier and more accurate recognition of reserve volumes;*
** Changes in the structure of oil and gas commodity markets which have become much more volatile than at the time the 1978 System was implemented;*
** Changes in the character and geography of projects undertaken in which appraisal is more expensive, requiring companies to innovate and develop more information per well than was previously possible.*
*This would enhance the SEC's ability to perform its regulatory role in the 21st Century with 21st Century methods*.
Canada was using SEC definitions but in 2003 they decided to drop them and to use proven and probable (*National Instrument NI 51-101 – Standards of Disclosure for Oil and Gas Activities*).
The rest of the world is using proven plus probable being the best estimate and the value used by operators when deciding e development
Proved reserves are there only to please bankers and shareholders, but should never be used for forecasting future production (as also R/P).
It is amazing to find that the word SEC is absent of the Draft, despite the strong warnings of Exxon Mobil and CERA in official statements on this bad practice.

-B2-Non-audited OPEC proved reserves
OPEC reserves are not proved at all because they are not audited, they represent the goals of each OPEC member in the fight on quotas. The example of Kuwait is a good example because after a recent audit requested by the Parliament proved has been divided by half and replaced by about 2P. The Draft does not mention this important hard truth on Kuwait reserves?

-B3-Reporting of reliable forecasts.
The North America natural gas production is one of the most important coming US problem, but there is only one graph showing EIA2006 and 2007 forecasts growing up, but missing to show Exxon Mobil forecast which shows a peak now
NPC graph
Figure 5: NPC figure S3B-13 on North America gas production

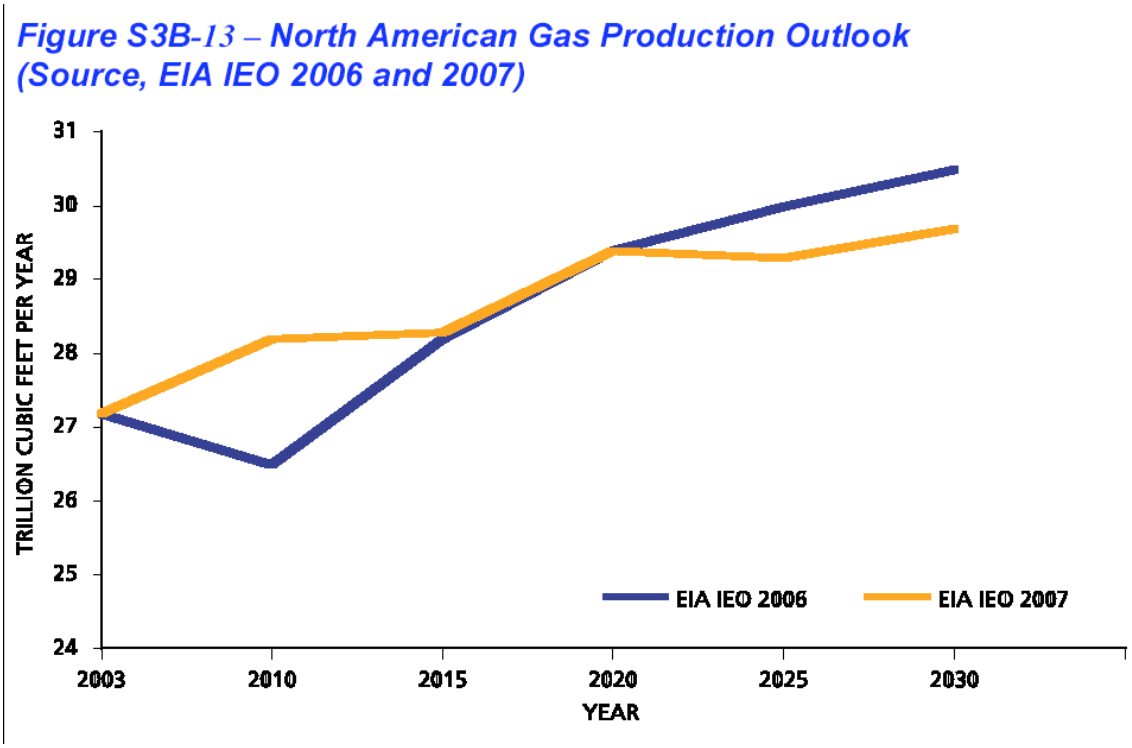
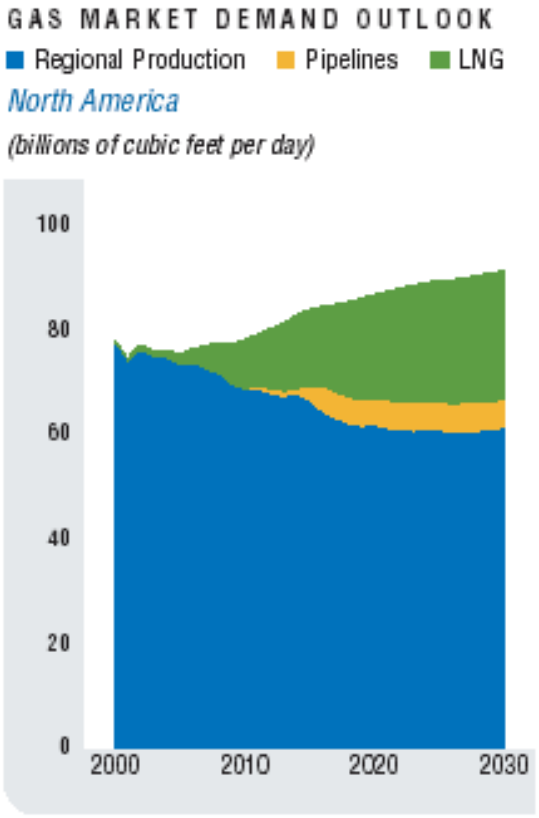


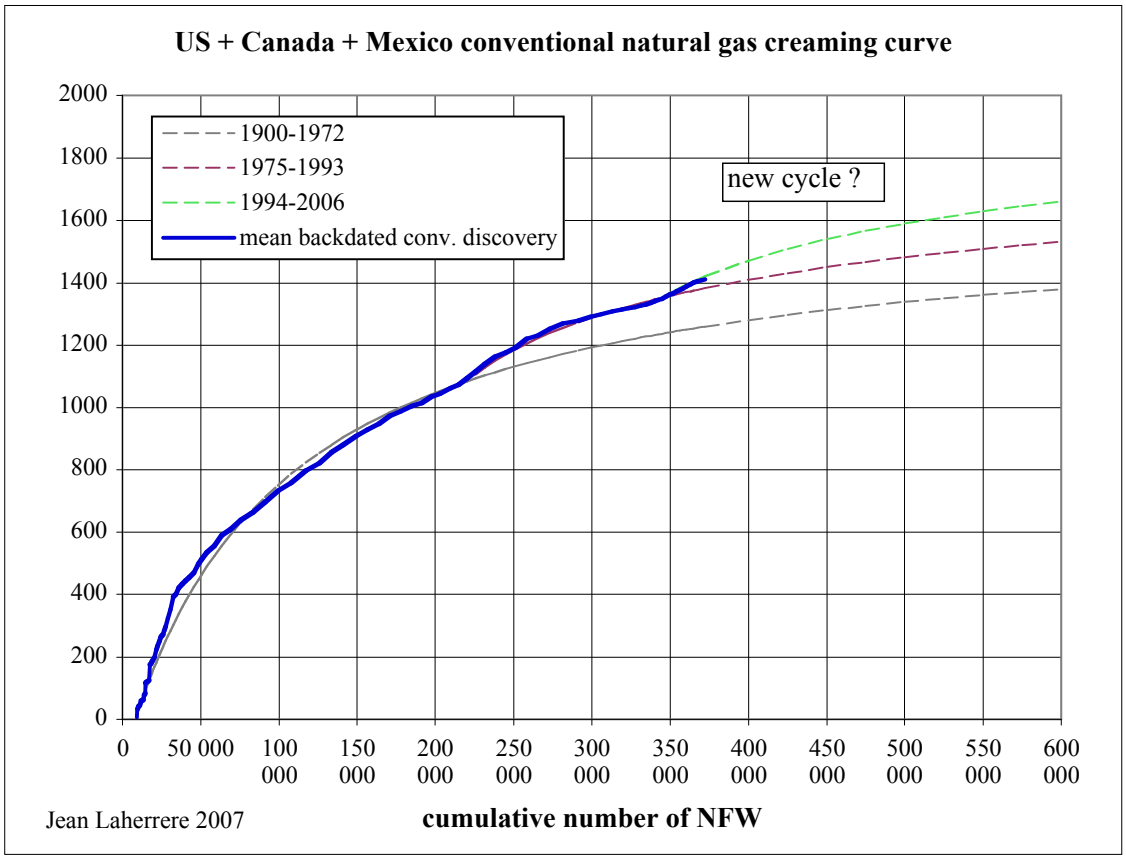

Figure 6: Exxon-Mobil AR2006 forecast on North America gas production




Using the backdated mean discovery from different files, the North America conventional natural gas creaming displays three cycles, first = normal areas ;

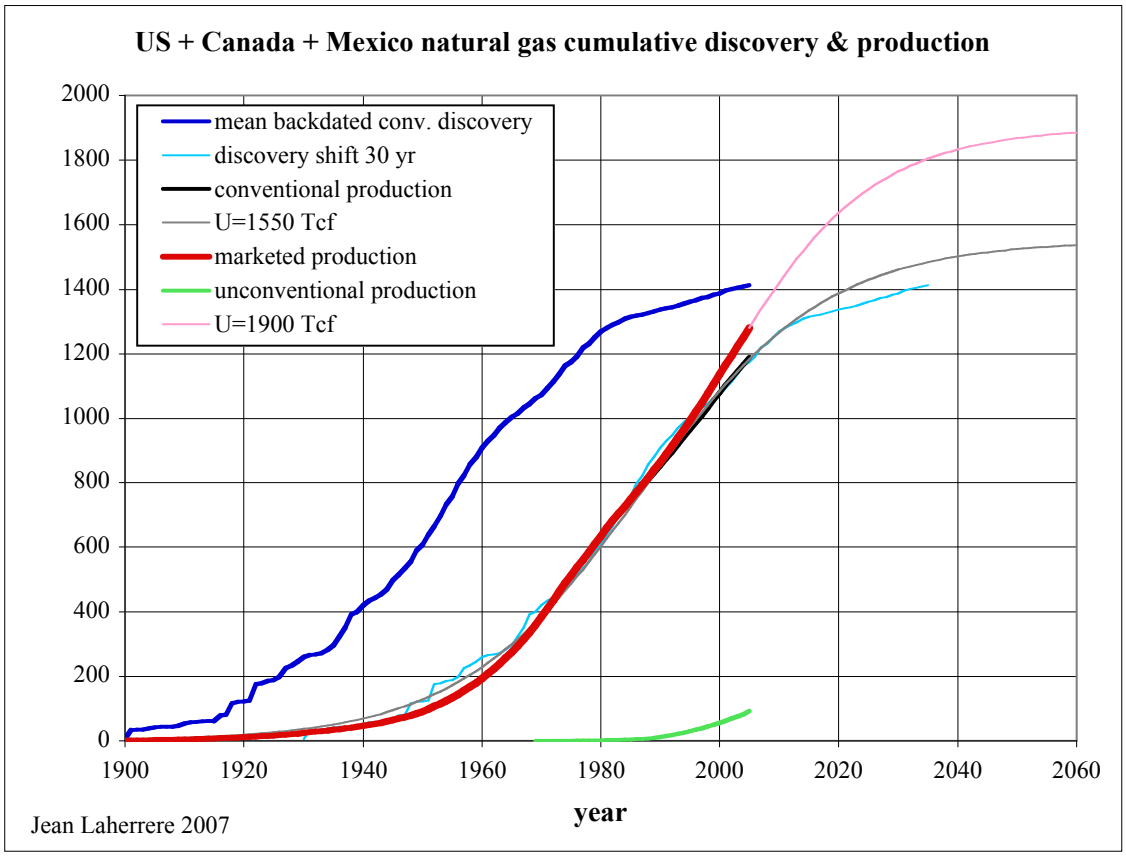
second = Arctic, third = deepwater. A fourth cycle is unlikely and the ultimate is about 1600 Tcf.

Figure 7: North America gas creaming curve from mean backdated discoveries

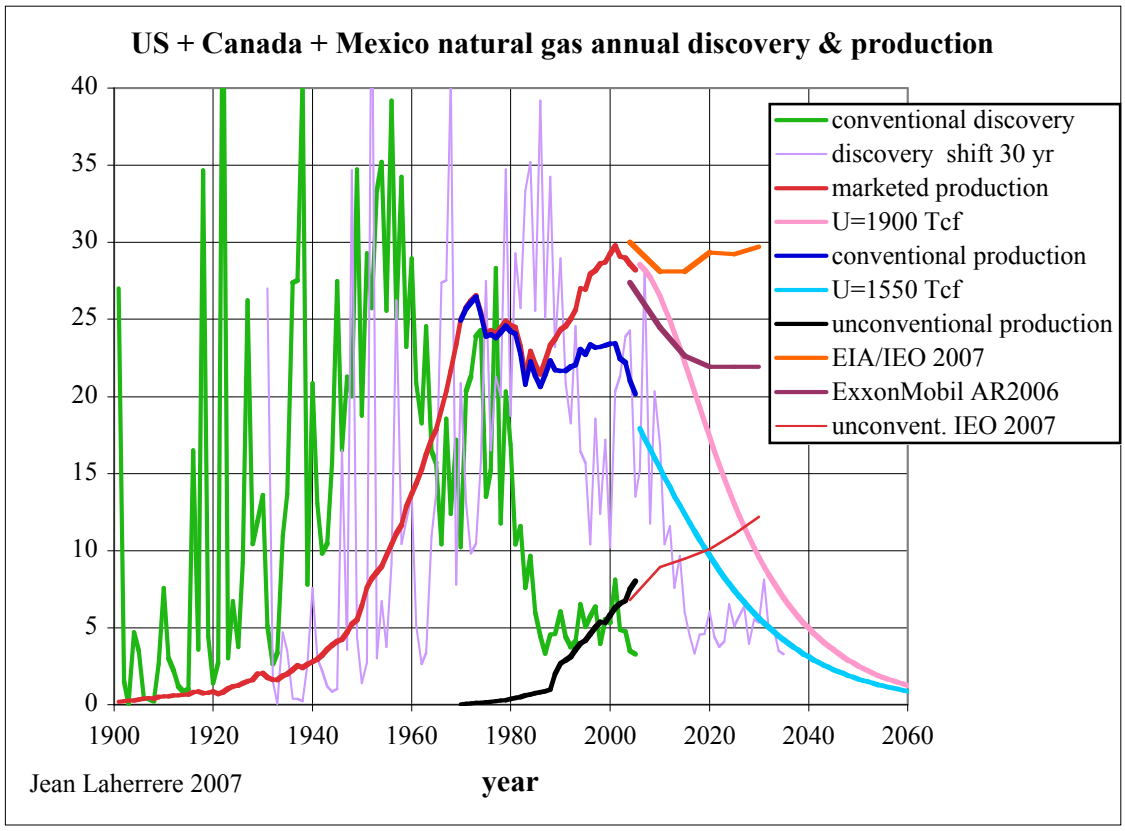



Cumulative conventional discovery, conventional production and marketed production are modeled, with an ultimate of 1900 Tcf for the marketed production

Figure 8: North America gas cumulative discovery and production and models




The annual marketed production modeled with an ultimate of 1900 Tcf displays a decline in line with the discovery shifted by 30 years. Exxon Mobil forecast is close to my forecast and EIA forecast looks really too optimistic
It is unwise to show only one North America gas production forecast, which seems too optimistic compared to forecasts from the basic field database and from one of the main operator. I trust more Exxon Mobil than EIA for production forecasts and Exxon Mobil is not rumored to be pessimistic!.
Figure 9: North America gas annual discovery and production and models




There are similar sets of graphs for each country : US, Canada and Mexico in the separate annex.

-B4-Homogeneous annual and cumulative database

EIA publishes a good inventory of world production, reserves and consumption, but also the States, as Texas and California, which provide annual field productions. I use them very often but it is a pity that data are not homogeneous and is not provided on a central organization.

For example US natural gas production for 2005 is reported by EIA in Tcf:

in production series:

Marketed 18.950734

Dry 18.074 table 2.4

but in reserve table (1977-2005)

Total gas wet 19.259

Total gas dry 18.458

Which one to be use to deplete reserves ?

without forgetting to subtract also flared & vented (0.119097) and non-HC removed (0.711095) to the reserves to get the remaining reserves.

Cumulative is reported without good definition and often disagree with the aggregation of annual reports.

In Canada we found a discrepancy of 35 Tcf in cumulative gas production compared to remaining reserves of 58 Tcf: it is more than significant

-B5-Possible demand constraint

In my papers since several years I mention that my forecast is done assuming that there will be no constraint from the demand (as it was in 1979) or from investments or from politics (nationalization, climate change), but because of the forecasts by Paul Volcker and now by Alan Greenspan of a coming economic recession the oil peak will be a bumpy plateau with chaotic prices.
There is not such mention of economic problems putting constraints to the demand. The present US housing bubble must have an impact on energy demand.
In contrary only dramatic growth in demand is mentioned, is a recession impossible?

-B6-Time is the worst constraint and the most important item of good forecasting

McNamara has issued his "law" where, compared to initial estimates of frontier projects, reality shows that cost have to be multiplied by pi and time by e (neperian number 2.7). This can be explained (Bourdaire) that megaprojects are always proposed with the minimum cost and the minimum time (to get the best NPV) and the ratio between minimum and mean (expected value) is about 3 in most distributions.
This time delay is found on most present megaprojects (Thunder Horse, Kashagan, tarsands, EPR).
Nature has its own timing and poor forecasts on staff and infrastructure have worsen the problem. It is impossible to get a baby in one month with nine women!
Rules on time forecast publishing could be issued. Time forecasts should be improved by publishing (post-mortem) ratio between initial and final values, instead of hiding these weak performances, as it is done by most operators.

-B7-Energy and GDP

In chapter VII. Cultural/Social/Economic trends (page 99 out of 422) energy in Mtoe is compared with GDP, but the cost of energy should be also compared with GDP. For the last 40 years world energy cost was about 5% of the GDP when the contribution of energy (Kummel, Ayres) is estimated to be about 50%. Such discrepancy between cost and contribution means that energy is undervalued. It is a hard fact which must be emphasized.

-B8-Waste of food = energy

Food is energy, but food is missing in most energy studies. The best solution to obtain a sustainable world is to eliminate all energy waste, beginning by food

wastes. US wastes 50% of the food (UK 33%, France 25 %). In US, it is a joke to call the "*core inflation*" inflation where excluding food and energy (on the excuse of being volatile), as if the US consumer can live without energy and food!
Obesity is a waste of food.
Obesity and waste of food should be fought as one of the first goals.

**-Conclusions**
Some hard truths are missing in the Draft, but also some simple recommendations for improving oil and gas database, which is the first step for good forecasts.
I suggest some US oil and gas database improvements:
-1-obsolete SEC rules should be modernized in agreement with SPE 2007 in order to report, in addition to proved reserves, proven + probable = 2P (being the best estimate)
-2-annual reports should provide together initial 2P reserves, cumulative production and remaining 2P reserves on the same line, as MMS database for GOM fields or Alberta EUB for pools
-3-USDOE/EIA should update every four years the "US oil and gas reserves by year of field discovery » as the "Geologic distributions of US oil and gas" published more than 15 years ago (in addition to NPC recommendations page 341-342 out of 422)
-4-USDOE/EIA should uniform the North America database in collaboration with the States files (Texas, California), the Provincial Canadian boards, NEB and Pemex and keep public historical series for annual (and cumulative) production and reserves (as OPEC is doing).
-5-USGS should update every four years the oil and gas inventory of the world resources (in addition to NPC recommendation page 44 out of 422)

Coal inventory is worse than oil and gas inventory, but I am not an expert in coal.

If the US does not eliminate obsolete practices, there will be a new bridge collapse and also energy failures because of incorrect knowledge.
Facing hard truths is one thing, improving our knowledge is another.

Annex: North America natural gas discovery and production for US, Canada and Mexico August 2007