Comments on BP Statistical Review 2012

-Oil

-Reserves

The new BP 2012 report shows a drastic change in the world proved reserves, increasing to 1653 Gb at end 2001 from 1383 Gb at end 2010 in BP 2011.

BP is wrong by

-adding proven reserves, when an arithmetic aggregation is wrong (it is only right for mean 2P) -adding conventional and non conventional reserves (where the size of the tap matters more than the size of the tank) and they should be reported separately, as it is done in Canada and as it was in BP 2011 and before

-using different definition for oil supply and oil consumption

-using a different definition for oil reserves by including oilsands in the "*total world*" item, when it was not in the previous years editions.

The evolution of BP estimates is shown from 1999 to 2012 editions. Figure 1: World proved oil reserves from BP 1999 to BP 2012



The new BP 2012 edition corrects the previous 2011 estimates drastically since 1999. It is not due to a new estimate of reserves but only a new presentation and a new definition This drastic change is due to the addition in the "*world total*" from 1999 of the Canadian oilsands reserves and since 2006 of extra-heavy oil from Orinoco belt. Before oilsands where presented outside the world total, as "*proved reserves and oilsands*", but Orinoco was included in the "*world total*".

In fact by removing oilsands, the BP total at end 2009 shows a decrease at 1348 Gb in BP2012 from 1376 Gb in BP 2011. There is negative reserves growth!

Figure 2: World proved oil less oilsands reserves from BP 1999 to BP 2012



BP now in 2012 considers Canadian oilsands like Venezuela Orinoco: in fact they are both extraheavy but with a completely different viscosity because the sharp difference in temperature in the reservoirs (55°C in Orinoco being fluid compared to 5°C in Athabasca being bitumen). They are both continuous-type accumulations and they should be treated separately!

BP world "total oil reserves" data as reported is compared with other sources and the "new" (different) BP2012 is ahead of the crowd

Figure 3: World proved oil reserves from different sources



The comparison of the current proved reserves (EIA) with the remaining backdated 2P technical data is drastic. Current proved reserves follows the financial SEC rules for audited data or the political non-audited OPEC sources. Arithmetic aggregation of proved data is incorrect, leading to an underestimate of the reserves and to future reserve growth. Backdating is also a very important factor (see Laherrère J.H. 2011 «Backdating is the key » ASPO 9 Brussels 27 April http://www.aspo9.be/assets/ASPO9_Wed_27_April_Laherrere.pdf)





Let's look at the detail of BP2012

In the oil proved reserves file at end 2011, the values are given in Gb and in Gt with many ridiculous decimals for many countries (14 for Azerbaijan in Gt, meaning down to 10 grammes!) and none for few (Azerbaijan in Gb)

Some countries report reserves in weight others in volume and the average density is often badly known and is guessed. A round value in barrels is converted in weight with many useless decimals: it is wrong to not restrict the amount of decimals to the accuracy of the measure (which is in fact an estimate and not a real measure).

country	Gb	Gt	b/t
US	30.8719987869262	3.72332507371902	8.29
Azerbaijan	7	0.95890408754349	7.30
Iraq	143.100006103515	19.3117408752441	7.41
Kuwait	101.5	13.980716705322	7.26
Total World	1652.61132445929	234.25108317424	7.05

BP with a ridiculous number of decimals down to the hundredth of a barrels, when usually country estimates are given in thousands barrels at the most, shows that BP does not know what is the accuracy of its data, being badly checked and managed!

BP b/t density value varies from 6.2 b/t (Canada) to 9.0 (Australia).

Figure 5: BP2012 oil reserves density (barrel per tonne) by country versus cumulative reserves



-Canada

Canadian oilsands production has started in 1967 but it is only in 1996 that BP reported large reserves from oil sands and only in 2010 by CAPP (Canadian Association of Petroleum Producers). Figure 6: Canada proved oil reserves from BP 2003 to BP 2012

CAPP reports established reserves, which represents proved plus half probable reserves (less than 2P). CAPP reports separately crude oil (broken down into light and heavy), bitumen mining and bitumen in situ, and also the backdated crude oil reserves. Unfortunately bitumen backdated estimates are not reported and they stopped reporting the backdated crude oil in 2009. Figure 7: Canada remaining oil reserves from proved BP and established CAPP in log scale

Bitumen production occurs in Alberta and the province site ERCB (Energy Resources Conservation Board) site provides data on production, reserves and forecast up to 2020. CAPP has published in June 2012 its crude oil forecast, markets & pipelines http://www.capp.ca/getdoc.aspx?DocId=209546&DT=NTV Figure 8: Canada bitumen production & forecast from CAPP & ERCB

Bitumen forecast is about 5 Mb/d in 2030 and 3.2 Mb/d in 2020. Mining which was higher than insitu before 2010 will lose definitely in 2030, because mining reserves in 2010 are 34 Gb when in situ are 135 Gb

-Venezuela

Another big increase it the extra-heavy oil from Venezuela. BP added about 200 Gb from 2006 to 2011. This Orinoco oil was produced since 1979 and had a sharp increase since 1999 with production in 4 fields from international companies associated with PDVSA in the areas called Hamaca, Zuata, Cerro Negro and Machete, but Chavez did nationalize these operations in 2005. Now the areas are called Ayacucho, Junin, Carabobo and Boyaca. Production data are now

unreliable and around 0.7 Mb/d in 2010. Forecasts vary from PDVSA (David Voght "Venezuela, the Faja and Elections" IPD Latin America Institute of the Americas XXI Annual La Jolla Energy Conference May 21-23, 2012 - La Jolla, California) around 3 Mb/d in 2020, but only in 2035 at 2.2 Mb for WEO 2011 and 1.5 Mb/d for IEO 2011.

Figure 9: Venezuela Orinoco extra-heavy oil production & forecasts from EIA, IEA & PDVSA

Figure 10: Venezuela Orinoco extra-heavy oil production & forecasts from PDVSA: D.Voght

BP reports Venezuela oil reserves by recopying OPEC values, but being always one year late! Figure 11: Venezuela proved reserves evolution from BP 2003 to BP2012

-Iran

BP follows Iran reserves estimates which are mainly political in their fight with Iraq! Figure 12: Iran proved reserves evolution from BP 2003 to BP2012

The remaining reserves from backdated 2P data is quite different from the current 1P from OPEC/BP, OGJ/EIA and WO.

Figure 13: Iran proved reserves evolution from different sources: OPEC, OGJ & WO

It is interesting to compare Iran oil official reserves changes with Iraq oil reserves and from technical sources. Iran was below when Saddam Hussein was in power! In October 2010, when Iraq increased their reserves to be a little above Iran, few days later Iran did increase to be a little above Iraq. Both proved reserves are quite higher than the technical 2P.

Figure 14: Iran & Iraq remaining oil reserves from OPEC and from technical sources

-OPEC and Canada

The OPEC and Canada oil proved reserves from OGJ (recopied by EIA) displayed steps, which are political steps, with long periods of no changes, when in reality remaining reserves always vary. Figure 15: OPEC and Canada oil proved reserves from OGJ

-Australia

BP oil proved reserves for Australia have changed significantly with time from 2003 to 2012 reports for the period 1980-2000

Figure 16: Australia proved oil reserves from BP 2003 to BP 2012

Australia oil reserves plot from different sources shows drastic differences. BP 2012 states to report crude oil plus condensate and NGL proved reserves.

Figure 17: Australia proved oil reserves from different sources

BP 2012 values agrees exactly from 1982 to 2002 with Geosciences EDR = Economical Demonstrated Resources for crude oil plus condensate plus LPG and EDR values are 2P and not 1P. But since 2003 BP reserves values are higher than EDR by about 0.3 Gb, meaning that some other liquids are reported. But it is difficult to find what it is. BP should report the LNG separately like EIA.

Australia reports oil production data through several organizations like Geosciences Australia, now taken over by Australian Petroleum Statistics (http://bree.gov.au/publications/aps/2011/index.html) and Australian Petroleum Production & Exploration Association (http://www.appea.com.au/oil-a-gas-in-australia/statistics.html). One of the problems of Australia is that the fiscal year covers two years and is different from the real annual one.

But Geosciences production data differs on the last years and APPEA data should be preferred. However the new APS production data (starting in 2010) is lower than APPEA data, but it agrees with EIA data

Figure 18: Australia oil production from APPEA, Geosciences & APS

The BP oil production values (in blue) is higher than crude oil +condensate + LPG from APPEA (in purple) and from EIA crude +LNG (in red). BP is either adding in oil production data (like in oil reserves data) something else than crude oil and NGL, or it just represents the inaccuracy of the data, despite that Australian data is in volume and not in weight! The difference peaked in 1975 at 28 Mb and again in 2003 at 23 Mb.

Figure 19: Australia oil production from BP, EIA, APPEA & APS

-Russia

It is hard to find data for Russia from the start, because up to 1996 most data covers the Former Soviet Union, and during the cold war, oil data was a State secret. This State secret was abolished at the break up of the USSR but the Duma reintroduced it and publishing oil reserves can be punished of 7 years of jail (but not for gas!).

The other problem is that FSU reserves estimates are Russian estimates called ABC1, following a classification presented by Khalimov at WPC 1997 (-Khalimov E.M., M.V.Feign 1979 "The principles of classification and oil resources estimation" WPC Bucharest, Heyden London 1980 p263-268). The same Khalimov stated in 1993 these ABC1 estimates as "grossly exaggerated" (Khalimov E.M., 1993, "Classification of oil reserves and resources in the Former Soviet Union" AAPG 77/9 Sept, p.1636)

It is necessary to correct ABC1 oil data to 2P (mean values) estimates and for a long time I was using a 30% reduction based on the ultimate estimated by the oil decline of the mean giants field (Romashkino, Samotlor, Urengoy). Fortunately Gazprom annual reports since 2000 provided reserves estimates using ABC1 and 2P. The ratio 2P/ABC1 from Gazprom is for the last few years for oil between 0.9 and 0.7.

Figure 20: Gazprom reserves ratio 2P/ABC1

The evolution of estimates ABC1 has increased with time but it is due mainly to the fact that the data was incomplete

At end 2007 the 2008 file is short of 117 fields compared to 2011 file, meaning that the cumulative discovery at this date was short

Figure 21: Russian cumulative oil & gas discovery from 2002 to 2011

The creaming curve for ABC1 oil (2011 file) trends towards 300 Gb and for 2P with a ratio of 0.75 towards 220 Gb

Figure 22: Russian oil & gas creaming curve

The cumulative 2P discovery in time can be modeled with S curve with an ultimate of 220 Gb for oil and 283 Gboe (1700 Tcf) for NG.

The cumulative production is modeled with two cycles (one with FSU and one after the break up) Figure 23: Russian oil & gas cumulative oil & gas discovery & production

Mainly studies having only production data extrapolates what is called the Hubbert linearization, but obviously the trend is not linear and any estimate is unreliable.

For oil the extrapolation of Hubbert linearization is poor and the ultimate of 220 Gb from the creaming curve is not obvious.

Figure 24: Russian crude oil production : Hubbert linearization

For NG, the extrapolation of the last period 2000-2011 trends towards 1800 Tcf in line with the questionable ultimate of 1700 Tcf from the creaming curve. Figure 25: Russian NG production: Hubbert linearization

The remaining 2P oil reserves have peaked during the 1970s and are sharply on decline since 1983, when the published proved reserves from OGJ/EIA/BP is rising by step. The 2011 estimate is flatly 60 Gb since 2001, which is obviously impossible, Russia is not finding exactly what they produce! World Oil magazine is showing erratic values and, because of that, they stopped reporting world reserves since 2009.

Figure 26: Russian remaining reserves from different sources

In the past my Russia oil ultimate was a round estimate about 200 Gb, now with better data (but still questionable) we assume an ultimate about 220 Gb and the annual oil production will decline from a second peak in 2011. Russian energy minister has stated on 20 June 2012 that oil production will decline from 500 Mt to 370 Mt in 10-20 years (about 7 Mb/d in 2025), which is in line with our forecast.

Figure 27: Russian crude oil production & forecast for an ultimate of 220 Gb

BP reports natural gas production excluding flared and recycled. But what is flared is lost and should be removed from reserves. The gross less reinjected is about 2 Tcf higher than BP, because of the flaring. Our modeling of the future for an ultimate of 1700 Tcf is simple, assuming only geological constraints (below ground) when in Russia there are above ground constraints, in particular with the investment of the giants fields in Yamal Peninsula (Bovanenko) and in Arctic (Shtokman) and also environmental problems. Bovanenko (discovered in 1971) is just developing and Shtokman (discovered in 1988) development is not yet decided.

The model with an ultimate of 1700 Tcf displays a second peak around 2020 at 25 Tcf/a Figure 28: Russian NG production & forecast for an ultimate of 1700 Tcf

It is likely that the gas peak around 2020 will be more complex, depending the development of giant fields like Shtokman.

-World oil production & oil consumption

BP uses different definition for oil for production and for consumption. Biomass, as also coal derivatives, are excluded in oil production, but not in oil consumption.

Oil production "includes crude oil, shale oil, oil sands and NGLs (the liquid content of natural gas where this is recovered separately)". Oil consumption is "inland demand plus international aviation and marine bunkers and refinery fuel and loss". Consumption of fuel ethanol and biodiesel is also included.

The change between previous editions and BP2012 for world oil production in volume shows a range of about 1 Mb/d (from - 0.8 to 0.2 Mb/d

Figure 29: change of BP 2012 world oil production (volume) from previous BP editions

The same plot for the world oil production in weight shows a different trend, meaning that the average density of oil is varying

Figure 30: change of BP 2012 world oil production (weight) from previous BP editions

The plot of the density (in barrel per tonne) of world oil production from BP 1998 to BP 2012 shows that oil is getting lighter from 7.4 to 7.65 b/t, but BP is continuously correcting this trend, meaning that they do not have the right data. It is mainly guesses and guesses change with authors! Figure 31: density of world oil production from BP 1998 to BP 2012

The plot of the density of world oil consumption from BP 1998 to BP 2012 shows a different behavior (because a different definition by including biofuels), but BP corrected in recent years by diminishing the density for the data from 1965 to 1977. The plots from editions before 2010 look more harmonious!

Figure 32: density of world oil consumption from BP 1998 to BP 2012

The world oil consumption change from previous BP editions shows erratic behavior, meaning that data is not reliable! It will change next year.

The difference between oil consumption and oil production (mainly due to biofuels and refinery gain) shows an increase from 1974 but with a range of uncertainty of about 2 Mb/d Figure 34: world oil consumption less oil production from BP 1999 to BP 2012

EIA reports oil production & consumption since 1980 and the world difference varies around zero (depending stocks). The plot of EIA 2012 is close to the plot of BP 1999 Figure 35: world oil consumption less oil production from BP and EIA

The difference is mainly due to the biofuels. Oil consumption data is about the same for BP and EIA, when oil production data are different because of biofuels and refinery gain! Figure 36: world oil consumption and production from BP and EIA

-oil production forecast

BP 2012 forecast to 2030 is similar to IEA/WEO 2011 NP, but being lower than USDOE/EIA/IEO2011 (which is similar to OPEC/WOO2011).

BP recopies other sources, but prefers IEA than USDOE/EIA!

Its main merit is to provide historical series on excel files. But BP does not like to report the discrepancy with others sources, or the discrepancy with its previous editions.

The comparison of official oil production forecasts with the forecast using the technical data shows an obvious difference like the figure 4 on remaining reserves.

The breakdown of the all liquids production is modeled with ultimates estimated from creaming curves: 2200 Gb for crude oil less extra-heavy (XH), 500 Gb for extra-heavy, 300 Gb for NGL and refinery gain being 3% of the crude less extra-heavy and other liquids (biofuels renewable) trending towards an asymptote of 6 Mb/d

Figure 37: world all liquids production & forecast

Official forecasts are "no worry": the business as usual will prevail, the peak oil is a myth, when technical data shows the contrary!

-Biofuels

BP reports biofuels since 2010 in ktoe and kb/d, but the conversion between barrel and toe looks queer!

Figure 38: world biofuels production from BP 2010 to BP 2012

The data in b/d is computed d for BP 2012 with a constant density of 7.33 b/t (toe) and constant 365 days per year and for BP 2011 with the real biofuel density varying from 12.6 to 11.6 b/t EIA reports world biofuels only in Mb/d from 2000 to 2010 and the data is the same as BP 2011, which is for 2010 over 1.8 Mb/d against less than 1.2 Mb/d reported by BP 2012. Figure 39: world biofuels production from EIA

BP should report biofuels data in volume in real barrel and not in volume of oil equivalent barrel to be in line what is done by EIA, it is only for data in toe that the density correction is done BP outlook to 2030 forecasts biofuels copying IEA/WEO 2011 New Policies Figure 40: world biofuels production

-Natural gas

-Reserves

BP NG proven reserves has changed significantly with time, not always on the increase, for 2005 BP2007 was higher than BP2012.

Figure 41: world NG reserves from BP1999 to BP2012

The comparison of remaining reserves for current 1P (political/financial) to backdated technical 2P is striking as it is for oil.

The 2P technical data has flattened since 1980 when the current 1P is on then increase since 1965! Figure 42: world NG remaining reserves from technical and political/financial sources

-Production

BP presently reports NG production since 1970 in cubic meter, cubic fee par day and toe (tonne oil equivalent).

The change of the NG production from BP 1999 to BP 2012 is small compared at the change for oil. Practically there is no change in production value for the period 1970-2011 for the data in volume (G.m3) or in energy (Mtoe)

Figure 43: world NG production (G.m3) from BP 1999 to BP 2012

Figure 44: world NG production (Mtoe) from BP 1999 to BP 2012

For the report in Gcf/d it seems that BP converted wrongly the data for the editions 2000, 2002 and 2003.

The conversion ratio from cubic meter to toe was almost constant (poor practice?) from 1999 to 2006 at 1.111 m³/toe, but increasing from 1.099 to 1.109 m³/toe from 2007 to 2012. Figure 45: density (m³/toe) of world NG production from BP 1999 to BP 2012

The same plot for NG consumption density, which starts at 1965, is slightly different for the editions since 2007, meaning that BP does not use the same conversion ratio since for production and for consumption as it was different gas!

Figure 46: density of world NG consumption from BP 1999 to BP 2012

The plot of the world NG consumption shows roughly not much change, but being slightly different from NG production.

Figure 47: world NG consumption (G.m³) from BP 1999 to BP 2012

-Primary energy

BP primary energy data vary little with time, showing a break in 1979 with the oil shock and an increase since 2002.

Figure 48: world primary energy consumption from BP 1999 to BP 2012

The same plot from different sources displays a certain uncertainty because different conversion factor and definitions. The main problem is the biomass.

Figure 49: world primary energy consumption from BP 1999 to BP 2012

The forecasts varies, BP 2012 is in line with Exxon 2012, less than WEO2011 and OPEC 2011. Figure 50: world primary energy consumption and forecasts

-Conclusions

BP Statistical Review has the merit to release every year free and convenient updated historical files in excel of the energy data.

But BP recopies what is officially reported by national agencies, avoiding diplomatic conflicts. Once in the 80s, BP in the annual statistical review changed the official UAE reserves estimates by their own data (being the operator of almost every fields), but the next day they were obliged to destroy all their reports and to replace their values by the official data. Since, BP avoids not to repeat this mistake! It is the same problem with most official agencies, official data from other nations are difficult to deny.

But BP reports heterogeneous and wrong data, displaying ridiculous numerous digits in contradiction with the real accuracy.

BP wrongly adds unconventional reserves to conventional reserves, despite the flow of them is completely different. They should be kept apart.

BP like many official agencies ignores backdating, when the use of current reserves with obsolete (SEC) rules leads to artificial reserve growth.

The problem is that most economists believe these wrong data, in particular the remaining reserves, which are on the increase since reported, when in reality oil and gas conventional reserves have peaked since 1980.