Jean Laherrère **ESCP Europe London Campus** **17 February 2014**

Debate on "Oil and gas perspectives in the 21st century"

Highlights & Comments on Energy Policy special issue January 2014

A-Introduction

Before commenting below on specific papers in the special issue, I will cover some general topics. These are: reserves definitions and data; production data and forecasts, and units of measurement.

(a) Reserves definitions and data

Most papers on oil and gas do not adequately define the word reserves that they use. There are many classifications for reserves and they differ widely in the way they are estimated.
Reserves represent the estimate of the cumulative production to the end of production; reserves could be initial reserves when the estimated cumulative production is from production start to production end; reserves could be remaining reserves when the estimated cumulative production starts from a certain date to production end, in this case the cumulative production from start to the beginning of the remaining reserves should be given. When reserves data without a date and without an adjective are mentioned there is no way to know if it is remaining or initial. Reserves should be always accompanied by an adjective and by a date (year of estimate and/or date of the start of remaining reserves).
Some believe that some OPEC countries confuse on purpose remaining and initial reserves, thus explaining why these reserves do not change much.
Initial Reserves can vary with time when new data result from new production, or new wells, or new seismic, or a new field model, or new economic or political changes.
Remaining reserves vary every year because the past year production should be deducted.
Because of the uncertainty of the estimate and of the conditions of the future production, there is a range of estimate from minimum to maximum values passing through a best estimate, or a median, or a most likely (mode) or a mean value
Reserves are often confused with resources, which are the volume in the ground, while reserves are the recoverable resources. The term "recoverable reserves" is a tautology, but often used by so-called experts!
As only about 1% of the hydrocarbons generated by the source-rocks are recovered within the conventional fields, resources can be 100 times larger than reserves.
There is no consensus on reserve definitions, but there are local (national) practices.
On the world level the situation is worse, there are no rules, no referees and no red cards!

The main local practices are:
-**OPEC** reporting "**proved reserves"** without any audit. With the battle for oil quotas (based in part on reserves) after the 1986 oil counter-shock, OPEC members between 1986 and 1989 increased their oil reserves by about 300 Gb without making any significant discoveries. Sadad al-Husseini (a former ARAMCO VP) stated in 2007 that these 300 Gb reserves were speculative resources:
OPEC reserves are thus political
-**SEC** (Securities & Exchange Commission) rules oblige oil companies listed on the US Stock market to report only audited "**proved reserves**" within the area of producing wells, with the loose definition of reasonable certainty to exist (reasonable in probability can range from 51% to 99%), but in fact proved reserves represent the minimum value. The goal was to satisfy the bankers (lending money) who want to know the minimum value, in order if bankruptcy occurred to be sure to recover this value.
In 2010, SEC rules went from pessimistic to optimistic by allowing companies to report proved undeveloped reserves from a confidential model covering undrilled areas. **SEC reserves are thus financial.**

In 2003 Canada has dropped using SEC rules and instead adopted SPE rules.
USDOE/EIA reports "proved reserves" by country and for the world, assuming that they follow the SEC rules of reasonable certainty (see their glossary).
USDOE/EIA uses the data from an enquiry process carried out by the Oil and Gas Journal (OGJ) in the fall of each year asking to national agencies for the data for the next 1st January (usually year data are reported for year-end) before any study which needs time and to gather all the year data to deliver the results at the best in March next year. The countries ,which do not answer, are assumed to have the same reserves as last year (implying that they have discovered exactly what they have produced, it is a joke!). For the estimate at 1st Jan 2014, out of 112 countries, there are 71 countries with no change for oil and gas reserves (i.e. two-thirds did not answer the OGJ enquiry) and only 41 countries showed a change!
Furthermore the arithmetic addition of country proved (minimum = P90) reserves to obtain the world proved reserves is statistically incorrect (as every country is unlikely to be at the minimum), giving underestimated results and this poor practice leads to incorrect reserve growth (see PRMS 2011 Fig 6.5)
BP reports also proved reserves by country but changing the data from time to time (Laherrère 2013 Club de Nice). UK is the only country with Norway and US federal lands to report true reserves by field. For example, UK DECC reports the UK remaining reserves 1P, 2P & 3P for natural gas (NG), but BP in their 2013 Statistical Review reports proved UK NG reserves being 1P DECC from 1980 to 1998, then 2P DECC from 1999 to 2004 and back to 1P DECC from 2005 to 2012: it is rubbish! BP does not know the difference between 1P and 2P reserves!
-SPE/WPC/AAPG: Before 1997 the rules were only deterministic using mainly the volumetric method with net pay, spacing and recovery of producing wells**.** In 1997 (I was an active member of the SPE/WPC task force) their rules on reserves definitions added the probabilistic approach, where the value used by oil companies to decide the development of a field is the 2P reserves = proved + probable = P50, close to the mean value. Note that arithmetic addition of mean (2P) values is statistically correct in contrast to addition of either 1P or 3P. Every reliable oil company decides the development of a field computing the Net Present Value based on the mean reserves value (2P).
The last SPE classification is called PRMS = Petroleum Resources Management System as shown by the following graph.

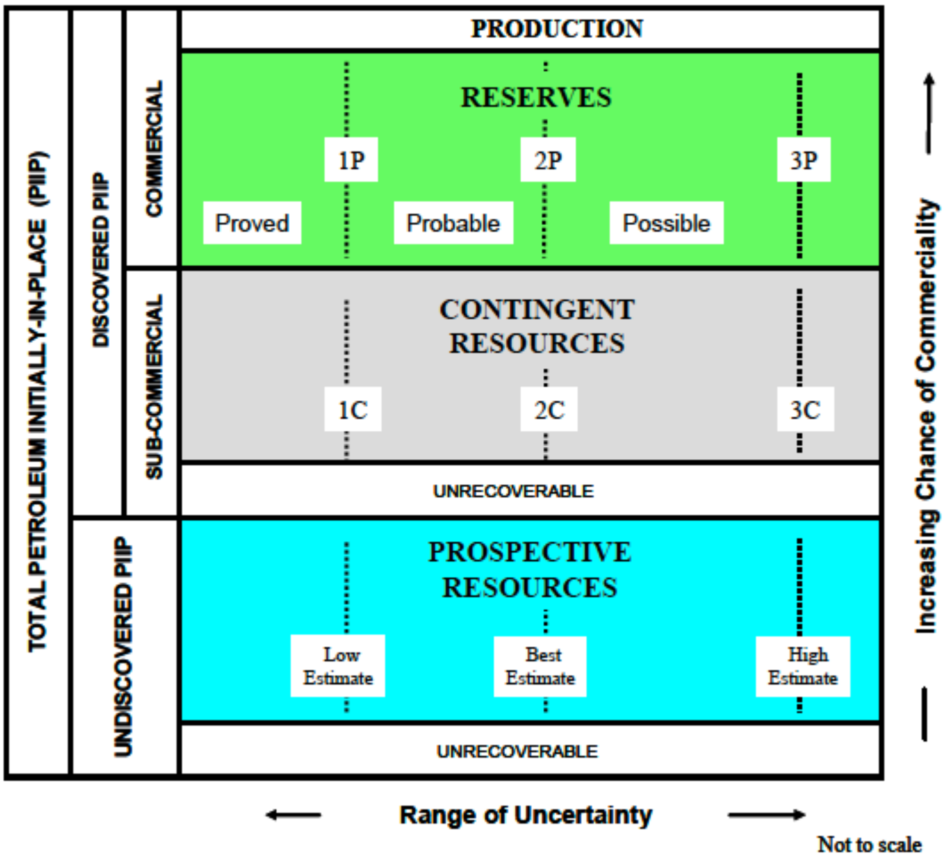


Figure 1-1: Resources Classification Framework.

-ABC1 reserves (Russian classification Khalimov 1979) are "grossly exaggerated" (Khalimov 1993) being close to 3P by assuming the theoretical maximum recovery. Gazprom reports both ABC1 & 2P audited reserves values where 2P are about 70% of ABC1. Most reserves data from the ex Soviet Union countries in databases are ABC1.

-Norwegian classification: NPD (Norwegian Petroleum Directorate) has its own classification and reports field reserves base estimate, which is the mean value, when calculated by a stochastic method.

-United Nations framework classification for fossil and mineral resources: This is very complex with three evaluation axes. The industry ignores the last 2009 version, as they did with the previous ones since 1997, but still many experts travel often around the world to improve (?) this unused classification!

The scout companies (IHS, Rystad,) gather heterogeneous reserves estimates from many sources and called them 2P reserves, despite they are not all 2P and need correction.

-Confusion with probable and 2P, and with possible and 3P

In the IEA/WEO 2013 in Box 13.2 they write:

"Probable reserves (or 2P), the amount of oil that has a more than 50% probability of being produced as part of projects that have a high probability of being implemented. The uncertainty can be in the geology, the possible production rates or the economics of producing that part of the resources. 2P reserves are usually quoted as including 1P reserves (and can also n be referred to as " proven + probable")

Possible reserves (or 3P)

The above is a contradiction, as 2P is described as probable first and then later as proven + probable. But 2P is 2P because it is proved +probable, and 3P is 3P because it is proved +probable +possible. The IEA is therefore wrong, whereas PRMS 2007 is clear, stating as follows

-Probable Reserves are those additional Reserves which analysis of geoscience and engineering data indicate are less likely to be recovered than Proved Reserves but more certain to be recovered than Possible Reserves. It is equally likely that actual remaining quantities recovered will be greater than or less than the sum of the estimated Proved plus Probable Reserves (2P). In this context, when probabilistic methods are used, there should be at least a 50% probability that the actual quantities recovered will equal or exceed the 2P estimate.
-Possible Reserves are those additional reserves which analysis of geoscience and engineering data suggest are less likely to be recoverable than Probable Reserves. The total quantities ultimately recovered from the project have a low probability to exceed the sum of Proved plus Probable plus Possible (3P) Reserves, which is equivalent to the high estimate scenario. In this context, when probabilistic methods are used, there should be at least a 10% probability that the actual quantities recovered will equal or exceed the 3P estimate.

UK, which is the only country with Norway to report field reserves, is also wrong, in the same way as the IEA, in their reserves definition (see https://www.gov.uk/oil-and-gas-uk-field-data)
Reserves Description
-Proven Reserves that on the available evidence, are virtually certain to be technically and commercially producible, i.e. have a better than 90% chance of being produced
-Probable Reserves that are not yet proven, but which are estimated to have a better than 50% chance of being technically and commercially producible
-Possible Reserves that at present cannot be regarded as probable, but which are estimated to have a significant – but less than 50% – chance of being technically and commercially producible

The French petroleum Institute, BP are also wrong on their website defining probable as P50 and possible as P10. This is a pity!
They are as poor as Wikipedia when searching for "oil reserves".
Chapman and Aguilera also did the same mistake, believing that IEA, UK DECC and IFP are the experts!

EIA in their glossary defines proved reserves with reasonable certainty to be recoverable under existing economic and operating conditions, similar to the SEC, but mentions that proved reserves are equivalent to the old definition (US Geological Survey circular 831 1980) of measured reserves, when measured and indicated reserves constitute demonstrated reserves. Demonstrated reserves and inferred reserves represented the economic identified reserves: in fact inferred reserves were the reserve growth or the probable reserves neglected by the SEC. Chuck Masters USGS world reserves estimates of WPC 1984, 1987, 1992, 1994 were based on identified reserves or 2P.
But now probable reserves is a forbidden word in the US: a long time ago Total and Exxon reported in their annual reports proved reserves but also probable reserves, but not anymore. Reserve growth, which is the result of the poor practice of using only proved reserves, is mainly artificial but is a good substitute to the lack of new discovery!

The following graph, Fig 1, reports the world (also OPEC and Non-OPEC) remaining reserves from two very different types of sources. It shows in brown the political/financial current 1P remaining reserves (as available on the EIA website or in the OGJ old bulletins). It shows in green the backdated 2P remaining reserves from confidential & expensive databases from scout companies like IHS, Rystad (but needing correction to the real mean). These green data are termed "technical data" and represent crude oil +condensate excluding extra-heavy oil.
There is no consensus on the definition of conventional (based on reservoir or fluid or location) and for me only extra-heavy oil has to be excluded because here the trapping mechanism is completely different, having no distinct oil-water contact level.
There are different key things to note from this very important Figure (indeed, the most important!).

The published proved reserves (in brown) have been on the increase consistently since 1950. This had led economists to the belief that there are no oil constraints from the supply side. But, as pointed out above, from 1986 to 1989 300 Gb were added by OPEC in their fight for quotas (termed as “speculative resources” by Al-Husseini in the 2007 Oil & money conference in London). Moreover the extra-heavy oil included in this curve (Athabasca Canada and Orinoco Venezuela were added in 2001 and 2011 despite these resources having been discovered a long time ago, and produced since 1967.

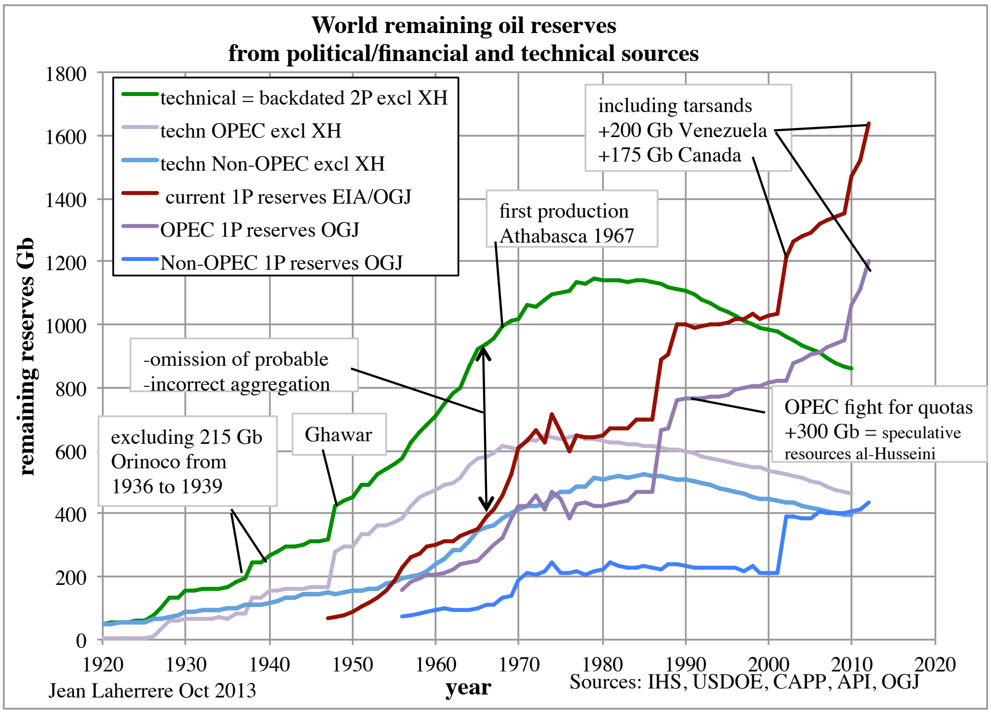


Fig 1: the contrast between world remaining oil reserves from political/financial and technical sources.

By contrast in Fig 1, the confidential backdated 2P oil reserves shown in green and excluding extra heavy oil, displays a decline since 1980. This is because since that date, as shown in Fig 2 below, the annual 2P discoveries (in green) have been smaller than production, whereas the annual 1P discoveries (in blue) have, most of this time, exceeded the annual production.
Economists generally have no access to the technical 2P reserves data, and tend to rely on USDOE/EIA or BP 1P reserves, which show a continuous rise. So it is not that they are not thinking incorrectly, but thinking on the basis of incorrect data.

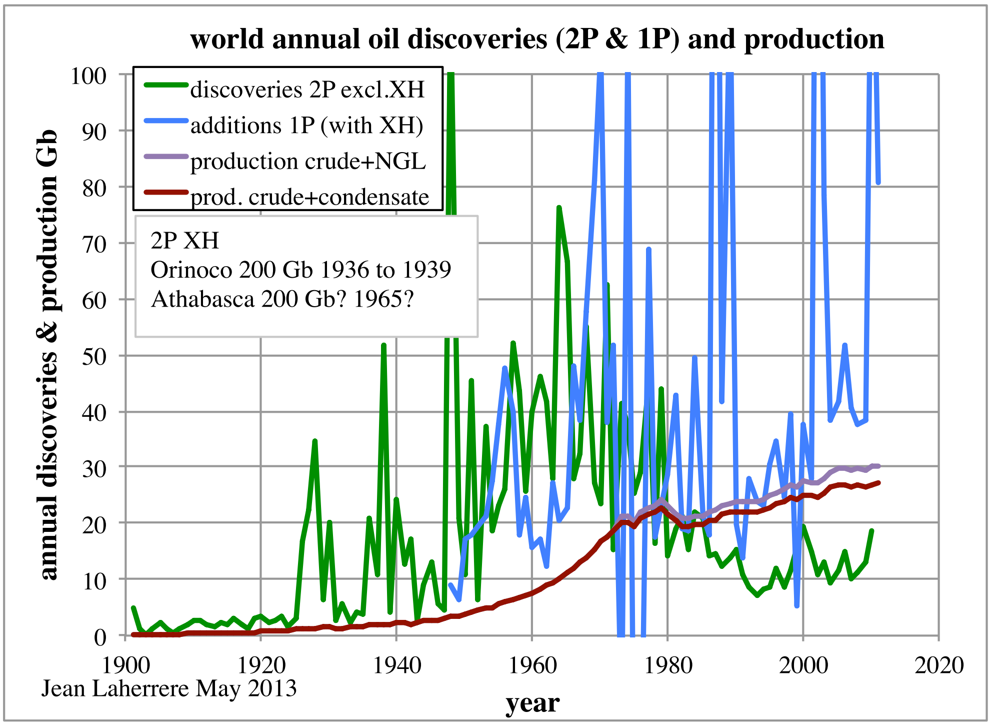


Fig 2: World annual discoveries, contrasting 2P discoveries (excluding extra-heavy oil) with annual 1P discoveries (including extra-heavy oil) and comparing to annual production.

Note that in terms of a methodology for forecasting future production, it is the backdating of 2P reserves (i.e. using the present 2P estimate of a region's reserves, backdated to the year of discovery) that is key to being able to extrapolate past discoveries to generate a reasonable estimate for an ultimate for the region. It is this 'extrapolated-discovery' ultimate that governs what will be practical to produce from the region, rather than some possibly much higher 'theoretically-assessed' ultimate that simply cannot be discovered over any reasonable timescale (see Laherrère, Brussels 2011).

(b)-production data and forecasts

Most of papers use the word oil without defining it.
"Oil" could be conventional (but with no consensus on the definition), regular (Campbell excluding heavy oil, arctic and deepwater), crude oil, crude oil with condensate, crude oil excluding extra-heavy oil, crude oil + NGL, or all liquids (including refinery gains, XTL, biofuels)

Fig 3 displays USDOE/EIA production data for the world for: crude oil + condensate, crude oil +NGL, and all liquids.
Because in the US condensate is always measured at wellhead with the crude, EIA reports also crude oil + condensate in international data. OPEC separates crude and condensate because condensate is not subject to quotas.
Crude oil +condensate production displays a bumpy plateau since 2005 around 74 Mb/d plus or minus 2 Mb/d.

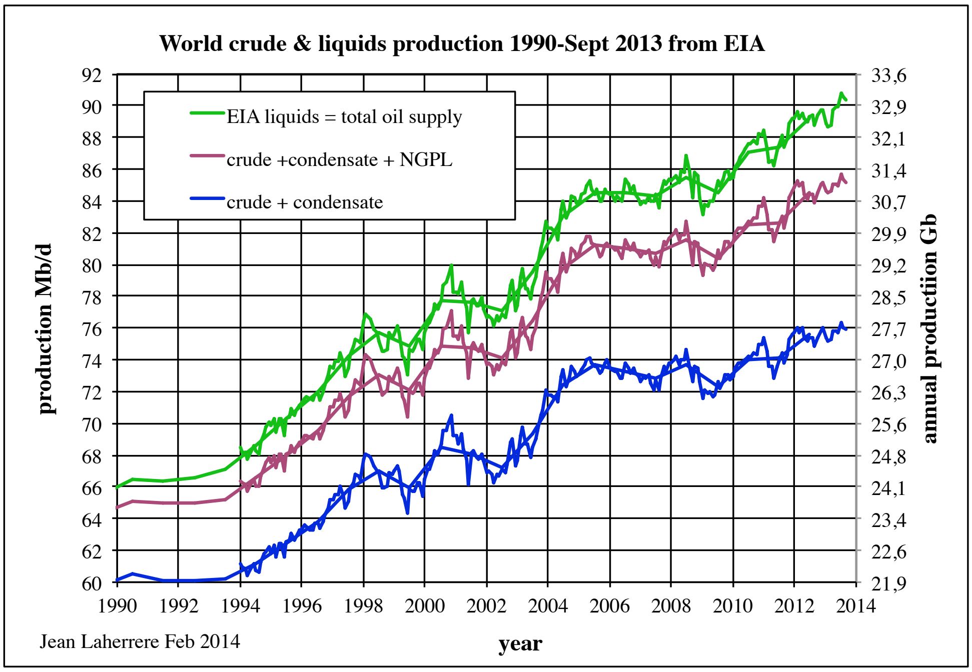


Fig 3: World crude & liquids production from EIA data

World oil supply is reported by several sources: EIA, IEA, OPEC & BP, and their data are all different. However, the discrepancy is about plus or minus 2 Mb/d, which is of the same order of the fluctuation of the crude + condensate bumpy plateau!

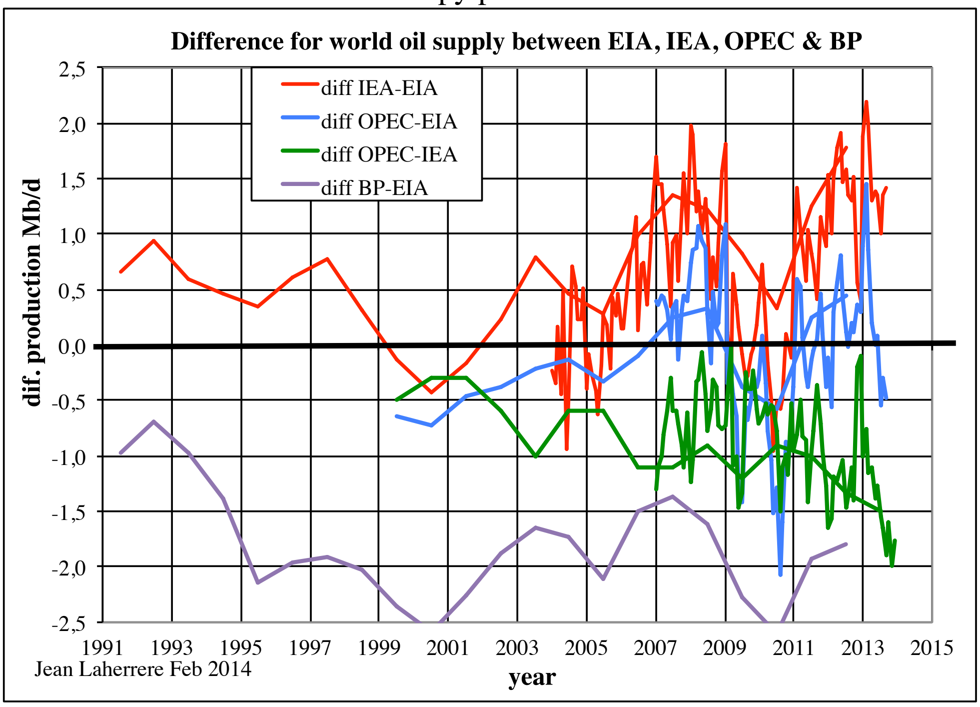


Fig 4: Showing the difference, for world oil supply, between EIA, IEA, OPEC & BP data

The discrepancy of the world oil supply from different sources is about 2%, meaning that reporting more than 2 significant digits for the world oil supply is wrong. BP Statistical Review reports the world oil supply with 14 significant digits (due to the conversion weight -volume): this is ridiculous and shows that BP does not understand the reality of the accuracy of the measures.

IEA oil supply data are higher than EIA data by 2 Mb/d, the red curve (as was already the case in WEO 2008 where NGL were at 10 Mb/d against 8 Mb/d for EIA) because the IEA defines condensate either being crude oil or being NGL depending the way it is sold, explaining the sharp change in the red plot on the first of the year 2009 and 2011, because this is when contracts for sales change.

Table 5.4: OPEC crude oil production based on *secondary sources*, tb/d

	2012	2013	2Q13	3Q13	4Q13	Nov 13	Dec 13	Jan 14	Jan/Dec
Algeria	1,210	1,159	1,168	1,155	1,144	1,116	1,150	1,148	-2.8
Angola	1,738	1,732	1,752	1,720	1,703	1,687	1,702	1,633	-68.8
Ecuador	499	515	511	520	527	528	531	529	-1.8
Iran, I.R.	2,973	2,693	2,678	2,678	2,705	2,700	2,736	2,733	-3.8
Iraq	2,979	3,036	3,101	2,998	3,015	3,019	3,023	2,998	-24.9
Kuwait	2,793	2,822	2,839	2,842	2,821	2,816	2,827	2,806	-20.4
Libya	1,393	928	1,342	653	332	243	240	510	270.3
Nigeria	2,073	1,911	1,889	1,906	1,868	1,815	1,895	1,903	8.0
Qatar	753	731	729	731	731	730	731	738	7.0
Saudi Arabia	9,737	9,584	9,480	10,024	9,721	9,707	9,743	9,628	-115.7
UAE	2,624	2,741	2,737	2,780	2,743	2,694	2,757	2,756	-0.3
Venezuela	2,359	2,356	2,355	2,361	2,358	2,359	2,350	2,331	-18.8
Total OPEC	**31,132**	**30,207**	**30,581**	**30,368**	**29,668**	**29,412**	**29,683**	**29,711**	**28.1**
OPEC excl. Iraq	**28,152**	**27,171**	**27,480**	**27,370**	**26,653**	**26,393**	**26,660**	**26,713**	**53.0**

Totals may not add up due to independent rounding.

Table 5.5: OPEC crude oil production based on *direct communication*, tb/d

	2012	2013	2Q13	3Q13	4Q13	Nov 13	Dec 13	Jan 14	Jan/Dec
Algeria	1,203	1,203	1,202	1,202	1,208	1,213	1,207	1,193	-14.0
Angola	1,704	1,697	1,730	1,701	1,625	1,568	1,626	1,616	-10.0
Ecuador	504	526	520	534	544	545	548	550	1.9
Iran, I.R.	3,740	3,576	3,711	3,653	3,239	3,300	3,220	3,250	30.0
Iraq	2,944	2,980	3,042	3,006	2,915	2,773	3,002	2,848	-154.0
Kuwait	2,977	2,922	2,970	2,992	2,912	2,922	2,940	2,935	-5.0
Libya	1,450	993	1,415	752	332	226	228	508	280.4
Nigeria	1,954	1,749	1,649	1,824	1,706	1,655	1,702	1,917	214.5
Qatar	734	724	724	719	725	719	733	732	-1.5
Saudi Arabia	9,763	9,637	9,538	10,115	9,773	9,746	9,819	9,767	-52.1
UAE	2,652	2,797	2,792	2,859	2,714	2,572	2,739	2,717	-22.5
Venezuela	2,804	2,784	2,762	2,773	2,858	2,854	2,894	2,888	-6.1
Total OPEC	**32,429**	**31,589**	**32,055**	**32,131**	**30,550**	**30,092**	**30,659**	**30,921**	**262**
OPEC excl. Iraq	**29,485**	**28,609**	**29,013**	**29,125**	**27,636**	**27,319**	**27,657**	**28,073**	**416**

Fig 5: OPEC monthly report Feb 2014; OPEC production from secondary sources and from direct communication.

OPEC members do not reveal their true reserves data because of the quotas issue, and likewise are not reliable on their production data for different reasons. OPEC monthly report trusts more the production data from secondary sources than the data from direct communications from their members. For example, for January 2014, Venezuela and Iran each reports 0.5 Mb/d more production than the scout data.

For homogeneous analysis of oil production it is thus necessary to use data from a single source. For this the US DOE/EIA is the most reliable and friendly source, despite their many problems, in particular very slow reporting (the EIA has had some budget cuts, and claim that they will stop reporting international data), which, if true, will be a great loss to the energy analysis community.

Oil production from the world excluding the US, from EIA data for the period 1900 to September 2013 displays a small first peak in 1973 (the first oil price shock), a larger peak in 1980 (following the second price shock), then a trough through to 1985, then a fairly steep rise up to 2005, and – as mentioned - a bumpy plateau since, in particular for crude oil + condensate.

US crude oil + condensate production peaked in 1970, followed by a decline slowed by Alaska production, and since 2009 a rise due to a combination of some recent deepwater fields coming on-stream plus shale oil (now called light-tight oil, or LTO) production.

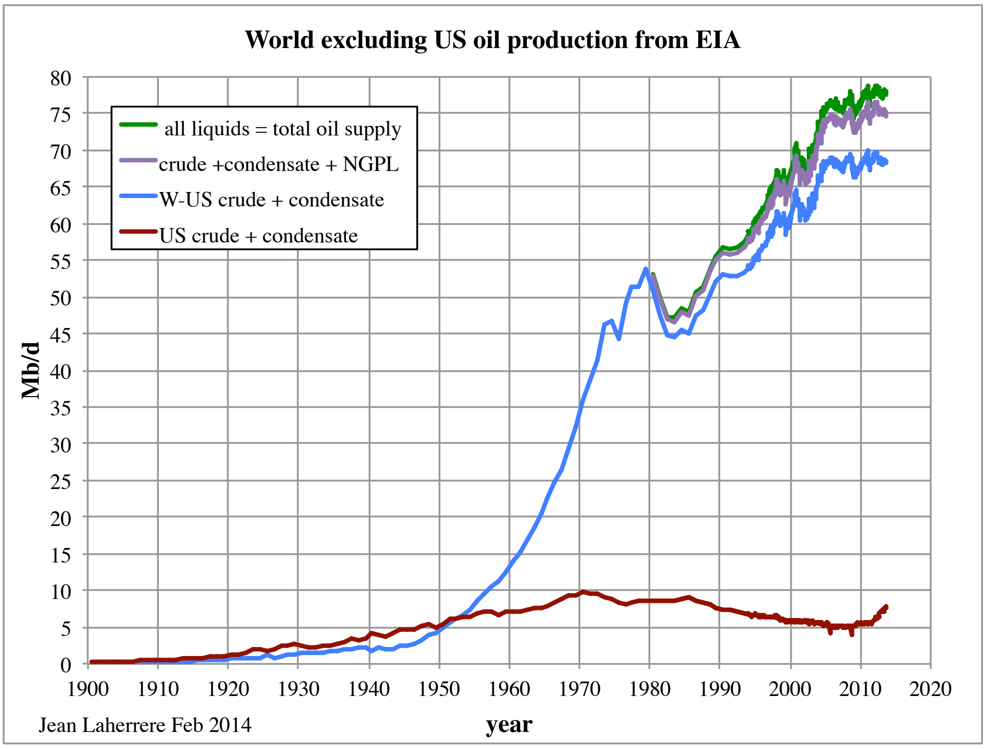


Fig 6a: "World excluding US" oil production (and US production) from EIA 1900-Sept 2013

Fig 6b displays the same plot as Fig 6a but with a larger scale for the period 1995-Sept 2013. The bumpy plateau is just a little eroded by the financial 2009 crisis, showing no sign of increase. The recent increase in the total world oil production comes mainly from the US and the LTO. The question is how long is the LTO bubble?

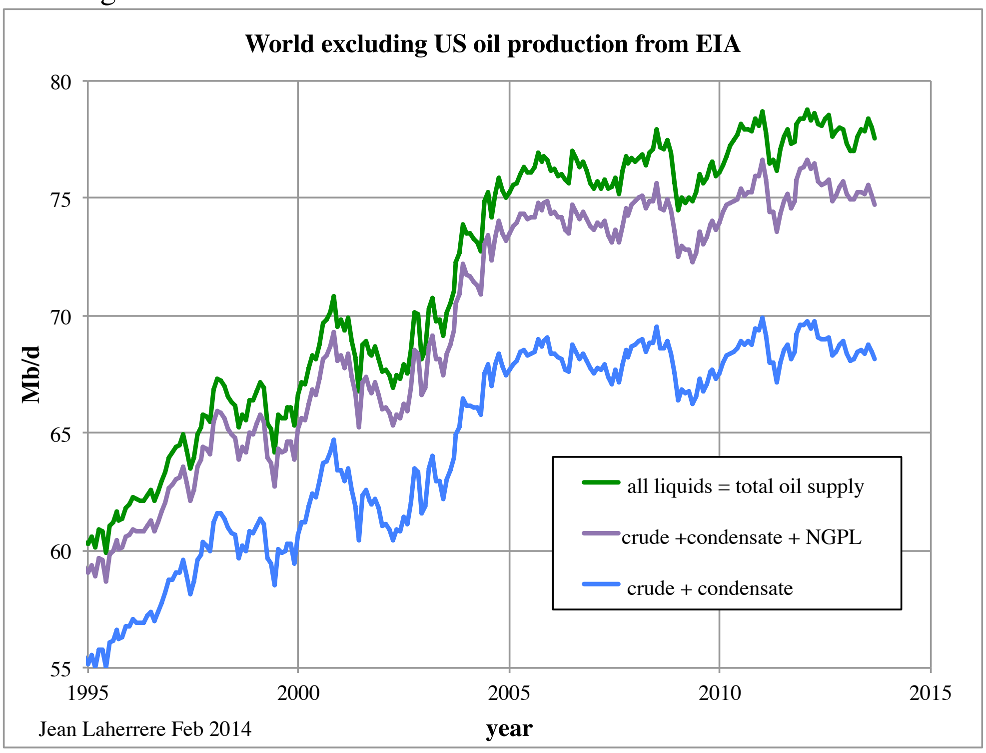


Fig 6b: World excluding US oil production from EIA 1995-2013

Now I turn to forecasts. Fig. 7 compares the AEO 2014 forecast for US crude oil + condensate production with my own forecast for the same components, modelled assuming an ultimate of 270 Gb. As can be seen, my forecasts have roughly the same date as AEO's for the US 'second peak, but at a considerably lower level, and also a much more rapid decline in production thereafter.

The figure also shows other AEO forecasts of various dates and components. Note that there was a big increase from the AEO 2012 forecast (peak 2020 at 6.6 Mb/d) to the AEO 2014 forecast (peak in 2019 at 9.5 Mb/d); and compare to my forecast in 2019 of 7.5 Mb/d.

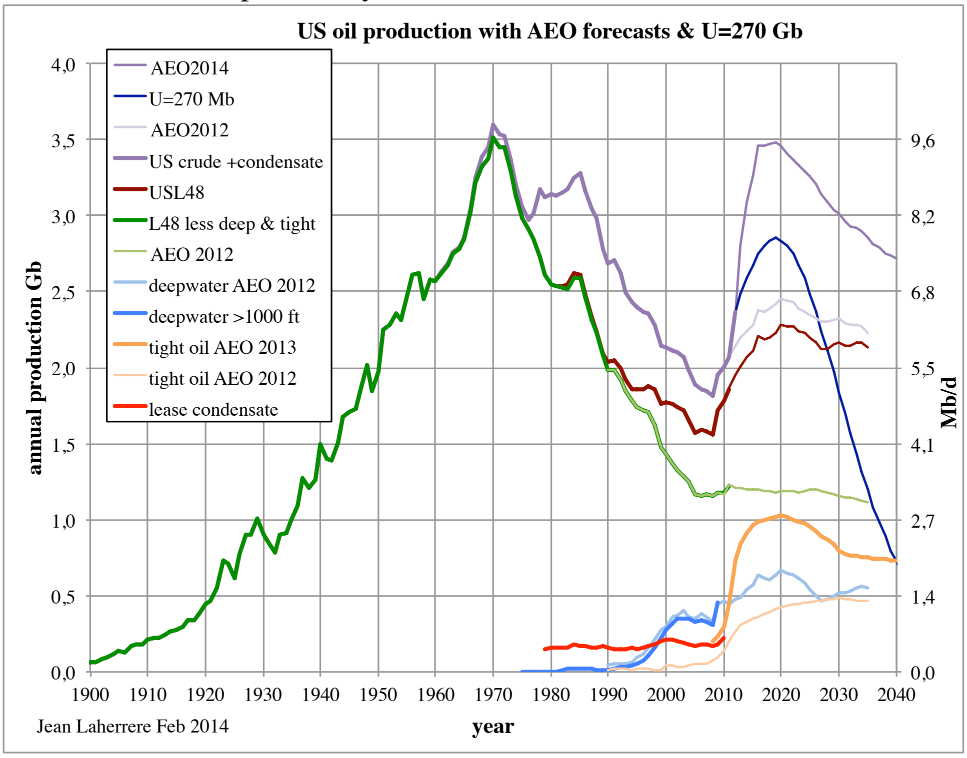


Fig 7: US oil production with AEO forecasts & U=270 Gb

The US crude oil + condensate estimate of ultimate of 270 Gb that I use is the extrapolation of the creaming curve from the only EIA report giving backdated discoveries, which is DOE/EIA-0534 1990 (the first and the last of a series of periodic EIA report reporting historical discoveries close to 2P from 1900 to 1988 by states). Attanasi & Root published in 1994 an updated version up to 1991. But this was the last time. Note that the Canadian Association of Petroleum Producers CAPP used to report backdated reserves by discovery year, but stopped doing so, possibly because of my 2011 presentation at ASPO Brussels which showed that extrapolation of discovery generated more pessimistic data than reflected in current reserves. For the US, the ‘creaming curve’ (i.e., the cumulative backdated discovery versus the cumulative number of new fields wildcats) can be modelled well with 3 hyperbolas; 1900-1968 = US L-48; 1968-1990 = Alaska; and 1990-2012 = deepwater and LTO; with the total of these curves trending towards an ultimate of 270 Gb, as shown in Fig. 8.

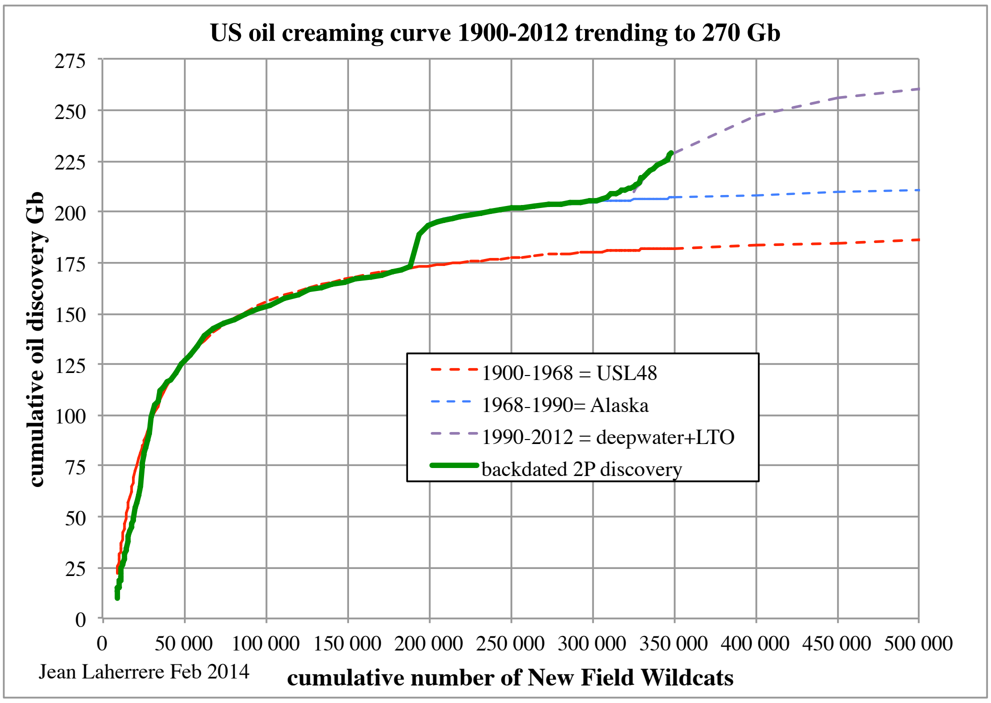


Fig 8: US oil creaming curve 1900-2012 trending towards an ultimate of 270 Gb

The US cumulative oil production plus 1P reserves (thick blue curve) in Fig. 9 has been extrapolated by a logistic model (thin blue line) to generate an estimated ultimate of 270 Gb. In 2010 the thick blue line coincides with the dark green line, which is the cumulative 2P backdated discovery, and its trend also supports the estimated ultimate. This dark green curve has then also been shifted by 33 years to generate the lighter green line, which coincides with the cumulative production (brown line) to 2012,

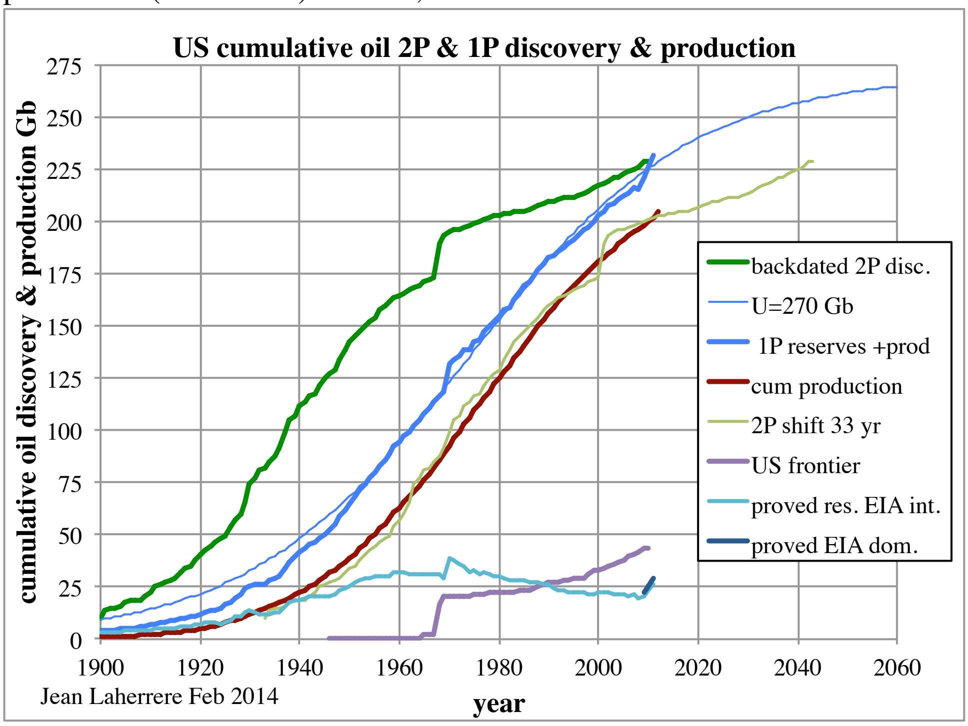


Fig 9: US oil cumulative crude oil discovery and production for an ultimate of 270 Gb

Thus while the estimate of the US crude oil +condensate ultimate of 270 Gb in Figs. 8 & 9 is uncertain (perhaps with a +/- 10% uncertainty?), it has been obtained by two independent approaches.

Now I look specifically at US LTO production. It seems that the US increase in LTO production could end soon, in particular for the Bakken. The other LTO regions are Eagle Ford and now the Permian Basin where prior production is now classified as LTO, whereas before it was called conventional.

The Bakken of North Dakota production has indeed exhibited a sharp increase, but a Hubbert linearization of the last two years' production trends towards an ultimate of 2.5 Gb. (Note that we do not trust the USGS estimate of undiscovered, because it is done without any connection with past discoveries and production). This value leads to a peak in 2015, for a production around 1 Mb/d (see Fig. 10). In fact peak did occur in November 2013 at 0,9 Mb/d, but this is partly due to poor weather in December!

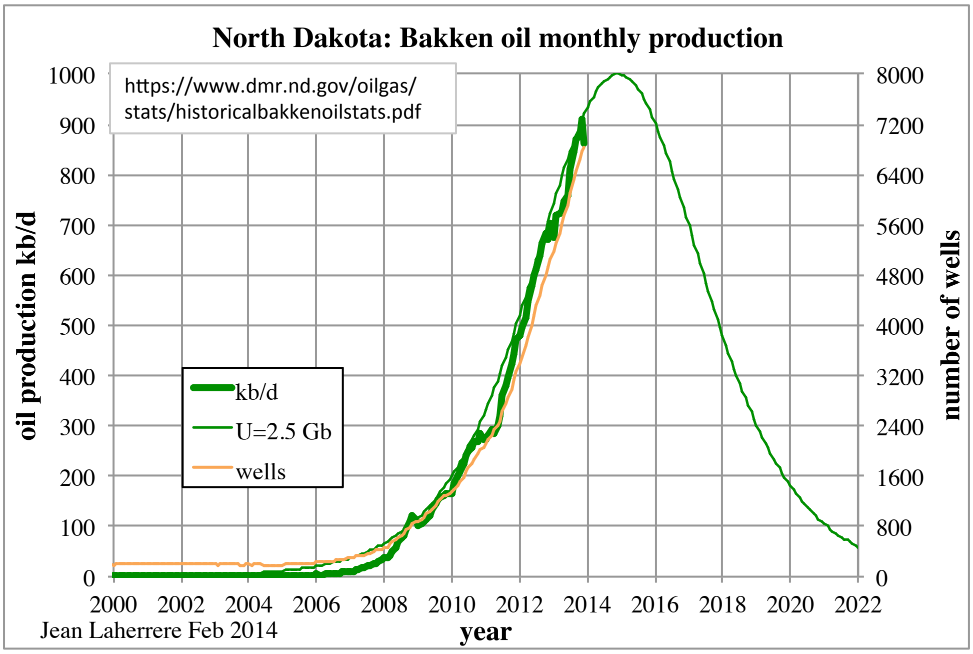


Fig 10: North Dakota: Bakken oil monthly production modelled with an ultimate of 2.5 Gb

Another approach to estimate this ultimate is to correlate production and number of rigs (Fig. 11). Here we assume that the best fit is to shift the number of rigs by 20 months (as fracturing is done several months after drilling, and presently there are close to 500 wells in North Dakota waiting to be fractured. This correlation forecasts a production peak in 2015, at around 1 Mb/d, in agreement with Fig. 10.

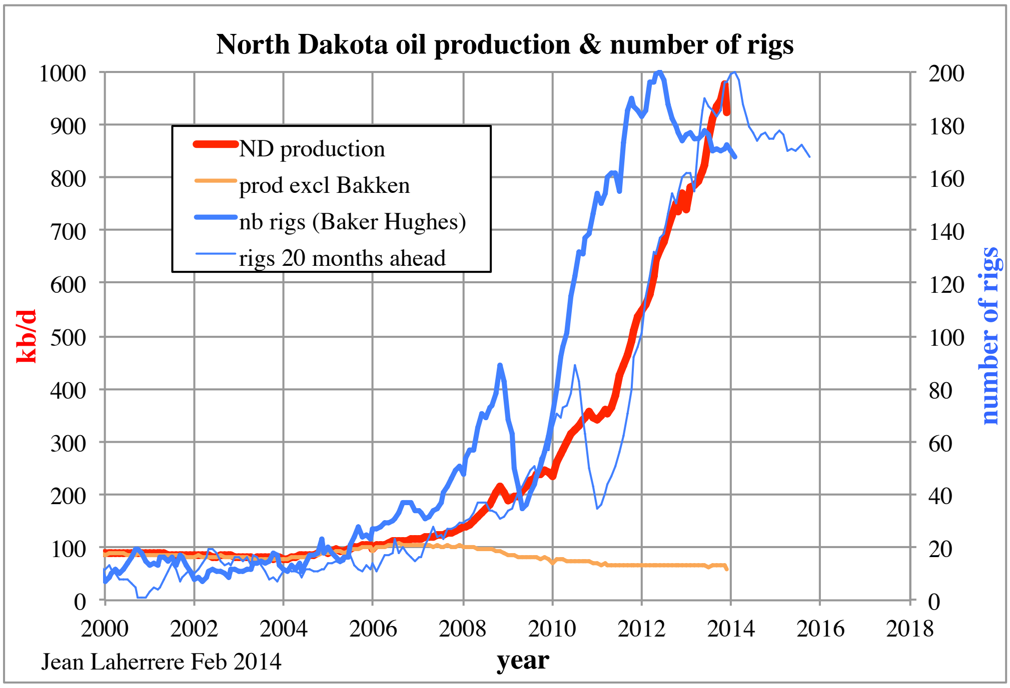


Fig 11: North Dakota production and number of rigs
Now I turn to forecasts of the world 'all-liquids' annual production (based on EIA data), as shown in Fig. 12, and compare my forecast with those of the USDOE EIA, the IEA, and OPEC.

My forecast is modelled using several ultimates estimated from extrapolation of cumulative discoveries (creaming curve) or cumulative production. The first ultimate is for 'crude oil less extra heavy' at 2200 Gb, giving a peak in 2010. The second is for extra-heavy at 500 Gb, giving a peak in 2070. The third for NGLs at 300 Gb, is for a peak in 2025. A fourth ultimate refers to refinery gain of 70 Gb (3% crude -XH). A fifth and final contribution covers 'other liquids' (mainly biofuels). Here an 'ultimate' is not appropriate (being renewable), but instead an asymptote is set at 5 Mb/d.

These assumptions generate a global all liquids peak in around 2016, at around 90 Mb/d.

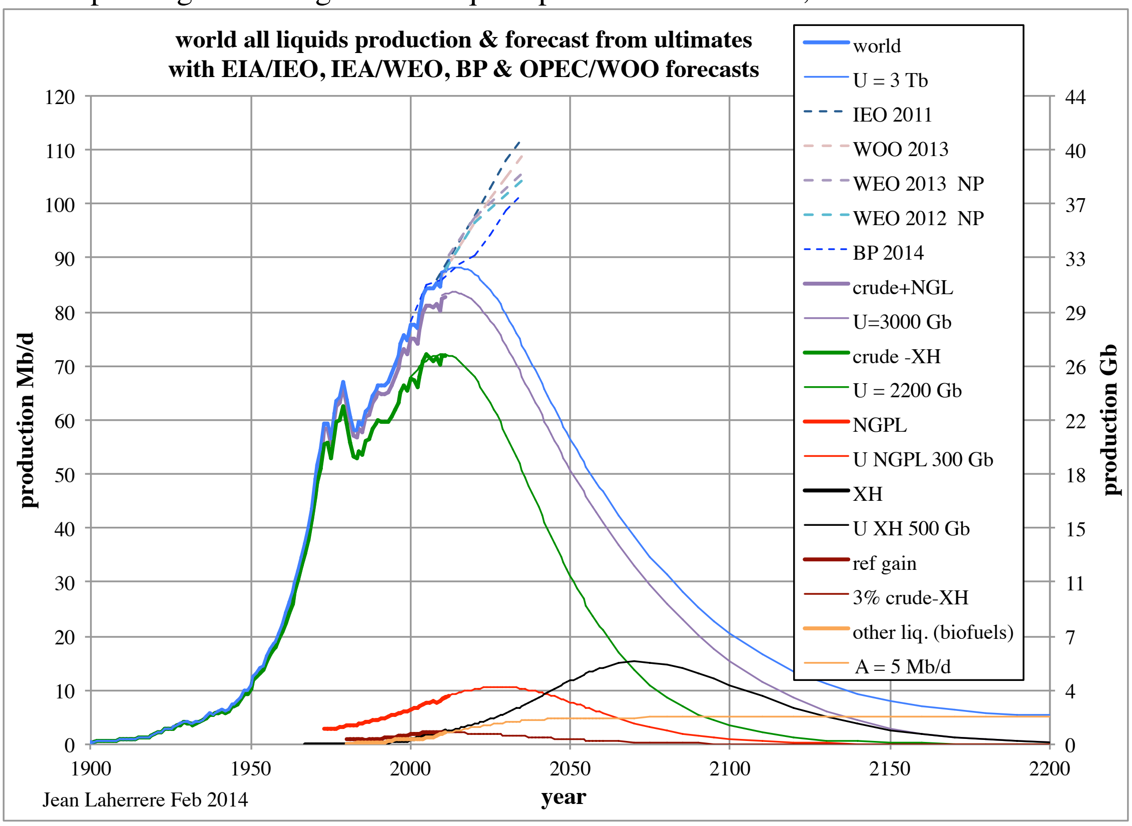


Fig 12: World oil all liquids production & forecasts from EIA/IEO, IEA/WEO, OPEC/WOO, BP/EO and from my ultimates

(c)-Units of measurements

Finally in this in introduction, I discuss units of measurement. As is well known, it is a must for every scientist to use the same language for describing numbers. This was the goal of the metric system, now called System International of Units (SI), which is compulsory of every country except US non-federal, Liberia and Myanmar!
The main problem is not the barrel or the cubic feet, but the use of symbols for prefixes.
Elsevier is a European company and the SI rules the European Union.
Another problem of vocabulary is that:
-US billion is thousand millions = 10^9, when SI billion is square million = 10^{12}
-US trillion is thousand billions = 10^{12}, when SI trillion is cubic million =10^{18}
but symbol of US trillion corresponds to prefix tera = T = 10^{12}
It is thus a pity to see that million can be written MM and also m when it should be M
It is a pity to also see confusion to speak about billion of cubic meters between km^3 and Gm^3
A US billion cubic meter is bcm = 10^9 m^3 in US but in SI it is a km^3, or $G.m^3$, when Gm^3 =10^{27} m^3
So I use Mb, Gb, Gcf, Tcf, G.m3 in my graphs

B. Comments on relevant papers in the Energy Policy special issue, January 2014 : 1-s2.0-S030142151300xxx-main

Note: Not all papers are commented upon, and these comments are not intended to be exhaustive. They are just remarks that occurred to me as I was reading through the papers. Some of these remarks may not in fact be correct, and they are offered simply to suggest ideas or topics that the various authors might want to consider in future publications.

1200986X
Long term building energy demand for India: Disaggregating end use energy services in an integrated assessment modeling framework
Vaibhav Chaturvedi Jiyong Eoma, Leon E. Clarke , Priyadarshi R. Shukla
H I G H L I G H T S
-Building sector final energy demand in India will grow to over five times by century end.
-Space cooling and appliance services will grow substantially in the future.
-Energy service demands will be met predominantly by electricity and gas.
-Urban centers will face huge demand for floor space and building energy services.
-Carbon tax policy will have little effect on reducing building energy demands

Not commented upon.

1300342X
The end of Peak Oil? Why this topic is still relevant despite recent denials
Ian Chapman Business School, University of Cumbria, Carlisle, United Kingdom
H I G H L I G H T S
Key advocates/opponents of Peak Oil reveal their biases.
Reserve calculation methods are considered, showing flaws.
Non-conventional oils' viability is critiqued and found wanting.
Alternative fuels are found to be unsuitable substitutes for oil.
Demand increases add to the potential for fuel shortages.

Comment: This is a useful paper, but it confuses probable = P50 = 2P and possible = P10 = 3P, in terms of reserves definition (see the Introduction, above).
See also: http://www.hubbertpeak.com/laherrere/ShellDecline2004.pdf
The history of reserves definitions is as follows;
-1936 API reserves definitions with proved reserves
-1961 API-AGA: Proved = "beyond reasonable doubt"
-1964 API, SPE « reasonable certainty »
-1975 USGS McKelvey classification of resources
-1978 SEC-FASB: Proved = "with reasonable certainty"
-1979 Khalimov: Russian classification A+B+C1 reserves reported to be equivalent to proved reserves, despite a different determination
-1979 McKay Esso: Proved (P) = probability 95 %; Proved + Probable (2P)= 50%; Proved + Probable + Possible (3P) = 5% , but minimum =99%, most likely =50%, maximum =1%
-1980 AAPG, SPE and API use SEC definitions
-1983 WPC (Martinez) Proved = "reasonable certainty" or 90% probability
-1985 Grossling: expected value = 2.3 Proved for Non-OPEC; 1.5 Proved for OPEC
-1985 Bourdaire: Proved (P) = 95% (minimum); 2P = mode (most likely); 3P = 5% (maximum); mean = "expected value" = Proved + 2/3 Probable + 1/3 Possible
-1987 definitions WPC (Martinez) Proved = 85%-95% Probability = "high degree of certainty"
-1990 Laherrère: Proved (P) = 85%-95%; 2P = 50%; 3P = 5%-15%
-1991 Caldwell proposes that "reasonable certainty" equates with a 75% probability, between Proved and Probable
-1991 SPE refuses to adopt the probabilistic approach
-1993 DeSorcy: Proved = 80% probability; Probable = 40%-80% probability; Possible = 10%-40%; "Expected Reserves" = Proved + 0.6 Probable + 0.25 Possible; "Established Reserves" = Proved + 0.5 Probable –
-1993 Khalimov: Russians reserves are « grossly exaggerated » because they are based on a maximum theoretical recovery.
-1994 Ross: Proved = 75% probability
-1994 NPD drops Proved, Probable and Possible in favour of 90%; 50% (called Most Probable?), 10% and defines 7 classes of resources
-1994 PDVSA (Roger) uses a probabilistic range of 80-50-20%
-1995 SPE/WPC task force on reserve definition headed by A. Martinez (I was a member) proposes a hybrid system whereby the Determinist terms are defined as follows: Proved = "reasonable certainty", but also having a "high degree of confidence"; Probable = "more likely than not"; Possible = "less likely than not"; and the Probabilistic terms are defined as follows: Proved (1P) = 80-85% probability; Proved + Probable (2P) = 40-60% probability; and Proved + Probable + Possible (3P) = 15% probability
-1997 SPE/WPC final text for probabilistic reserves: 1P = 90%, 2P=.50%, 3P=10% and Martinez approaches the SEC to adopt probabilistic approach (without success). Resources are not mentioned.
-2000 SPE/WPC/AAPG definitions of resources (contingent & prospective)
-2003 Canada National Instrument 51-101 obliges to report proved as 90 % and 2P as 50%, 3P is optional
-2004 International Accounting Standards Board (in UK) project to publish rules to be adopted by SEC, but date of completion likely after 2007.

1300493X
Some inconvenient these
H I G H L I G H T S
Ted Trainer Social Sciences, University of N.S.W. Australia
The assumption that energy problems can be solved sustainably is challenged.
Selected areas of difficulty are briefly discussed, including limits to renewable energy.

It is asked whether abundant energy would be desirable.
A low energy "Simpler Way" is sketched.

Not commented upon.

949X
Forecasting global developments in the basic chemical industry for environmental policy analysis
M.L.M. Broeren , D. Saygin, M.K. Patel Utrecht University,
H I G H L I G H T S
We develop a global cost-driven forecasting model for the basic chemical sector.
We study regional production, energy-efficient technology, emissions and policies.
Between 2010 and 2030, 60% of new chemicals capacity is built in non-OECD regions.
Global CO2 emissions rise by 50%, but climate policies may limit this to 30–40%.
Measures beyond energy efficiency are needed to prevent increasing CO2 emissions.

Not commented upon.

952X
Demarketing fear: Bring the nuclear issue back to rational discourse
Charles C.Han Tamkang University, Taiwan
H I G H L I G H T S
Both cognition and emotion are critical in decision-making processes.
Dealing with the emotion of fear is essential for resolving the nuclear issue.
Fear should be mitigated to make rational discourses on nuclear power happen.
Fear can be mitigated by manipulating issue familiarity and response feasibility.
Using equivalency and issue framing may alter public perceptions of nuclear power

Not commented upon.

966X
Un-burnable oil: An examination of oil resource utilisation in a decarbonised energy system
Christophe McGlade , Paul Ekins University College London
H I G H L I GHTS
We examine volumes of oil that cannot be used up to 2035 in a low CO2 energy system.
500–600 billion barrels of current 2P reserves remain unused.
At least 40–55% of yet to be found deep water resources must not be developed.
Arctic oil and most light tight oil resources remain undeveloped.
Unconventional oil production is generally incompatible with a low CO2 energy system.

Comments:
The authors present Table 1, that include the *BP Statistical Review* data for global 1P (proved) oil reserves. I reproduce their table here.

Table 1
Declared 1P reserves, 2P reserves and remaining ultimately recoverable resources of oil from a selection of countries and regions.

Country/Region	'Proved' reserves	2P reserves	Remaining URR	
			CO	UCO
Brazil	14	32	110	25
Canada	175	53	58	630
Mexico	12	12	80	0
Russia	87	96	280	190
Norway	7	11	36	0
UK	3	7	21	5
USA	31	50	180	650
Venezuela	297	85	80	420
Africa – OPEC	110	83	190	15
Africa – Other	23	28	100	50
Australia and New Zealand	4	6	33	130
Central and South America	325	136	290	450
China and India	21	38	90	110
CIS	126	152	360	360
Europe	14	25	110	35
Japan and South Korea	0	0	0	0
Middle East	766	689	1050	12
North America	218	115	320	1300
Other developing Asia	17	23	75	4
OPEC	1167	847	1270	470
Non-OPEC	455	448	1350	2000
OECD	235	143	390	1450
Non-OECD	1387	1150	2250	1000
Global	1622	1294	2620	2470

Note: CO is conventional oil and UCO unconventional oil. URR are the remaining ultimately recoverable resources as defined in the text. All figures are from the authors (McGlade, 2013) except the 'proved reserves' which come from BP, 2012. Numbers are in billion barrels (Gb) and may not add due to rounding.

The authors need to warn readers that the arithmetic aggregation of proved reserves, as used for example in these BP 2012 data, is statistically incorrect, and hence largely underestimates the proved reserves values for many regions of the world. (But where these underestimates need to be set against the over-reporting of proved reserves in some important OPEC countries, and the non-reporting of annual proved reserves changes in many countries, that bedevil these data.)

IPCC 40 SRES scenarios were designed in 1997 and are storylines for the past (1990 & 2000) and the future to 2100"

They should mention that it is not known if CCS can operate on the size of world carbon emissions in 2030 (LCS), but what is certain is that CCS will increase energy consumption by 25-30 %

In my view, their forecast on 500 Gb of oil non produced in 2035 in a low CO2 scenario to stay below +2°C is pure wishful thinking. In Canada, people will prefer to have a high CO2 than to freeze to death!

I reproduce below the authors' charts for Canada:

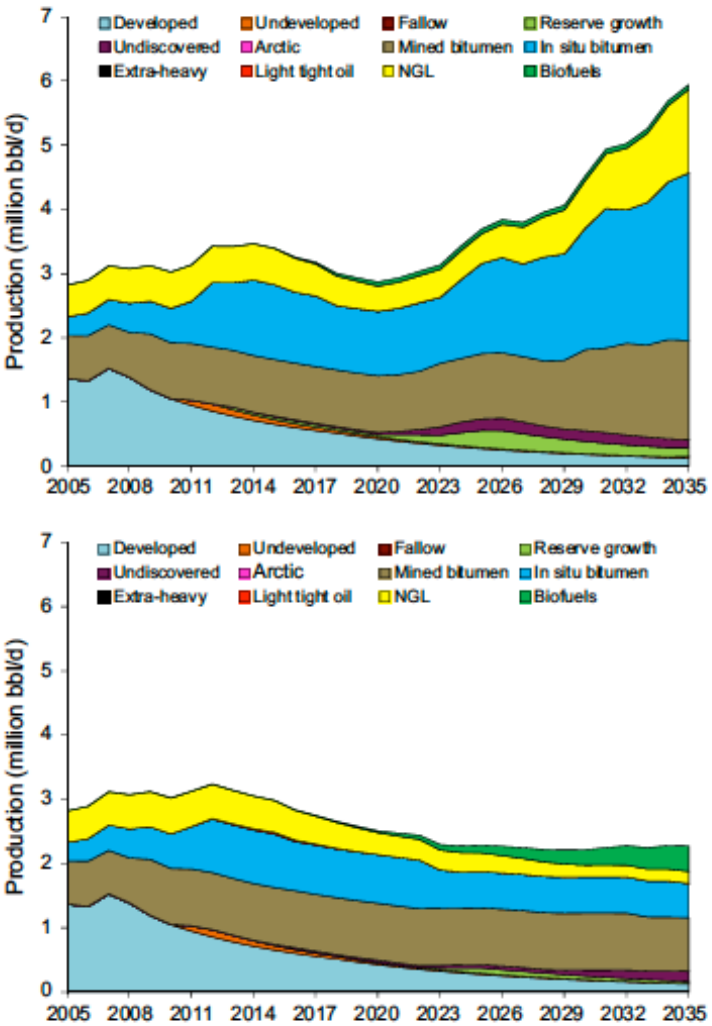


Fig. 5. Production in Canada in the LCS (top) and LCS-noCCS (bottom) scenarios split by category.

McGlade estimates in 2012 the global shale (light-tight) oil central estimate of recoverable resource at 278 Gb. In terms of current discussion of this issue, it is worth noting that this value is smaller than Al-Husseini's quote of 'speculative resources' for OPEC proved reserves increases of 300 Gb!

3856
EROI of different fuels and the implications for society
Charles A.S. Hall, Jessica G. Lambert, Stephen B. Balogh State University of New York,
H I G H L I G H T S
For nations examined, the EROI for oil and gas has declined during recent decades.
Lower EROI for oil may be masked by natural gas extracted/used in oil production.
The EROI trend for US coal is ambiguous; the EROI for Chinese coal is declining.
Renewable energies lack desirable fossil fuel traits, including often higher EROI, but create fewer pollutants.
Declines in EROI of main fuels have a large impact on economies.

Comment: In the authors' table of EROI data (reproduced below), there is no measure of the uncertainty of the EROI data. There are many references to data uncertainty in the text, and the authors probably need to add a footnote to the table on this, so people do not simply reproduce this table without suitable caveats.

Table 1
Published EROI values for various fuel sources and regions (adapted from Murphy et al. (2011)).

Resource	Year	Country	EROI (X:1)[1]	Reference
Fossil fuels (Oil and Gas)				
Oil and gas production	1999	Global	35	Gagnon, 2009
Oil and gas production	2006	Global	18	Gagnon, 2009
Oil and gas (Domestic)	1970	US	30	Cleveland et al. 1984, Hall et al. 1986
Discoveries	1970	US	8	Cleveland et al. 1984, Hall et al. 1986
Production	1970	US	20	Cleveland et al. 1984, Hall et al. 1986
Oil and gas (Domestic)	2007	US	11	Guilford et al. 2011
Oil and gas (Imported)	2007	US	12	Guilford et al. 2011
Oil and gas production	1970	Canada	65	Freise, 2011
Oil and gas production	2010	Canada	15	Freise, 2011
Oil, gas & tar sand production	2010	Canada	11	Poisson and Hall, in press
Oil and gas production	2008	Norway	40	Grandell, 2011
Oil production	2008	Norway	21	Grandell, 2011
Oil and gas production	2009	Mexico	45	Ramirez, in preparation
Oil and gas production	2010	China	10	Hu et al. 2013
Fossil fuels (Other)				
Natural Gas	2005	US	67	Sell et al. 2011
Natural Gas	1993	Canada	38	Freise, 2011
Natural Gas	2000	Canada	26	Freise, 2011
Natural Gas	2009	Canada	20	Freise, 2011
Coal (mine-mouth)	1950	US	80	Cleveland et al. 1984
Coal (mine-mouth)	2000	US	80	Hall and Day, 2009
Coal (mine-mouth)	2007	US	60	Balogh et al. unpublished
Coal (mine-mouth)	1995	China	35	Hu et al. 2013
Coal (mine-mouth)	2010	China	27	Hu et al. 2013
Other non-renewables				
Nuclear	n/a	US	5 to 15	Hall and Day, 2009, Lenzen, 2008
Renewables[2]				
Hydropower	n/a	n/a	>100	Cleveland et al. 1984
Wind turbine	n/a	n/a	18	Kubiszewski et al. 2010
Geothermal	n/a	n/a	n/a	Gupta and Hall, 2011
Wave energy	n/a	n/a	n/a	Gupta and Hall, 2011
Solar collectors[2]				
Flat plate	n/a	n/a	1.9	Cleveland et al. 1984
Concentrating collector	n/a	n/a	1.6	Cleveland et al. 1984
Photovoltaic	n/a	n/a	6 to 12	Kubiszewski et al. 2009
Passive solar	n/a	n/a	n/a	Cleveland et al. 1984
Biomass				
Ethanol (sugarcane)	n/a	n/a	0.8 to 10	Goldemberg, 2007
Corn-based ethanol	n/a	US	0.8 to 1.6	Patzek, 2004, Farrell et al. 2006
Biodiesel	n/a	US	1.3	Pimentel and Patzek, 2005

(1) EROI values in excess of 5:1 are rounded to the nearest whole number.
(2) EROI values are assumed to vary based on geography and climate and are not attributed to a specific region/country.

4151
The European framework for energy and climate policies
Dieter Helm University of Oxford
H I G H L I G H T S
The design of the internal energy market.
The design of the climate change package.
The interaction between the internal energy market and the climate change package.
Required reforms.

Noted: European leaders "knew" that oil and gas prices would go ever upwards. Many of them believed in the "peak oil" theory.
Europe's energy and climate policies are going nowhere. They are achieving the remarkable consequence of driving up prices, driving down competitiveness and not making much difference to climate change. It is an unenviable record.

4163

Oil and natural gas prospects in South America: Can the petroleum industry pave the way for renewables in Brazil?

José Goldemberg a, Roberto Schaeffer b,n, Alexandre Szklo b, Rodrigo Lucchesi b
a Institute of Electrotechnics and Energy, University of São Paulo, Brazil
b Energy Planning Program, Graduate School of Engineering, Universidade Federaldo Rio de Janeiro, Brazil

H I G H L I GHTS

Nowadays, Brazil´s investments are concentrated in new frontier areas of the petroleum industry.
Rents from this industry can generate multiplicative effects into the country´s economy.
Part of these rents should be diverted to the promotion of renewable energy.
A major energy innovation program based on a target-oriented agency should be funded.
The security of ethanol fuel supply can be improved from these rents as well.

Noted the Brazil oil production forecast:

J. Goldemberg et al. / Energy Policy 64 (2014) 58–70

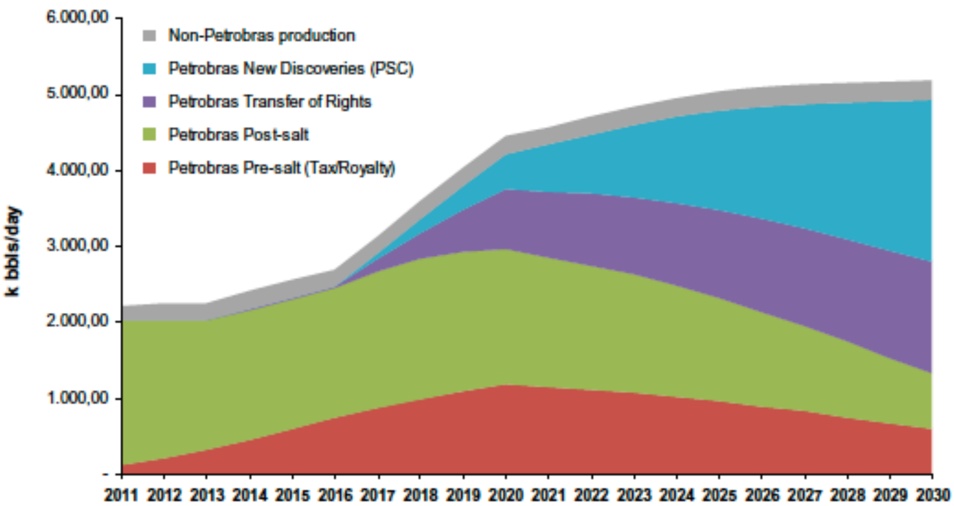


Fig. 5. Brazil's petroleum production forecast up to 2030.

4783

The economic growth enigma: Capital, labour and useful energy?

Robert Ayres, Vlasios Voudouris
INSEAD, France, Research Centre for Energy Management, ESCP Europe Business School London, ABM Analytics Ltd London

H I G H L I GHTS

Economic growth needs three factors of production.
We propose a semi-parametric generalized production function.
Exploitation of inexpensive fossil fuel resources has profound policy implications.

This paper does not say where to find reliable historical data on useful energy for every country? This paper displays graphs of capital, labour & useful energy for UK, Japan and US with 1900 = 1 as follows:

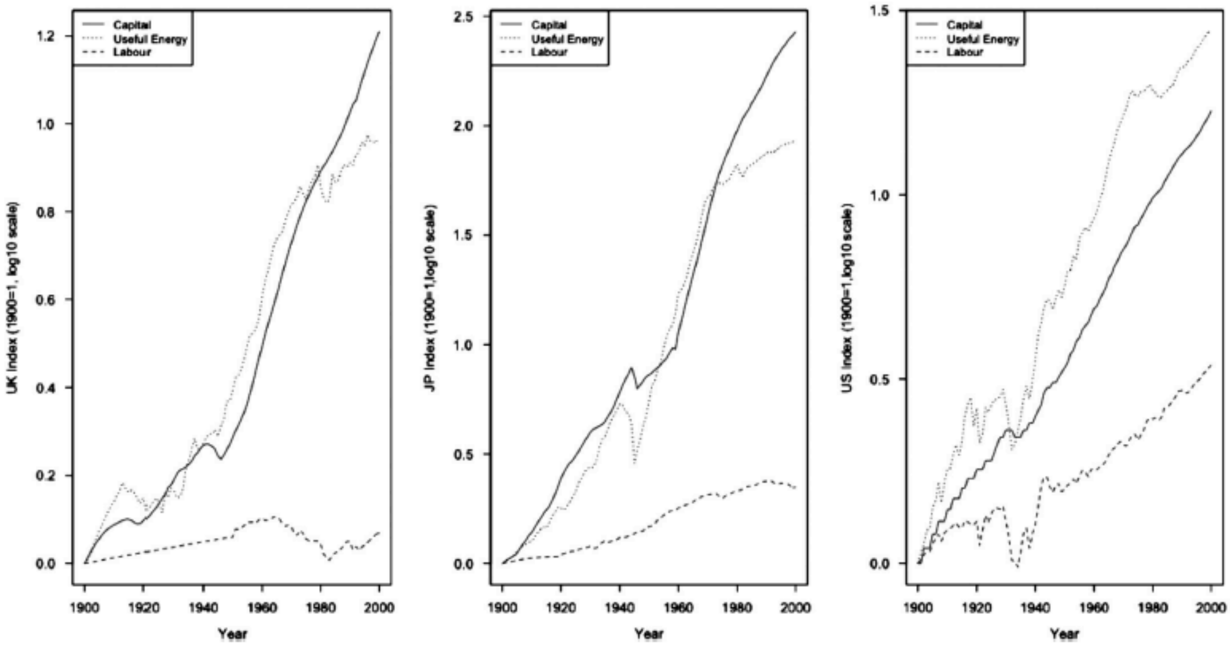


Fig. 9. Capital (solid line), labour (dashed line) and useful energy (dotted line).

It is not clear about the difference between useful energy and exergy. I found exergy data in "Energy Use and Economic Development: A comparative analysis of useful work supply in Australia, Japan, the United Kingdom and the US during 100 years of economic growth" 2010 by Benjamin Warr, Robert Ayres, Nina Eisenmenger, Fridolin Krausmann, Heinz Schandl

I compare for UK their graph (log scale) with GDP, primary energy consumption and exergy from Warr et al: capital and GDP (blue) are similar but useful energy is quite different after 1920 from primary energy (green) and exergy (blue): Why is this?

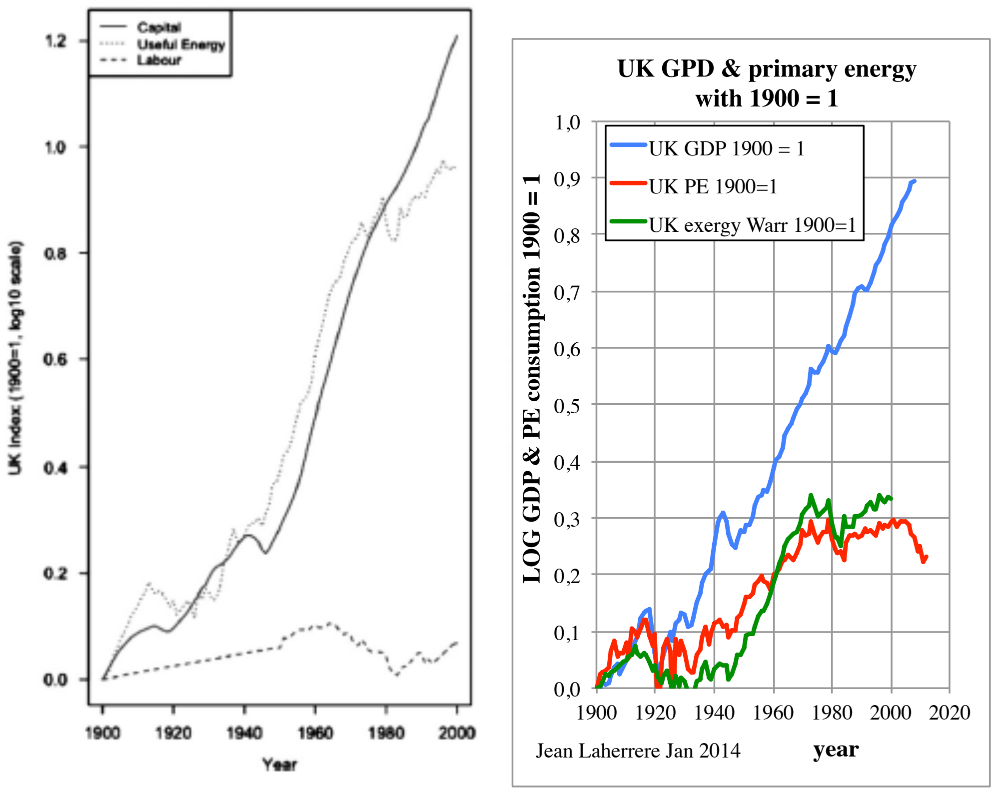


Fig 11: UK 1900=1: capital, useful energy, labour compared to GDP, primary energy & exergy (log scale)

And here is the aame comparison for US:
Capital and GDP are similar but again useful energy differs with exergy and primary energy consumption: why?

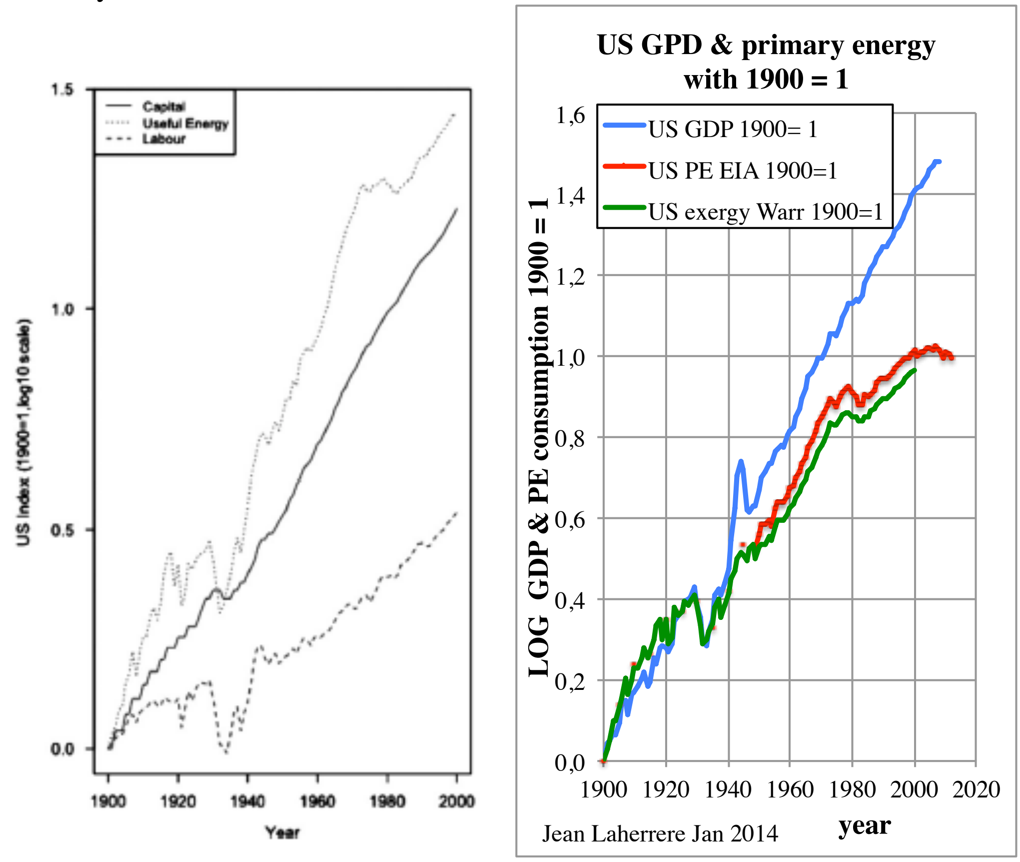


Fig 12: US 1900=1: capital, useful energy, labour compared to GDP, primary energy & exergy (log scale)

The same comparison for Japan, but I did not find primary energy consumption starting in 1900
Capital (2.4 in 2000) is higher than GDP (1.7 in 2000), and useful energy (1.9) is higher than exergy (1.3)

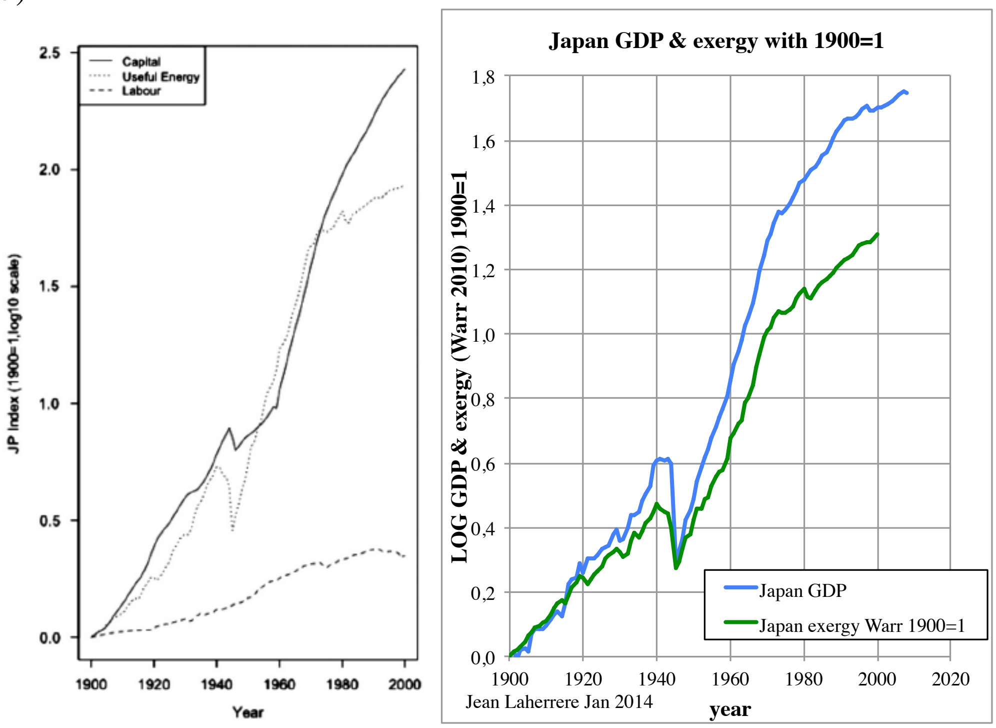


Fig 13: Japan 1900=1: capital, useful energy, labour compared to GDP & exergy (log scale)

The previous graphs were in log scale: the three countries exergy in normal scale display different behaviour! UK was already in 1900 an industrial country.

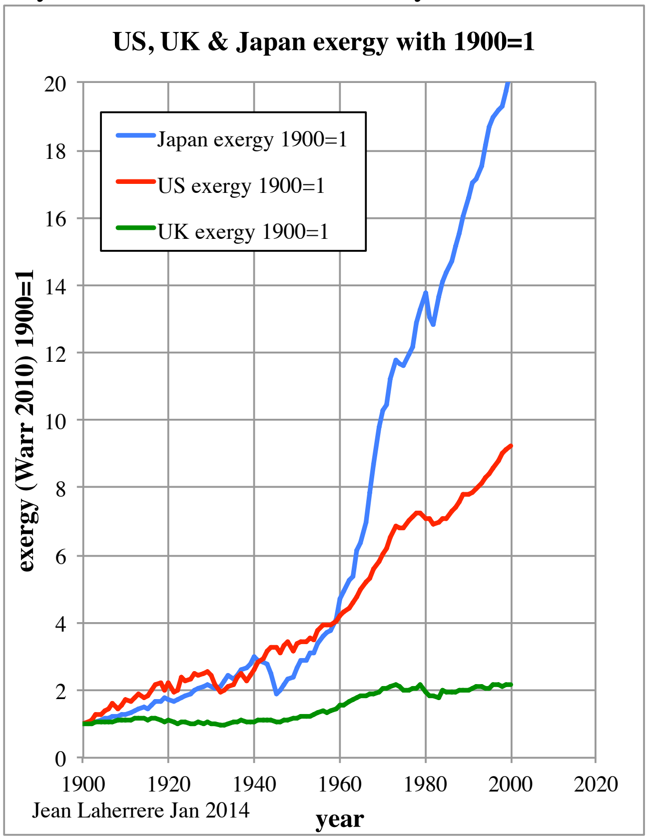


Fig 14: US, UK & Japan exergy (Warr) with 1900=1 in normal scale

Japan primary energy (EIA) in PJ = petajoules agrees with Warr's exergy supply

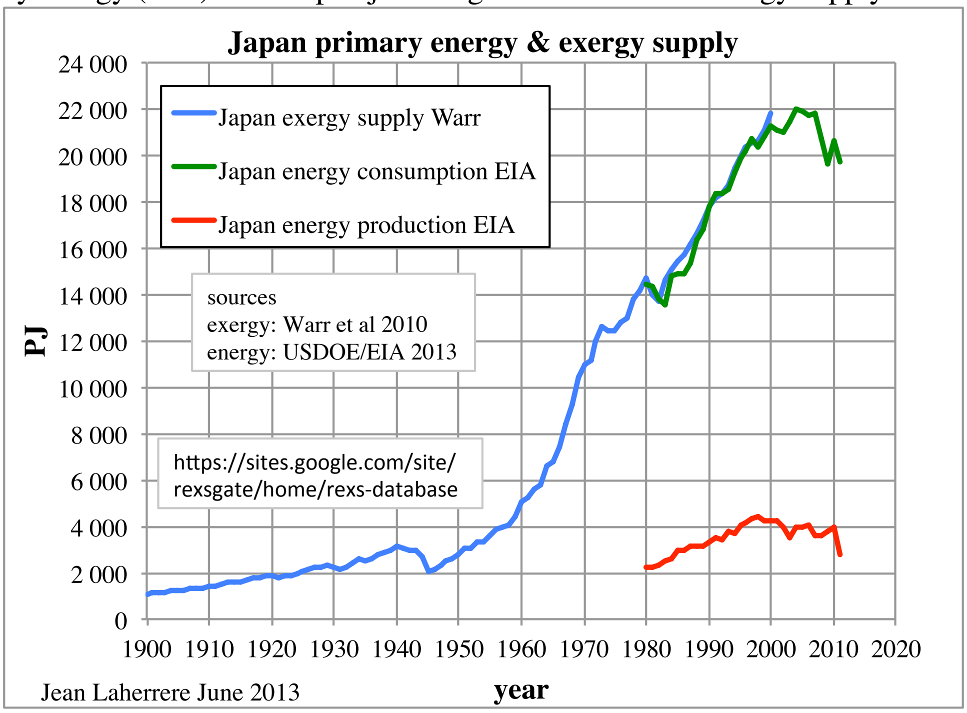


Fig 15: Japan primary energy & exergy supply

US primary energy consumption (EIA) is smaller than Warr's exergy?

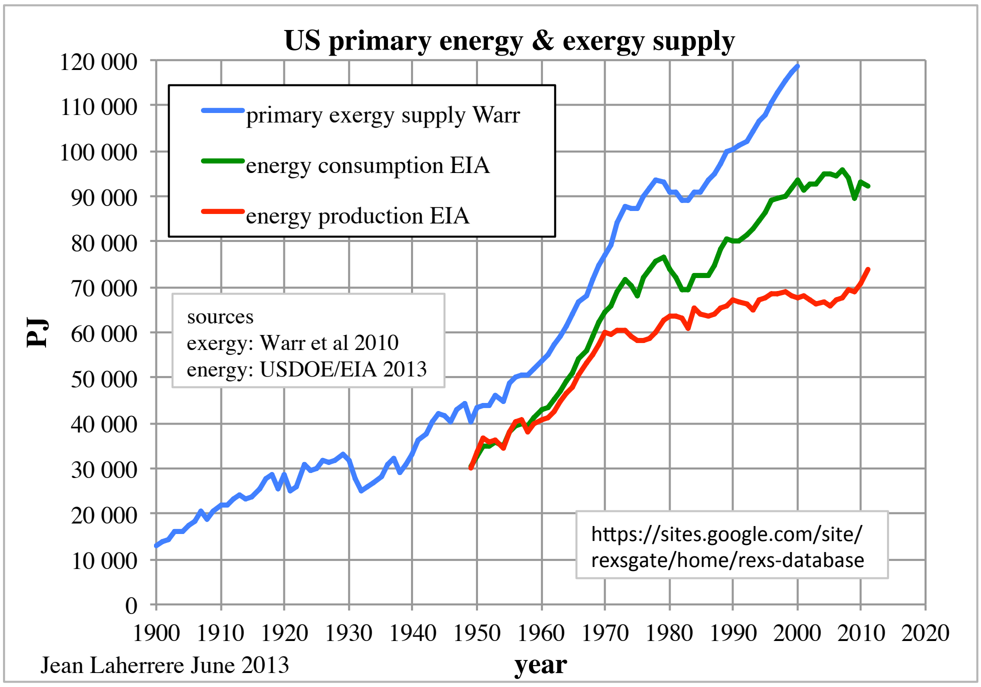


Fig 16: US primary energy & exergy supply

UK primary energy consumption (EIA) is smaller than Warr's exergy?

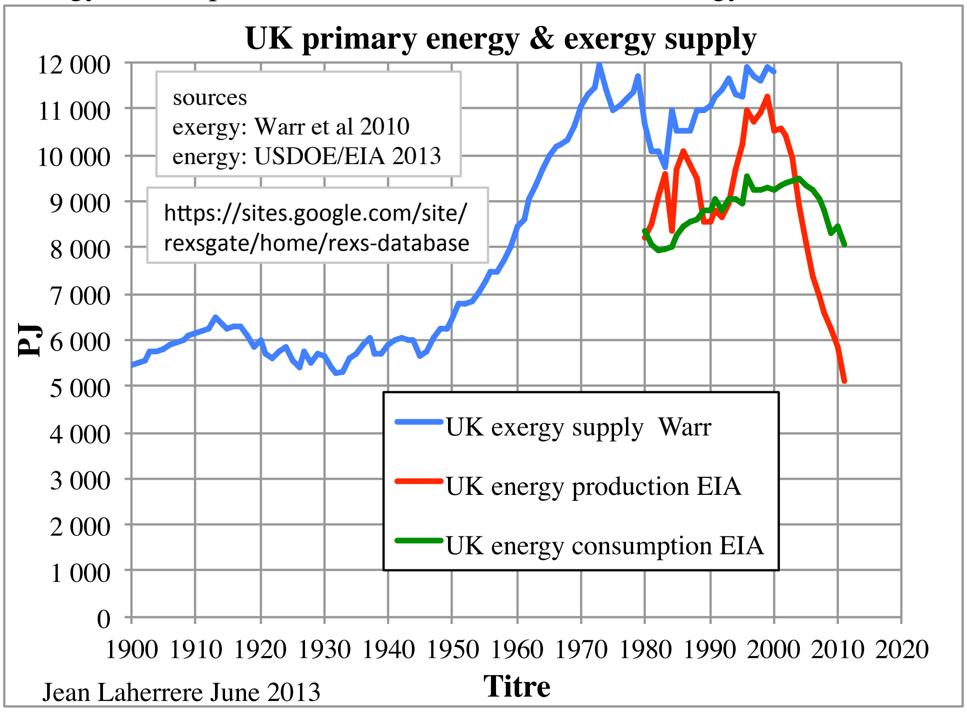


Fig 17: UK primary energy & exergy supply

Austria primary energy consumption (EIA) is smaller than Warr's exergy

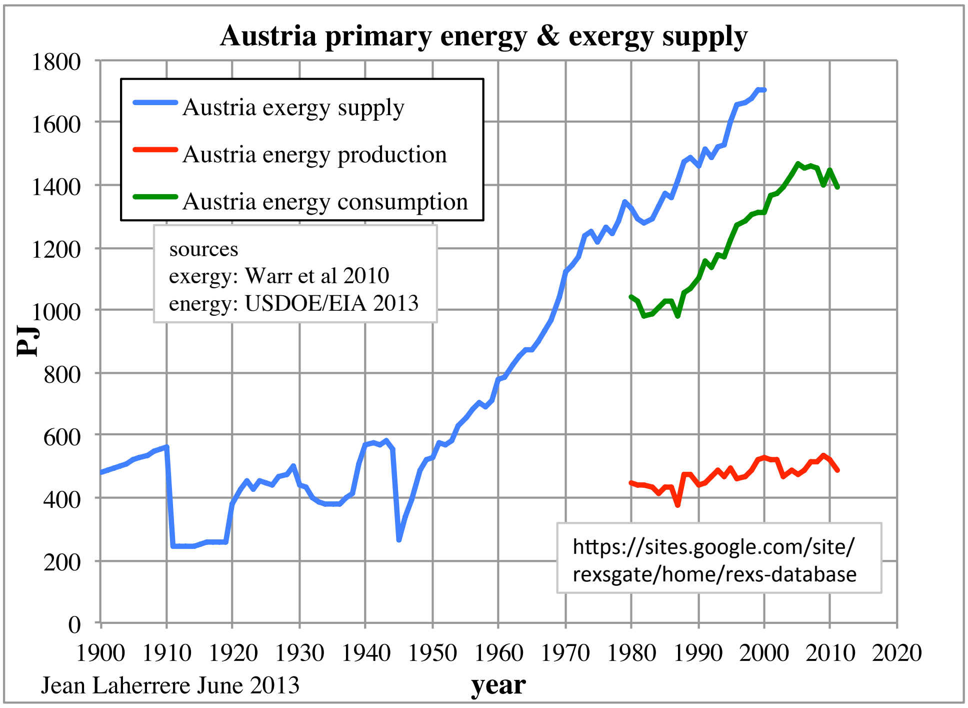


Fig 18: Austria primary energy & exergy supply

All the above graphs on energy, useful energy and exergy brings questions on the reliability of measures and on interpretation.

Ayres & Voudouris paper does not answer all these questions. But It has great merit to ask these questions.

The main problem is to obtain historical values per country of exergy (or useful energy): there is no such database: which organisation or personality can do so? Angus Maddison was able to establish a very reliable GDP & population historical database: where is the new Angus Maddison for exergy?

I found an interesting paper on UK energy consumption and GDP by Peter Pearson "Energy history, development and sustainability" ESS conference Tokyo December 2003. This displays interesting graphs on the UK, in particular Fig 4 (when will the linear decline 1910-2000 stop?) as follows:

Fig. 1: UK final energy consumption 1500-1800 (TWh)

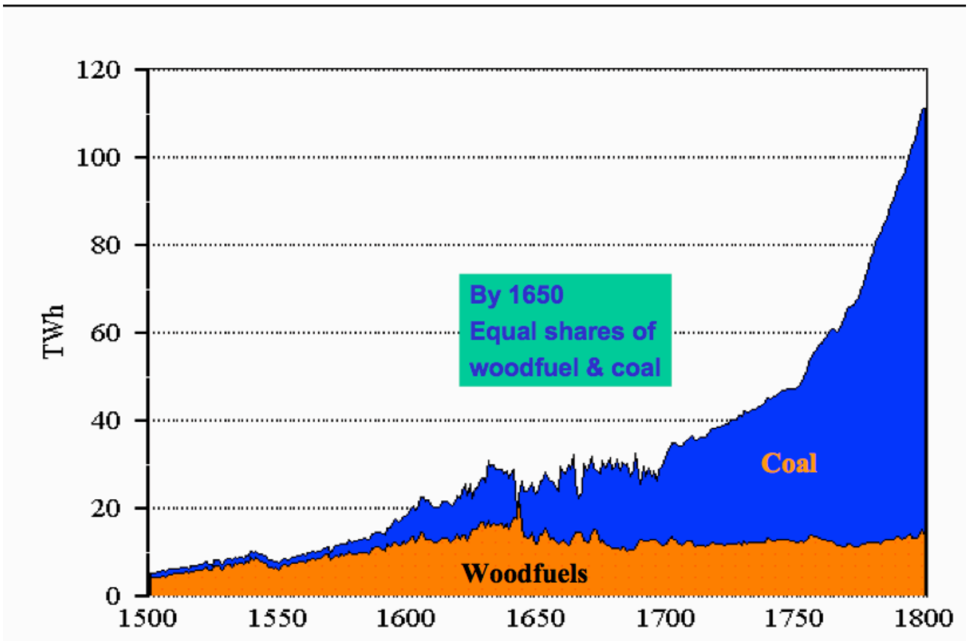


Fig. 2: UK final energy consumption, 1800-2000 (TWh)

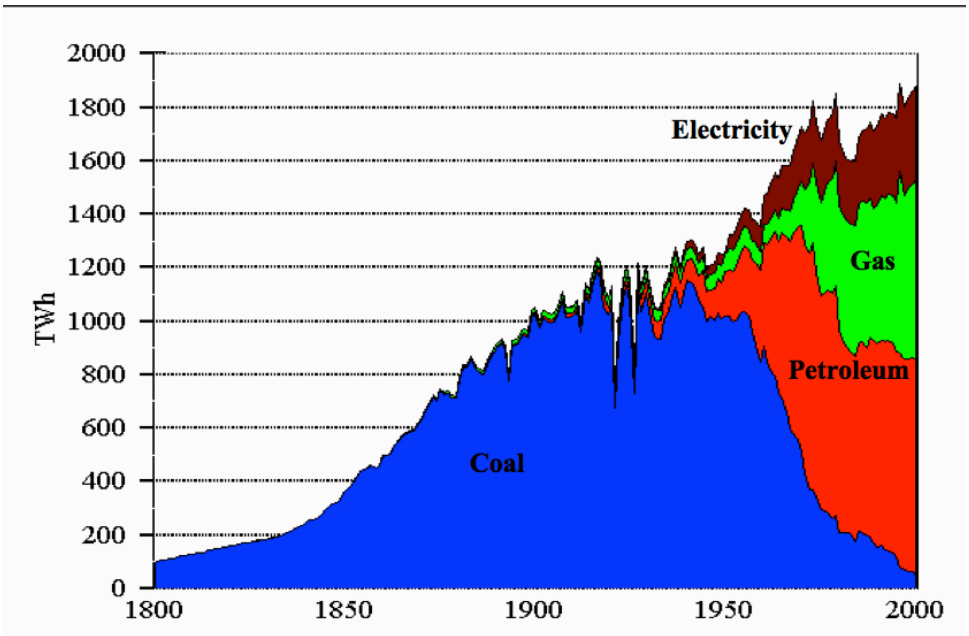


Fig. 3: UK Shares in final user fuel expenditure, 1500-2000

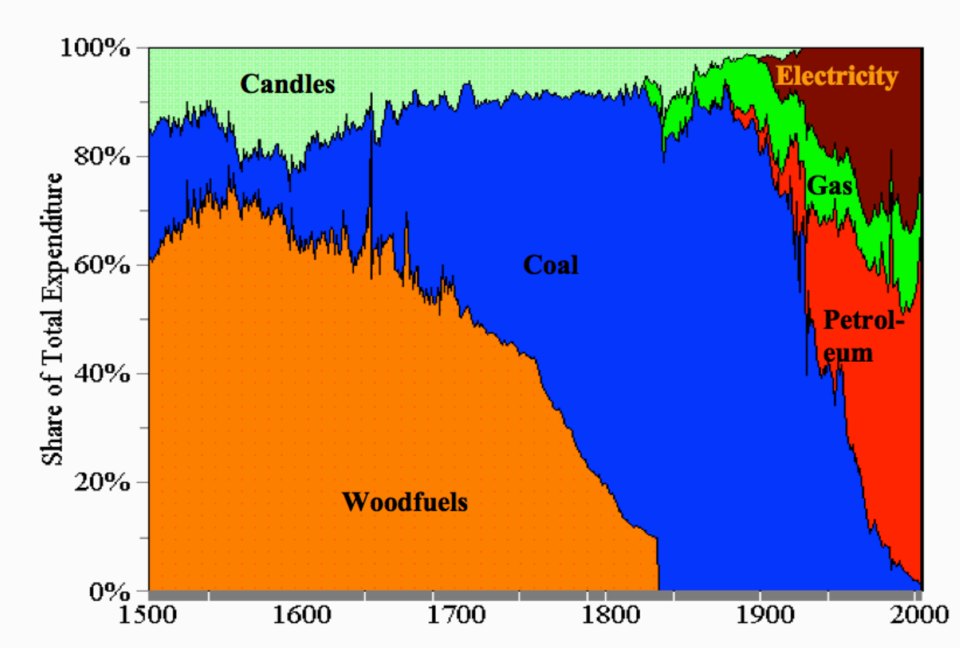


Fig. 4: UK energy intensity - final use energy consumption per unit real GDP, 1500-2000

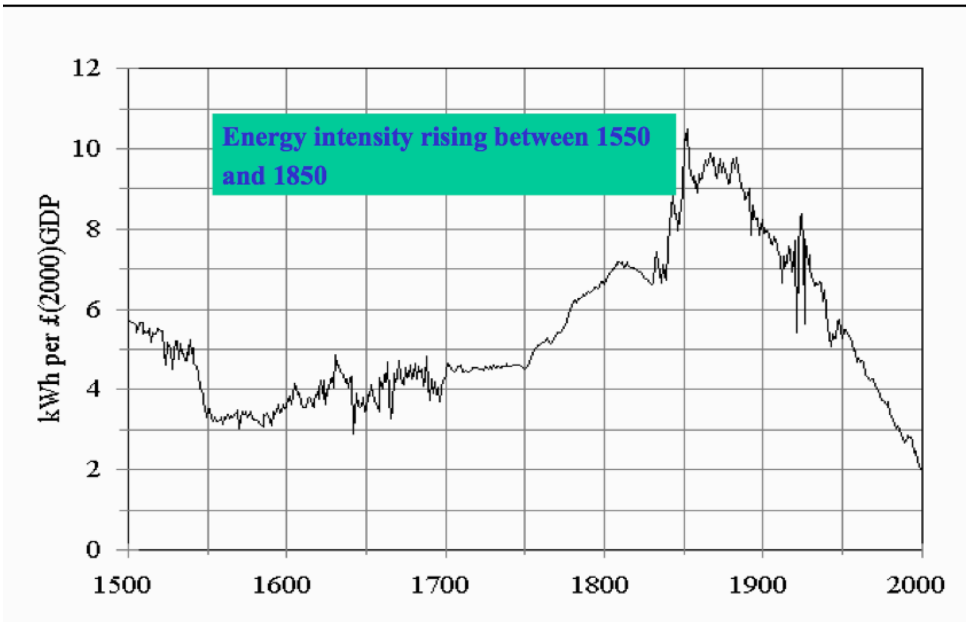
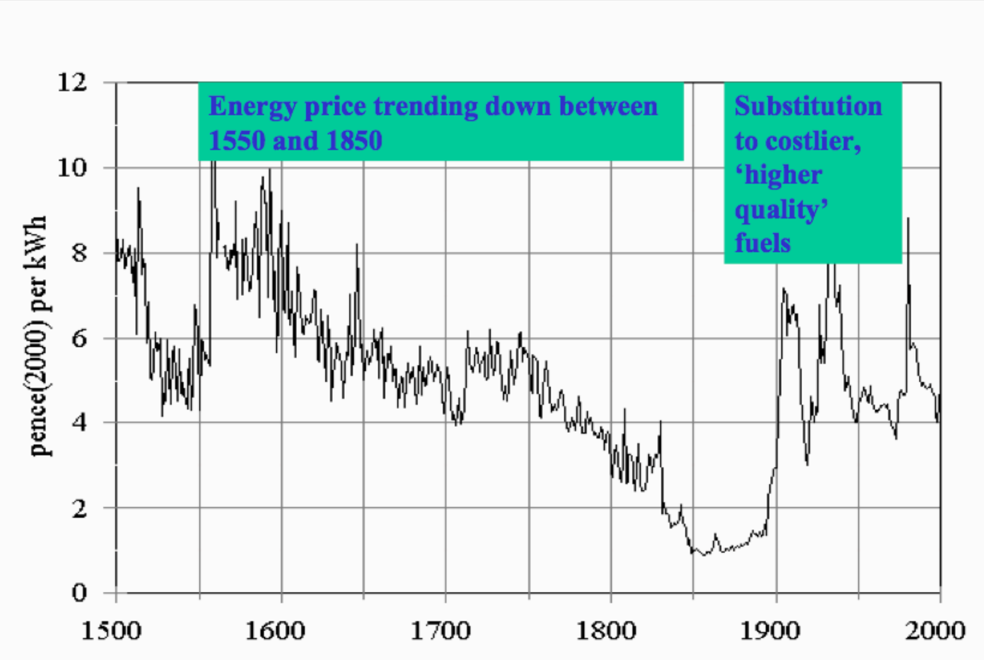


Fig. 5: UK average real 'energy' price series, 1500-2000



4916
International gas pricing in Europe and Asia: A crisis of fundamentals
Jonathan Stern Oxford Institute for Energy Studies Oxford
H I G H L I G H T S
International gas prices in Europe and LNG importing Asia no longer reflect market fundamentals
This became highly problematic in Europe post-2008 and in Japan post-Fukushima.
The result has been a significant switch to hub pricing in Europe.
In Asia, no substantial action has been taken beyond some new contracts based on Henry Hub prices

Not commented upon.

5259
Building energy efficiency in rural China
Meredydd Evans a,n, Sha Yu a, Bo Song b, Qinqin Deng b, Jing Liu b, Alison Delgado a
a Pacific Northwest National Laboratory USA
b China Academy of Building Research China
H I G H L I G H T S
Building energy use is larger in rural China than in cities.
Rural buildings are very energy intensive, and energy use is growing with incomes.
A new design standard aims to help rural communities build more efficiently.
Important challenges remain with implementation.

Not commented upon.

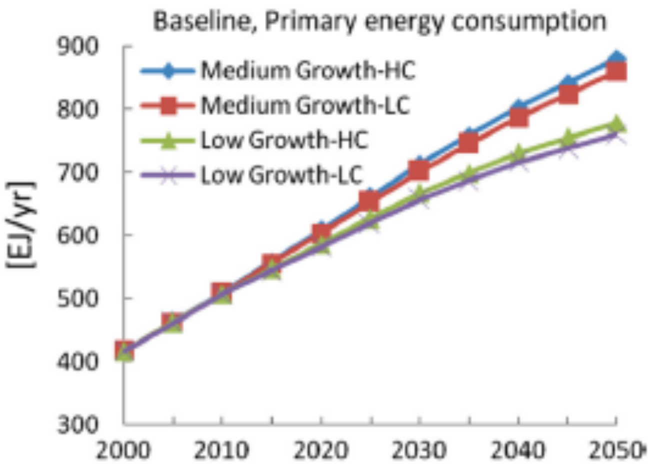
6447
Energy, EROI and quality of life
Jessica G. Lambert n, Charles A.S. Hall, Stephen Balogh, Ajay Gupta, Michelle Arnold
Next Generation Energy Initiative, Inc USA
H I G H L I G H T S

Large quantities of high quality energy appears to contribute to social well-being.
LEI examines the quantity, efficiency and distribution of energy with in the system.
$EROI_{SOC}$ of <25:1, <100 GJ/capita and LEI <0.2 point to poor/moderate quality of life.
A threshold of well-being is: $EROI_{SOC}$ of 20–30:1, 100–200GJ/capita and LEI 0.2–0.4.
Improvement in well-being levels off at: ERO_{ISOC}>30:1, >200 GJ/capita and LEI>0.4
A new composite energy index (Lambert Energy Index), to select indicators of quality of life (HDI, percent children underweight, health expenditures, Gender Inequality Index, literacy rate and access to improved water)
Comment. This is certainly an interesting paper, especially the new LEI index.

6459
A blessing in disguise: The implications of high global oil prices for the North American market
Ron Alquist n, Justin-Damien Guénette Bank of Canada Ottawa,
H I G H L I G H T S
There has been a large increase in U.S. unconventional oil production.
The increase in production was made possible by high oil prices and new technology.
The increase is not large enough to make a large contribution to global supply.
The U.S.experience in unlikely to be replicated in other countries.
Those countries lack the infrastructural and technological advantages the U.S. has.
Not commented upon.

6897
Low climate stabilization under diverse growth and convergence scenarios
A. Markandya a, M. González-Eguino b,n, P. Criqui c, S. Mima c a Basque Centre for Climate Change(BC3) and IKERBASQUE Basque Foundation for Science Spain University of the Basque Country Spain c PACTE-EDDEN CNRS Université de Grenoble France
H I G H L I GHTS
We study the implications of GDP growth and convergence on climate stabilisation.
A partial equilibrium model (POLES) of the world's energy system is used.
Low climate stabilization is technically feasible and economically viable.
Low stabilization is more likely to occur with more modest global growth.
Convergence places pressure in terms of the required reduction in emissions.

Comment: Not a word on the reliability of IPCC SRES energy scenarios, despite several papers (and also K. Aleklett's book: *Peeking at Peak Oil*) highlighting the very unlikely nature – some would say infeasibility! – of the higher SRES scenarios; which largely translate to the higher-valued of the newer representative concentration pathways ('RCPs) now currently used. (And see the graph below). It is pure business as usual! But like many!



PE consumption	Fig 1	BP	Exxon
2035 medium	750 EJ	17,6 Gtoe = 740 EJ	
2040	800 EJ		705 quad = 745 EJ

7052

Measured winter and spring-time indoor temperatures in UK homes over the period 1969–2010: A review and synthesis

K. Vadodaria a, D.L.Loveday a, V.Haines b
a School of Civil and Building Engineering Loughborough University, Loughborough UK
b Loughborough Design School Loughborough University,Loughborough UK

H I G H L I GHTS

We review indoor temperatures measured in UK homes during 1960-2010.
We present analysis of temperature recorded by our study in 20 UK homes.
Little or no increase observed in living room temperatures for the last 40years.
Occupied bed room temperatures appear to have increased.
Living room temperatures have been historically lower than the WHO guidelines.

Not commented upon.

7349

Oil and natural gas prospects: Middle East and North Africa

Hisham Khatib World Energy Council Amman Jordan

H I G H L I G H T S

Global oil and gas reserves and prices.
Energy sustainability and the Middle East.
Energy economics and investments in the Middle East.

Comment; Not a word on OPEC 300 Gb ‘speculative resource’s in OPEC proved reserves stated by Sadad al-Husseini in 2007. This is a major oversight in the paper’s understanding. Although comparison of 1P with 2P oil data has generally been difficult due to the commercial nature of most of summarised sources for the latter, there are now a number of papers and websites etc. that allow such comparison, where for certain key OPEC countries the 2P reserves data are smaller (!) than the widely-published 1P data; see for example the listing on: www.globalshift.co.uk
(And see the table reproduced above from the paper: 966X by Christophe McGlade and Paul Ekins, titled: ‘Un-burnable oil: An examination of oil resource utilisation in a decarbonised energy system’)

7350

Opportunities and Challenges for Petroleum and LPG Markets in Sub-Saharan Africa

William G. Matthews n Ottawa Canada

H I G H L I GHTS

Examines comparative efficiencies of oil product supply chains in twelve sub-Saharan countries.
Identifies areas for improvement towards “best practice”.
Objective is to reduce differential between international reference prices and consumer prices.

Not commented upon.

7374

Structural crisis in the oil and gas industry

John V. Mitchell a,n, Beth Mitchell b a London b London

H I G H L I GHTS

Dominance of the state companies in world oil supply.

Differences between developed and developing countries oil demand.
Likely changes in structure of oil and gas industry.
Increasing oil interdependence between Middle East and Asia.
Uncertainties about size and coherence of international gas trade

Comment: Natural gas is about ten times more expensive to transport than oil: there is only one oil market and several gas markets

7763
Production costs of global conventional and unconventional petroleum
Roberto F. Aguilera Curtin Research Fellow Curtin University Perth Australia
H I G H L I GHTS
Examination of petroleum (oil and gas) production costs.
Methodologies and sources are discussed.
Methods for future cost estimation assessed.
Supply cost curves are estimated for conventional and unconventional petroleum.
Costs may decrease as development methods improve and supplies come on line.

Comments:
-The paper estimate future costs, but hardly the accuracy of them.
-*page 136 probable P50 resources*: it is 2P = P50
-page 138 Fig 3 liquid supply cost: is it past or future cost?
The volume of the OPEC supply looks optimistic compared to OPEC report ABS 2013
138 *R.F. Aguilera / Energy Policy 64 (2014) 134–140*

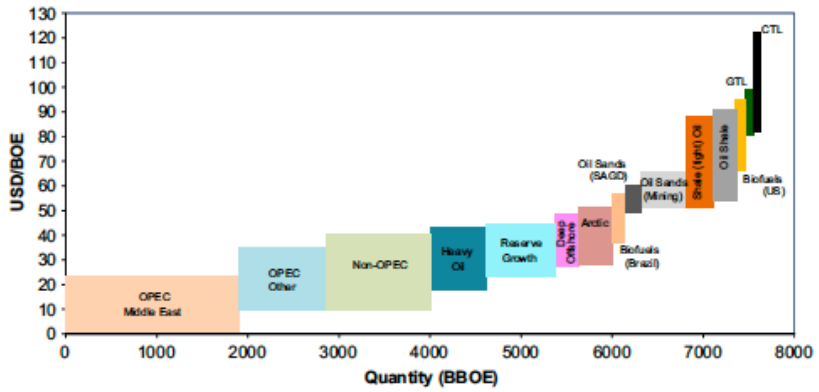


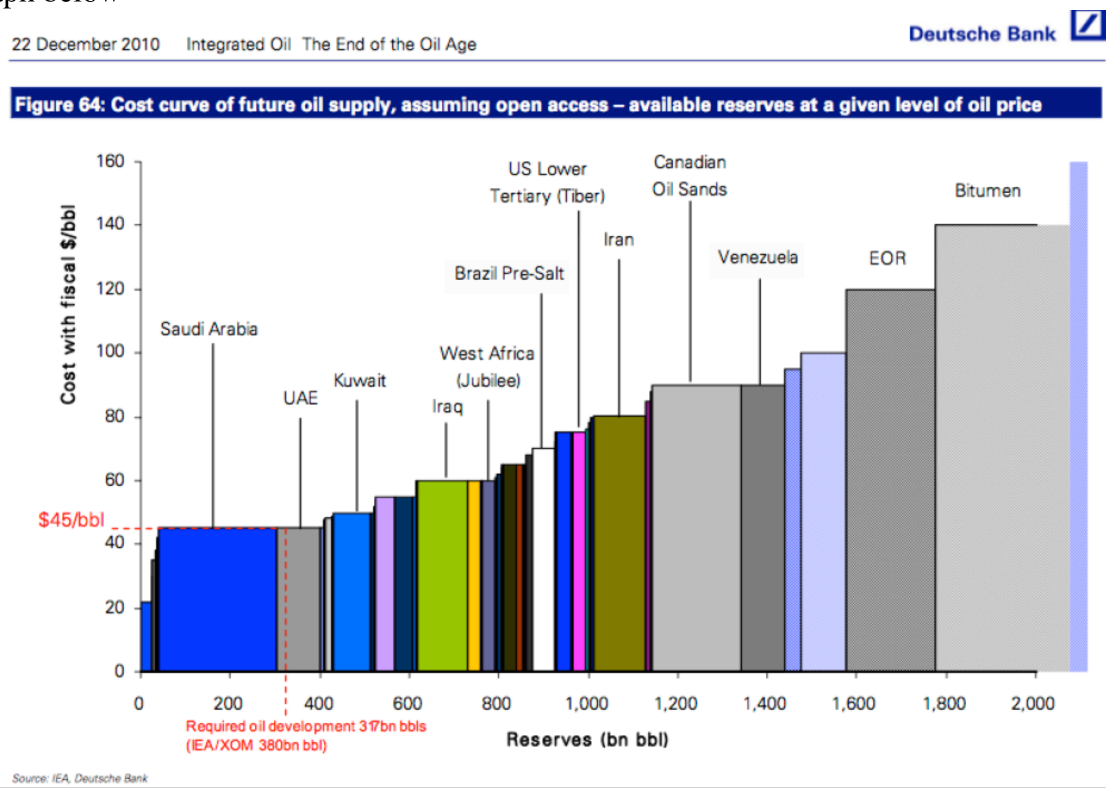
Fig. 3. Liquid supply cost curve showing production costs versus recoverable quantities (based on Aguilera et al., 2009; Medlock III/IEA/Booz Allen, 2012; Farrell, 2008; IEA, 2013; CERI, 2013; Rystad Energy, 2012; GEA, 2012).

OPEC ME reserves 1900 Gb at <22 $/b compared to OPEC ME data at 1100 Gb (cumulative production + remaining reserves)
OPEC ABS 2013

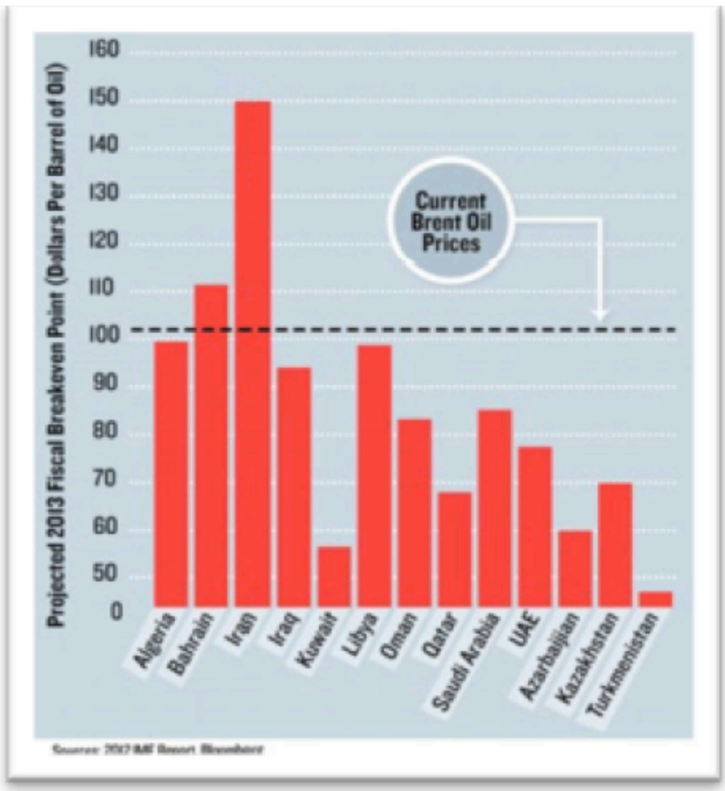
at end 2012 Gb	cum prod	reserves	CP+RR
Iran	67,8	157,3	225,1
Iraq	36,6	140,3	176,9
Kuwait	42,6	101,5	144,1
Qatar	9,3	25,2	34,5
Saudi Arabia	129,4	265,8	395,2
UAE	30,2	97,8	128,0
OPEC ME	315,9	788,0	1103,9

OPEC other reserves 1000 Gb at <35 $/b compared to 567 Gb (prod + remaining reserves ABS 2013)

The ultimate of 7500 Gb of recoverable quantities of liquids looks very optimistic, when compared to Deustch Bank 2010, which has a different estimate for cost (OPEC = 50 $/b) and for reserves (2 Gb), see graph below



And Bloomberg 2020 reports the fiscal breakeven point for OPEC countries as follows:



Sources :2012 IMF Report/Bloomberg

It is very hard to get recent drilling cost: EIA reports US drilling cost per foot in 2000 $: the cost has been multiplied by 3 from 1960 to 2000 in 40 years and by 2 in the last tow years. Unfortunately EIA has stopped reporting drilling cost since 2008!

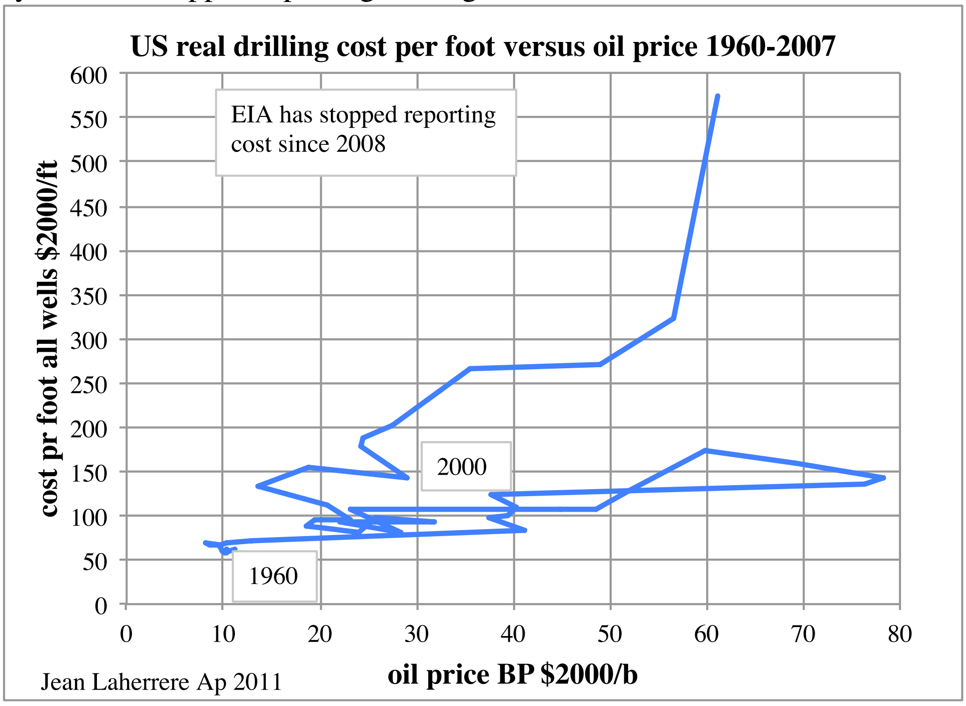


Fig 19: US real drilling cost per foot versus oil price 1960-2007

-page 138 *Technological advancements in horizontal drilling and multi- stage hydraulic fracturing have lowered costs to the point where unconventional oil and gas production is economically viable in many provinces around the United States and Canada (in spite of low prices, in the case of gas).*
The fit between the US monthly number of rigs for gas and the natural gas price is amazing: less than one month shift except since April 2012 where price was the lowest at 1.9 $/MBtu
The number of US gas rigs has dropped with the price of gas to less than 400 rigs in Dec 2013 and needs more than 5 $/kcf to go up again: it is at end 2013 at 4.2 $/Mbtu (same for kcf).
Today US shale gas price is less than the cost!

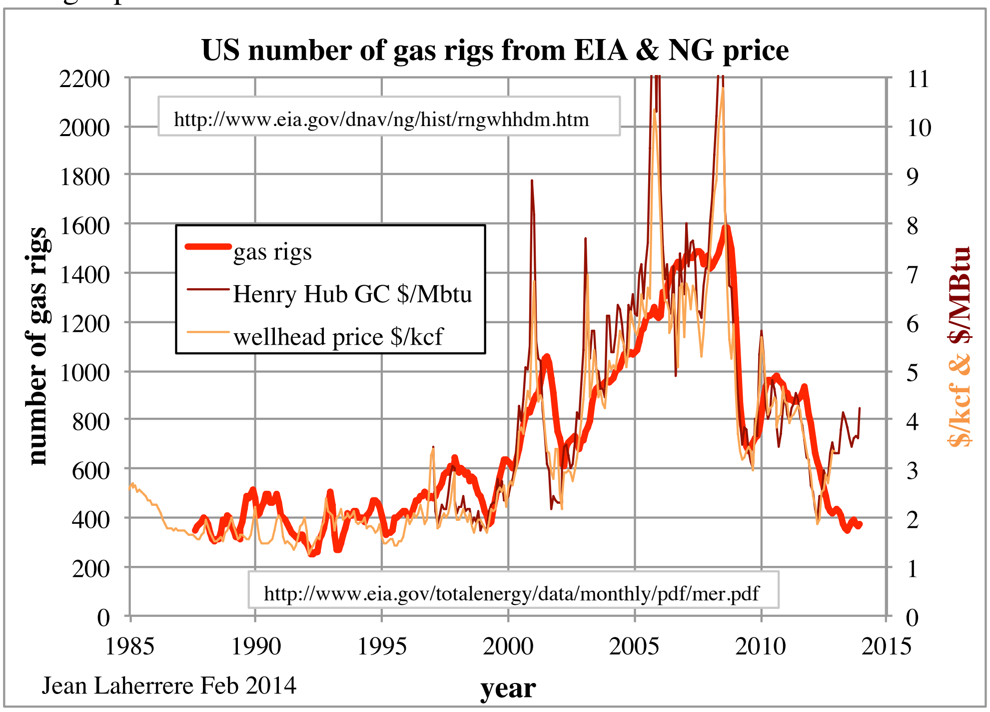


Fig 20: US number of rigs from EIA and natural gas price

The authors say: "With regard to shale gas, there were thousands of shale vertical wells producing gas commercially in 1980 from the Appalachian basin in eastern United States (US DOE,1980; Gatens et al.,1989)."
Yes this is important to remember. For many, shale gas is new and started in the 2000s when shale gas was produced in 1821 at Fredonia in the New York State

page 139

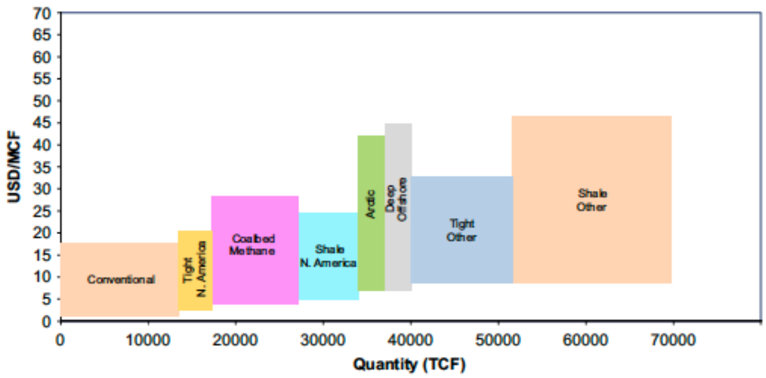


Fig. 4. Gas supply cost curve showing production costs versus recoverable quantities (based on Aguilera et al., 2009, 2012; IEA, 2013; GEA, 2012).

In Australia the rule is clear only SI units should be used and the use of mcf is incorrect: it should be kcf!
In Figure 4 shale gas in North America is estimated at a production cost of 5 to 25 $/kcf (30 to 150 $/boe) despite the fact that in the text the authors write:
Unconventional gas in the United States and Canada, which can be produced at a lower cost than other regions, is also economic as summing gas prices of $3 to $4 per mcf in North America

8124
The scenario approach to possible futures for oil and natural gas
Jeremy Bentham n VP Global Business Environment, Head of Shell's Scenarios Team, Shell International The Hague The Netherlands
H I G H L I G H T S
Shell has used scenarios to deepen its strategic thinking for 40 years.
Shell scenarios cover a broader set of drivers than traditional energy outlooks.
Shell's New Lens Scenarios were published in February2013.
They look at trends in the economy, politics and energy over the 21st century.
Coordinated policies are essential to meeting the world's rising energy needs.

Comment: The range of Shell's scenarios names and the range of estimates are large. As the author states: "*scenarios are stories about future*" » they are not forecasts, but they have varied a lot over recent years. Shell scenario titles have been:
2013 ocean & mountains
2008 scramble & blueprints
2005 low trust globalization & open doors & flags
2002 business class & prism
1998 the new game & people power
1995 just do it & da wo
1992 barricades & new frontiers
1975 boom and bust & constrained growth

The Shell scenarios for world primary energy is mainly business as usual

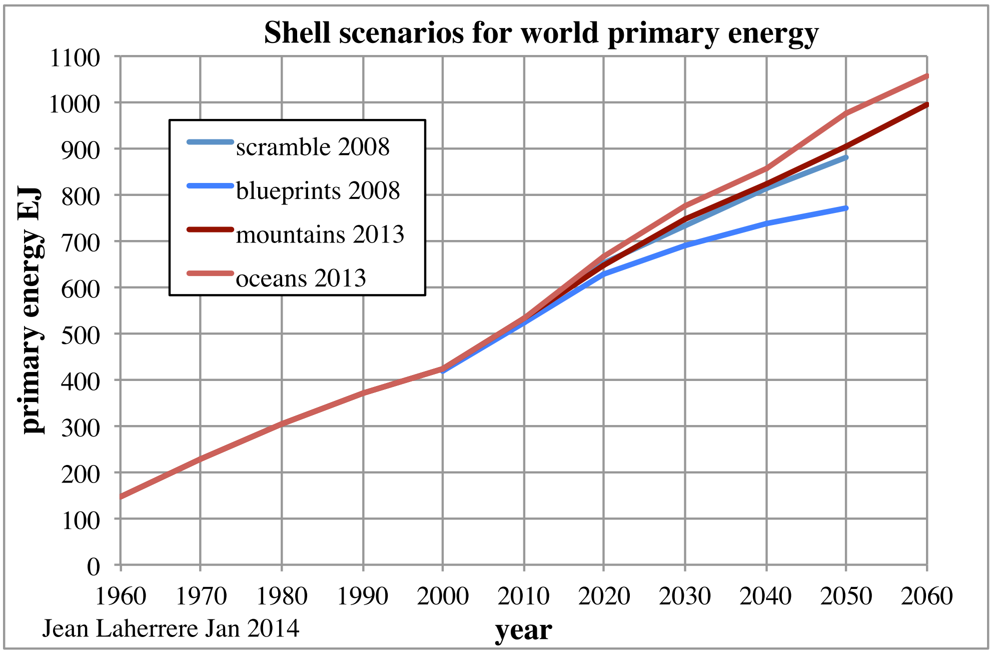


Fig 21: Shell scenarios for world primary energy from 2008 to 2013

The Shell scenarios for world oil production have changed widely!

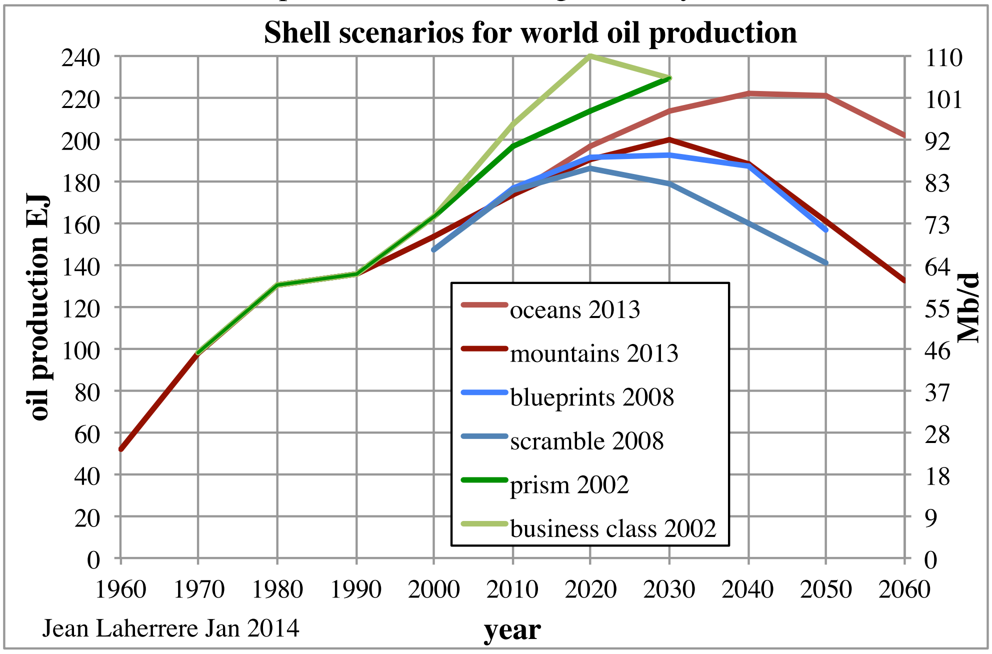


Fig 22: Shell scenarios for world oil production from 2002 to 2013

The Shell scenarios for world natural gas was wild in 2002, low in 2008 and more in line in 2013 with the Fig 24 on 8574 paper

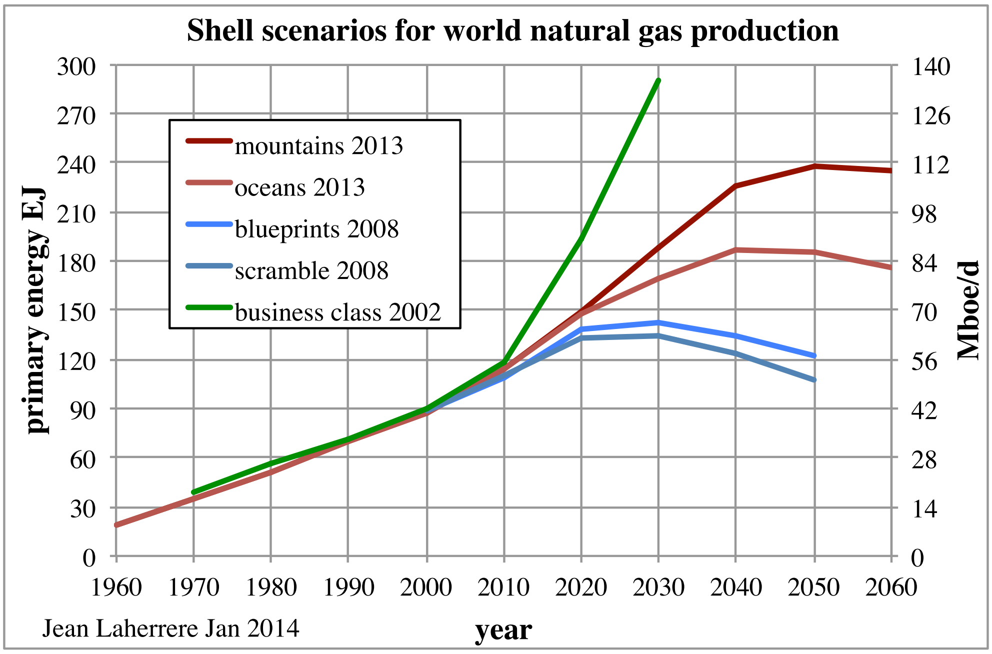


Fig 23: Shell scenarios for world natural gas production from 2002 to 2013

My point is that Shell scenarios for the last eleven years cover a large range, going up and down with time !

8239
Renewable Energy Sources Act and Trading of Emission Certificates: A national and a supranational tool direct energy turn over to renewable electricity-supply in Germany
Selder Kirsten Munich Germany

Not commented upon.

8574
Exploring the production of natural gas through the lenses of the ACEGES model
Vlasios Voudouris a,b,e,n, Ken'ichi Matsumoto c,e, John Sedgwick e, Robert Rigby b,e, Dimitrios Stasinopoulos b,e, Michael Jefferson a,d,e Research Centre for Energy Management ESCP Europe Business School London b Statistics, Operational Research and Mathematics Centre London Metropolitan University, c Department of Environmental Policy and Planning School of Environmental Science The University of Shiga Japan d Department of Economics and International Studies Buckingham University, e ABM Analytics, London
H I G H L I GHTS
We present the 'Collective View' and 'Golden Age' Scenarios for natural gas production.
We do not observe any significant supply demand pressure of natural gas until 2035.
We do observe 'jumps' in natural gas supply until 2035.
The ACEGES-based scenarios can assess the resilience of long term strategies.

Comment: The authors include a table (reproduced below) of various estimates of global gas EUR (i.e., URR), and also – where appropriate, dates for peak production, and the peak production volume.

Table 1
Natural gas projections (in Trillion cubic feet – Tcf).

Sources	EUR	Peak year	Peak production
Edwards (1997)	1165	2040	120
Al-Jarri and Startzman (1997)	7060	2011	103
Al-Fattah and Startzman (2000)	10,000	2014–2017	99
Laherrere (2002)	10,000	2015	NA
Aleklett and Campbell (2003)	10,000	2015–2040	130
Imam et al. (2004)	9215	2019	88
Guseo (2006)	7332	2008–2014	100
Laherrere (2007)	10,000	2020	135
Campbell and Heapes (2009)	9886	2012	108
Zhang et al. (2010)	NA	2030–2035	130
Mohr and Evans (2011)	9952–17027	2025–2065	112–151

My most recent forecast for the global gas peak is in 2030 at 165 Tcf/yr., based on an ultimate of 13 Pcf (Peta cubic feet). See the chart below that compares this forecast with others.

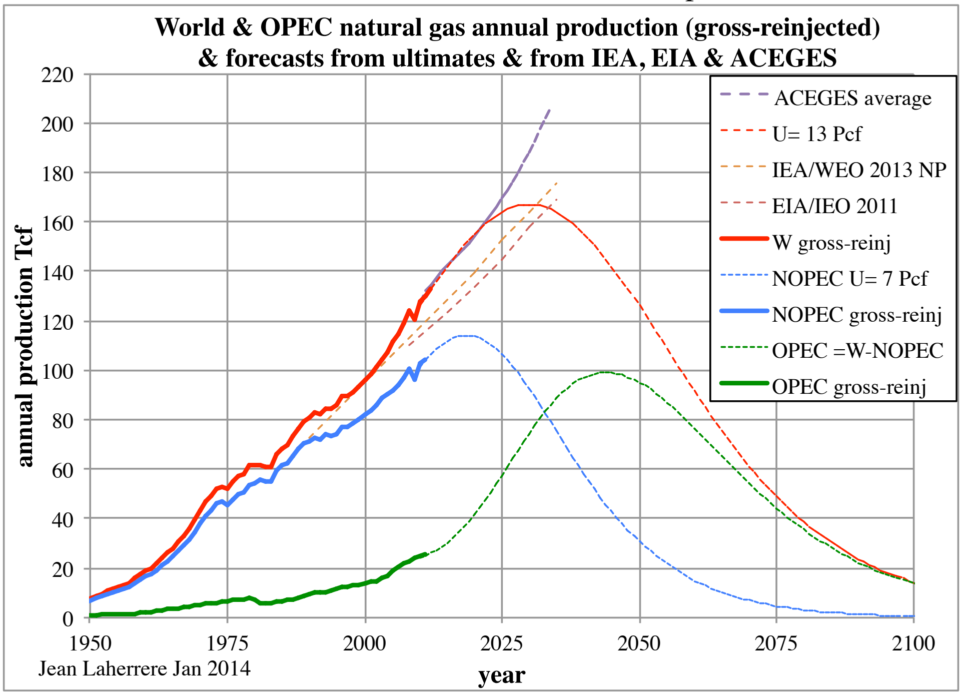


Fig 24: World & OPEC natural gas annual production (gross-reinjected) with forecasts from ultimate 13 Pcf & from IEA, EIA & ACEGES

With the two scenarios "Collective view" & "Golden Age" it is hard to find in the text what are the ultimates, the peak times and the peak values of the two scenarios

Both Collective view & Golden age scenarios forecast for 2035 a natural gas production (dry or marketed wet?) in Figure 6 & 8 of about 5.31 (logarithm scale) corresponding to about 205 Tcf, much higher than my forecast (gross less rejected) for a peak in 2030 of 165 Tcf

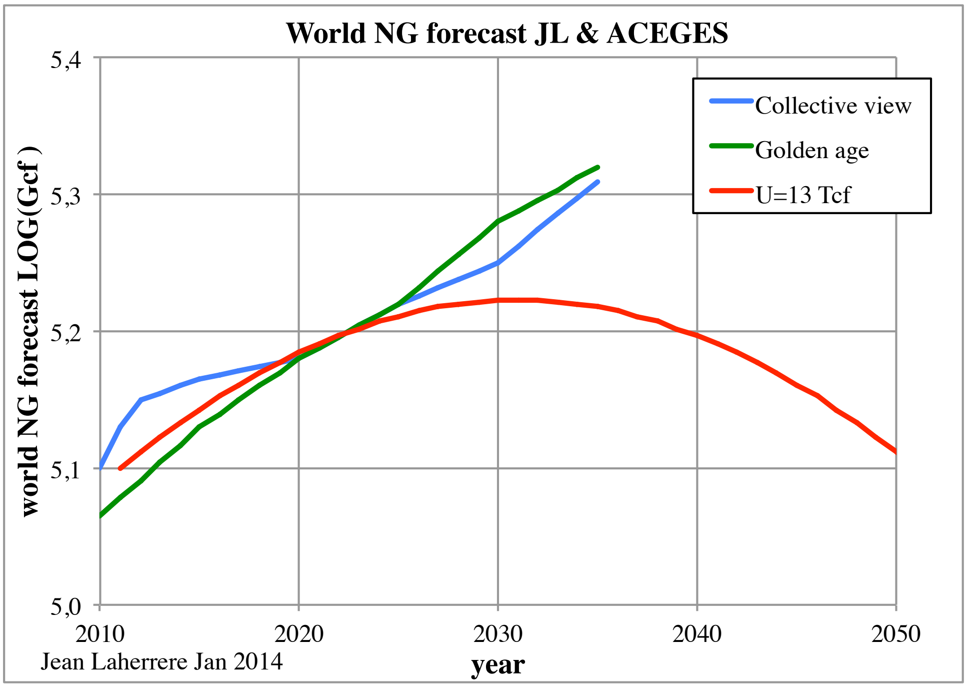


Fig 25: World natural gas forecast (logarithm) from ACEGES and from my ultimate estimate of 13 Pcf

Thus with this high value of 200 Tcf, Voudouris et al do not observe any significant supply demand pressure until 2035, in sharp contrast to my forecast, see chart above.

8690

Downstream regulation of CO2 emissions in California's electricity sector

James Bushnell a,b,n, Yihsu Chen c, Matthew Zaragoza-Watkins d

a Department of Economics University o fCalifornia ,Davis ,United States b NBER, UnitedS tates c School of Social Sciences Humanities and Arts School of Engineering, Sierra Nevada Research Institute University of California Merced United States d Department of Agricultural & Resource Economics University of California Berkeley United States

H I G H L I G H T S

We model the effectiveness of rules designed to regulate the carbon content of electricity imports under California's carbon cap-and-trade system.

We construct a simulation of the electricity market in the Western U.S. based upon actual 2007 market data.

We perturb the market model with variations of cap-and-trade designs.

We find that current policy will lead to substantial "reshuffling" of emissions and limit the impact of California's emissions cap.

Comment: Table 7 confuses SI & US symbols: M & mm

8732

Energy-conversion measures in the industries of Saudi Arabia and development of methodology for certification of energy personnel in the Kingdom

Abdullah Alshehri a,n, Ahmad Hussain b, Youssef Mobarak c

Department of Electrical Engineering Faculty of Engineering Rabigh King Abdulaziz University Jeddah

H I G H L I G H T S

Saudi Arabia has the cheapest electricity rates in the world, yet it needs to promote an energy-conservation culture.

The country needs to develop local experts with the required competency to implement energy-efficiency aspects in the industry.
This article discusses aspects of energy efficiency and certification of Energy Managers in terms of academic and accreditation requirements

Comment: The authors include the following table:

A. Alshehri et al. / Energy Policy 64 (2014) 203–208

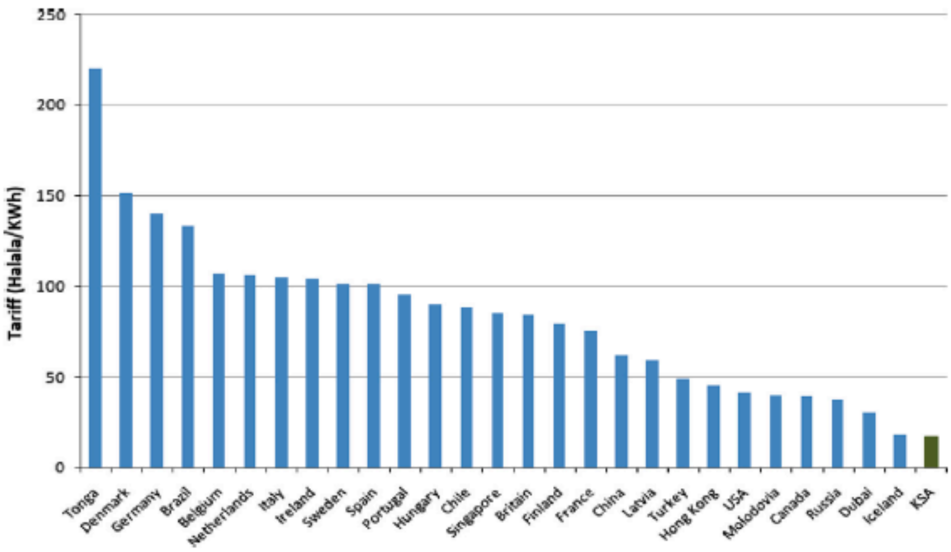


Fig. 4. Comparison of average electricity tariff in the Kingdom with a number of countries.

8926
Innovative method of RES integration into the regional energy development scenarios
Valentinas Klevas n, Kestutis Biekša Lina Murauskaitė Lithuanian Energy Institute, Laboratory of Regional Energy Development Kaunas Lithuania
H I G H L I GHTS
RES integration into the regional energy development scenarios is done.
Innovative process network system (PNS) analysis method is used.
PNS method is used to optimize the use of local and renewable resources.
Analysis of energy flow in region using PNS method is done.

Not commented upon.

8987
How much information disclosure of building energy performance is necessary?
David Hsu n University of Pennsylvania Philadelphia
H I G H L I G H T S
A comprehensive panel data set of energy performance and building characteristics was assembled and cleaned.
The effectiveness of the disclosed information to predict building energy performance was tested using a regression model.
Building-level variation has a greater effect than any building characteristic or systems.
Benchmarking data alone predicts energy performance equally as well as both benchmarking and engineering audit data together, and better than audit data alone

Not commented upon.

9002

The policy implications of the different interpretations of the cost-effectiveness of renewable electricity support

Pablo del Río a,n, Emilio Cerdá b a Institute for Public Goods and Policies (IPP) Consejo Superior de Investigaciones Científicas (IPP-CSIC) Madrid Spain
b Universidad Complutense Campus de Somosaguas Madrid Spain

H I G H L I GHTS

Significant confusion exists in the literature on the cost-effectiveness of public support for renewable electricity.
Clarify the differences between two main approaches to cost-effectiveness.
Policy implications clearly differ, leading to very different policy prescriptions.

Not commented upon.

9324

A public choice view on the climate and energy policy mix in the EU — How do the emissions trading scheme and support for renewable energies interact?

Erik Gawel, Sebastian Strunz n, Paul Lehmann Helmholtz Centre for Environmental Research Department of Economics Leipzig,Germany

H I G H L I G H T S

We analyze the interaction of the EU Emissions Trading Scheme and support policies for RES.
Stylized framework with emission cap as variable to be negotiated between regulators and emitters.
RES-support contributes to a more stringent emission cap and may even increase overall efficiency.

Not commented upon.

9385

China's energy consumption under the global economic crisis: Decomposition and sectoral analysis

Fangyi Li a,b,c, Zhouying Song b,c,n, Weidong Liu b,c a School of Management Hefei University of Technology Hefei China b Key Laboratory of Regional Sustainable Development Modeling Chinese Academy of Sciences, Beijing China c Institute of Geographic Sciences and Natural Resources Research Chinese Academy of Sciences, Beijing China

H I G H L I G H T S

We analyze the reasons for China's energy consumption change under the global economic crisis during 2007–2010.
Domestic final use growth, especially in construction and manufacturing of machinery and equipment, resulted in energy consumption increase.
International trade is identified as a driver of energy consumption reduction during and after the crisis.
Increasing China's share of consumption or reducing its share of investment in the GDP can reduce national energy intensity

Not commented upon.

9488

The role of seaports in end-to-end maritime transport chain emissions

David Gibbs a, Patrick Rigot-Muller b, John Mangan b,n, Chandra Lalwani c
a Department of Geography Environment and Earth Sciences University of Hull Kingston-upon-Hull United Kingdomb School of Marine Science and Technology,Newcastle University Newcastle-upon-Tyne United Kingdom c Logistics Institute Business School University of Hull Kingston-upon-Hull United Kingdom

H I G H L I G H T S

Investigates role of ports in mitigating GHG emissions in the end-to-end maritime transport chain.
Emissions generated both by ports and by ships calling at ports are analysed.
Shipping's emissions are far greater than those generated by port activities.
Ports may have more impact through focusing efforts on reducing shipping's emissions.
Options for ports to support an drive change in the maritime sector also considered

Not commented upon.

9543
Analysis of Saud iArabia's behavior within OPEC and the world oil market
Khalid Alkhathlan a, Dermot Gately b,n, Muhammad Javid c a Economics Department King Saud University Riyadh SaudiArabia b Economics Department New York University NewYork c Pakistan Institute of Development Economics Campus Islamabad Pakistan

Not commented upon.

9671
Bottom-up modeling of oil production: A review of approaches
Kristofer Jakobsson a,n, Bengt Söderbergh a, Simon Snowden b, Kjell Aleklett a
a Department of Earth Sciences Uppsala University, Sweden b University of Liverpool Management School Liverpool
H I G H L I G H T S
Bottom-up models are influential in the study of the oil production supply chain.
Nine existing bottom-up models are reviewed.
The high level of detail is of questionable value for predictive accuracy.
There is a potential for more systematic sensitivity analysis
http://dx.doi.org/10.1016/j.enpol.2013.09.043

Comments: this paper contains no forecast of world oil production

9749
Climate friendly technology transfer in the energy sector: A case study of Iran
Alireza Talaei a,n, Mohammad Sadegh Ahadi b, Soroush Maghsoudy c
a Copernicus Institute of Sustainable Development University of Utrecht The Netherlands
b National Climate Change Office, Department of Environment Tehran Iran
c School of Engineering University of Tehran Tehran Iran
H I G H L I G H T S
We examined the process of technology transfer in the energy sector of Iran.
Multi Criteria Decision Analysis techniques are used to prioritise the technological needs of the country.
Transportation, electricity and oil and gas sectors are found as recipients of new technologies.
A policy package was designed for facilitating technology transfer in the energy sector.

Not commented upon.

9956
Oil and gas perspectives in the 21 st century
On the above 34 articles of the EP January 2014 bulletin, only 26 are quoted in this paper
Ayres & Voudouris: However, the concept of "useful energy" also highlights the huge wastage which occurs between providing primary, then secondary, and finally useful energy

Comments:
a). On the above 34 articles of the EP January 2014 bulletin, only 26 are quoted in this paper.

b). Ayres & Voudouris: say: "However, the concept of "useful energy" also highlights the huge wastage which occurs between providing primary, then secondary, and finally useful energy"

However, this important concept, it is not clearly quantified by country, nor or the world.
We need an exergy historical database per country

11002
list of 2013 reviewers of Energy Policy
I note rather wryly that am not anymore on this list, when in the past I have reviewed 15 papers from Energy Policy from 2006 to 2009 (see chart, below).

My feeling is that I was maybe too rude on the authors, and, on the editors, in particular on the use of SI units; and I required an 'open' review and no longer to be anonymous. On this basis, I guess that I may be considered as "past peak"!

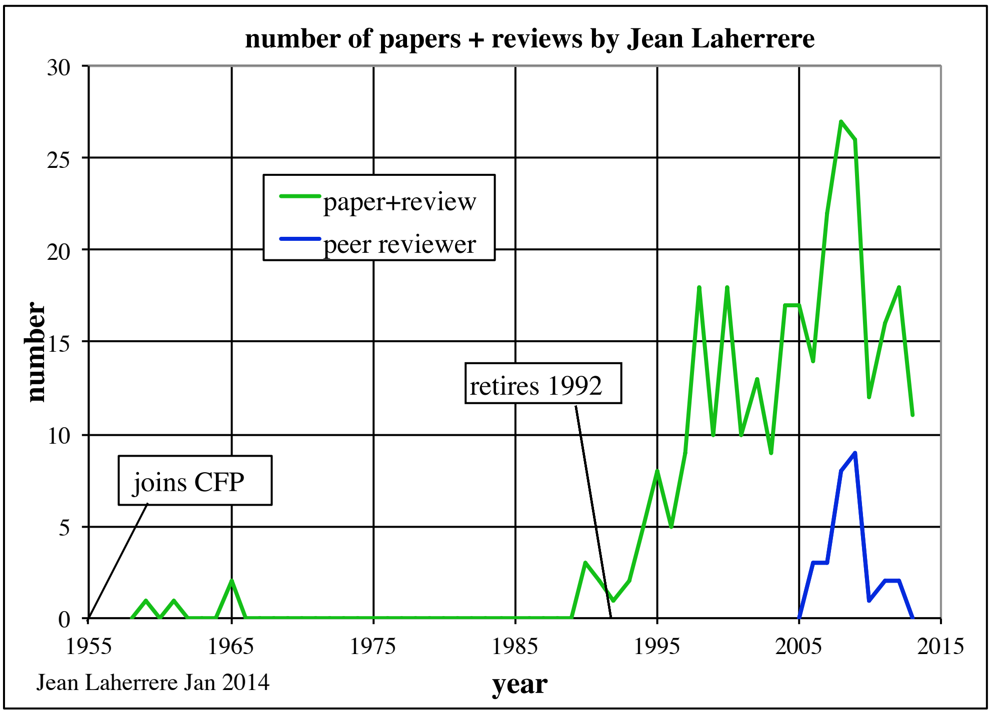


Fig 26: numbers of papers and reviews by Jean Laherrere

11014
Publisher's note

Not commented upon.

11579
International Advisory Board

I am surprized to see on this Energy Policy board two members of TERI, which was involved in the "Himalayagate" issue, where critics on the melt by 2035 of Himalaya glaciers were described as "voodoo science"! Poor science! Nobel Price for Peace has nothing to do with science!

NB: my thanks to Roger Bentley, who helped with my broken English

References:

-Attanasi E.D. & D.H. Root 1994 "The enigma of oil and gas field growth" AAPG bulletin V78 n°3 March
-BP reserve definition: http://www.bp.com/en/global/corporate/about-bp/energy-economics/statistical-review-of-world-energy-2013/review-by-energy-type/oil/oil-reserves/oil-reserve-definitions.htmldefinitions.html
-DECC reserves definition: https://www.gov.uk/oil-and-gas-uk-field-data
-DOE/EIA-0534 1990 "US oil and gas reserves by year of field discovery"
-IFP reserve definition: http://www.ifpenergiesnouvelles.fr/espace-decouverte/les-grands-debats/quel-avenir-pour-le-petrole/la-notion-de-reserves#6
-Laherrère J.H. 2003 "Oil and Natural Gas Resource Assessment: Production Growth Cycle Models" Encyclpedia of energy myweb.lmu.edu/bfitzpatrick/peak_oil_discussion.doc
-Laherrère J.H. 2011 «Backdating is the key » ASPO 9 Brussels 27 April http://www.aspo9.be/assets/ASPO9_Wed_27_April_Laherrere.pdf
-Laherrère J.H. 2013 «Le chaos des réserves d'hydrocarbures : exemple : les dernières estimations de BP 2013 pour le gaz » Club de Nice 28 nov.
http://aspofrance.viabloga.com/files/Nice2013long.pdf;
http://www.clubdenice.eu/2013/Jean_LAHERRERE.pdf
-Peter Pearson 2003 "Energy history, development and sustainability" ESS conference Tokyo December http://www.scj.go.jp/ja/int/kaisai/ess2003/pdf_pre/s33_pearson.pdf
-SPE/PRMS reserve definition:
http://www.spe.org/industry/docs/Petroleum_Resources_Management_System_2007.pdf
http://aspofrance.viabloga.com/files/JL_ASPO2011.pdf
http://www.spe.org/industry/docs/PRMS_Guidelines_Nov2011.pdf
-Warr Benjamin, Robert Ayres, Nina Eisenmenger, Fridolin Krausmann, Heinz Schandl 2010 "Energy Use and Economic Development: A comparative analysis of useful work supply in Australia, Japan, the United Kingdom and the US during 100 years of economic growth"

Conclusion

This special issue gathers interesting articles, which can bring better understanding on the oil and gas perspectives in the future. But the big problem is the poor reliability of the data and the lack of consensus on definitions.
UK is one of the few countries with a "Freedom of information Act" which should be adopted by many other countries.
Everyone should ask governments to push laws for more historical data and better data.