The Oil Drum: Europe
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Comments on Scientific American's "Squeezing more oil from the ground"

Posted by Luis de Sousa on October 19, 2009 - 10:30am in The Oil Drum: Europe
Topic: Geology/Exploration
Tags: colin campbell, jean laherrère, kern river, leonardo maugeri, scientific american [list all tags]

This article, put together by Jean Laherrère and edited by Colin Campbell, is a critical review of the recent article by Leonardo Maugeri published by Scientific American.

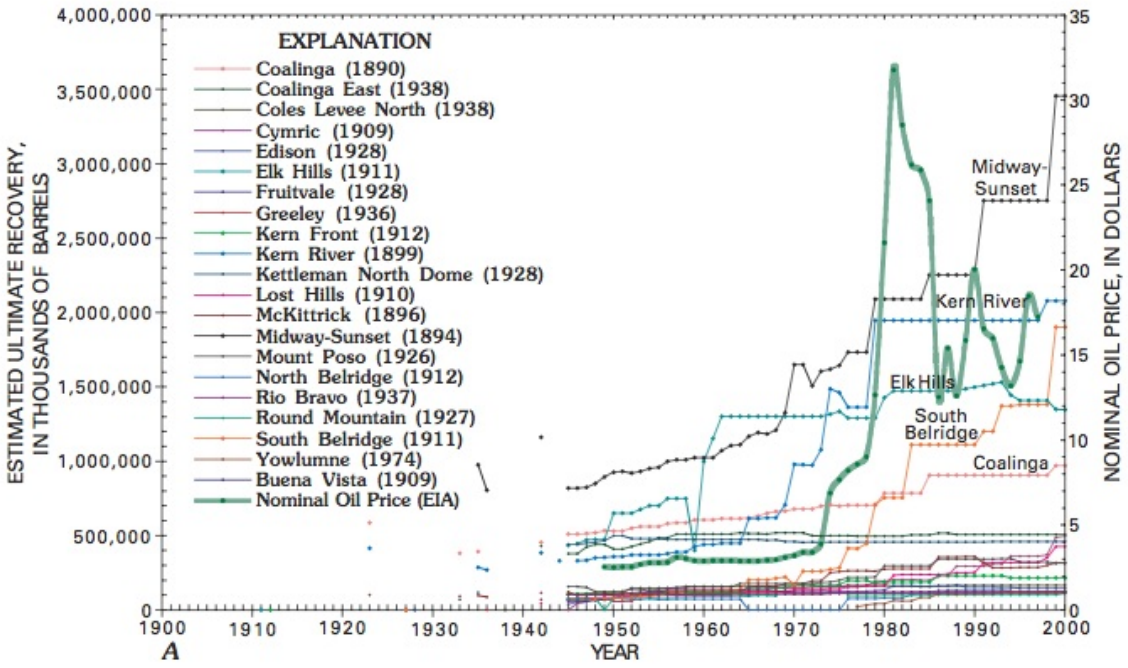
A decade ago, Scientific American published the seminal article by these two luminaries of the Peak Oil awareness movement, that relaunched the debate on M. King Hubbert's finds, Scientific American appears now as a completely different publication. Now, however, scientific content doesn't seem to be a requisite for its articles. Among other eerie details, Leonardo Maugeri goes as far as citing "Common Wisdom" to present erroneous facts.

Leonardo Maurgeri starts his Scientific American article by quoting statistics for the Kern River oil field in California, suggesting that its very favorable reserve growth is representative of what can be expected more generally throughout the world. In using this approach, Maurgeri, an economist and vice president of the Italian oil company ENI, follows the work of Professor M. Adelman. The basic statistics Maugeri quotes are shown in the following table:

Mb	**1942**	**2007**
Comulative Production	280	2000
Remaining Reserves	60	480
Ultimate Recovery	340	2480

Alderman commented that *the field itself had not changed; but knowledge of it had.* Maugeri follows the same argument but fails to mention that the number of producing wells had increased from 500 in 1942 to 9318 in 2007 and that as many as 16 000 wells had been drilled in total. In other words, drilling increased by a factor of twenty yet the reserves increased no more than eight-fold.

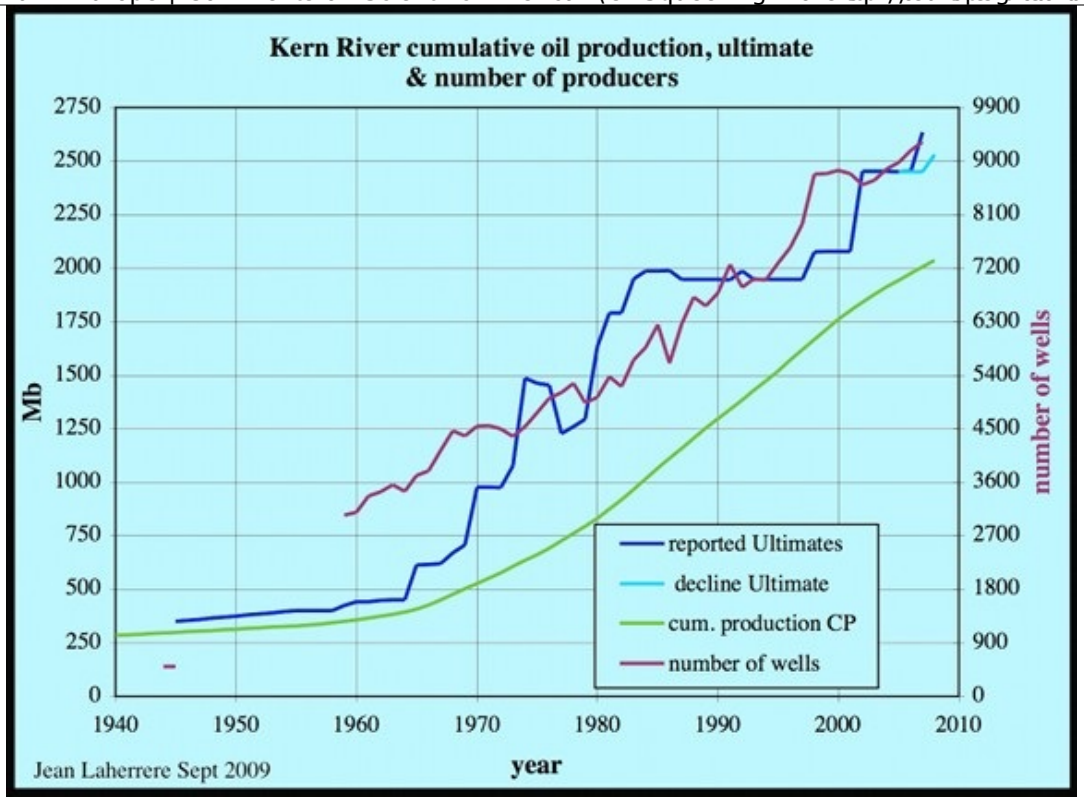
He also fails to note that published Proven Reserves in the United States are based on SEC rules such that only the developed part of the field could be reported even though its full size was known from geological maps and appraisal drilling. The field was discovered in 1899 by a hand-dug well, no more than 45 feet deep, and has been in production since then. It contains heavy oil ranging in gravity from 10° to 16° API, and steam stimulation commenced in 1963 to improve recovery.



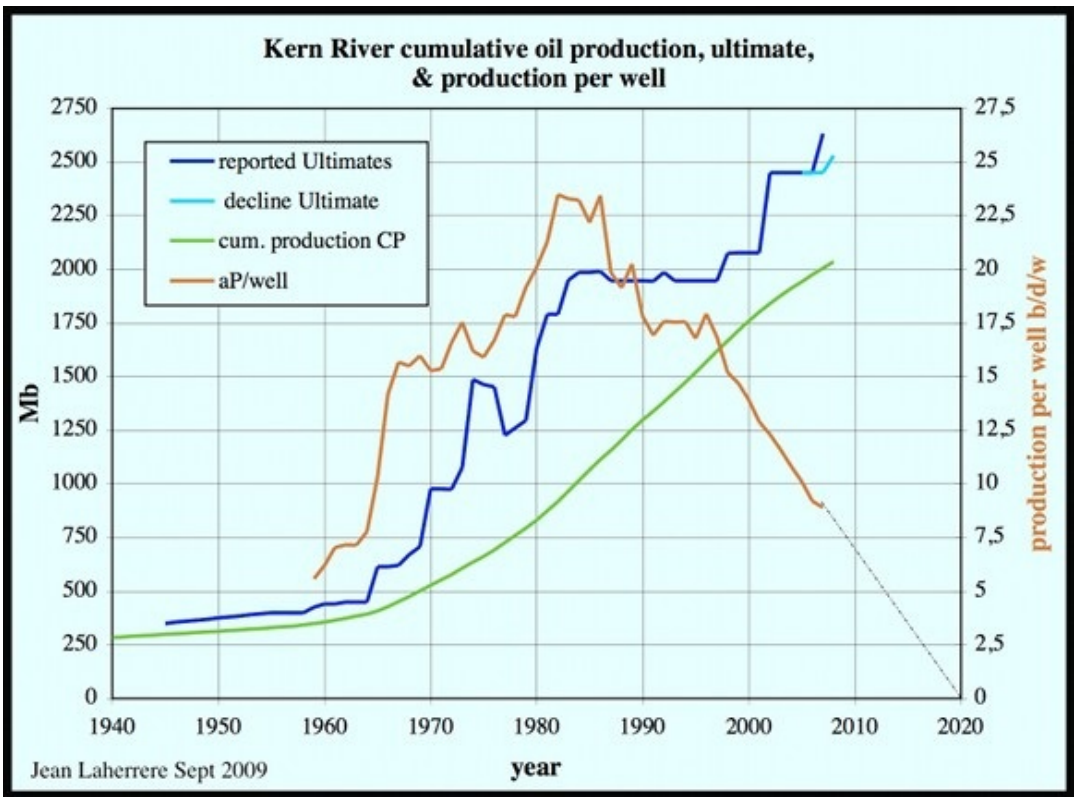
The above illustration, taken from the USGS Bulletin 2172-H 2005 Growth History of Oil Reserves in Major California Oil Fields During the Twentieth Century*, shows that Kern River reserves (in blue) were larger in 1923 than in 1937 and 1942.*

The California Department of Conservation reports annually all the details of field production, and it is easy to plot annual oil production and reserves of the Kern River Field.

The following graph shows how the reported Ultimate Recovery (cumulative production + remaining reserves) of the field have grown in parallel with the number of wells, reflecting the constraints of the SEC reporting rules. Production began to increase significantly with the steam flooding in 1963, preceded by cyclic steam injection in 1958. These processes, which are well established and normal industry practices, are called *technological miracles* by Maugeri.



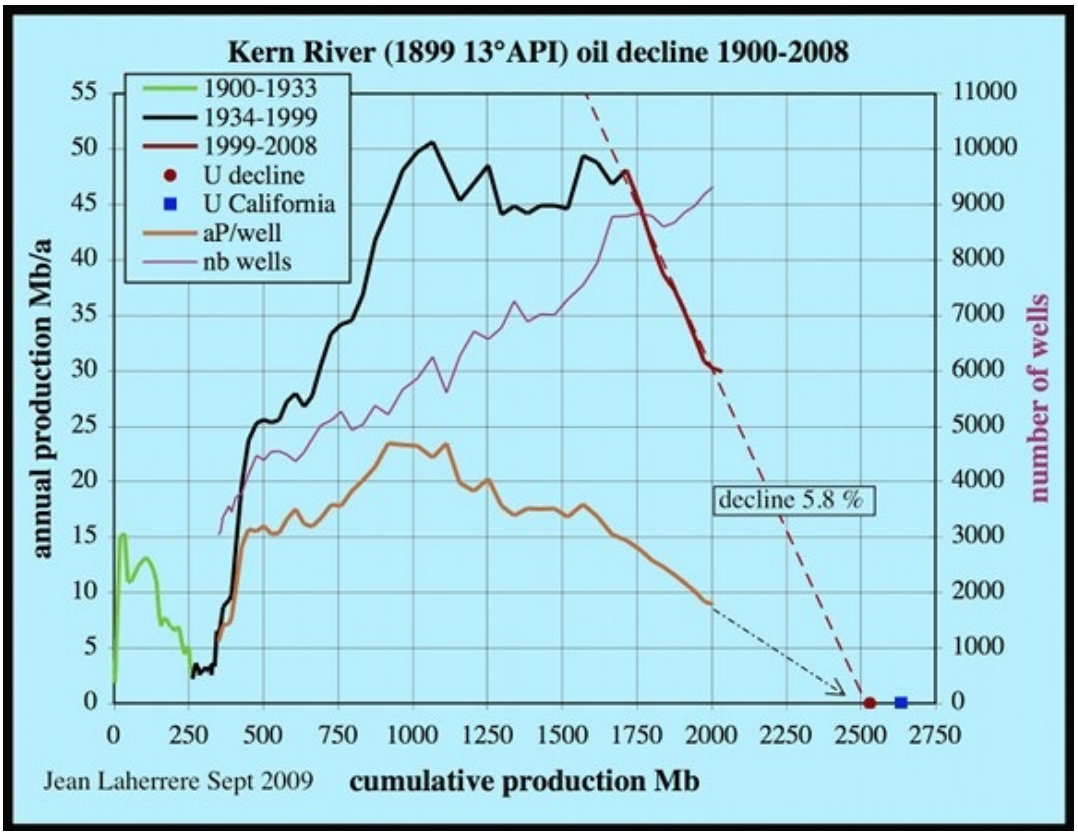
The reported Ultimate ceased to grow in 1985, reflecting the peak of production per well at 23 b/d in 1982, being now below 9 b/d. Production per well seems to have been linear since 1996 and could be extrapolated towards zero in 2020, meaning that the field will have to stop production before then.



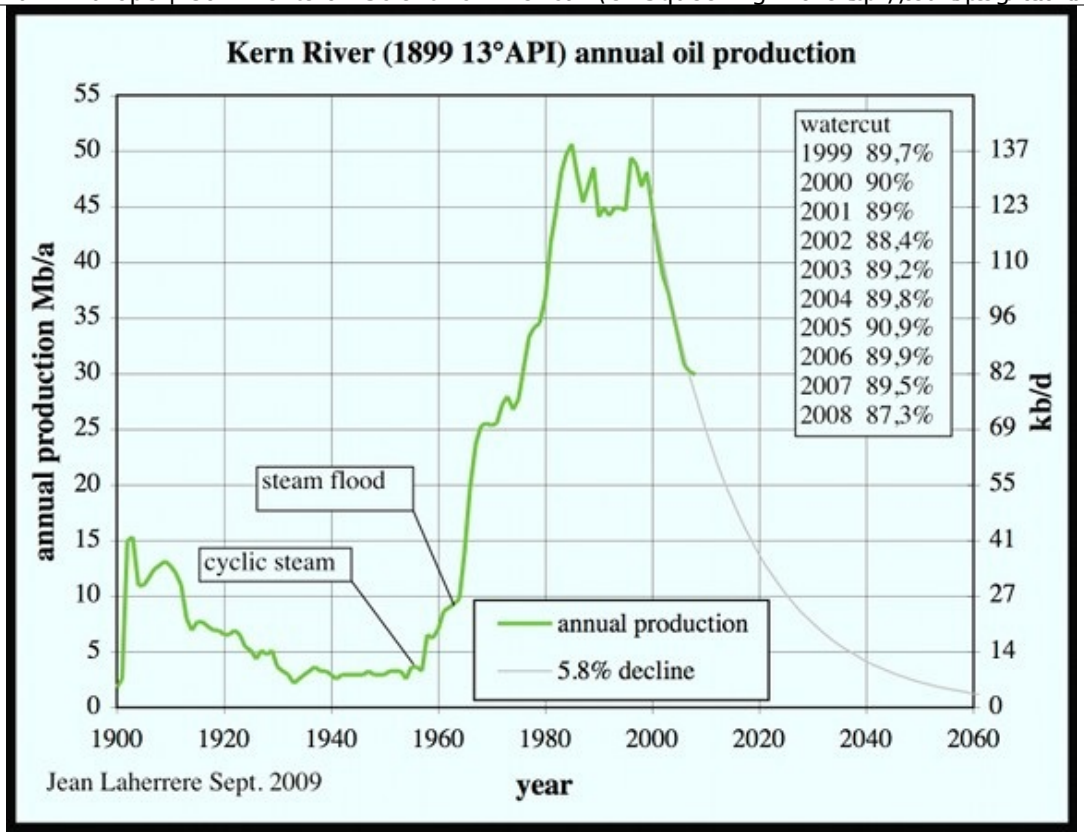
The field covers an area of about 10 000 acres (43,5 km2), and supports 9 300 producing wells, giving a spacing of one per acre. The normal US spacing was one well per 40 to 160 acres, with 10

per acre for infill drilling,. Kern River is a good example of a field that has been over- drilled.

The ultimate recovery is reported to have grown again in 2001 and 2007 to over 2 500 Mb. But plotting annual against cumulative production shows a decline since 1999 of about 6% a year. As illustrated in the following figure, an extrapolation of the 1999-2008 data gives an ultimate of 2 530 Mb, compared with the 2 634 Mb reported by the California Department of Conservation for 2007.



It may also be noted that production per well since 1996 can also be linearly extrapolated towards 2 530 Mb. Annual oil production may be extrapolated with a decline of 5.8 % per year, which corresponds with a cumulative production 2009-2060 of 436 Mb. This is below the reported remaining reserves, which with an indicated production of less than 1 b/d are likely to be below the economic or EROI limit, that being the energy return on energy invested, which has to be positive to make sense.



The Oil-in-Place is variously estimated at 3 500 Mb by Swartz et al 2008 (*Kern River Field: Framework and Future of an Old Giant* AAPG Search and Discovery Article #90076), or at 4 000 Mb by McGregor (1996). It means that the recovery factor is over 70%, when Maugeri talks about a present 35% recovery factor for the world.

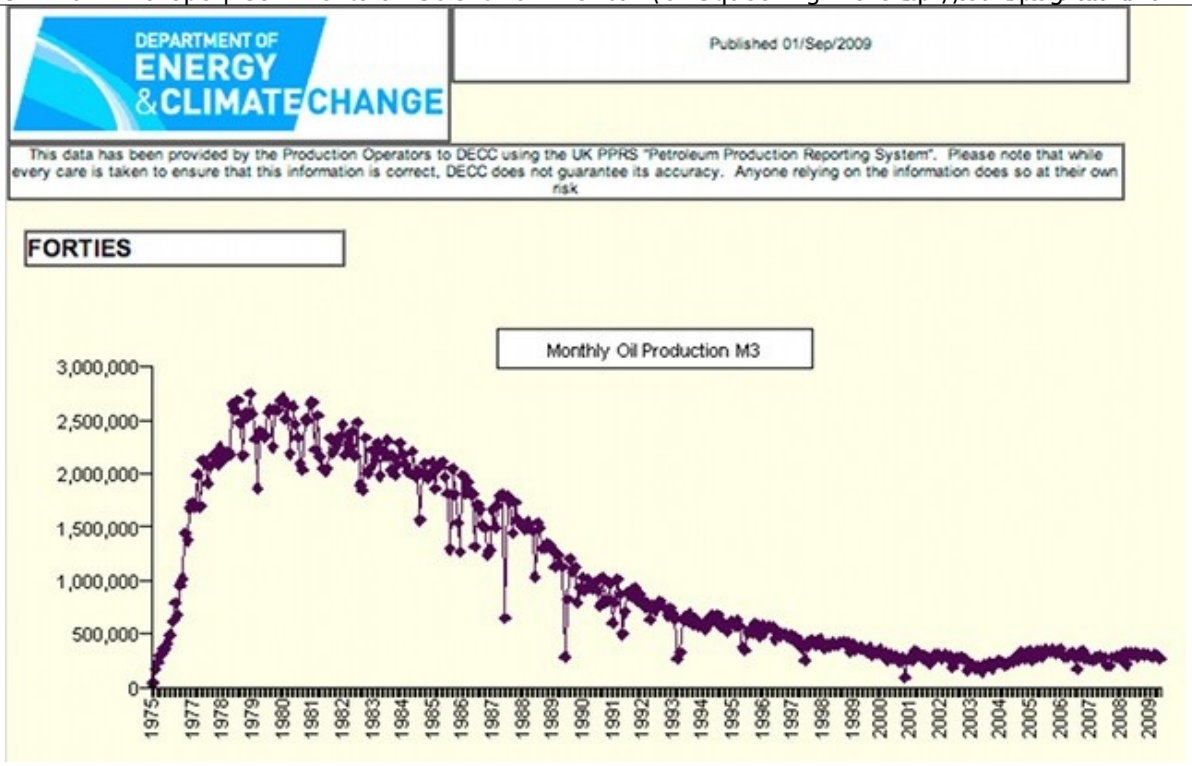
It is clearly ridiculous for Maugeri to take the example of this very old field of heavy oil found by a hand-dug well and subject to steam flooding, that peaked more than 80 years after discovery, and is still producing, as in any way representative of modern conventional fields. It is like comparing apples with oranges. The USGS makes the same mistake when it applies US field growth based on Proved Reserves (1P) to the world as a whole that is based on Proved & Probable (2P) reserve reports.

US field growth is due to the outdated reporting practice, based on obsolete 1977 SEC rules. These rules will be changed in 2010, to allow Proved and Probable Reserves (2P) to be reported, meaning the US reserve growth will likely disappear.

Maugeri writes:

> According to common wisdom, a field's production should follow a bell shaped trajectory known as the Hubbert curve and peak when half of the known oil has been extracted.

He confuses the pattern of individual field production with that of basin or country patterns. Hubbert was modelling US and world oil production, and not that of an individual field which normally increases rapidly in its early years before declining slowly, with the peak coming before the midpoint of depletion, as well illustrated by the Forties Field in the UK North Sea.



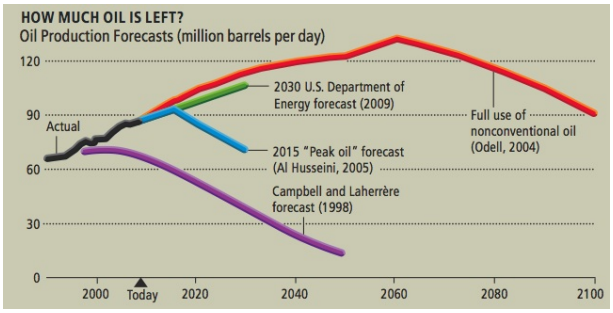
Maugeri, as an economist, talks only about Proven Reserves, but he should know that the development of a field, especially offshore is based on Proved and Probable Reserves. The net present value of a development is computed on the Mean Probability value and not on Proved Reserves alone, which have a 90% Probability.

Maugeri writes:

> But I believe that those projections will prove wrong, just as similar « peak oil » predictions (Campbell & Laherrère, SciAm March 1998) have been mistaken in the past.

That article was entitled The End of Cheap Oil, at a time when oil was trading at $13/barrel, before sinking to $10/ barrel in the following year. It was in fact ranked by the Sonoma University as within the top 25 most important papers published in 1999. It is hard therefore to accept Maugeri's claim that it was mistaken.

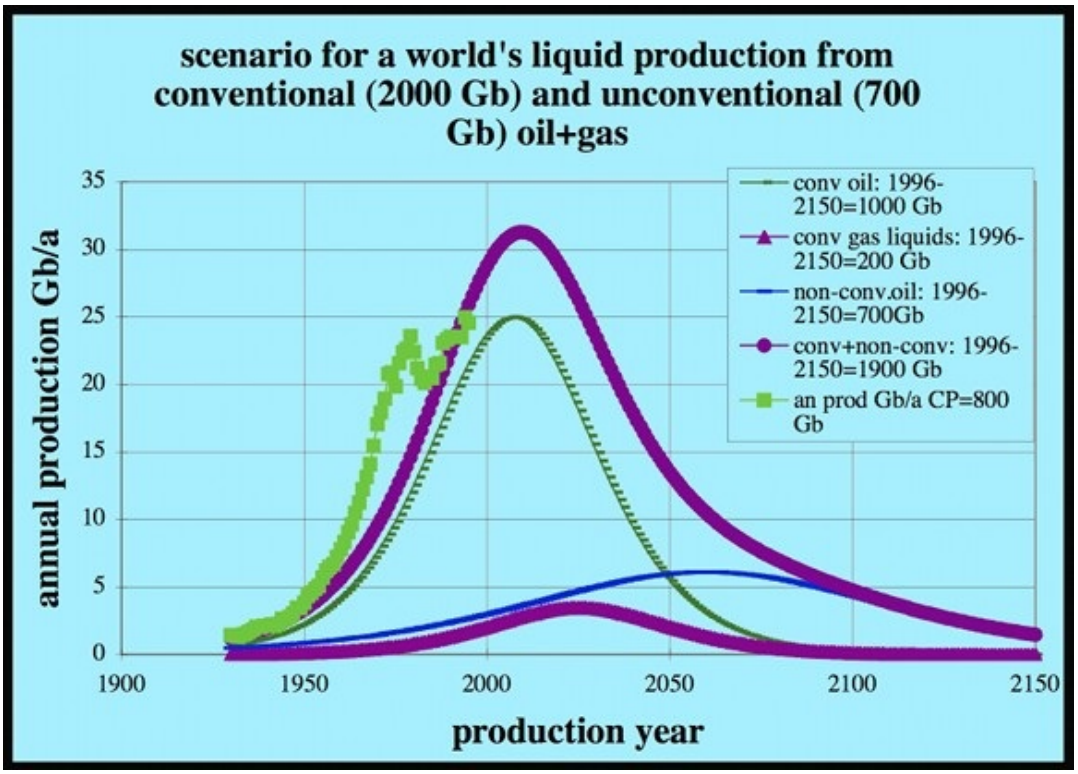
Maugeri's graph compares the oil production forecast of Campbell and Laherrère 1998 with others, failing to note that the former referred to conventional oil only whereas the others refer to all categories.



In fact, Campbell and Laherrère submitted graphs covering all the categories, which were not in

fact published. The plot for combined conventional and unconventional forecast 31 Gb/a (namely 85 Mb/d) for 2007, which is close to what was actually produced. The mistake was not in the substance of the forecast but in not having better checked the title of the graph published by the Scientific American.

The following graph, for the world's liquid production, was published in Laherrère J.H. 1999 *Assessing the oil and gas future production and the end of cheap oil?*, CSEG Calgary, April 6.



Recent ASPO (Campbell &Laherrere) forecasts are compared with others (but not those from Maugeri) by the US National Petroleum Council 2007 «Hard truths».

Maugeri writes:

> It is absurd to predict a peak of world production because it presupposes that one knows how much oil is in the ground.

On that basis, logic suggests that it would be equally absurd to accept Maugeri's claim that the peak is not coming until 2030 or that more than 50 percent of the oil known at the time will be recoverable.

That said, we can agree that no one really knows the volume of oil in the ground, meaning that little reliance can be placed upon assumed recovery factors.

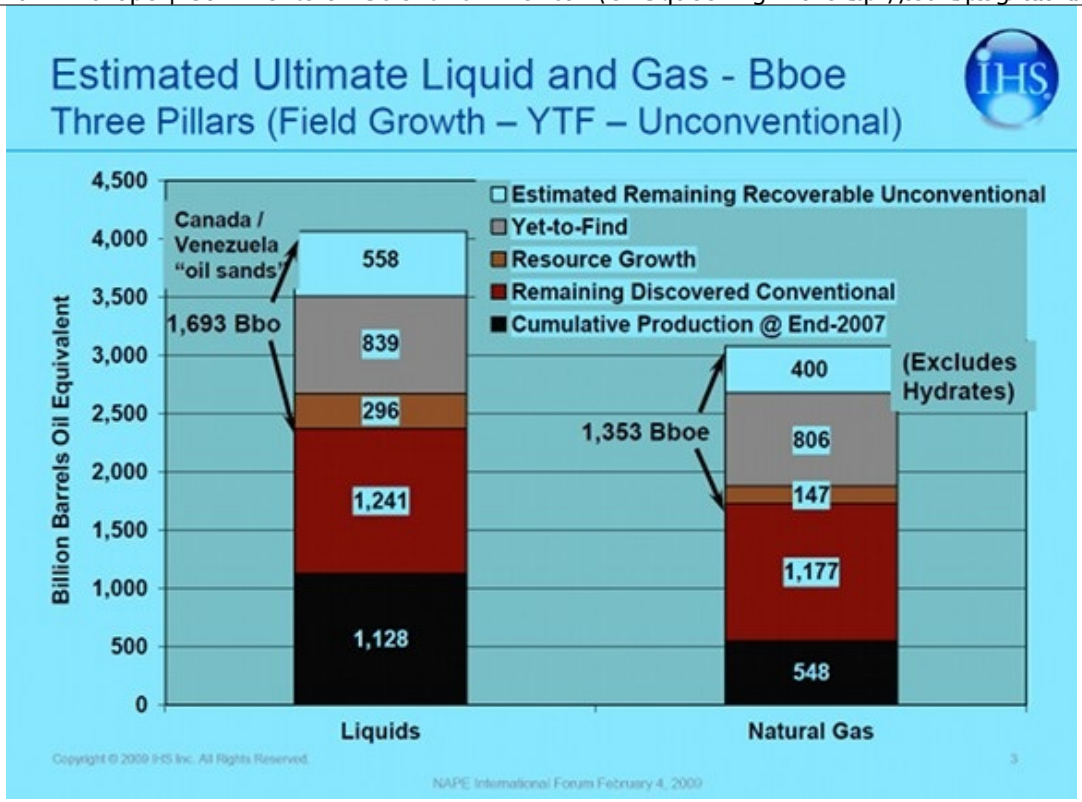
Maugeri believes that only one third of sedimentary basins have been explored, but out of about 600 sedimentary basins only 200 basins have the potential of generating oil or gas for well understood geological and especially geochemical reasons. He shows that for the past 25 years, the United States had more exploration drilling than any other country.

But he fails to say that the ownership of oil rights in the United States differs from that in the rest of the world. The United States supports more than 20 000 oil companies, and the economics are also quite different. For the last 25 years over 60 000 pure exploration wells (New Field Wildcats) have been drilled in the United States compared to 5000 in Canada and 40 000 for the rest of the world. The average size of oil discovery is 0.3 Mb for United States, 0.9 Mb for Canada and 740 Mb for the Middle East, 14 Mb for Africa , and 7 Mb for the world outside US & Canada. Again comparing the United States with the rest of the world is comparing apples and oranges!

Maugeri writes:

> [...] by 2030 we will have consumed another 650 billion to 700 billion barrels of our reserves, for a total of around 1600 billion barrels used up from the 4500 to 5000 billion figure

This implies that today we have consumed less than 950 billion barrels, which is clearly mistaken. Cumulative production is over 1100 Gb according to the industry database produced by IHS (NAPE International Forum February 4, 2009 Where Will Tomorrow's Oil and Gas Come From? Pillars of Oil and Gas, P.H. Stark and K. Chew).



Paolo Scaroni, the Chief Executive of ENI, the company for which Maugeri works received the Petroleum Executive of the year 2008 award. He said in the Petroleum Review of March 2006 [pdf!] in page p25 that replacing reserves is the nightmare of IOCs.

Scaroni's words seem to be conflict with Maugeri's statement that *most of the planet's known resources are left unexploited in the ground, and still more wait to be discovered.*

Perhaps Maugeri should tell his Chief Executive where all these unexploited and undiscovered oil reserves lie to help ENI replace oil reserves. Its 2008 Annual Report shows that both its oil reserves and production have fallen compared with 2006 but that its gas has increased. It may prompt the cynic to ask if whether Maugeri can distinguish oil from gas.

Luís here again: Maugeri's article has some similarities with one penned by Peter Jackson of CERA a couple of years ago; in both cases the authors do not seem to understand what the Hubbert Method is. But while Peter Jackson definitely showed some scientific objectiveness, the same can't be said of Leonardo Maugeri.