In Defense of the Hubbert Linearization Method

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The *Hubbert Linearization* (HL) method (the Hubbert Linearization term was coined by Stuart Staniford, with The Oil Drum) is essentially based on the mathematical observation that a parabolic (bell shaped) curve can be plotted as a line, when we plot P/Q versus Q, where P = annual production and Q = cumulative production to date. The parabolic curve assumption is based on the premise that we tend to find the big fields first. In essence, "Peak Oil" is the story of the rise and fall of the big fields. The parabolic HL model suggests that the world and Saudi Arabia are both probably now in terminal decline. While the overall world decline may be quite gradual, the impact on world oil exports will probably be very severe. See the following article for more information on the HL method: *Texas and US Lower 48 Oil Production as a Model for Saudi Arabia and the World.*

Note that if the Ghawar Field in Saudi Arabia is in long term decline, which I believe that it is, it is my understanding that every single field that has ever produced one million barrels per day (mbpd) or more of crude oil (crude + condensate) is now in decline. Saudi Arabia has one field coming on line that might make one mbpd, although a lot of people have their doubts. The only real confirmed one mbpd and larger field on the horizon is Kashagan, which probably won't break the one mbpd mark until 2020 at the earliest.

As many people know, Kenneth Deffeyes predicted, using the HL method, a world crude oil peak between 2004 and 2008, most likely in 2005. (He observed that world production apparently peaked in 2000, but he never backed away from his mathematical model that the probable peak was between 2004 and 2008.)

In any case, in the above referenced Texas/Lower 48 article, we supported Deffeyes' work, and we added the Texas model. I observed that Texas peaked at a later stage of depletion than the Lower 48. Post-peak, Texas declined at a faster rate than the overall Lower 48. This was the basis of my warning a year ago that the world and Saudi Arabia were on the verge of a decline in crude oil production. It may be a coincidence, but relative to monthly peaks in 2005, world crude oil production is down more than one percent and Saudi crude oil production is down about 11% (EIA data, crude + condensate).

Note that the initial Lower 48 decline was quite gradual, less than 1% per year for the first two years. Also note that the world has the benefit of the non conventional tar sands production that was not a factor in the Lower 48.

A key piece of data in support of an involuntary decline for the world and Saudi Arabia is the price of oil. The average monthly Brent crude oil price in the 20 months prior to 5/05 was $38 per

barrel. The average monthly Brent crude oil price after 5/05 has been about $62, within a range of $54 to $74. Again, we saw this pattern of higher oil prices and lower production in the Texas and the Lower 48 in the Seventies.

The Lower 48 peaked in 1970. Based only on production through 1970, the Lower 48 was right at the 50% of Qt mark in 1970 (Qt is a mathematical estimate of URR for a region).

Russia peaked on a broad plateau centered on 1984. Based only on production through 1984 Russia was right at the 50% of Qt mark in 1984. Russia made from just above 11 mbpd to just below 11 mbpd for five years on both sides of 1984.

At my request, Khebab generated a post-1970 production profile for the Lower 48 and a post-1984 production profile for Russia, using only production data through 1970 for the Lower 48 and through 1984 for Russia to generate the models.

The post-1970 cumulative Lower 48 production, through 2004, was 99% of what the model predicted it would be, see Figure One, Hubbert Linearization technique applied to the Lower-48. Only the data between 1942 and 1970 (green points) are used to perform the fit (red curve).
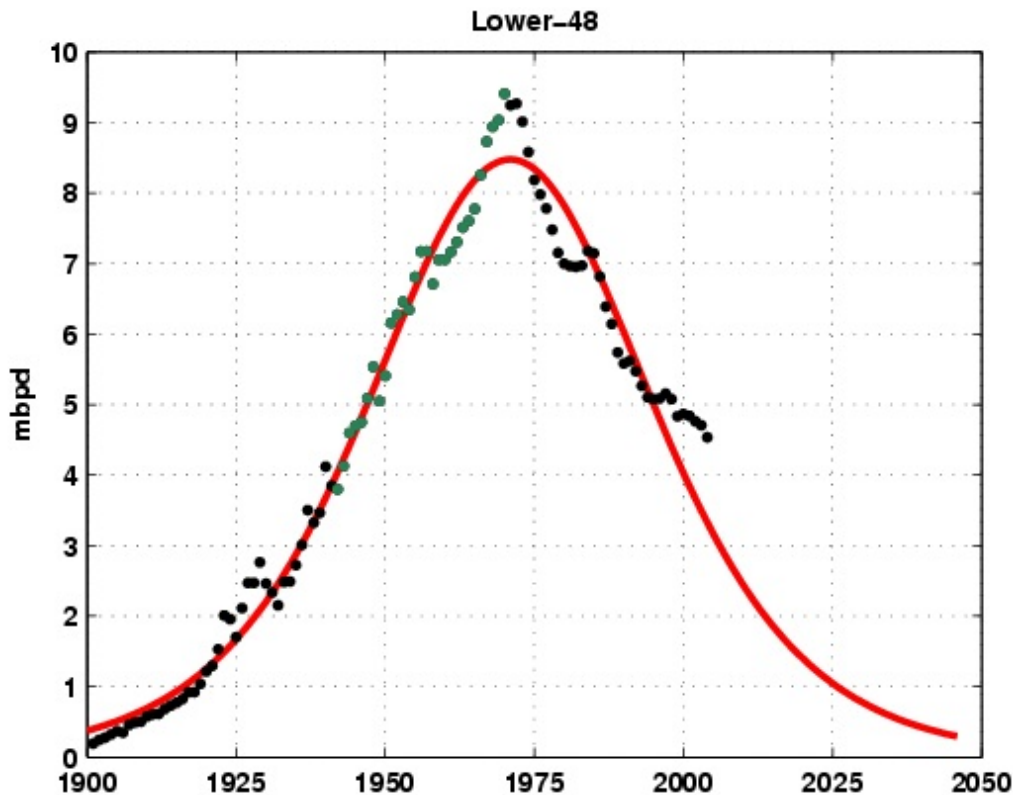
The post-1984 cumulative Russian production, through 2004, was 95% of what the model predicted it would be. In other words, Russia was "underproduced" through 2004, see Figure Two, Hubbert Linearization technique applied to Russia. Only the data through 1984 (green points) are used to perform the fit (red curve).

Russia (Crude Oil + Condensate)
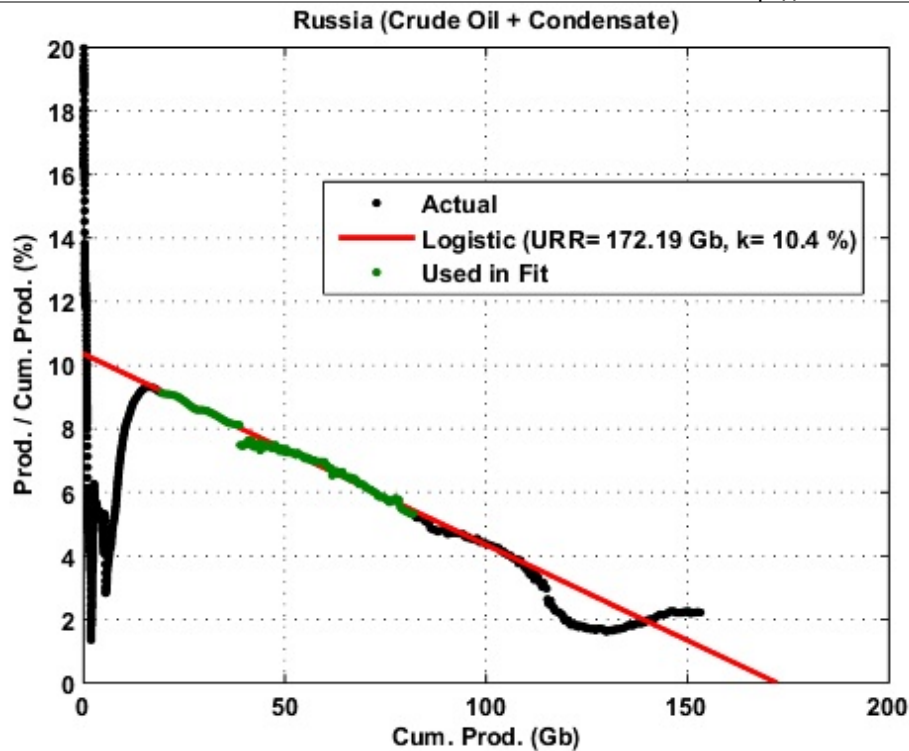
In 2006, Russia "caught up" to where it should be. Now, as Russia has approached the 100% mark (100% of what it should have produced based on the HL model), its year over year increase in production has been slowing appreciably, and since October, 2006, the EIA has been showing basically flat production for Russia.

Russia (Crude Oil + Condensate)
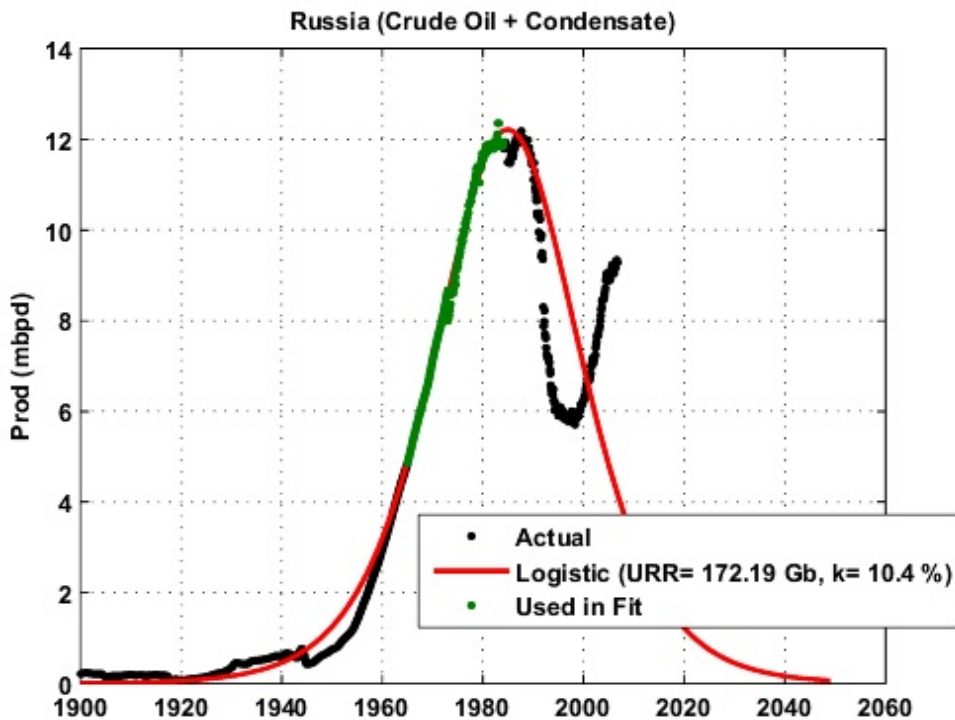
By the way, based on data through 1999 and 2005 respectively, both the North Sea and Mexico started declining right at their respective 50% of Qt marks.

Now, a lot of claims that the HL method is inaccurate are based on a misuse of the method. In most cases, we don't get an accurate Qt estimate until we get a P/Q intercept in the 5% to 10% range. For example, a lot of people use the UK as an example of where the HL method doesn't

work, but this is based on wildly improbable early P/Q intercept of 30%.

A lot of the disbelief/denial about a World/Saudi peak is very similar to the reaction that we saw in the Lower 48/Texas in the Seventies. Probably 9 out of 10 Texas oilmen were shocked that Texas didn't show increasing production after the Texas RRC went to a 100% allowable in 1972.

But the bottom line is that we are using a fairly objective method that takes the two pieces data that we have the most confidence in, annual and cumulative production, to generate mathematical models. And many large producing regions--Texas; Lower 48; Total US; North Sea; Russia and most recently Mexico and the world--have shown production patterns that are consistent with the HL models.

The most common response I get to all of this is simply denial. The reserve situation "can't be that bad."
All I can tell you is what the mathematical models are telling me. In a nutshell, I think that the reserve situation is that bad, and I think that we are facing the near certainty of rapidly declining net export capacity worldwide.

While reasonable people can disagree on what the annual and monthly production data are telling us about our proximity to Peak Oil, in my opinion it is a virtual certainty that Peak Oil, from the point of view of importers, is here. This virtual certainty is due to the absolutely lethal combination of flat to declining crude oil production in exporting countries and the (sometimes rapidly) rising domestic consumption in exporting countries, resulting in sometimes catastrophic declines in oil exports. For example, based on EIA data, net total liquids exports by the UK dropped at an annual rate of 60% per year from 2000 to 2005.

In effect, in my opinion the very lifeblood of the world industrial economy is draining away in front of our very eyes. The only question is how fast the patient is bleeding to death.

Sorry to be the bearer of bad news, but you wuz warned.

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