



Peak oil: The four stages of a new idea

Ugo Bardi *

Dipartimento di Chimica, Università di Firenze, Association for the Study of Peak Oil and Gas (ASPO), Polo Scientifico di Sesto Fiorentino, Via della Lastruccia 3, 50019 Sesto Fiorentino (Fi), Italy

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ABSTRACT

The present paper reviews the reactions and the path of acceptance of the theory known as “peak oil”. The theory was proposed for the first time by M.K. Hubbert in the 1950s as a way to describe the production pattern of crude oil. According to Hubbert, the production curve is “bell shaped” and approximately symmetric. Hubbert's theory was verified with good approximation for the case of oil production in the United States that peaked in 1971, and is now being applied to the worldwide oil production. It is generally believed that the global peak of oil production (“peak oil”) will take place during the first decade of the 21st century, and some analysts believe that it has already occurred in 2005 or 2006. The theory and its consequences have unpleasant social and economical implications. The present paper is not aimed at assessing the peak date but offers a discussion on the factors that affect the acceptance and the diffusion of the concept of “peak oil” with experts and with the general public. The discussion is based on a subdivision of “four stages of acceptance”, loosely patterned after a sentence by Thomas Huxley.

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1. Introduction

“Peak oil” is a term that summarizes the concept that the production of crude oil—as well as that of most finite resources in a market economy—grows, reaches a maximum (peak), and then gradually declines to zero. This concept was expressed for the first time by Marion King Hubbert in 1956 [1] and today the maximum production is often termed “Hubbert's peak”. Hubbert had proposed that the production curve is “bell shaped”, that is symmetric. In this case, the peak occurs when about half of a non-renewable resource is extracted.

The mechanisms that lead to bell-shaped production curves are by now well understood [2–4]. Initially, the extraction of an abundant and cheap resource leads to economic growth and to increasing investments in further extraction. Gradually, however, the cheap resources are depleted and extraction costs become higher because of the need of extracting lower quality deposits. In time, investments cannot keep pace with these rising costs; the growth slows down and, eventually, production starts declining. Here, “costs” are to be understood in monetary terms but, at the same time as energy costs which grow for physical reasons related to the lower concentration and or lower quality of the resource. In other words, what creates the bell curve for an energy resource as oil is the variation with time of the net energy of extraction, also

known as “Energy Return on Energy Investment” (EROEI). [5] In the case of oil, the EROEI effect is enhanced by physical factors related to the fall in reservoir pressure and also with the fact that less and less oil-bearing reservoir is in touch with the wells as the oil is progressively extracted.

The worldwide Hubbert's peak for crude oil (“peak oil”) is expected to occur during the early decades of the 21st century [6]. It is often stated that peak oil is a turning point for humankind, a “rollover” that will cause dramatic changes in the world's economic and social system. The concept of peak oil is more and more often mentioned in the media and it has caught the imagination of the public. In general, the reaction to peak oil is not different than that to any new idea, and we may say that it follows a series of four phases, loosely patterned after a well known sentence by Thomas Huxley “*History warns us that it is the customary fate of new truths to begin as heresies and to end as superstitions.*”

Phase 1: Never heard of it.

Phase 2: It is wrong.

Phase 3: It is right, but irrelevant.

Phase 4: It is what I had been saying all along.

At present, the attitude of the public and of the specialists is spread over these four attitudes. The situation is dynamically changing with perceptions moving from one stage to another. Human perception does not change the reality of oil depletion, but

* Fax: +39 055 457 3118.

E-mail address: ugo.bardi@unifi.it

it does change the way society reacts to it. Most people of the “peak oil movement” will say that it is important to diffuse the concept of the impending worldwide peak in order to accelerate the work on measures able to prevent its negative consequences. The question is whether the public will actually react to an event that will likely spread over several years and that will not be, in itself, spectacular. If history is a guide, it is likely that the global peak oil will be forgotten in the turmoil of political events accompanying it. [7,8].

In the following, I will briefly discuss the present situation with peak oil, how the concept is spreading, the criticism it generates, and its likely perspectives in the near future. It may well be that the peak has already taken place for the so called “conventional oil”; but here I am not going to enter into a specific discussion of the peak date.

2. Stage one: never heard of it

At present, it seems that almost all operators in the field of oil and fossil fuels have at least heard something about the concept of peak oil. The idea is also spreading with non specialists and the general public. A search of the web shows that the term “peak oil” has had a certain success, but that it is still overshadowed by news about politics, entertainment, and other scientific concepts. In October 2006, a Google search returns the following results

Google hits

Hollywood	197,000,000
Terrorism	111,000,000
Nanotechnology	26,600,000
Global warming	26,500,000
Peak Oil	4,320,000
Hydrogen economy	1,120,000

Howard [9] has examined the diffusion of the peak oil idea in the media, finding a hierarchy similar to the one above. The term “peak oil” and similar ones are mentioned in the media orders of magnitude less frequently than such terms as “war to terrorism” and “Hollywood”. Reading the newspaper and watching TV, the general public has a much different view than that of the people studying resource depletion. Nevertheless, the concept of peak oil is fast growing in people’s consciousness. According to Howard [9], the growth rate of mentions in the media for terms related to the peak oil concept is of the order of 500–2000% per year and even more.

The problem is that the diffusion of the idea is accompanied by a loss of focus on what the idea exactly means. As it spreads, “peak oil” becomes a poorly defined concept. It becomes the focus of highly pessimistic visions and it risks becoming a cult. This is clearly counterproductive as it causes strong counter-reactions based on arguments just as emotional as those of expect the end of the world from the peak. Still, it is evident that the public awareness of the concept is destined to increase in the near term.

3. Stage two: it is wrong

Facing for the first time the concept that oil production is going to peak and to decline, the reaction of the public and of experts alike is one of complete disbelief. Assuming that the concept is understood, and not trivialized as meaning something like “the end of oil is coming”, a more articulated reaction can take two main forms; one that Hubbert’s theory itself is wrong, the other that the data in input are overly pessimistic.

Sometimes, the criticism can be simply stated as “if there is still oil to be extracted, why should production decline?” Apparently, some people cannot understand that extracting oil from the ground is not like extracting beer from a refrigerator. Barrels are not all the same and extracting low EROEI oil is not the same as extracting high EROEI oil. Sometimes, it is pointed out that not all historical cases of oil production show a bell shaped curve (e.g. Saudi Arabia) or show double peaks (e.g. Iran or Russia). Indeed, the assumptions that stand behind the Hubbert model are based on a free market economy. That is not always the case, of course, depending on the political situation and the actual production may stray away from the Hubbert curve [10]. The multiple peaks observed historically can be often correlated with abrupt political changes, wars and revolutions. The Hubbert based models of the world production do not, and cannot, take into account such events which, however, will often worsen the situation.

A different kind of criticism is that the price mechanism of a free market will prevent the peak from occurring. If peak oil gets close, it is argued, prices will increase. High prices will generate more investments in exploration and extraction technologies and this will also increase the amount of oil that will be found and put on the market. Hence, there will be no peak. This model is often termed the “Resource Pyramid” and it goes back to Zimmermann [11]. On this point, it should be noted that there are obvious differences from a geological point of view in the fact that some resources are “graded”, that is exist in a range of declining concentrations (such as most metals) and some resources being “either-or” such as oil, which either is present in liquid form, or not present at all. However, from an *economic* point of view, all mineral resources are graded. That is, even for crude oil the cost of extraction varies smoothly with such factors as depth, size, quality, location, etc. In principle, therefore, the Resource Pyramid model should be valid for crude oil, as well. It is a seductive model since it implies that no mineral resource will ever run out. However, it does not take into account that in an economy there is more than just the extraction of mineral resources. If all the elements of the economy are dynamically considered [12,13], the result is that the amount of capital that can be transferred to the extraction of minerals from other sectors of the economy is limited. At some point, the costs of extraction become too high to be sustained and the decline must start even though a fraction of the resources may be left in the ground.

But, by far, the most common criticism made at the peak oil concept is that the reserves available are so huge that there is no reason to worry; the peak will come, maybe, but we still have several decades, or even more, to go [14]. Indeed, the estimation of the global peak date is often based on a geological assessment of the available reserves. This assessment is, of course, uncertain both because of geological uncertainties and because of economic uncertainties. The latter kind of uncertainty is perhaps more important since it depends on market prices, something notoriously difficult to forecast. Another cause of misunderstanding is the wide use of reserve/production (R/P) ratio. It claims that reserves support current production for say 40 years. But it is absurd to suggest that production can stay flat for so many years and then stop overnight.

As long as we consider estimates made by professional geologists, modelling based on the Hubbert curve is robust, in the sense that the uncertainty in the estimates does not strongly affect the year predicted for the peak. Unfortunately, nothing prevents people with no other qualification than that of being able to put together strings of (more or less) intelligible sentences on a keyboard from stating that oil is actually “infinite” as it is created by mysterious abiotic processes in the earth’s mantle. At the same time, nothing prevents people with no qualifications in geology

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