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Sustainability, Peak Oil

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Synonyms

Highest global oil production level; Maximum level of crude oil production

Description

In 1956, Marion King Hubbert, studying the trend of US oil reserves and production, elaborated a model and predicted that world production of conventional oil would peak around 2000. According to the Hubbert model, oil production in a large geographical region follows a symmetric, bell-shaped curve, at the top of which the peak is reached; this happens when approximately half of the available oil resources are extracted. Later in the 1990s, a new study about oil depletion was published by two petroleum geologists, and the peak oil issue started to receive a renewed interest around the world. Based on the same Hubbert curve, they predicted that oil production would have reached its peak around 2010 (Bardi 2019).

Even if in 2019 the predicted peak oil has not been reached at global scale yet and we can still count on oil, its supply has become less sustainable because it counts more and more on unconventional oil reserves, which require more expensive, complex, and environmental impacting, extraction, and production processes. The easily accessible and cheap crude oil seems to be in decline.

Introduction

Today, fossil fuels represent the most important global commodities and are essential for all human activities as they supply the majority of the total energy consumed by societies. Oil is the most important energy source in the world, and its main use at the moment is in the transport sector. It must be remarked that oil is not only used as a fuel, but it is also the fundamental raw material for the petrochemical sector which is at the basis of many other downstream industrial sectors, which produce thousand different products, such as plastics, textile fibers, dyes, detergents, drugs, etc. Petrochemical sector seems to be the main source of oil consumption growth. It has been calculated that even if the recycling rate of plastics doubled at global scale, this would result in a reduction of oil demand of 1.5 million b/d, compared to a forecasted increase of consumption at global scale of five million b/d (IEA 2018).

According to the BP statistics, global oil production rose by 2.2 million b/d in 2018, and almost all of the net increase was accounted for by the USA, considered an absolute record. At the

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same time, global oil consumption grew by an above-average 1.4 million barrels per day (b/d), equivalent to 1.5%. The largest growth occurred in China (680,000 b/d) and in the USA (500,000 b/d), while important declines occurred in Venezuela (−580,000 b/d) and Iran (−310,000 b/d) (BP 2019).

The increase in oil prices does not reflect directly the scarcity of oil reserves, but it is linked to several technical, political, and economic factors. This is the reason why oil price cannot be used for making predictions about oil resources depletion, and different theories have been elaborated over the years about the peak oil. To predict the time when oil will be no longer available for human activities is very complicated due to the lack of reliable data regarding three aspects: the cumulative production, i.e., the quantity of crude oil which has been extracted until now; the estimate of the amount of oil which can be extracted from known fields; and the quantity of oil which still has to be discovered (Campbell and Laherre 1998).

The Peak Oil Predictions

In the field of fossil fuels studies, one of the most popular names is Hubbert.

Marion King Hubbert proposed his model and predicted the decrease of oil production, basing his assumptions on empirical studies about the production of coal and oil in USA, conducted until the time he presented his work in 1956. He stated that: ". . .the total amount of oil discovered is the sum of cumulative production and proved reserves. Since this is approaching the peak of the curve, the figure suggests that, even if we are less than half through in our exploration for petroleum, the period of declining rates of discovery has almost arrived" (Hubbert 1956). Hubbert applied his model to the production of oil in USA and predicted that the production of oil would have reached its peak in 1970, while the production of oil at global scale would have reached its peak around 2000 (Bardi 2019).

Since that moment, a general fear started to circulate at global scale, and many studies were carried out in order to assess the most veritable time in which humanity would have faced the peak oil and then the irreversible decline in oil production. It has been argued later that Hubbert never proposed a theory that should have explained the reasons for his "bell shaped" curve. Many years later, Campbell and Laherrere wrote a paper titled "The end of cheap oil," in which they updated Hubbert's model with new estimates of oil reserves and predicted that the global crude oil production would have reached the peak around 2004–2005 (Campbell and Laherrere 1998).

This study also generated a movement of ideas called the "peak oil movement," followed in 2001 by the birth of the ASPO (Association for the Study of Peak Oil and Gas), constituted by different scientists and researchers, with the aim of studying and sharing knowledge about the peak oil, and alerting, at the same time, about oil scarcity (ASPO 2019).

All these predictions have been demonstrated to be only partially correct, especially because they did not take into account the huge importance that unconventional oil would have reached on the market later on.

The Role of Unconventional Oil

In recent years, the majority of new oil come into production derives from unconventional resources. Conventional oil is extracted through traditional process, based on single wells in which oil flows to the surface, almost naturally, thanks to the difference of pressure with the underground, or through the use of artificial lift mechanisms. A producing system for unconventional oil is instead more complicated, requiring more sophisticated recovery technologies and a completely different production scale (Deutch 2014). Unconventional oil includes: heavy oil, tar sands and shale, or tight oil (Gordon 2012). All these unconventional sources require special extraction and production processes.

Usually when the price of oil is high, added to the uncertainty about the amount of reserves and the prediction of the peak moment, there is an

increase in investments in innovative exploration and extraction techniques, and this in turn makes unconventional oil production competitive.

The annual flow rate of production is usually smaller for unconventional oil than for conventional oil, in addition to hugely capital-intensive nature of the production processes as well as bigger environmental impact (see environmental impact). For example, the hydraulic fracturing technique used to extract tight oil may constitute a risk for fresh water resources pollution; oil sands recovery requires a lot of energy and pollutes a lot of water (Hughes 2011).

For sure, the production of unconventional oil has given the opportunity to expand the global oil supply in the recent years, but this has happened with a substantially higher economic and environmental cost. Furthermore, many scientists agree that these unconventional sources are unlikely to offset the depletion of conventional oil production for long time (Aleklett et al., 2010).

A useful indicator for assessing the cost efficiency in the use of energy sources is the Energy Return on Investment (EROI). It has been calculated that EROI for discovering oil in the USA has decreased from more than 1000:1 in 1919 to 5:1 in the 2010s, and for production from about 25:1 in the 1970s to approximately 10:1 in 2007. Unconventional oil, such as tar sands and shale oil, gives a lower EROI, having a mean EROI of 4:1 and 7:1 (Hall et al. 2014).

Conclusions

Even if the exact date for peak oil is still unknown, we all should start to adopt alternative strategies to preserve oil reserves, to find better alternatives, use oil more efficiently, and save it just for the petrochemical use until we will be able to shift the world dependence from crude oil to biobased materials.

Rather than investing in searching new oil extraction sites, a better and more efficient alternative could be to introduce policies that reduce demand for fossil fuels by encouraging energy conservation and efficiency, using renewable electricity and biofuels (see energy biofuels) in the transport sector, using carpooling (see carpooling) and carsharing, and implementing intelligent traffic management measures. It has been calculated, for instance, that an efficiency improvement in traditional cars can bring a positive effect, in terms of reduction in oil demand, which is three times bigger than that given by 300 million electric vehicles forecasted in 2040 (IEA 2018).

Considerable savings of oil can also come by modal shifts from private vehicles to public transport in the case of passengers, and from road to rail in the case of freight (Wakeford 2012).

Summary

The prosperity and stability of modern society is strictly linked to the production and consumption of energy and especially oil (Tverberg 2012), which is still the world's largest energy source, providing 33% of global primary energy consumption (BP 2018). For this reason, scenarios and projections, regarding the availability of oil reserves, the production costs, and market prices, are very important for decision and policy making. The world has not faced the peak oil yet, and this is due especially to the exploitation of unconventional oil and the exploration activities in difficult geographic areas. So, even if human population can still count on oil supply, what has to be considered is at which conditions this happens. Easy and cheap oil reserves have been exploited already, and what we are using now are reserves of low-quality oil which is more difficult to extract, more pollutant (see pollution), and more expensive to work with; unconventional oil which needs very impacting extraction processes; and oil extracted from new fields discovered through expensive and impacting techniques, as in deep waters. So, as much as oil production gets closer to its predicted peak, it becomes less and less sustainable.

Cross-References

► Carpooling

- ▶ Energy Biofuels
- ▶ Environmental Impact
- ▶ Pollution

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