

Encircling the Peak of World Oil Production

by Richard C. Duncan
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The peak of world oil production, followed by an irreversible decline, will be a watershed in human history. The goal of this paper is to predict the world peak. Production data from 42 countries representing 98 percent of world oil production are used rather than reserve estimates. We believe the former is a more reliable indicator of the future for

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most oil-producing regions, with the exception, to some extent, of the OPEC nations which, at times, observe production quotas. In addition, we recognize that regional and global economic cycles occasionally change demand for oil, so production figures are not always a current indication of oil-field potentials. However, for the longer term, production is a useful measure of true oil-field potential. A judgmental factor also is applied based on the structure, stratigraphy, thermal maturity of oil basins, and volumes of sediments in potential oil basins yet to be fully explored. Combining these factors with the oil production numerical data, we have arrived at 2007 for the time of world oil production peak. Alternative fossil fuel sources, which might replace conventional oil (defined as oil from wells using only primary and secondary recovery methods) cannot come on stream early enough or in sufficient quantity to significantly affect the peak time. They will merely augment the far end of the world production curve. Our estimates do include recent technological developments in both exploration and production, but these also seem to be a minor factor in establishing the peak. Replacement of oil, to the degree this can be done, by renewable energy sources, such as solar, wind, hydro, or tidal require much time and capital to bring on

stream in significant quantity, and only limited world progress has been made in these sources. They likewise do not seem to move the peak significantly. We do recognize, however, given all possible variables, it is likely that our date of 2007 may be wrong. The question is how far wrong? We believe it is reasonably close and on-going studies will narrow whatever error exists. Importantly, the peak of oil production will occur within the lifetimes of most people living today.

The Coming of Oil

In all human history, no substance has so changed economies, social structures, and lifestyles so rapidly, so profoundly, and affected so many people as has oil. Oil brought personal motor transport, intercontinental air travel creating worldwide economic and cultural interchanges, revolutionized agriculture and manufacturing, and lifted much work from the backs of many people.

Oil converted muddy trails into millions of miles of paved roads and continues to maintain them. Oil powers vehicles to transport goods cheaply across great distances. Oil is high-density energy in a most convenient form, which can be taken to remote areas for use and can be stored easily for long periods of time. Oil's versatility in end use has no equal. Oil also is a cause of war.

Oil More than Energy

Oil and its close companion, natural gas, are the bases for thousands of other petrochemical products, especially chemicals to promote crop growth and to defend crops against insects and diseases. Bartlett (1986) correctly states that modern agriculture is simply a way of converting petroleum into food.

The Going of Oil

The coming of oil has changed the world, presumably much for the better. However, oil is finite, and its inevitable eventual decline and departure will be a signal event in human history. Anticipating the time when this trend begins is the subject of this paper. It seems to be sooner than most people expect. The critical related matter of what alternatives may exist to replace oil also is briefly examined.

A 550 Million-year Inheritance

Oil has formed in the upper approximately 16,000 feet of the earth's crust since at least as far back as the Cambrian Period, some 500 million years ago (MYA). It is a rich inheritance of highly concentrated solar-derived energy captured by myriad organisms, chiefly algae, and then distilled by geological processes into an energy form that is unequaled by any other energy source in its versatility and convenience in handling. Now, within one human lifetime, one-half of this unique 550 MYA inheritance will have been spent. The remainder will go very fast.

The Oil Interval

We are not in the Age of Oil – the term "Age" is for things of longer duration. We are living in a

brief oil interval. The average citizen pulling into a service station and saying "Fill'er up" gives little or no thought to where the oil came from or how long that stream of gasoline will continue to be available to flow into the car's tank. There were two brief times in the 1970s when the American public was made acutely aware of what the lack of oil might portend. However, those long gas lines are now a faded memory and, for the youngest third of the U.S. population, there is no such memory at all.

THE WRONG QUESTION, AND THE PEAK

If the public does think briefly about future oil supplies, the question usually asked is, "How long will oil last?" This is the wrong question. Oil will be extracted in some insignificant quantity perhaps 200 years from now. The critical question is: "When does the *peak* of world oil production occur?"

IMPORTANCE OF WORLD PEAK

The importance of the "peak of world oil production" generally is not grasped. However, it is the peak time that is critical. Hubbert (1967) emphasized its significance stating:

Because gas and oil are exhaustible resources, the discovery history of these fuels in any particular area must be characterized by a beginning, a period of increase, a period of decline, and ultimately, an end. In this sequence, the most significant dates are neither those of the beginning nor of the end,

but that of the transition between the period of increase and the period of decline.

In other words, the peak.

The United States already has felt briefly the importance of peak. Precisely, as forecast by Hubbert in 1956 (either ignored, or regarded in gross error by most people at the time), U.S. oil production peaked in 1970. The United States actually had to begin to import oil about 15 years before the peak was reached, as demand already had outstripped production capacity by peak production time. The fact that U.S. production had peaked in 1970, and then began to decline further assured the success of the Arab oil embargo against the United States in 1973, and altered U.S.-Middle East foreign policy.

The United States, well past its peak of oil production, now imports more oil than it produces. When world oil production peaks, there will be nowhere else for the world to go for more oil. The problem then will become the harsh reality of distribution of an irreversibly declining resource, rather than dividing more and more oil, as has been the pleasant experience to the present. This is when final competition begins for the last half of world oil reserves. It will be a global struggle. All countries will be involved, the industrialized countries more so than the less developed countries. For the first time, the entire world will be locked in one massive contest for a single resource.

This may be the most important event in human history. In terms of lifestyles, our relatively cheap and

abundant food supplies, the manufacture of many things, which depend on the energy of oil, and the distribution of these products, the beginning of the decline of oil production will be a momentous event.

The Study

We have forecast the peak of oil production and related data in each of 42 countries, accounting for 98 percent of 1996 world oil production.

From production data, together with a judgmental amalgam of the possible production variables in the 42 countries, we have produced a composite world oil production profile from 1960 to 2040. This also shows the profile and production peaks of OPEC and non-OPEC nations, and the significant final crossover point when OPEC nations (by that time chiefly those of the Persian Gulf region) will be producing one-half and, from then on, more of the world's remaining oil.

The profile forecasts that the peak of world oil production will occur about the year 2007. After this time, with the world production peak at 30.6 Gb a year (the International System term "Gb" is equivalent to the use of the term billion barrels in the United States), world production drops rapidly to 24.6 Gb a year in 2020 and to 11.5 Gb per year in 2040, a total decline of 62 percent in just 33 years. The importance of the date when OPEC production becomes the dominant world oil source is also at the time world oil production peaks – 2007! This may have significant implications, because at that time

the world's remaining oil reserves and production will be mostly under control of the Persian Gulf nations.

Present world oil production is about 25 Gb a year. The 2040 production will be less than one-half the present oil consumption, and will face a demand from a world population, which is estimated to be 50 to 70 percent greater than at present. Compounding world energy demands will be the increasingly industrialized nations (particularly Southeast Asia, China, and India) wanting more energy per capita. China, Southeast Asia, and India, now with some 60 percent of the world population, are getting motorized wheels. If China used oil on a per capita basis, as does the United States, China alone would use more than ten million barrels a day beyond the present entire world oil production.

Insignificant Production Beyond 2040

Although some oil will be produced well beyond 2040, we have not plotted the "tail" of the production curves of individual countries or of the world beyond the year 2040. Production then will be insignificant compared with potential world demand. The happy oil interval will have come to an end for all practical purposes. This is why the question "How long will oil be produced?" is of little consequence.

Forecasts of Oil Peak

In earlier years a number of forecasts have been made about the peak time of world oil production. With few data points and many of the potential world oil

basins only poorly explored at that time, most of these estimates already have proved to be wrong. Thus, by implication, it may be assumed that current projections also will (hopefully) be wrong. However, the world's potential oil provinces now are well known (Campbell, 1997b). Recently, based on more and better data, further forecasts have been made and, although each estimate is slightly different than the others, most now cluster remarkably, one might say alarmingly, close together on that critical time. These include forecasts by Campbell (1991, 1997b), Campbell and Laherrère (1998), Duncan (1997), Fleay (1995), Hatfield (1997), Ivanhoe (1995, 1995, 1997), and MacKenzie (1996). All estimate the peak by 2013, or earlier, except for the most optimistic forecast by Edwards (1997) of 2020. There are, however, some divergent views on the time of world oil production peak as noted by Brown (1998), but those cited here are the most recent and, we believe, the most nearly correct.

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