

## THE END OF THE FIRST HALF OF THE AGE OF OIL ABSTRACT

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Petroleum geologists know that oil and gas were formed but rarely in time and place in the Earth's long geological history, which means that they are finite resources, subject to depletion.

In brief, oil is derived from algae that proliferated in certain geological and climatic settings. The great bulk of the World's oil comes from two brief epochs of extreme global warming, 90 and 150 million years ago, which coincided with the development of stagnant rifts as the continents moved apart. Gas is derived both from plant remains and from ordinary oils that been overheated on deep burial. Peak generation commenced when the organic material had been buried beneath younger sediments to depths of about 2000m

Once formed in these exceptional conditions, oil and gas migrated upwards through the rocks to zones of lesser pressure. Some was dissipated; some escaped at the surface, leaving behind a heavy tarry residue; and some was trapped in geological structures large enough to become oil and gas fields.

The first step to find oil and gas is to secure the rights to do so. Geologists then examine the area searching for the rare right combination of circumstances. They are aided by geochemistry to determine the effective source rocks and geophysical surveys to map the structures beneath the surface. Petroleum geology has itself made great strides. Prospects of varying degrees of scientific assurance are identified and then tested by an exploratory borehole, known as a *wildcat*. It determines whether or not the prospect is valid, also providing more information with which to evaluate the remaining prospects. Exploration proceeds in any area until a moment-of-truth is reached either by a discovery or by the realisation that the area lacks the essential geology, in which case it remains forever barren. Normally, the larger fields were found first, being too large to miss.

When a promising discovery is made, responsibility passes from the explorers to the engineers, charged with implementing an efficient scheme of production to maximize profit against investment. Huge investments are at stake offshore and in remote areas, so it makes good sense to work on a cautious step-by-step basis.

There is a polarity about oil, being either there in profitable abundance or not there at all, that distinguishes it from coal and other minerals, where concentration is the key factor.

There are many different categories of oil and gas, each having its own costs, characteristics and depletion profile. Some are cheap, easy and fast to produce, whereas others are the precise opposite.

To avoid confusion, it is useful to identify *Regular Conventional Oil (and Gas)*, and define it to exclude:

- Oil from coal and "shale"
- Bitumen
- Extra-Heavy Oil
- Heavy Oil (10-17.5° API)
- Deepwater Oil and Gas (>500m)
- Polar Oil and Gas
- Natural Gas Liquids from gas plants
- Coalbed methane, "tight gas" etc.

It has contributed most to-date, and will dominate all supply far into the future, determining the peak of all production.

Production has to mirror earlier discovery after a time-lag. Discovery in any field or area comprises the sum of past production and estimated future production of known fields, termed *Reserves*.

The determination of *Reserves* poses no particular scientific challenge, but the reporting of reserves is subject to much confusion. Oil companies generally under-reported to comply with strict Stock Exchange rules. The practice

led to a comforting but misleading impression of *Reserve Growth* that has been mistakenly attributed to technological progress and extrapolated into the future. Certain OPEC countries over-reported, as they vied with each other for production quota, based on Reported Reserves. Many countries have failed to update their estimates.

If valid information were in the public domain, the issue of peak production and decline would be entirely self-evident. As it is, the skills of a detective have had to be used to obtain the assessment of *Regular Oil* as follows:

Produced	944 Gb (billion barrels)
Reserves	761
Discovered	1705
Yet-to-Find	145
Yet-to-Produce	906
Total	1850

There are various ways by which to forecast production, but theoretical and empirical evidence indicate that the peak in any country normally comes close to the midpoint of depletion when half the total has been consumed. On this basis, and making allowance for the special circumstances of the Middle East, the global peak of oil production is forecast for 2005/6. Gas depletes differently, being more influenced by infrastructure, but is expected to reach a plateau of 125 Tcf/a (trillion cubic feet a year) from 2025 to 2045.

After peak, oil production declines at 2-3% a year, such that the production of *Regular Oil* is set to decline from 66 Mb/d (million barrels a day) in 2005 to about 45 Mb/d in 2020 and 20 Mb/d by 2040. It is not about to run out.

The evaluation implies that the World reaches the end of the First Half of the Age of Oil, which lasted 150 years. It was an epoch in history that saw the rapid expansion of Industry, Transport, Trade, Agriculture and Financial Capital, made possible by an expanding supply of cheap oil-based energy. The population increased six-fold in parallel.

Of particular importance is the issue of Financial Capital, which is not easily grasped. Banks lent money in excess of what was on deposit and charged interest, creating money out of thin air, but the system worked because

confidence in Tomorrow's Expansion provided collateral for To-day's Debt. In addition, world trading currencies, now the US dollar, delivered a hidden flow of new capital to the issuing country. The current high oil prices reflect profiteering from shortage by oil companies and producing governments, as production costs have not changed materially, providing yet more unearned Capital.

The Second Half of the Age of Oil now dawns, and will be marked by the decline of oil and all the depends upon it. This includes Financial Capital as the decline of oil-based energy removes the essential confidence that there will be Expansion Tomorrow to support To-day's Debt, a critical relationship. It spells, in other words, the End of Economics, as presently understood and practiced. That in turn calls for entirely new political structures and policies to replace those based on out-dated economics.

The evidence accordingly suggests that the World faces a discontinuity of unprecedented magnitude, undermining the very fabric of society and economic wellbeing. In short, it faces a Second Great Depression, triggered not by Peak Production itself but by the perception of the long downward slope that follows it.

An economic downturn will be accompanied by a fall in the demand for oil and gas such that prices may collapse, rendering the development of *Non-Conventional Oil* and Renewable Energies uneconomic, compounding the problem.

The primary challenge is to deal with the transition. One simple and straightforward mechanism is for the countries of the world to cut their demand to match world depletion rate. A Depletion Protocol to so achieve needs to be implemented as a matter of urgency

The transition will be a time of great tension and difficult adjustment, with a strong possibility of more resource wars. But as the Century passes, the survivors will come to terms with their new environment. It may herald a new regionalism as world trade declines, and people again come to live within their own resources. It might indeed be a time of happiness giving people a new-found respect for themselves, each other and the environment within which Nature has ordained them to live.