ENERGYFILES FORECASTING MODEL
- Oil Production

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3.1 INTRODUCTION

Oil is valuable because it is versatile and easy to find, currently existing in commercial quantities in over 100 countries of the world. It is easy to transport, through pipelines and in tankers, and can be readily transformed into useful work in simple engines. The high energy density of oil makes it the fuel of choice for automobiles and its jet fuel fraction is the only viable energy source for the airline industry. The energy density of most other sources is just not high enough.

Furthermore oil has been abundant for over a century. Many of the technologies to find and produce oil in onshore locations were developed early in the 20th Century and since then, with the appearance of fully offshore operations in the 1950s and then deep water operations in the 1990s, oil has been relatively straightforward to find.

Except in war time increases in oil demand have easily been met by supply whilst exporters, collaborating to restrict output, have only artificially created upward pressure on price. Various such groups have attempted to do this but especially The Texas Railroad Commission in the 1930s and the OPEC alliance after 1973.

However at the end of 2003 times began to change. Instantaneous (available in less than a year) spare oil production capacity in the OPEC countries, outside of generally unwanted heavy oil fractions, had all but disappeared. OPEC members too were bringing oil onstream as fast as they could, encouraged by higher oil demand and declining supply elsewhere, but restrained by shortages of politically acceptable investment capital and, in part, political will.

Exceptional demand growth in Asia, coupled with flagging levels of output in some major countries and persistent delays elsewhere, had created a new capacity-constrained environment in which permanent geological supply limitations now controlled price, with investment in more demanding oil fields physically unable to proceed fast enough. Although supply was recovering due to new developments in deep waters (especially in West Africa, Brazil and the Gulf of Mexico), the Caspian Sea and off Sakhalin Island in Russia, demand was easily able to mop up the new capacity as other areas declined, most notably the North Sea and Mexico, and onshore Russia.

And then, in 2008, after an unprecedented oil price spike, demand collapsed due both to high prices and the beginnings of a global economic crisis. Projects began to be deferred and to support the price OPEC began restricting output once more. This exceptional volatility is a sign of things to come and, at such a critical time, with oil still uniquely important to the health of the global economy, and in particular its transport needs, it is important that businesses have a realistic, consistent, and unbiased picture of future global oil output. Businesses need to develop the most suitable investment strategies by weighing true oil consumption levels that can be met, against desired global demand over the short and medium term.

OIL AND GAS 2009: Global Ten-Year Projection in Excel

Contact admin@energyfiles.com for details

Having predicted and witnessed oil price volatility signalling permanent geologically-controlled supply problems, Energyfiles has published a comprehensive dataset forecasting oil and gas production, consumption and trade in every producing country in the world and all of the key regions.

The data are divided into 4 parts including countries within the mega-regions of; The Americas; Europe and the FSU; Africa and the Middle East; and the Asia-Pacific. Each dataset is a 10-year historic and 10-year projected production, consumption and trading series, split into oil/gas and onshore/offshore where appropriate. Units are barrels per day for oil and cubic metres per year for gas. Where volumes are summed gas is converted to barrels per day equivalent using a standard conversion factor. Charts graphically demonstrating the production, consumption and trading trends accompany the datasets, along with brief descriptions of projected supply and demand conditions in each country or region.

This document describes the forecasting supply model used by Energyfiles.

3.2 MODEL SUMMARY

Author: Energyfiles (Michael R. Smith)

Availability: www.energyfiles.com (detailed results for a fee)

Date: First model February 2000, several full-scale revisions since then, updated daily

Scope: Global (100 oil producing countries, 219 oil consuming countries)

Type: Bottom-up (fields) where possible, otherwise operators, projects and/or basins

Oils: Fossil hydrocarbon liquids including condensates, LPGs, other NGLs, oil sands; not including liquids converted from gas, coal, shales and algae/plants

Splits: Sedimentary basins/countries/regions
Onshore (fields, projects, yet-to-find/yet-to-develop, NGLs, oil sands)
Offshore (fields, projects, yet-to-find/yet-to-develop, NGLs, 0 to 399mWD, 400 to 1000mWD, 1001m to 2000mWD, above 2000mWD)

Profiles: Old producing fields constrained by past performance and decline curves (including expected IOR)
New producing fields constrained by past performance (if available), announced plateau and decline curves and most likely volumes (not necessarily proven plus probable)
Undeveloped fields constrained by plateau and decline curves (where announced) and most likely volumes
Yet-to-develop (where numbers not announced)/yet-to-find - modelled profiles based on expected gross volumes by basin and timing of developments
Summed estimates where individual data unavailable

Reserves: Summed most likely volumes (which implicitly includes "reserves growth") plus most likely volumes for new and potential finds

Assumptions: Investment proceeds rapidly based on historic investment rates driven by oil price; the world remains a stable place to work (a previous, now superseded, model had different scenarios at different levels of OPEC restriction)

Uncertainties: Many - most sensitive are; estimate of length of plateau and rate of decline in old giant fields that apparently have sustained output in OPEC countries; presence and timing of large scale YTF volumes in relatively unexplored basins; detailed data from developing world

Data sources: Too numerous to list

Purpose: To provide businesses with fundamental and substantiated production forecasts based on technical data (rather than demand expectations) to improve forecasting of prices as well as capital, equipment, materials, services and labour needs; the realisation, quantification and timing of peak and decline in global oil supply is a side effect of this analysis

3.3 DETAILS

3.3.1 Definitions

There are many ways to categorise and measure oil production and consumption. Different countries and companies use different units and splits, and there are various rules defining how numbers should be publicly recorded. In the Energyfiles data resource considerable effort has gone into ensuring that definitions for oil are internally consistent and apply equally in all regions.

Produced oil volumes are volumes at the surface, not in the pressured reservoir where the presence of dissolved gas means oil occupies around 10% to 30% more space.

Any fossil hydrocarbon production that can exist without conversion as a liquid at surface temperatures is allocated to the oil domain. Thus natural gas liquids (NGLs) and liquefied petroleum gases (LPGs) are oil, even though they must be recovered from oil or gas, whilst liquefied natural gases (LNGs) and gas-to-liquids (GTLs) are not included as oil since they have to be converted from gas and/or stored at low temperatures.

Some extra-heavy oils and bitumen may be extracted by mining under a different economic model to conventional oil. This production may later be converted by refining into synthetic oil (synfuel). These, specifically those contained in the Athabasca oil sand Belt of Canada and in the extra-heavy oil Orinoco Belt (La Faja) of Venezuela, are also included as oil production.

An alternative definition is that all fossil liquid hydrocarbons that can move in a pipe and are directly useable after refining as a fuel supply or in the chemical industry, are defined as oil, except those converted from gas, coal or shale. Their abundance or otherwise controls the oil price in the same general fashion.

The only oil volumes not included within the detailed analyses are refinery gains as these volumes are partly dependent on refineries and their design (that could be located anywhere in the world).

Offshore and onshore regions are considered separately as they may present different basic profiles. All production from offshore wells is allocated to the offshore category even if the field from which it is derived is primarily onshore. Thus, where onshore fields extend offshore but offshore wells are used to exploit the oil and/or gas in these reservoirs (such as in California and Azerbaijan), the hydrocarbons produced from these wells are assumed to be offshore including those produced from man-made islands.

However, where onshore fields extend offshore or fields are entirely offshore but close to the coast, production may solely or partly be obtained through deviated wells drilled from onshore locations (such as in England, Germany, Alaska and Sakhalin Island). All the production from the onshore wells, including those drilled from piers, is assumed to be of onshore origin. Of course sometimes the true allocation is uncertain (but usually immaterial).

Oil and gas production volumes from freshwater inland areas, particularly from Lake Maracaibo in Venezuela but also from Lake Erie in Canada and the swamps of Louisiana, are assumed to be onshore. The equipment used to drill and develop such fields is primarily of an onshore type, erected on submerged barges or fixed platforms. Although similar to wells drilled from piers and on artificial islands, such a breakdown is convenient in view of how data are published in relevant countries.

Deep water volumes are subdivided into 3 intervals; 400 to 1000m; 1001 to 2000m; and above 2000m. This is for the convenience of forecasting deep water production volumes where output is growing rapidly and is subject to extra uncertainty, but is also useful for high tech equipment suppliers to estimate future needs.

3.3.2 Production profiles

Oil production peaks in wells, fields, individual basins, in provinces, in countries and in regions. It has been shown both theoretically and empirically that oil (and gas) production, freely extracted from a sedimentary basin, rises to a peak at a roughly steady rate as new fields come onstream then begins to decline at a roughly steady rate as the first fields begin to lose pressure and deplete and the last few are unable to make up the difference.

Oil production has a relatively sharp peak whilst in the past gas production has tended to, at first, form a plateau due to different marketing methods, in particular due to restricted pipeline capacity. Pricing adjustments, improved technology and the use of earlier infrastructure that subsidises later output, all act to stretch decline out creating a skewed distribution.

It is often stated that peak occurs when 50% or 60% of ultimate total recoverable oil reserves have been produced. Empirical analysis of the many offshore and onshore basins that have already peaked show that the sharpness of the peak and the timing are much more variable, heavily controlled by commercial conditions, fiscal terms, infrastructure and one-off events. But eventual decline is always inevitable.

Empirical studies also show that output from wells declines by an average of around 15% per year. Individual fields made up of a collection of offshore wells decline by an average of around 10% per year because the best wells are worked-over and secondary and tertiary recovery projects briefly stem decline (although some small offshore fields can decline at up to 30% per year depending on the production method and reservoir). By the same token onshore fields and sedimentary basins decline by around 5% per year as, respectively, new wells or progressively smaller fields are added. These are averages – individual wells, fields and areas have considerable variation.

Countries and regions may decline by less still, if they contain several different basins, which are not developed in parallel. Giant onshore fields also decline at slower rates as development expands slowly across large surface areas. Offshore the oil peak is easier to define than onshore because of the rapid and consistent way full field developments proceed in individual basins.

Gross decline rates are averages and can be affected by factors such as new investment ideas, technological breakthroughs (e.g. deepwater exploitation), by the discovery of new provinces or plays that lead to a one-off jump in output unrelated to decline in the existing system, and by commercial and political circumstances, such as output restriction by OPEC members.

3.3.3 Past (historical) production profiles

Cumulative production is the total volume of oil up to a given year that has been produced. For obvious reasons cumulative production figures are much more certain than remaining reserves and resources and yet-to-find resources described below. However even these may vary from source to source due to inclusion of different sets of oil sources (e.g. condensates and NGLs) in the totals, failure to realise which oil sources have been included, and poor reporting in the past, especially in the developing world.

Energyfiles analyses past production profiles to the end of the preceding year using bottom-up year by year data. Field by field, basin by basin and/or country by country data are reviewed, where possible, whilst attempting to account for, and iron out, inconsistencies in reported yearly production and cumulative production numbers from different sources.

3.3.4 Remaining reserves and resources profiles

There are various definitions of resources and reserves used in the oil industry. For example SPE definitions differ from SEC rules, and different views are presented by geological surveys around the world (such as those in USGS Circular 831). Unfortunately many conflict with each other in some way. Furthermore the same terms are used in promotional documents designed to obtain money from investors - documents that are undoubtedly subject to bias.

In common English "financial reserve" covers the value of shares held and assets such as buildings and other possessions. "Financial resource" covers cash that can immediately be obtained from current and savings accounts. Thus reserves are assets that cannot be immediately converted to cash (they are held for later use or "in reserve") whilst resources are available straight away.

The oil industry reverses this usage. Reserves are quantities that can be produced under current economic conditions whilst resources are quantities that may be produced at some time in the future. Reserves must have economic connotations, defined as that part of a resource that has been discovered and will see production under prevailing or reasonably anticipated economic conditions. The differences are confusing for economists and the confusion leads to highly uncertain reserve numbers emanating from even the most rigorously scientific countries and companies in the world.

For this reason Energyfiles uses published reserves numbers as little as possible, preferring the use of past or published forecast plateau volumes based on likely reservoir performance as the driver for the full life field or basin profiles available to clients. Energyfiles only considers published reserves as a secondary check. This also has the important benefit of making the false concept of reserves/production ratio redundant.

However, because of widespread usage, and the desire of many organisations to obtain so-called reserves numbers for countries, Energyfiles uses the term "most likely remaining reserves" to estimates reserves and resources of developed fields and discovered fields that are producing, under development, planned or announced (with potential production profiles). These "reserves" are summed from production profiles to the year 2140 (the year chosen is the width of a standard Excel sheet with some spare columns for information).

Although reserves must always be economic for them to be recovered, for the purposes of Energyfiles, "most likely remaining reserves" are taken to be the most likely amount of oil that has been discovered but not yet produced, and will be recovered under economic conditions that could exist in the future if the world remained a stable, comfortable place to live in. If the world becomes unstable (due to a third world war or a massive global recession for example) then all economic forecasts, and indeed most other forecasts, become temporarily meaningless.

An estimate of remaining reserves profiles through meticulous analysis of every field in production or scheduled for production is the most effective and unbiased way to arrive at a gross profile. However, apart from the potential for errors in each individual field (which may be significant but also may, in a gross sense, cancel each other out), there is a major drawback. The method will under-estimate remaining output by omission. The potential under-estimate is accounted for in yet-to-find and yet-to-develop numbers described below.

Published proven reserves estimates (tabulated in publications such as the Oil and Gas Journal and World Oil) are enigmatic. For countries that define proven reserves to be economic at prevailing conditions (especially in the US where the SEC is very strict to prevent stock market fraud) they are likely to be under-estimated due to normal accounting conservatism. The value of an upstream oil company is not based on its balance sheet or current net income; it reflects future cash flow from production, which in turn is based on its reserves. Such reserves thus rarely accurately reflect total "most likely remaining reserves" except very near depletion and abandonment. In any case NGLs and condensates may or may not be included.

Conversely for countries with a vested interest in maintaining a high proven reserve figure (for example to encourage exploration or, in the case of OPEC, to negotiate for production quota) proven reserves are more often than not an overestimate of most likely recoverable volumes. This is clearly seen in historical numbers where sudden changes coincide with political events or changes in world conditions or when no changes at all occur because of lack of updating.

When OPEC members increased their reserves so dramatically in the 1980s the countries were scrambling for quota so there was strong pressure for overestimation. Conversely it may be argued that pre-nationalisation numbers were deliberately underestimated in order for the western oil companies to justify restraining output to keep prices high. Whatever the case the numbers are clearly unsupportable in their current form and Energyfiles takes the view, based on a survey of the geological evidence, that true OPEC "most likely remaining reserves" lie somewhere in between the two extremes, depending on individual countries. In fact, it seems that as exploration matures fewer countries are even announcing reserves and detailed production, perhaps to avoid embarrassing admissions of decline.

It is also worth noting that Soviet era reserves classifications, which are still used in some FSU areas and China, consider only the physical presence of resources, ignoring commerciality issues. For this reason Soviet remaining reserves could have been overestimated in the past by up to 50%. A special problem in the forecasting model is that detailed, trustworthy information on Russia and the Middle East is difficult to access.

Unfortunately, most publications simply adhere to published values, which invariably do not reflect actual most likely remaining reserves for the reasons given above. In fact many of the world's large organisations use information as unreliable as that in the BP Annual Statistical Review of World Energy, which draws on the Oil & Gas Journal, which in turn relies on a questionnaire sent to foreign governments to which many do not reply. Analysts use the BP Annual Statistical Review of World Energy widely and often unquestioningly.

Energyfiles analyses all categories of remaining reserves derived from as many sources as possible but, where necessary, amends them using control from likely production profiles of individual fields. Past production, reasonable future production profiles, and estimates of how a government or company might be influenced by outside factors in declaring reserves are all given consideration.

3.3.5 Reserves growth

The term "reserves growth" (reserves added) has been used to express the apparent increase in remaining oil reserves attributed to producing fields over time. If real, this increase should increase global estimated remaining reserves each year without additional discoveries. However only oil discovered through new exploration wells drilled into new prospects may truly be thought of as reserves added.

It is important to realise that upward revisions of reserves in producing fields derived from additional development drilling or new recovery methods or re-interpretation of production, engineering and seismic data are not reserves added in the year in which the revisions were announced but reserves added in the year the field was first declared commercial. This is because the new oil is actually oil that was deemed to have been probably or possibly present in field discovery and appraisal wells that were drilled at the time of discovery. The fact that lower numbers were announced merely reflects the need for conservatism to satisfy stock exchange and other actual or psychological rules.

Consequently reserves included in future years through "reserves growth," where the reserves are defined as "most likely remaining reserves" (rather than an artificial "proven" reserves), are already included in the figures used in Energyfiles production profiles. Statistics that do not account for this artificial discrepancy, and attribute the reserves added to the year in which they are announced, are often taken as evidence that we are still finding more oil than we are producing – a falsehood as most of the oil was actually identified years ago.

3.3.6 Yet-To-Find and Yet-To-Develop resource profiles

Volumes of oil that have not been physically defined, except by analogy with other areas, are the most difficult to estimate. Energyfiles benefits from an evaluation based on sedimentary basin (or plays) where possible so that trends of discovery can be identified geologically. However numbers are inevitably uncertain, especially in areas where output may be realised far in the future. Fortunately such output is largely irrelevant to the short and medium term; the key intervals of importance to investment decisions.

Production profiles derived from YTF/YTD volumes are created using simple generalised models. For example Figures 1 and 2 show an offshore model. First fields are large and easy to find with later ones progressively smaller. Offshore fields are onstream within 3 or 4 years of discovery. The subsequent production profile is set by reservoir and fluid type as well as location and investment conditions. Output for each field reaches a plateau in 2 or 3 years; stays there for 2 or 3 years and then declines at a rate depending on circumstances (onshore fields tend to rise and fall slower and plateau longer).

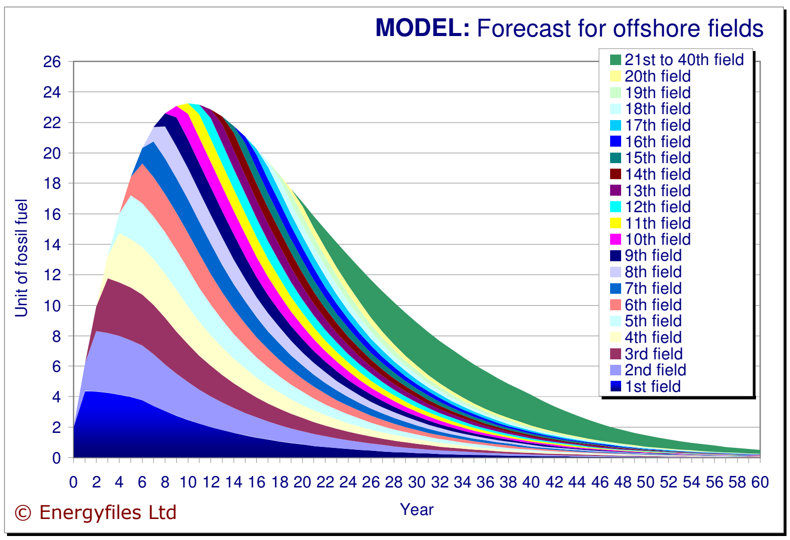

Figure 1: Model profile – Offshore oil production

SOURCE: Energyfiles

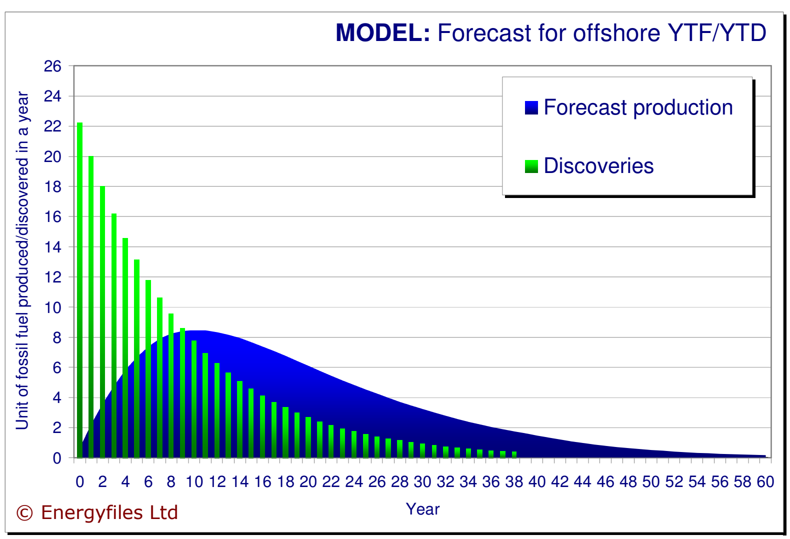

Figure 2: Model profile – Offshore oil discoveries

SOURCE: Energyfiles

Although the summed volumes realised in Energyfiles models coincide with many oil company estimates, some analysts believe that the world's YTF total is much greater. The United States Geological Survey (USGS) report a mean estimate around 3 times the total numbers in this model. USGS numbers have been criticised by many experts in petroleum geology although the American Association of Petroleum Geologists (AAPG) and the US's Energy Information Administration (EIA), in the main, support the USGS.

Some Europeans have suggested a conspiracy – high potential global availability ensures that oil prices remain low whilst the US is the largest importer. Energyfiles does not believe in conspiracies (except conspiracies of incompetence); instead it believes that the problem lies in both the optimism of geologists directly exposed only to exploration in one of the most prospective countries in the world and a misunderstanding of the fact that proven reserves, especially onshore, are deliberately minimised in the US (for commercial reasons) but this is not necessarily the case elsewhere.

Geologists are, in their nature, optimists. If they were not many of the world's discoveries, estimated at having less than 50% chance of success, would never have been drilled (nor would the over 90% of exploration wells that have been dry holes). But when a geologist says he or she is an optimist, the truth is that realism would have given a different result. Exploration geologists get paid to speculate. Geologists speculate on outcomes without incurring personal cost. In fact a geologist unenthusiastic about his exploration area is unlikely to stay in his post for long. Furthermore technology has led success rates to improve substantially in the last two decades, which partly explains why exploration drilling levels failed to rise as high as those of the early 1980s, despite the substantially higher oil price in 2007 and early 2008. There are not enough good prospects.

The US has always led the world both in finding oil and in disseminating technology and believes it will continue to do so in the rest of the world despite the fact that such technology has, for many years, been freely available everywhere. The truth is that companies have struggled to find global reserves for 30 years and have now explored almost everywhere that it is possible to explore. The best estimates of the discovery inventory available show that discoveries peaked back in the 1960s. We may have used near to half our global oil but over 60% has been consumed **since** 1980. What's more 65% of the remainder was identified **before** 1980.

New companies are always appearing to exploit new ideas (such as enhancing recovery from mature or even abandoned offshore fields). In fact deep waters, the Arctic and Iraq are the last frontiers and there is no reason why advanced oil companies should be spending huge amounts of money or taking massive risks to explore and exploit these difficult plays if other options were available.

For example estimates of the total undiscovered resources lying within the Arctic Circle are of academic interest only. They have no bearing on the short and medium term future of oil and gas supplies. In any case there are numerous discovered accumulations of oil in Canada and Russia, as well as vast quantities of discovered gas in all the countries bordering the Arctic, all of which await development should permissions and capital be forthcoming. These are the areas where cash-rich oil companies are now concentrating their efforts. Perhaps the huge resources numbers provided by the USGS, which are completely speculative anyway, have political ramifications for those countries with land claims on unresolved areas but, in practice, they do not affect energy security over the next two decades.

YTF production profiles are significant to companies planning their capital needs and so must be considered and separately quantified but, notwithstanding the above, for countries past, at, or near peak production capacity, YTF resources are of little global consequence to peak volumes of supply. This is because many of the undiscovered fields will be smaller and will have poorer reservoirs than those that have gone before. YTF resources in over 60 countries will not affect the timing of peak production. They will only reduce, to a certain extent, overall decline rates.

3.3.7 Natural Gas Liquids and other unconventional oils

NGLs are estimated in a rather simpler manner. Although for some countries individual field NGL profiles are available, for most they are not. Future NGL output is considered by reference to total gas production, including flared, vented and recycled gas. Energyfiles also produces full gas forecasts and, unless more precise information is available, NGLs are estimated as a proportion of that gas at a share matching the proportion in the past. This is likely to change over time so each country is examined in a general way to identify changing and likely future changing ratios.

Oil sands and synthetic fuel production rates are well documented in Canada and future projects are signposted well in advance. For the long term however oil price and environmental issues will strongly affect output. A best guess forecast is made assuming synthetic fuels remain competitive despite their lower energy return on investment (EROI). In Venezuela synthetic fuel volumes are poorly documented and the future is particularly uncertain. Some growth is assumed but deemed to be much slower than in Canada.

Refinery gains are estimated globally as a simple fraction of total output. This analysis could be improved but volumes are immaterial to the key purpose of the database.

No account is taken of the different energy contents of different oils.

3.3.8 Special events

Most countries try to produce as much oil as they can as quickly as possible which would generally lead to the perfect profile shown in Figure 1. However OPEC countries have deliberately restricted oil production since the late 1970s. In the mid-1980s the global production profile step changed downwards and economic growth was subdued at that time partly because of the much increased oil prices brought about through OPEC actions. Meanwhile supplies were surging from more expensive areas outside of OPEC control and oil prices dropped sharply. All these modifications to output were the result of these special events and they ultimately led to OPEC beginning to conserve resources and prop up and stabilise the oil price by restricting output artificially.

Other special events of varying magnitudes are recognised in individual regions and countries. For example, the economic failure and then collapse of communism caused rapid declines in all the countries of the Former Soviet Union; the Piper Alpha disaster and its ramifications created a false peak in the UK; the adoption of capitalism in China has caused a surge in Chinese indigenous production; the development of deep water production systems has allowed Angolan and Brazilian output to grow; and Iraqi wars (and other wars) have reduced output dramatically many times in the past as have natural disasters related to geology and meteorology.

There are many examples of special events, and each producing country must be examined in detail to determine whether any recovery in output in the future is likely or possible based on events in the past. And of course sharp changes in the oil price (for whatever reason) lead to changed levels of exploration and demand. The effects of economics are very complex.

3.3.9 New technology and supply

Misunderstandings exist about the capacity of new technology to increase supply. Improved technology allows production from reservoirs at a faster rate and at a reduced cost. Thus technologies help recover more oil and gas but they do not necessarily substantially increase reserves. In fields where unforeseen recovery improvements can be made, the technologies are always late-stage techniques, perhaps reducing decline rates in a region but unable to reverse overall decline.

Even in extreme environments new technologies merely turn geological estimates of yet-to-find resources into cumulative production at a faster rate. For example large deep water reserves are now being produced but this was in fact foreseen 30 years ago when deep water drilling began. Angolan, Brazilian and Gulf of Mexico deep water production have probably surpassed most expectations at the time they were identified but elsewhere, more often than not, geological estimates have been found in recent years, (for the short and medium term at least), to have been grossly over-estimated (as much as they were under-estimated in the early part of the 20th Century).

Consequently the influence of new technology in the future will be the same as it has been in the past. Unless there is a dramatic step-change in technology (which is doubtful) past peaks and decline rates will guide future peaks and decline rates as they always have done. Technology has always been "new."

3.4 DATA SOURCES

The following are some of the data sources used in Energyfiles:

BP Statistical Review
EIA publications
Energyfiles Internal Files
Government Websites
IEA publications
Oil and Gas Journal
Oil Company Websites and Annual Reports
OPEC publications
World Oil Magazine

However the actual number of sources is very large with individual field profiles, where available, sourced from a wide variety of written and verbal communications.

3.5 EXAMPLE PROFILES

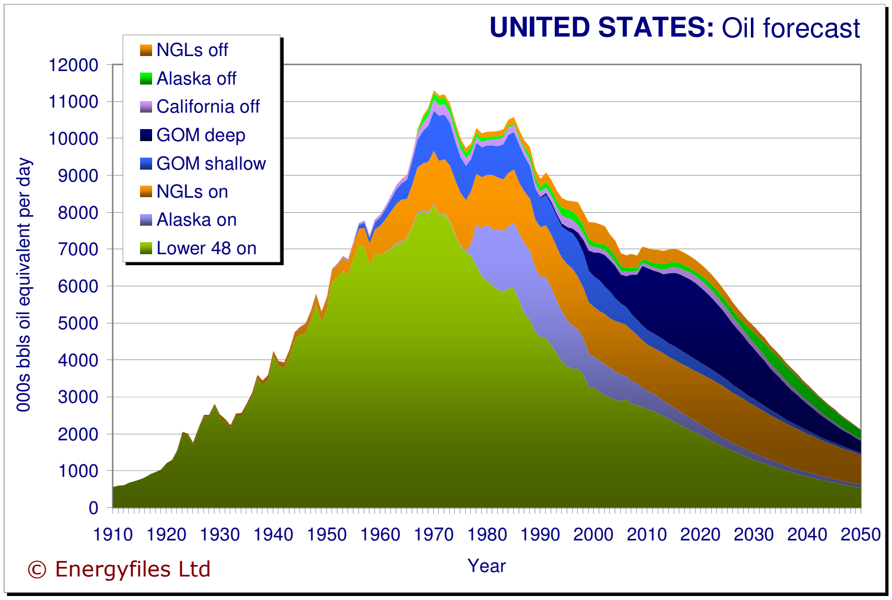

Figure 3: USA – Long term oil production profile (Apr 2009)

SOURCE: Energyfiles

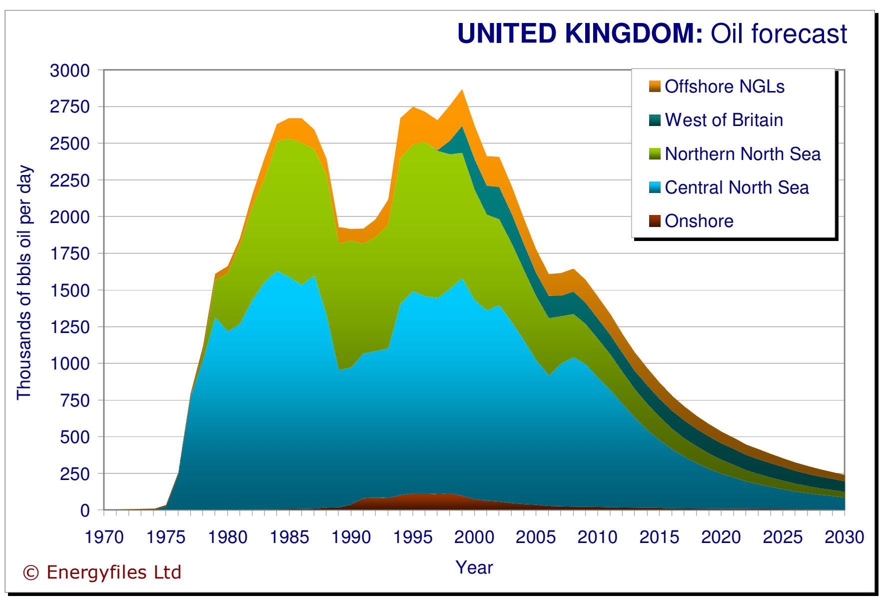

Figure 4: UK – Long term oil production profile (Apr 2009)

SOURCE: Energyfiles

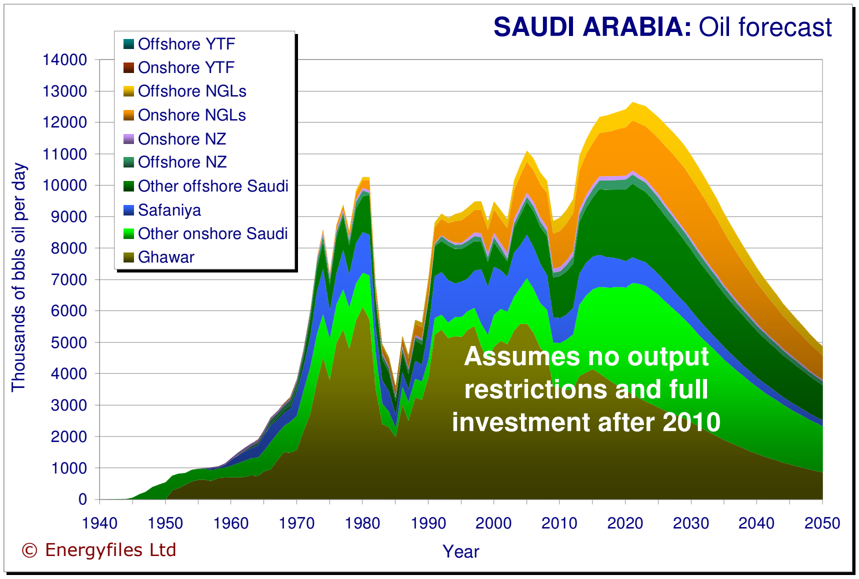

Figure 5: Saudi Arabia – Long term oil production profile (Apr 2009)

SOURCE: Energyfiles

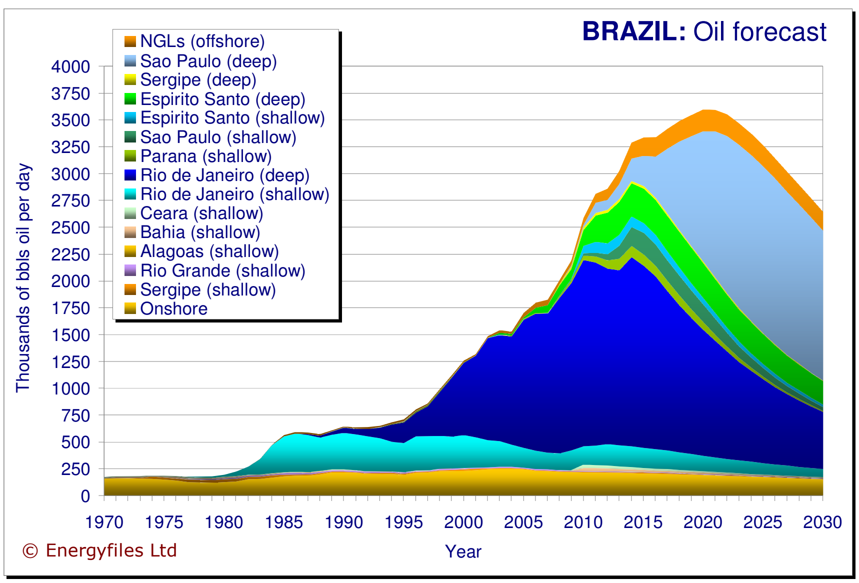

Figure 6: Brazil – Long term oil production profile (Apr 2009)

SOURCE: Energyfiles