Filling the oil supply gap

Dr Michael R Smith, Energyfiles, has been writing on oil supply issues since 1995, in particular the imminent supply gap and the looming new energy era. He forecasts a peak in global oil supply arriving between 2010 and 2020, depending on demand growth. The Energyfiles report Oil & Gas – Global Ten-Year Projection* *(now in its 2007 edition) was published in response to queries about the data used to arrive at these conclusions.*

Despite new evidence in the form of higher than expected demand, capacity squeezes and price rises, there remains a view amongst some geologists and economists that the peak in global oil supply is many years away and even that technology, new energy sources and new efficiencies will make it irrelevant. Although I believe such views are largely driven by wishful thinking, not scientific analysis of data, I do not want to digress on this subject here. It is unrealistic to expect a reader to believe one or other view (except the one he or she already holds) without properly comparing conflicting data analyses.

Instead, I want to address energy supplies after peak; the size of the so-called supply gap and how it might – or might not – be filled by alternative transport fuels and by efficiencies. This article is about potential production rates and uses the Energyfiles databases to establish history matches and forecasts, based wherever possible on thousands of bottom-up field and basin production profiles.

The supply model

A simple supply model describing how oil or gas fields progressively come onstream in a typical sedimentary basin reveals that after the first 15 or 20 have been developed then a permanent peak will already have been created. Later fields do not affect peak; they merely slow decline, whilst technology such as enhanced oil recovery using the latest horizontal and multilateral drilling methods slows it further. What's more, production peaks lag discovery peaks by around 25 years and are a signal as to what the future holds for a basin. A figure depicting this profile was published in the October 2005 issue of *Petroleum Review*.

Production rates are fundamental, but resources assessments are almost irrelevant to peak. Whatever the true volume of oil resources in the globe, empirical production analysis shows that only the first 1,000bn to 1,500bn barrels will be produced up to peak. For example, Greenland may have billions of reserves, but certainly won't come onstream within ten years. The Ghawar field in Saudi Arabia could have over 50bn barrels remaining, but will not produce faster than 5mn b/d. In a decade's time an additional 18bn barrels will have been produced from Ghawar at most.

The argument is about rates – could Greenland come onstream earlier, Ghawar produce faster? For organisations that concentrate on resources assessments this may be hard to swallow since they serve no useful purpose in the peak oil debate (although there are other roles, such as for planning and implementing long-term infrastructure projects).

What oil companies want to know is specific information on where to drill prospects with a positive NPV (net present value), dependent, *inter alia*, on the production profile. The national oil companies (NOCs) and international oil companies (IOCs) responsible for finding and producing the world's oil get better at this every year. For the purposes of evaluating what really matters globally, ie our short- and medium-term energy future, arguments about rates and how fast oil sands etc will come onstream, and about price elasticity and the effect of technology, are valid. However, arguments about gross resources and so-called reserves growth obscure the true issues.

Thus, using an empirically proven supply model, real world future production rates can be estimated. For the 64 countries already past peak, decline rates can be defined by extrapolating field production data. For countries pre-peak, of which there are perhaps 36, discoveries are a signal, whilst individual fields already past peak specify decline rates. Potential yet-to-find production profiles may then be added. Assembling basins and countries in this way, whilst understanding the special complexities of each (eg Opec members) defines how output will pan out in the future for areas well past peak, such as Egypt, for those just past peak, such as Norway, for countries on an extended plateau, such as China, for countries whose peak is far way, such as Angola, and for countries with special restricted profiles, such as Saudi Arabia.

'Usual oil' supply gap

Figure 1 illustrates results of modelling the world's 'usual oil', including natural gas liquids (NGLs) but excluding deposits that require special methods to extract and refine. The ensuing supply gap is not a real gap. It depends on a future demand level that the world will need to maintain economic growth. Of course, in the real world there will be

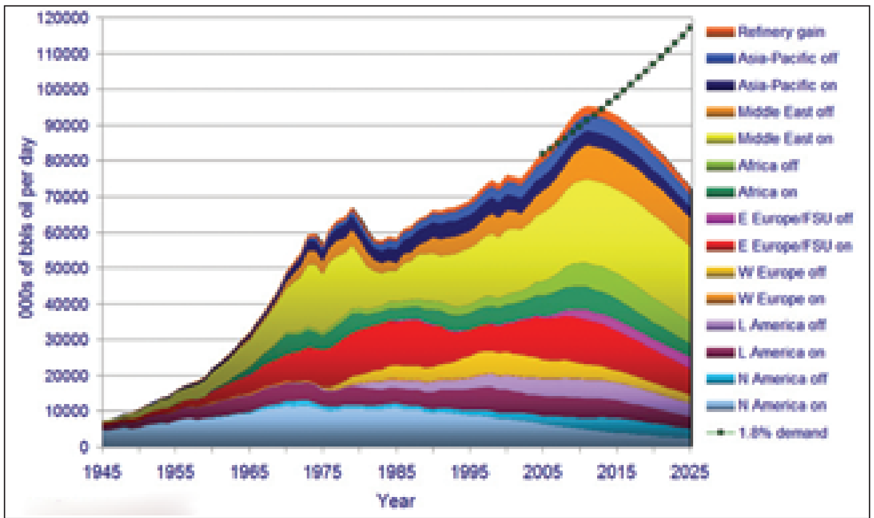

Figure 1: 'Usual' oil forecast, by region *Source: www.energyfiles.com*

no gap, as demand will be forced to follow supply.

From the end of the Second World War up to the turbulent years of the mid-1970s, oil supply grew on average by 6.2% per year, with global economies expanding exceptionally rapidly. After 1985, supply growth averaged around 1.8% annually. Technology helped to keep per capita energy use in the developed countries relatively stable. Of course, real supply changes, led by demand, were erratic, but it may be proposed that a comfortable demand growth of around 1.8% per year ensures economic stability. This is the business as usual (BAU) demand growth shown in **Figure 1**.

A small supply surplus up to 2013 is evident, followed by an increasing deficit to the end of the period plotted. The supply surplus will partly be compensated for by spare capacity, especially heavier oil in Saudi Arabia, and partly by surges in demand (mostly in Asia) as prices briefly fall. For comparison, the deficit in 2020 represents all of the current production from the Middle East.

Looking at the alternatives

The model for oils that do not fall into the usual category is given in **Figure 2**. It may not be a precise model and there is certainly room for additional growth in some of these liquids sources should massive, dedicated investment programmes be instigated rapidly and well before the peak. However, it is a realistic model for a real world in which things move at a rapid pace in a free market.

Time Magazine has said that Canada's Athabasca oil sands belt '…could satisfy the world's demand for petroleum for the next century'. The oil sands may be huge (or they may be a huge environmental problem), but for certain they will not go close to filling the supply gap on their own, even if problems of energy return on investment (EROI) and the need for gas and water supplies to develop them effectively are overcome.

Venezuela's La Faja region of extra-heavy oil is also regarded as a saviour. *Energy Bulletin*, in 2004, argued that Venezuela '…will reap a huge bonanza' from this; however, it will hardly impact on global supply after peak. There are other such areas. The World Energy Council has documented 54 different geological basins that contain oil sands. But, considering the time it has taken to develop Canada's and Venezuela's resources, any substantial short-term output from these is unlikely.

Oil shales have been exploited for hundreds of years, but rarely commercially due to their poor EROI. The largest recent operations in China and Estonia shrunk when in direct competition with cheaper fuels, but perhaps new technology and higher prices will turn this around. In fact, *Rocky Mountain News*, in 2005, portrayed Shell's method of in-situ conversion and extraction as '…simplicity itself in concept but exquisitely ingenious in execution'. Exquisite it may be, but the time needed for significant volumes of oil from shales must be measured in decades.

Gas-to-liquids (GTL) was described by *AAPG* in 2003 as '…ready to arrive'. GTL has been ready to arrive for at least a decade and it will still be ready to arrive a decade from now. In a market where stranded gas supplies are in demand for LNG, GTL can rarely compete. Conversely, coal-to-liquids (CTL) conversion technology has massive potential. Up to now, CTL has been used only in non-commercial operations, notably in Hitler's Germany and apartheid South Africa. China, with its huge coal resources, is trying to kick-start a new CTL industry and substantial growth is forecast. But, again, the amount of possible growth within the next two decades will hardly impact the supply gap.

Finally there are the biofuels. *Renewable Energy World*, in 2006, said that '…the world is on the verge of unprecedented growth in the production and use of biofuels'. Such growth is coming from a low level and biodesel and bioethanol, whose energy density is less than 70% that of crude oil, eat into valuable agricultural land.

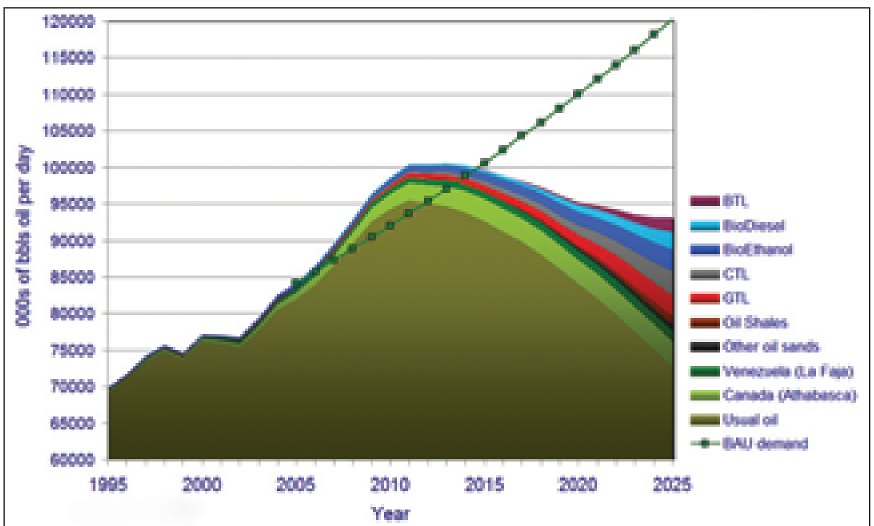

Figure 2: Realistic alternatives *Source: www.energyfiles.com*

They will be incapable of filling the gap. Conversely, cellulosic ethanol (BTL) is the 'holy grail' of the biofuels industry; however, it is still in the pilot plant stage and the massive year-on-year growth needed is not likely for at least 20 years.

Closing the gap painlessly

Figure 3 thus illustrates a reduced gap, especially in later years. The global shortfall now begins in 2015, but the deficit in 2020, assuming BAU demand, will still equal current production from Saudi Arabia and the US combined. With surpluses to 2014, the drive to save oil will remain with the environmentalist movement for some years – although it is likely that surplus oil, should Opec allow it on the market, will be rapidly mopped up by the growing economies of China and India.

However, once capacity falls and high prices recur there will be every incentive to develop efficiencies, some of which may be realised without pain. This is not to be confused with conservation, which will require radical changes to life style – unwanted and, to say the least, uncomfortable. **Figure 4** illustrates the efficiencies that could push the demand curve lower.

It may be possible to reduce plastics use by half in 20 years using natural alternatives and less waste. In the US, miles per gallon performance could be significantly increased, perhaps approaching European levels by 2025. Similarly, the rest of the world has room for improvement on current trends. There are few options to save jet fuel with the current airplane mix, although routing improvements may offer some savings. Continued introduction of electrified train, metro and tram systems should also offer additional savings throughout the transport industry. Finally, full conversion of all the remaining oil-powered heat and power sources to gas, coal, and renewables will lead to substantial oil savings in the developing world.

These efficiency estimates are approximations and often involve both increased use of natural gas, which, certainly in Europe and North America, will be difficult, and coal, which will be environmentally damaging. **Figure 5** illustrates the new gap if all efficiency policies were effective. The deficit, now beginning in 2016, will have reached the approximate current output of Saudi Arabia and Kuwait combined by 2020. The year 2016 is significant. It was the peak date cited in my first analysis (*The World Oil Supply Report*) in 2000. An honest model is remarkably insensitive to new information. For

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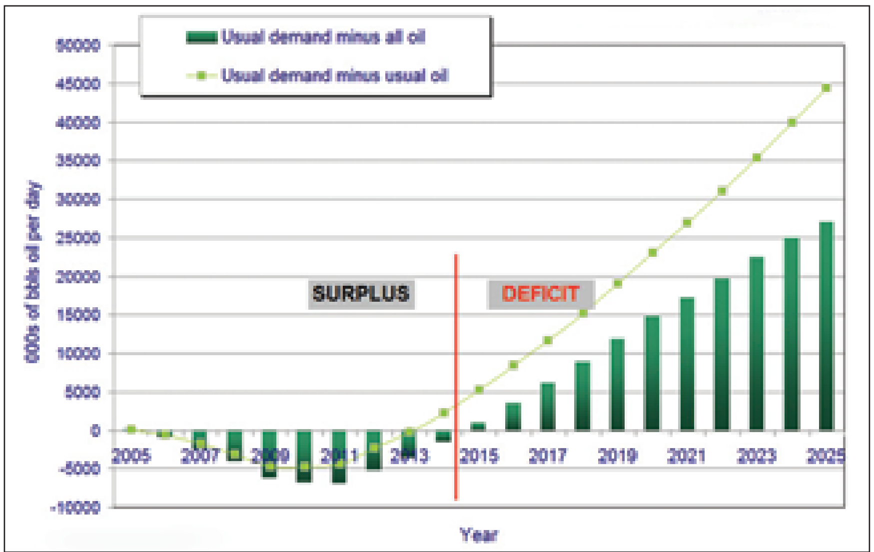

Figure 3: True size of deficit *Source: www.energyfiles.com*

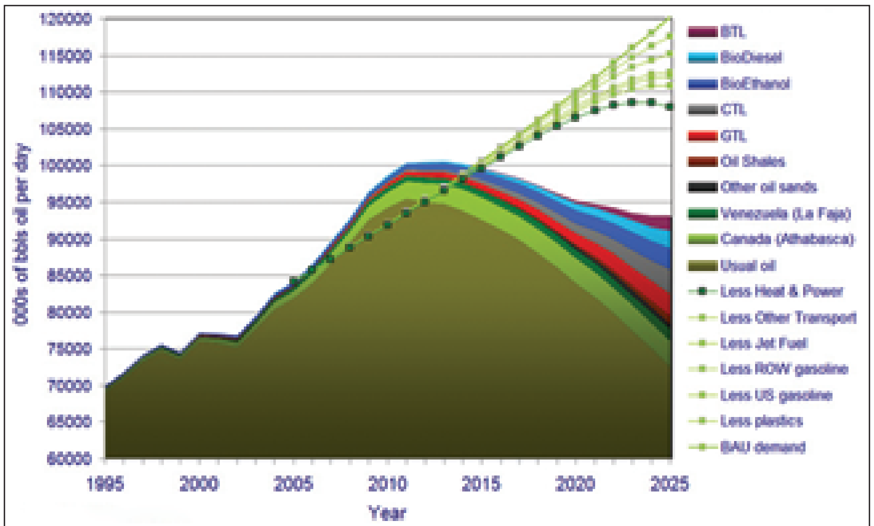

Figure 4: Maximising efficiencies *Source: www.energyfiles.com*

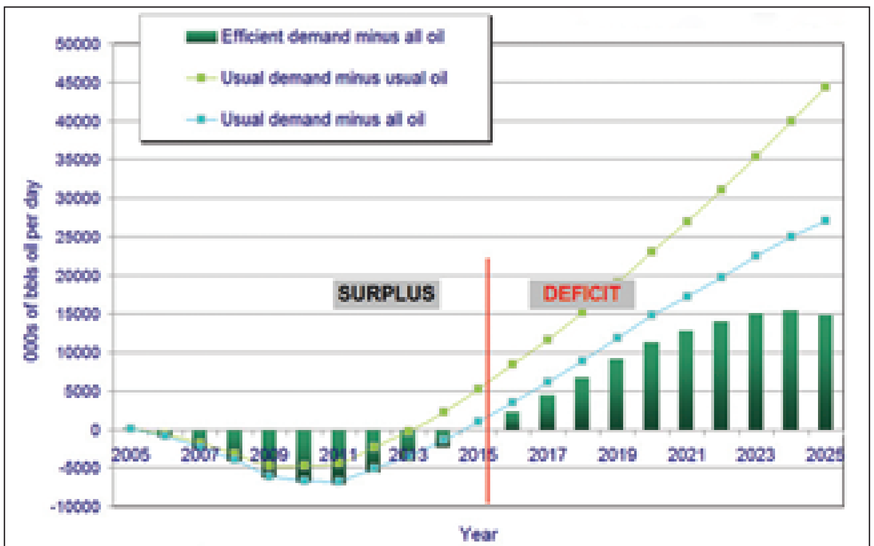

Figure 5: Final size of deficit *Source: www.energyfiles.com*

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example, a huge discovery, such as the Jack trend in the Gulf of Mexico, can affect the global peak date by less than a year.

The only realistic option

I do not pretend my analyses are exactly right, but they are realistic. They contradict recent projections by Cambridge Energy Research Associates (CERA), who foresee growth until 2030. CERA challenges 'the peak oil theory' but fails to demonstrate realistically where its forecast oil will come from. CERA's announcements are turning attention away from real issues, although they purport to do the opposite. It overestimates the ability – and perhaps willingness – of the Opec countries to meet demand growth and, as pointed out in *World Energy Review* in December 2006, '…CERA states that huge resource estimates cloud the debate [but] it continues to promulgate them'. It has been proven that late stage oil flows will reduce decline rates, but rarely, if ever, affect peak. Good engineers and production geologists know this in individual fields, and it has been demonstrated empirically in almost all of the hundreds of sedimentary basins where decline has begun.

Thus, there is no painless way to fill the oil supply gap. Of course it will be filled, partly from traditional sources, partly from new alternatives, partly from simple efficiencies, but a large portion will have to be filled by demand destruction. In the real world, demand destruction means poverty and conflict, so we should be working towards reducing our vulnerability to such destruction.

In 2006, a Senior Vice President of ExxonMobil said that '…no combination of conservation measures, alternative energy sources and technological advances could realistically and economically provide a way to completely replace these imports [of 10mn b/d into the US] in the short- or medium-term'. And ExxonMobil's solution is: '…do not tamper with markets'. By 2020 the globe will be in a worse condition, even with all the alternatives and efficiencies outlined above. Should governments really do nothing at all? Vested interests do not provide the best solutions. They are clouded by wishful thinking.

And if we cannot do it globally, we should do it locally – at least to gain a competitive edge. Companies and governments must take energy risks with capital intensive projects, innovative energy sources, new modes of transport and through cutting consumption with taxes and rationing systems. Growth and decline will, in truth, be erratic as chaotic price movements drive demand up and down, but liquid energy demand will always want to grow faster than supply. The global population has reached an unsustainable energy demand level to support the lifestyles we desire. Conservation will be a necessity, but it will be painful. ●

*'Oil & Gas 2007: Global Ten-Year Projection' *is published by Energyfiles. It provides a quantitative survey of every country and region in the world – forecasting world oil and gas production, consumption and trade; onshore and offshore. For more information e: admin@energyfiles.com or visit* **www.energyfiles.com**