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Oxford ENERGY FORUM

A QUARTERLY JOURNAL FOR DEBATING ENERGY ISSUES AND POLICIES

Issue 64 February 2006

We are starting 2006 with a look at the way in which the high current price of oil might affect our economic expectations and how the oil producers are dealing with this sudden increase in their revenues. This will be a subject of particular interest to those of our readers who can easily recall the experiences of the 1970s. We also have two articles dealing with aspects of environmental policy, one that looks at the role of technology in reducing EP costs and one that looks at Gas Strategies for suppliers of the Atlantic Basin.

Roger Van Noorden looks macro-economically at the oil price increase. He picks out three apparent problems, sets out an answer to each and then discusses these answers. The three problems concern the United States' trade deficit, the persistent budget deficits of many Western economies and the absence of inflation. Although all three have so far been under relative control and have not as yet upset international economic balances he concludes that we are not necessarily out of the wood.

Hassan Hakimian looks at the problem of managing the new wealth from the producers' point of view and questions whether this time they can make a positive and lasting effect on their domestic economies. He finds some evidence that this is so. One hopeful sign is, for instance, that some of the extra revenue is being syphoned off into stabilisation funds rather than being spent. Nevertheless, the way in which the very extensive remainder is spent is crucial. It is needed in social expenditure generally rather than in the over-supplied military investment. Youth unemployment is the most acute challenge for Middle East governments. Inflation remains a threat, as do property and local stock exchange prices. The outlook remains uncertain.

Walid Khadduri considers the situation of the Arab oil producers, particularly in their ability to absorb the new streams of revenue. One hopeful sign is the privatisation of state companies and public investment opportunities provided by family firms, although the national oil companies themselves remain out of bounds. Another is the policy focus on debt reduction and restructuring. While money

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is for the most part being invested locally or regionally there is, however, a grave danger from stock market and property speculation, and there is always the threat presented by the ever-present problem of regional politics.

Looking to the environmental issues, Malcolm Keay raises the important question of how to measure progress. As he points out, governments are at present unable to measure outputs from policy decisions even though the desired outputs are easy enough to state. He gives the examples of energy efficiency and renewables and shows how neither is subject to any meaningful measurement. His message is brutal – if governments want to take climate change seriously they will have to start taking measurement issues seriously.

A more enthusiastic message comes from Benito Müller in his report from the latest 'Kyoto' meeting (working under the peculiar acronym of COP/MOP) in Montreal. First, the Marrakesh Accords were adopted; second, a compromise was reached on the question of compliance with the Kyoto targets; third, the Clean Development Mechanism was improved; and, finally, an agreement (of sorts) was reached on negotiations for a post-2012 regime. None of this was certain before the delegates arrived.

Turning to the capacity of technology to reduce E&P costs, Mark Andersen points out that from 1981 to 2003 E&P costs reduced by two-thirds. Now they are rising, but he describes some of the ways in which technical development has been able (and hopefully will continue to be able) to reduce these effects. Furthermore, some of these new developments are the result of research by the service companies, so that there is now good reason for a greater and more willing cooperation between the oil and service companies.

We also have an article by Hadi Hallouche, Michael Tamvakis and Bryan Train on the strategies of non-OECD gas producers in the Atlantic and Middle East. Their analysis leads them to define gas producers in terms of those with gas rather than oil reserves, those with undeveloped gas reserves and those who are niche players. Their geographical location and the extent of state involvement in their operations are further elements in defining how best individual countries should develop their gas reserves.

Lastly, the Personal Commentary in this issue is by Charles Henderson who muses on the nature of the so-called Gas Crisis in the UK, a particularly appropriate subject in the light of the more recent problems highlighted by the actions of Gazprom in Ukraine.

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Economic Implications of the Oil Price Increase

Roger Van Noorden considers some macroeconomic implications

Three Problems

While my undergraduates learn their macroeconomic theory they are encouraged to follow three real life problems, as the statistics emerge month by month. The good students ask whether and how the three problems are connected.

The first problem is why the dollar remains strong when the US trade deficit has just established a new monthly record of $68 billion. The second is how so many Western economies function with persistent government budget deficits of more than 3 percent of their Gross Domestic Products. The third is to account for the non-emergence of inflation, given the similarities between the current rises in energy prices and those of 1973–74 and 1978–79.

The Immediate Answers

There is an immediate and well understood answer to the first problem. Although the US current account deficit has risen to about 6 percent of Gross Domestic Product, and there are also deficits in the UK and Eastern Europe, there are corresponding surpluses in other countries being recycled back into the US Capital Account. Both the Asian economies and Russian and OPEC economies could choose to increase domestic consumption levels but are instead choosing to invest their surpluses in the United States, where domestic consumption continues above the level of production.

On the second problem, out of the 'old Europe' (pre-accession) countries France, Germany, the UK, Italy, Greece and Portugal are running government budget deficits above the maximum 3 percent of Gross Domestic Product suggested by the Maastricht agreement. If a single country operated at this level it would have been under pressure to reduce government spending, but the recent deliberate weakening of the Growth and Stability Pact suggests there is safety in numbers. In Italy, for example, which has had 20 percent more inflation than Germany since the Euro was established in 1999, a conventional macroeconomic response would be a cut back in spending and a raising of taxation to induce a slowdown of the economy. With so many countries in the same position no collective pressure is being applied to individual countries which can promise to bring down their budget deficits over a period of years. While it might be expected that interest rates should rise in countries with persistent budget deficits – so that governments can induce private sector lending to cover their deficits – governments have in fact been fortunate in being able to borrow at record low real interest rates. The nominal yields on ten-year government bonds are below 3.5 percent in the Euro area.

> "With so many countries in the same position no collective pressure is being applied to individual countries"

On the third problem we have to recognise that the world has changed since the 1970s. Consumer spending on fuel (for transport and housing energy) has fallen in that time from 8 percent to about 4.5 percent of total spending. In advanced countries spending on oil equivalents is declining as a proportion of Gross Domestic Product, falling from 6 percent to 3 percent in the USA between 1970 and 2003. The effect of an oil price rise is no longer so dramatic, therefore. In the particular case of the UK there are other contrasts. In 1973 the North Sea Continental Shelf had not been developed, so there were not the benefits to offset the rise in the price of oil. The main difference, however, in the UK is that in the labour markets of the 1970s union power and wage indexing implied that price rises fed quickly into rises in earnings, and this secondary effect then had a major impact on prices. The wage indexation came from a particular form of incomes policy, the 'threshold' in operation from November 1973 to November 1974, whereby increases above 7 percent in prices led to matching increases in wage rates. So far in the UK during this period of oil price rises there has been no appreciable feeding through of energy prices to earnings. This has been due in part to the lack of pressure on the labour supply. Net immigration is running at 200,000 a year, and this is about the same as the annual job creation. Earnings figures are rising only at around 3.9 percent per year – a level justified by adding productivity gains to the inflation rate – and are not an independent source of inflation. In the Euro area as a whole wage inflation is likely to be gentle and price inflation subdued. That argument would however suggest that higher energy prices would have a greater impact on the United States, where growth above 3 percent a year continues and the labour market is tighter.

Will these Immediate Answers Continue to Hold?

A first pass through these three problems, then, is disturbing for students of macroeconomics. The USA is not suffering the consequences macroeconomics students would expect to follow from its high consumption level; European industrialised countries can operate long-term government budget deficits without interest rates being driven up; the doubling of oil prices is not expected to lead the world into increased inflation.

The first conclusion is the shakiest. The Asian countries, especially Japan, Singapore, Korea and Taiwan, are putting their surpluses into dollar bonds, as is China in order to prevent its currency from appreciating. If these countries come to expect that the dollar is about to fall, however, such investment would seem foolhardy. The expectation of a falling dollar could then quickly become a self-fulfilling one. The OPEC countries can justify the recycling of their surpluses into the USA on the grounds that given the lead of the Asian countries it is rational to do likewise. But this reasoning would lead to a withdrawal of funds if the Asian countries decided to diversify their investments away from the United States.

"In the Euro area as a whole wage inflation is likely to be gentle and price inflation subdued."

The second conclusion is influenced in the Euro area and the UK by the determination of the interest rate by the European Central Bank and the Bank of England's Monetary Policy Committee, with control of inflation the main policy target. If governments are no longer free to raise interest rates to attract long-term financing then they will eventually have to use fiscal policy to rectify the budget position, inducing deflation just as much as would a policy of raising interest rates. Only if no inflation emerges will it be possible to keep interest rates at their present low levels. In the UK the Chancellor's projections of a lower current debt to Gross National Product ratio have been met with scepticism. Assuming the oil price remains around $60 a barrel there is still some inflation to come, though it is not expected to accelerate. Suppose, however, that the dollar depreciated. This would raise the price of oil in dollars and lower US demand. This would spark a raising of energy prices, and eventually the broader price indices.

That there must still be inflation to come from the doubling of the spot price of oil from $20 a barrel at the beginning of 2002, or from $30 a barrel at the beginning of 2004, to nearly $60 now, comes from the persistence of the causes of the rise. Demand is still growing from China in particular, but is growing worldwide. Supply of refined oil will be lessened for several years by refinery damage from hurricanes in the Gulf of Mexico. At the same time there are lags before price rises in oil are felt in the wider economy arising from the writing of long-term contracts at lower prices in the past, and probably from hedging, although all hedging contracts have counter-parties. Further, users of oil are still absorbing price increases in reduced profit margins, rather than passing them on. In the UK the producer input price index is running at 13 percent and the producer output price index at 2 percent year on year. That is not a gap that can persist.

There is another argument for there being lagged effect still to come in that many prices are affected only indirectly by rises in the oil price. The immediate effect of a rise in costs could be reflected quickly in petrol prices. Indeed it is possible to raise petrol prices at the pump as soon as there is general awareness of a shortage of refining capacity, say. But transport and distribution costs then work their way through more slowly to the costs of raw materials, and only then through the manufacturing goods used as inputs for other goods, and then the wholesale and retail systems, with costs absorbed initially at each stage. The ultimate dependence of any final good on oil and the lag before its price is affected by the price of oil at the start of the supply chain is a complicated calculation involving input-output tables and time lags for each process.

Against the argument that there is inflation still to come is the counter-proposal that the current inflation rate of 2 to 3 percent already takes account of the rising oil price, since without the rise in the oil price the indices would be reflecting the downward effects of cheaper goods arising from outsourcing supply to Asia and Eastern Europe. This counter-proposal is not very strong, though, since outsourcing predates the recent oil price rise while inflation has been broadly unchanged. It seems likely that oil price rises are still working their way through the system.

Even so there may not be a rise in the inflation indices, since monetary policy cannot be assumed to remain unchanged. The Policy Committees of Central Banks will raise interest rates to control any inflation. If incipient inflation were to emerge it would be countered by a tighter monetary policy. In that case it is all the more likely that the effect of the oil price rises in OECD countries will be felt in restricted manufacturing output and damped demand rather than emerging in general inflation.

"Only if no inflation emerges will it be possible to keep interest rates at their present low levels."

Professors Robert Barsky and Lutz Kilian (*Journal of Economic Perspectives*, Fall 2004) examine the evidence for surges in the oil price causing US recessions since 1970. The recessions of November 1973, January 1980, July 1981, July 1990 and March 2001 do follow periods of rising oil prices. They quote an estimate of Rotemberg and Woodford that a 10 percent increase in oil prices results in less than 0.5 percent reduction in gross output. It is of course hard to tell whether a reduction of output comes from lower or delayed investment, from a reduction of demand following higher prices or from the policy taken by the monetary authorities in response to rises in oil prices.

Overall there can be a gentle and long-term response of consumers to high energy costs, such as trading down to more economical cars or lower temperatures in houses, but any such effect is swamped by the continuing rise in demand from fast growing economies. The most

plausible scenario is that suggested by forward rates – that oil will continue at around $60 a barrel for another three years. In that case inflation will be higher next year than it would otherwise have been, but then the inflationary pressure will drop out of the year to year comparisons.

That leaves the big uncertainties over the recycling of surpluses into the US dollar, the strangest part of the macroeconomic scene today. Not only is it unlikely that the mutual interest of the surplus countries, in propping up overspending in the USA, is likely to persist, but the longer it goes on the worse the resulting correction will be.

Hassan Hakimian looks at the domestic context of managing the oil wealth

Only a thin line divided the last experience of oil boom in the Middle East from the wider economic crisis that engulfed the international economy in the 1970s. Indeed, OPEC's golden age of unprecedented opulence and prosperity is still widely associated with global financial instability and the deep-seated recession that swept much of the rest of the world, principally the oil-importing nations in the west.

The less than successful management of oil revenues then had, however, as much to do with their international recycling as with their domestic deployment and absorption. Even before oil prices had plunged to new lows by the mid-1980s, the scale of economic wastage was evident. Mounting supply-side bottle-necks, spiralling inflation, widespread wastage and conspicuous consumption fuelled macroeconomic imbalances at home and left most of the region's governments with swelling public debt, incomplete and extravagant show-case projects, worsening income distribution and largely undiversified economies.

Almost three decades on and with the recurrence of exceptionally high oil prices, the challenge is still on to ensure the oil windfall can be utilised for genuine economic diversification and reduction of the exporters' dependence on oil in the long term. In fact, the opportunity cost of failure is higher now, partly because of the imperative to avoid past mistakes and partly because of the size of the oil bounty, which is much larger now.

Table 1 shows Middle Eastern oil producers' cumulative revenues in approximately five-yearly intervals since the mid-1970s. It can be seen that – measured in today's dollars – the revenues for the most recent period (2000–05) amount to almost half the total revenues for the entire two-and-a half decades between 1974 and 1999. The GCC states have increased their share from about two-thirds to almost three-quarters of these revenues, thus doubling their annual oil income compared to the early 1970s (and quadrupling over the late 1980s).

In most oil producers, these revenues form the mainstay of public finances (in the GCC states their share of government revenue reaches as high as 90 percent). Invariably, public policy, i.e. what governments do with these sums, is crucial.

The real impact of these staggering sums is, however, much larger given the relative size of these economies and their willingness – or ability – to absorb them internally. The oil producers' current-account surpluses are expected to reach 25 percent of their GDP on average (compared to China's 6 percent). Saudi Arabia is expected to record surpluses as big as one-third of its GDP. The same is expected of the large oil producers outside the Middle East with Russia and Norway likely to record current account surpluses of about 13 percent and 18 percent of their GDP, respectively.

> "the challenge is still on to ensure the oil windfall can be utilised for genuine economic diversification"

But are things different now and can the oil bounty be managed more advantageously this time to make a lasting effect on the producers' domestic economies? In other words, can the oil money be turned into a blessing or will it be another opportunity squandered?

Leaving aside foreign savings and spending on imports, the answer to this key question depends on how wisely or prudently extra revenues are deployed internally. The form and pattern of such utilisation, in turn, depends on four sets of highly interrelated issues:

a) How much of the extra revenue is spent (and how much is saved)?

b) At what pace does extra spending

Table 1: Oil Exports Revenue, Middle Eastern Countries (1974-2005)
(Billions of 2005 US dollars)

	Total	*% GCC*	*Average Annual GCC*
1974–1979	776.5	64.7	83.7
1980–1984	743.4	75.7	112.6
1985–1989	337.2	69.3	46.7
1990–1994	510.6	70.5	72.0
1995–1999	576.9	73.4	84.7
2000–2005	1,384.6	73.2	169.0

Source: IMF.

take place (a short-term spending spree or a more measured approach favouring long-term investment)?

c) Who controls and disposes such expenditure?; and

d) What form does additional expenditure take (productive versus unproductive spending; current versus deferred consumption; physical infrastructure versus human capital; etc)?

Early indications point to a different story so far, suggesting that some lessons may have, indeed, been learnt from the past.

First, it appears that oil producers are far more cautious in their spending habits now than they ever were at the height of the 1970s' oil boom. This is evident, to some extent, from Figure 1 which depicts major producers' fiscal surpluses as a percentage of their GDP. It can be seen that, with the exception of Iran and Nigeria, all other producers (including Russia) are running healthy balances on their budgets – an indication of the restraint with which public finances are managed despite the extra oil revenues. For smaller GCC states, the average budget surpluses are around 6 percent for 2005.

Based on current patterns of expenditure, the IMF projects the spending multiplier (the fraction of additional oil revenue spent by governments) to be much lower now, especially in the GCC countries (down from 1.36 in 1973 to 0.34 in 2004). Such is, in fact, the order of caution exhibited this time – in a region not best known for its public sector size and frugality – that the IMF even advocates a modest increase in their spending.

Second, the question of how fast spending should take place depends at least partly on how long the oil bounties are expected to last, and partly on the nature of such expenditure. Lumpy and resource-intensive investments, for instance, can lead to supply bottlenecks in key sectors (transportation, construction and utilities) and risk major disruptions if oil revenues dry up. They can also exacerbate problems of over-capacity in the economy if they are based on optimistic assumptions regarding the supply response elsewhere in the economy.

This is why the third issue – which particular internal agencies control the additional income and expenditure – is equally important for the speed, volume, composition and management of such spending. In the 1970s, extra oil incomes acted as a direct vehicle for expansionary fiscal policy as additional revenues accrued to national oil companies and boosted the public sector's coffers directly. But extra oil incomes also stoked expansionary monetary policy by boosting the central banks' reserves and enlarging the domestic monetary base. Combined with short-term supply shortages and bottlenecks, this provided a lethal potion for inflation as real productive capacity lagged behind over-blown demand.

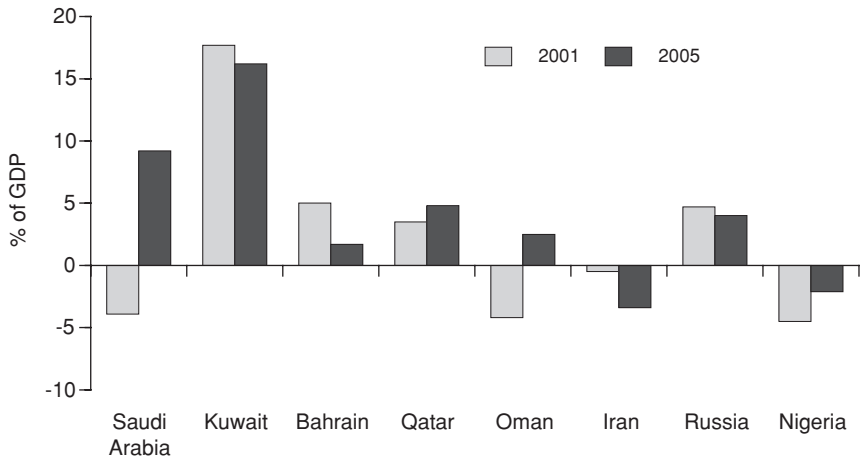
One key lesson from the 1970s was that there is a limit to how much of the extra money may be absorbed within the domestic economies in the short term without building up inflationary pressures. The rush to spend could, in other words, make both fiscal and monetary policies ultimately self-defeating if all it did was to push prices up.

"most oil producers still lag behind considerably in terms of their comparative social and human development indicators"

Interestingly, it is this same issue that differentiates to a large extent the current experience of oil boom from that in the past. In many oil-producing countries, only part of the revenue is now made available for budgetary purposes, as a myriad of oil stabilisation funds siphon off excess revenues leaving general government budgets to cope with much more conservative oil price projections. Although these funds were set up to equip oil exporters to deal with the type of austerity that followed the price collapse of the late 1990s, and despite the fact that their operation can in practice be politicised and heighten inter-governmental conflict (as in Iran where the disbursement of such funds requires parliamentary approval and thus increases tension with the government), they can be effective in limiting the short-term impact of oil revenues. Even in states with more profligate spending habits, such as Russia and Nigeria, part of the sums 'set aside' in this way is used for special developmental purposes or to pay back external debt.

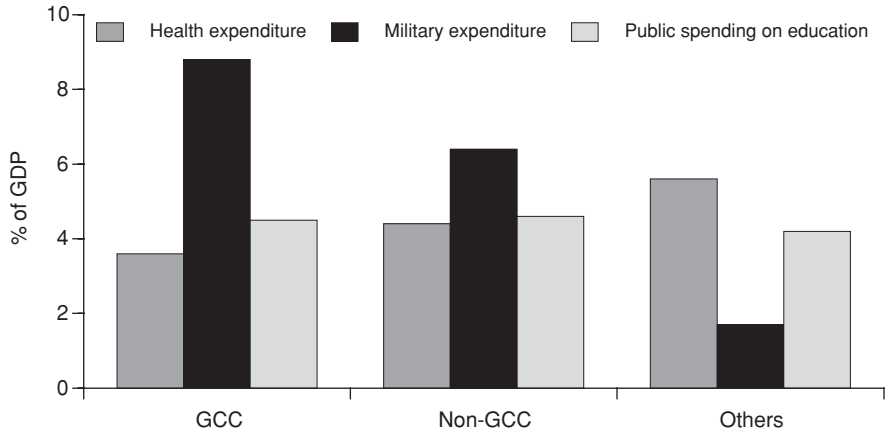
But no matter how measured domestic absorption is or what processes it takes, it is its composition (what

Figure 1: Oil Producers' Budget Balances, 2001 and 2005



Source: *Global Insight.*

Figure 2: Selective Public Sector Expenditures – Oil Producers, 2000–04



Figures are averaged over the period. Non-GCC includes: Iran, Algeria, Libya. Others include: Russia, Norway, Mexico, Indonesia, Nigeria and Venezuela.

Source: *World Bank, Development Indicators*.

money is spent on) that ultimately decides the opportunity cost of the oil wealth – now as in the past. In the 1970s, much of the oil wealth financed extravagant projects with low returns, lavish physical investments and military and technical hardware with limited shelf-life. Despite the restrained spending seen so far, it is quite likely that this will be the site of much future strife, especially in the more populous oil producers with both greater appetite and internal capacity for absorption of the funds.

Figure 2 shows the major oil producers' expenditure on health, education and the military in recent years as a proportion of their GDP in a comparative light. Most strikingly, it can be seen that the GCC's military expenditure (at about 9 percent of GDP) is well in excess of expenditure on health and education in this sub-region, and almost five times higher than military expenditure in other, non-OPEC, producers (relative to their size Oman, Kuwait and Saudi Arabia were, indeed, among the top six military spending nations in 2003). By contrast, military expenditure is much smaller in countries such as Norway and Mexico, where it is, respectively, only one-fifth and one-tenth, of expenditure on health and education.

This issue epitomises a wider paradox. Despite their staggering natural and mineral riches, most oil producers still lag behind considerably in terms of their comparative social and human development indicators.

According to the United Nation's *Human Development Report*, the broad Education Index for the Arab countries as a whole was only 0.65 in 2003 compared to 0.83 for East Asia and the Pacific and 0.72 for all LDCs. Similarly, female literacy (as a proportion of females above the age of 15) is, on average, 76 percent in the GCC states – only moderately higher than the level attained in lower middle-income countries (71 percent) and considerably below that of China's (86.5 percent). Most significantly perhaps, in spite of the recent surge in oil income, most countries face high rates of unemployment (conservatively estimated at around 13 percent in two of the big producers – Saudi Arabia and Iran – and likely to be much higher among the youths). By all accounts, it would require high and sustained growth rates (of about 7 percent) to reduce the unemployment rate in the Arab world and Iran.

This may suggest that the question of how much to absorb (and over what period) is far from determined by technical considerations of how to optimise long-term macroeconomic stability and growth. In countries with larger, and much younger, populations with growing aspirations for lifting their living standards, the litmus test to spending restraints may yet come from intensified struggles over the shaping of social priorities (this is arguably the case in Iran where control over oil resources played a key role in the new government's rhetoric and electoral strategy).

As for smaller states with ambitions to become regional financial and trading centres, the road ahead is not without its bumps either. The threat of inflation, the demon of the 1970s, cannot be totally discounted here, although it is more embedded in the booming stock exchanges and overheating property markets. Indeed, if and when the bubble is burst, despite their considerable financial reserves, the consequences will not be too dissimilar to the 1997 Asian crisis – a stark reminder that oil can indeed be a beast – yet again in a disguise!

Walid Khadduri assesses the oil price increase from the Arab point of view

There are three differences between the current rise in oil prices and that of the seventies.

First, the impact on the world economy this time is much more limited. A range of $55–60/bbl WTI price appears to be acceptable to the consumers, and has not made much of a dent in most economies.

Second, the price increase has been the result of market factors, due to shortages in certain petroleum products, the lack of upgraded refineries, and the high rise in demand made possible by sustained economic growth in the industrial economies and the

significant growth in leading developing economies.

Third, the producing countries – unlike in the seventies – are now investing a large amount of the oil revenue in their own countries and regions. Much has also been invested globally, but there is an absence of the re-cycled 'petro-dollar' phenomenon that dominated the headlines previously.

This article will focus on the last factor and describe how the Arab countries are dealing with the oil price increase of the last three years.

Different Experiences

There is no uniform pattern as to how Arab producing countries have dealt with the present oil price cycle. Some are still struggling to create a semblance of a stable state. Others have adopted various degrees of economic reforms, provided enough opportunities to encourage local investments and are trying to use the process to redistribute wealth in their countries. The politics of each state have played an important role in determining the process that each has followed.

"the producing countries – unlike in the seventies – are now investing a large amount of the oil revenue in their own countries and regions"

Iraq, an extreme case, has hardly seen one major development project, mainly because of the lack of security, and partly for the absence of an effective government in the past three years. However, there are also the examples of Algeria, Syria and Libya. These three countries have made interesting sounds about structural economic reforms and market liberalisation, but it has become obvious that strong and well-entrenched domestic interest groups are hindering such moves. There are simply too many interests invested in the old regime to allow a gradual and smooth transition to a more liberal and competitive economic system. The only exception amongst this group has been the legislation of the Hydrocarbon Law in Algeria, which has put the petroleum industry on a new course, with the Ministry of Energy acting as a supervisory and policy-making body, while independent agencies regulate and oversee the work of the state-owned Sonatrach and the international oil companies; and Sonatrach operates on equal terms with international firms, with no more monopolistic powers but with more independence than before.

In the Gulf countries, as well as Egypt and Jordan, a different experience is taking place. There has been a determined effort to privatise state-owned firms, encourage Initial Public Offerings (IPOs) of new companies, and re-structure the economies. The purpose, though not stated publicly, is to assist in the distribution of wealth among a larger sector of the population. This process started before 9/11, but has speeded up since then.

There is a common pattern here, though with differences between one country and the other. Mobile companies were among the first IPOs in the region. This was followed by the gradual privatisation of public utilities (power and water). Finally, family firms are going public, along with the rise of luxurious housing developments, tourism projects and private energy firms (gas distribution and sales, drilling, upstream services and tankers). There are today over 100 firms in the Gulf region ready to increase their capital or be transferred to a public holding company. The one sector that remains out of bounds is the national oil companies (NOCs).

Money Staying Home

A complex set of factors has attracted Arab investors to look for opportunities domestically and regionally, instead of globally. There is, of course, the fear after 9/11 that their money is not safe abroad, or that there are too many regulations that make it cumbersome, if not suspicious, for an Arab investor to establish a global presence.

There are, however, more fundamental economic factors involved. One cannot ignore the fact that global interest rates have been very low during the past few years, major stock markets hardly moving beyond a narrow range month after month, and returns being rather limited.

In fact, there was no exodus of Arab money from the West after 9/11 as is popularly assumed. People did not cash their assets and transfer them to their countries. The new money, however, that was being made as a result of the new cycle of the high oil prices mainly stayed home.

"There are today over 100 firms in the Gulf region ready to increase their capital or be transferred to a public holding company."

The reason for this is simple to understand. First local and regional real estate, and then the stock markets, earned investors double, and even triple, digit returns, profits much higher than could be earned abroad. The easing of credit facilities by local banks, the encouragement of the privatisation process and the rise of major construction firms attracted the attention of the local and regional investors. This interest spread from the large and wealthy families to the middle class and any owner of resources.

Former US President George Bush, in a speech in Kuwait sponsored by the National Bank of Kuwait in mid-December 2005, commented that Gulf Cooperation Council (GCC) markets, with a $900 billion capitalisation and $3 billion in daily liquidity, were no longer local or illiquid. Stock markets in Gulf countries became an instrument of investment, speculation and quick wealth throughout the region. This phenomenon was not restricted to the nationals of a single country, but GCC citizens, residents in the Gulf and foreign investors.

The new wealth dynamic has been

created by the rise in oil prices and the revenue generated in the past few years. However, equally important is the management of the local economies. In the seventies, the main concern was how to deal with the major bottlenecks following the mega contracts awarded to build infrastructure and public utilities. Ships had to wait days and weeks to unload their cargo, and in some cases helicopters had to be used to carry the freight from the ships to the docks.

Today, the focus is on how to reduce the debt, restructure the economies, change the laws to attract investments, and sign bilateral and multilateral agreements that expand commerce with industrial countries within the rules of the World Trade Organization.

"The majority believe that as long as oil prices remain high, the stock market will be attractive."

According to IMF data, oil export revenue in the ten largest Middle East oil-exporting countries was around $200 billion in 2003, approximately $450 billion in 2005 and is expected to rise to $500 billion in 2006, an increase of 150 percent over 2003. Forecasts for GCC GDP annual growth in 2006 are around 8–10 percent, with expansive budgets, scores of capital projects, particularly in health and public education, and with the windfall profits used to reduce debt.

Problems Ahead

There is no question that the way oil funds are being invested this time around is greatly different to what took place in the seventies. The problems are also different.

The unemployment rate among the youth in the various Arab countries is still at an all time high of 35 percent. While this unacceptable rate was probably there three decades ago, and was tolerable, it is more critical now, with the spreading of wealth across wider segments of the population and the increasing influence of fundamentalist and radical religious groups who try to use this phenomenon to their advantage.

Furthermore, the national oil companies are investing billions of dollars in new production capacity and refineries. The cost per barrel these days is much higher than before. The fear among Arab oil professionals is for another slump in world oil demand with the Arabs being left alone carrying the can. While this has happened before, this time around it would be far more costly than previously.

Moreover, lurking in the background is the phenomenal rise in the regional stock markets. The profits achieved in 2005, paper or real, are unprecedented. A large segment of the middle and lower middle class mortgaged their homes, sold the jewellery of the wife and invested whatever savings were available in the stock markets. The problem is that much of the money is in small unprofitable companies, and many of the decisions were made on hearsay and rumours. At end-2005, the market started to decline. The public debate is whether this was a 'technical correction' or the beginning of a major fall. The majority believe that as long as oil prices remain high, the stock market will be attractive.

There is also the rise of inflation, with prices of rent, real estate and fuel increasing by as much as 20–30 percent in countries like Qatar and the UAE. The rise of the euro compared to the dollar has contributed to this high rate, as have the 'bottlenecks' resulting from the high global demand for raw materials and equipment which has driven the cost of local contracts way beyond their original estimates.

Finally, and despite the fact that Arab entrepreneurs have taken the initiative and have begun investing regionally whenever there are profitable opportunities, there are still many bureaucratic and political hurdles in developing regional markets with a free flow of capital, goods, labour and firms. This situation is accentuated by the fact that corruption remains rampant and the politics as gloomy and dismal as one can ever remember. Religious and sectarian parties are gaining both in the ballot box and in the streets; there are no signs of a breakthrough in the region's two main conflicts – Palestine and Iraq; and there are signs of trouble in Syria and the fear of an armed conflict over the Iranian nuclear programme. Such developments do not bode well for long-term investment despite the availability of a healthy cash flow.

Environmental Issues

Malcolm Keay considers the problem of environmental targets

Measurement sounds like the sort of technical detail best left to the anorak-clad experts – of passionate interest to them, perhaps, but of no great importance in the wider scheme of things. Yet a few moments' thought will show how wrong that view can be. It is a basic tenet of management that 'if you can't measure it, you can't manage it'. Furthermore, everyone involved with policy analysis knows that measuring public policy outputs is difficult – it is always possible to measure inputs (how much money is spent; how many schools or hospitals built?), but relating that to outputs (how does this affect standards of education or health?) is very complicated – and often not even tried.

At first sight, climate change might seem more favourable ground for measurement. The overall objective is clear enough – reducing greenhouse gas emissions – and there are tangible milestones and targets on the way, in the form of Kyoto and other obligations, so the desired outputs of policy are easy to define. Yet the old problem of linking inputs (expenditure on, say, energy efficiency or renewables) with those outputs remains – and, until that link can be made, governments cannot seriously plan the measures they require to meet their targets. At present, they are unable to do so.

A clear example is energy efficiency. Energy efficiency has been a centre-piece of government energy policy at least since the 'Save It' campaign of the 1970s, and central to climate change measures since the early 1990s. The expected outputs have been quantified – the UK Energy White Paper says 'we expect more than half the reductions in our existing Climate Change Programme – around 10MtC by 2010 – to come from energy efficiency' as well as 'half the additional 15–25MtC savings we are likely to need by 2020'. Yet today, two-thirds of the way through the Kyoto period, the UK is not in a position to say what its energy efficiency measures are achieving.

The problem is not new. A few years ago, the Environmental Audit Committee (Tenth Report, session 2003–2004), commented that

> A central theme emerging from this report is the difficulty of assessing progress on energy efficiency in the absence of robust and reliable energy projections and systematic ex post appraisals of the impact of specific policy measures…Indeed, in dealing with energy efficiency, there is a sensation of standing on shifting sands.

More recently the House of Lords Science and Technology Committee reported in July this year that little had changed: 'the Government appear to have no clear view on how to measure, and thereby manage [energy efficiency]'.

The problem is that there is no automatic link between improvements in energy efficiency and reductions in greenhouse gas emissions. Energy efficiency does not necessarily reduce energy use – indeed by effectively making energy services cheaper it may increase consumption. Careful analysis of the links between efficiency and energy demand, and hence emissions, is required.

In other areas this is well understood. For instance, in relation to labour efficiency (productivity), it is clearly wrong to make the simple top-down calculation that an improvement in productivity of, say, 1.5 percent a year means the loss of an equivalent number of jobs. Similarly, at least since the times of the Luddites, no one has advanced a bottom-up calculation, adding up the impact of all the efficient new machines installed across the economy, as a way of estimating levels of employment. Economies are dynamic and complex systems; the various interactions and feedbacks need to be taken into account. The government itself argues that improved productivity creates, rather than destroys jobs (i.e. increased labour efficiency increases demand for labour). Yet on energy efficiency, it takes the opposite view; it uses top-down and bottom-up calculations, of the sort it would reject out of hand in relation to productivity, based on the assumption that energy efficiency reduces demand for energy.

"The problem is that there is no automatic link between improvements in energy efficiency and reductions in greenhouse gas emissions."

More accurate measurement involves considerable methodological difficulties, from whatever end you approach the issue. To examine bottom-up impacts properly, sophisticated analysis is required – taking account of such issues as income and substitution effects; free-riding; principal/agent slippage; persistence; gaming; appraisal optimism; the impact of new services and so on. In practice, virtually none of this is done – it is very expensive and difficult to undertake. In the past, this did not matter much, since the aim was to improve efficiency rather than reduce demand as such. Now, when the aim is to reduce emissions, a much more determined approach is called for. In practice, however, the government does not measure the outputs of energy efficiency interventions in any rigorous way. Instead, it concentrates on measuring inputs (for example, insulation installed, compact fluorescent light bulbs distributed) and simply assumes that they achieve the expected results.

Top-down measurements are no easier

– partly because of the many confounding factors, such as movements in energy prices, changes in industrial structure and so on, but also because the government's energy projections are essentially econometric. They incorporate a factor known as autonomous energy efficiency improvement, a steady but undifferentiated increase in efficiency. There is no easy way of knowing, ex ante, whether an energy efficiency measure or programme will increase that rate of improvement; or, ex post, whether an energy efficiency gain was the result of policy measures.

In other words, as the Committees complained, there is no clear baseline, and therefore no way of knowing what effect energy efficiency measures are having. There is also no evidence that measurement is getting any better. It is difficult to see anything more than the triumph of hope over experience in the statement in the Government's Climate Change Review that: 'Since 1990, carbon dioxide emissions from the household sector have fallen by about 3%. On the basis of current policies, carbon dioxide emissions are expected to decline by about 16% between 1990 and 2010.'

Renewables, one of the government's other key measures, raise analogous problems. It is not in principle difficult to measure the physical output from renewable sources. Furthermore, support for renewables leads to increased, rather than lower, prices, so one might expect some positive feedback in terms of carbon mitigation. Yet here too there are enormous methodological problems.

The practical issues are relatively well recognised – will the desired quantity of plant be built and perform as expected? The facts that: all previous renewables targets have been missed; the practical problems are daunting (as pointed out in another recent report from the Science and Technology Committee on 'Renewable Energy: Practicalities'); and that there have been a number of recent announcements of problems with major renewables projects all reinforce the general belief that the government's 2010 target will be missed.

But even if it were met, what savings would it realise? The measurement problem here is that renewables are being introduced into a dynamic and responsive electricity market. It cannot be assumed that all other things will remain equal, apart from the renewables themselves – the savings can only be measured by looking at the impact on the whole electricity system, including non-renewable sources.

"But the short-run problems are relatively straightforward compared with the longer-term issues"

Even in the short run, that impact is difficult to measure. It involves a calculation of what the renewables replace when they are operating. This depends on the rest of the system. During the last century, when coal was virtually always at the margin in UK generation, renewables generation could be regarded as displacing coal. Increasingly this century, as gas takes a greater place in the generating system, wind may find itself displacing gas-fired generation. That would, in itself, more than halve the CO_2 benefits from wind generation.

But the short-run problems are relatively straightforward compared with the longer-term issues. A programme for new capacity stretching into the future will have an effect on the composition of the system by displacing other new investment, which in all probability would either be new (and therefore highly efficient) gas stations, or even nuclear. The nominal CO_2 savings would fall – indeed if nuclear were displaced there would be no savings at all. Even if new fossil plant were displaced, there would be a significant penalty, because the new investment would have raised system efficiency. If the composition of the system changes as a result of a wind programme, emissions will rise for the whole time of operation (as compared with what they might otherwise have been); whether this increase is offset by wind power during the minority of hours during which it operates is uncertain, especially given the losses in operating efficiency across the system caused by the intermittency of wind.

The impact depends on what new plant is displaced. To take a simple example: If the UK were to meet its 2020 aim of 20 percent of electricity from renewables with wind only, the Sustainable Development Commission calculates that 26 GW of wind power would be needed, equivalent (because of the intermittency of wind) to around 10 GW of alternative plant. What investment if any would it displace? Wind advocates normally assume that investment elsewhere in the system would be unaffected, but this seems very implausible. The introduction of a significant volume of wind power, with its intermittent output, inevitably reduces the load factor of other plant on the system and increases the uncertainty about whether it can operate for long enough to remunerate the investment. The incentives to build new plant would be substantially reduced; the temptation to retain older plant, despite its lower efficiency and higher emissions, would increase.

So the impact of wind would be to reduce investment elsewhere, but the question is by how much – the 10 GW of fossil equivalent, the 26 GW of total wind power or some other (possibly higher) figure? The new plant displaced is likely to be new CCGT capacity (as the government assumes in its business-as-usual projections). As this would operate at up to 60 percent efficiency and would probably replace older coal plant operating at around 35 percent efficiency, enormous cost-effective CO_2 savings, which would otherwise have taken place, would be foregone. The effect could be to reduce, or even eliminate, any savings from the wind when it actually operated.

Similar uncertainties arise with other climate change measures – for instance with combined heat and power. Governments usually praise its high potential efficiencies – up to

90 percent – and compare that with the efficiency of existing fossil power plant (say, around 35 percent). But this is triply misleading;

- First, because in practice CHP plant rarely reach the high levels of efficiency that are technically possible. As the *Digest of UK Energy Statistics* shows, CHP schemes in the UK have an average efficiency of around 70 percent.
- Second, because CHP stations produce heat as well as power – indeed heat is usually their main output. In the UK, for instance, heat output is on average about two and a half times greater than power, so a comparison with power only plant misses the main part of the picture.
- Third, because comparing existing plant with new CHP investment ignores the significance of investment displacement. New CHP plant is normally installed at a time when a decision has already been made to replace existing plant; it is therefore likely to displace alternative new investment, rather than the existing plant (which would have been retired anyway). Since new heat plant may have efficiencies of 90 percent or so, and new power plant up to 60 percent, the comparison does not necessarily favour CHP.

Again, therefore, the result may well be that there is little or no emissions saving in practice; as with its other main policy measures, unless ways can be found of measuring the impacts more accurately, governments really have little idea whether the promotion of CHP makes a contribution to their climate change targets.

The analysis could go on, but it would only reinforce the message – that governments are not able to measure the impact of their climate change policies or forecast the results in terms of emissions. As a consequence, although they have both targets and supporting policies in relation to climate change, whether those policies contribute to meeting the targets is essentially a matter of chance.

It is therefore no surprise that only two countries in the EU-15 are on track to meet their targets. Most of the rest are set to fail; a small number might meet the target if planned new measures work as expected (which, as explained above, is unlikely). Outside the formerly centrally planned economies, other countries with Kyoto targets, like Japan and Canada, are in an even worse position.

Even in the two countries which are on track, the causes of CO_2 emissions reductions are to be found elsewhere than in their climate change programmes – in the UK, all the CO_2 emissions reductions since 1990 took place in the early 1990s, primarily as a consequence of the dash to gas in power generation, i.e. as a result of liberalisation rather than climate change policies. Sweden has a target of + 4 percent for overall greenhouse emissions. Although it is on track, its CO_2 emissions have increased by around that much since 1990. Given that it managed to reduce CO_2 emissions by about 40 percent during the preceding 15 years (i.e. in 1975–1990, as a result of its nuclear construction programme, and the substitution of electricity for oil in heating – this trend continues to influence the figures) that is hardly an overwhelming achievement.

In short, if governments want to take climate change seriously, they will have to start taking these measurement issues seriously. It will cost money to do so, but that can be no excuse for not trying. The present situation, where they rely on policies whose impacts they cannot measure, and fail to achieve the reductions they expect, benefits no one, neither the economy (there is no way of knowing if the measures on which governments are relying are cost-effective); nor the environment (Kyoto countries are missing their greenhouse gas targets and undermining their credibility for future regimes).

Benito Müller reports on the Montreal Climate Change Conference

Between 28 November and 10 December 2005, the capital of the Canadian province of Quebec hosted what was generally expected to be an important session of the annual United Nations climate change conference, an expectation reflected in a record attendance of almost 10,000 participants. The reason for this was, on the one hand, its being the first session of the governing body of the Kyoto Protocol – known as 'Conference of the Parties serving as Meeting of the Parties to the Kyoto Protocol' (COP/MOP) – signalling the full legal implementation of the Protocol, and, on the other, the fact that, by coincidence, it was also the year in which the Kyoto Protocol required the launch of negotiations on industrialised country commitments for the period after 2012, when its current initial commitments expire.

And, although not completely unexpected, it was seen as a good omen when the forty odd decisions of the 'Marrakech Accords', the Kyoto Protocol rule book – named after the Moroccan host city of COP7 (the 2001 seventh session of the Conference of Parties, the governing body of the UN Framework Convention on Climate Change) where they were finalised – were adopted without objection at the beginning of the Montreal meeting.

The mid-conference resolution of another issue, on which agreement had not been possible at Marrakech, was much less expected. The issue was, in essence, whether the consequences of non-compliance with the Kyoto Protocol targets should be legally binding penalties, or some form of 'rehabilitation' measures. In practical terms, the argument boiled down to the manner in which the draft compliance instrument would be adopted. For binding penalties, it had to be adopted as an amendment to the Protocol, for non-binding consequences an adoption by

decision of the COP/MOP would be sufficient.

Saudi Arabia had tabled a controversial proposal ahead of the meeting that adoption of the compliance instrument should be by way of an amendment to the Protocol alone and not through a COP decision. The reason why this was more than just a legalistic point is that an amendment would require separate ratification by the Parties to the Protocol, a process which experience has shown could take years. Without its adoption, the Protocol and its carbon trading instruments could not actually be implemented. The Saudi proposal, in short, could have easily led to a last minute derailment of the whole Kyoto process. As it happens, the Conference made a classic compromise, namely to adopt the compliance instrument by decision now, and at the same time schedule discussions on adoption as an amendment, to be concluded at COP/MOP3 in 2007.

"With the adoption of the Marrakech Accords and the compliance regime, the Kyoto Protocol became fully operational."

With the adoption of the Marrakech Accords and the compliance regime, the Kyoto Protocol became fully operational. Yet the Conference went further by also adopting improvements of some of its elements, in particular the Clean Development Mechanism (CDM), an emission trading mechanism in which developing countries can attract much needed investment in clean development projects from (industrialised) Kyoto Parties in return for emission credits generated by the projects. The CDM in its initial form had proven to have some bottlenecks which were unlikely to let it develop its full potential.

These achievements, by themselves, would have been sufficient for the first COP/MOP to have been deemed a success. Yet, at Montreal, there was more at stake. As mentioned, it was also meant to initiate the negotiations on the future of Kyoto beyond its first commitment period. And what made Montreal a historic meeting was that the Kyoto Parties decided to initiate formal negotiations to adopt industrialised country targets for a period beyond 2012.

This was historic because it finally gives the business sector, particularly in the industrialised world, the regulatory certainty indispensable for the investment decisions required to solve the climate change problem. Energy infrastructure investments, in particular, are medium to long-term and thus much more in need of regulatory certainty than other types of investments. The Kyoto Protocol has now moved on from being merely a potential 'one-period wonder' to the one and only multilateral regime which is here to stay.

'Finally,' – as Stéphane Dion, the Canadian Environment Minister and Conference President – reminded the delegates in his conference closing statement, 'we have achieved what many claimed was unattainable, a decision launching a dialogue on long-term cooperative action to address climate change by enhancing implementation of the Convention.' The reason why this was felt to be impossible was that it actually includes the United States, who until the very last moment categorically refused to enter into any discussion on future action under the aegis of the United Nations, to the point of actually walking out of the negotiations, in an act of brinkmanship, at one stage of the negotiations. There is no doubt that getting them to finally agree to some dialogue – if only one that is 'non-binding' and explicitly not meant to lead to negotiations of new commitments – is a tremendous personal success for M. Dion, and it is understandable that he considers this to represent 'a major victory for the global community. Now national governments will have the forum to exchange experiences and analyse strategic approaches and to free our imaginations to find further innovative solutions that I know we are capable of.'

But precisely because of the explicit limitations on its ambitions, one should not get too carried away about the Bush administration 'having blinked', as one observer put it, or even having changed their mind on either the Kyoto Protocol, or the usefulness of the UN process as a whole. The only way for the international community to engage with the USA in a meaningful manner on climate change in general, and to address US emissions in particular, is to bypass the White House, and instead deal directly with the many sub-national entities – be they cities, states, and even groups of like-minded states – who are willing to take on serious mitigation efforts, such as the group of north-eastern states that have introduced a carbon cap and trade system for their utilities.

"The Kyoto Protocol has now moved on from being merely a potential 'one-period wonder' to the one and only multilateral regime which is here to stay."

Indeed, given that the emergence of such regional trading systems is highly likely to lead at some point to a US-wide system – due to pressures from the sectors involved regarding inter-state competitiveness and regulatory streamlining – the most important step forward for the Kyoto Parties with regard to engaging the USA would be to integrate these regional US schemes with their own schemes, so as to ensure that an international component and Kyoto compatibility is from the outset built into these prototypes of such a US-wide scheme.

But the main 'message from Montreal' to the world has to be that the Kyoto Protocol, with its emission caps and trading mechanisms, is not only fully operational, but is the only viable existing multilateral effort to combat greenhouse gas emissions, and, most importantly, that it is here to stay!

The Role of Technology in Reducing E&P Costs

Mark Andersen

The global demand for oil has considerably reduced the cushion of excess supply of the past. While demand continues to rise, productivity from established fields has continued to fall because of natural decline. The exploration and production (E&P) industry must steadily add production to counter both trends.

E&P companies are increasing activity to meet the demand, and OPEC countries have announced plans to increase production. For example, Saudi Arabia plans to increase its oil production capacity from 11 to 12.5 million b/d by 2009, with the potential for a later increase to 15 million b/d. At the time of the announcement in 2005, the country was producing 9.5 million b/d.

The Saudi petroleum minister cited application of technology as an important aspect of the strategy. Indeed, technology is key to the continuing success of the E&P industry throughout the world. Advances in technology have enabled the energy sector to provide for today's energy needs, but further advancement will be necessary to meet future needs. The challenge is not only to locate new oil resources, but also to produce more from existing resources.

Both challenges require new solutions. The easy oil has been found, and in many cases, already produced. New oil is being sought in extreme locations – ultradeep water, high-pressure, high-temperature formations, and arctic areas – or in small accumulations in more conventional locations. Furthermore, in mature fields, the industry must manage production decline in a manner that maximises net-present value without jeopardising ultimate recovery. This includes dealing with technology deployed many years ago that might limit options today.

In recent years, accessing these more difficult-to-reach resources has led to an increase in the finding and development (F&D) cost of each new barrel of oil. This is a reversal of a trend that began about twenty years ago. Between 1981 and 2003, the price of oil fell and then fluctuated around a low level. Over the same period, inflation-adjusted F&D costs fell by as much as two-thirds.

During this same period, the oilfield service companies assumed a greater role in developing new technologies, while striving to bring down F&D costs. Much of the reduction in these costs can be attributed to newly deployed technologies, particularly three-dimensional (3D) seismic data and extended-reach and horizontal drilling. The E&P industry relies on seismic, drilling, logging, completion, stimulation, testing, modelling, and monitoring methods that were not widely available a decade ago; some were not available at all. To the extent that technology can reduce costs, its application extends the life of a field, makes smaller fields economical and can even enable the redevelopment of fields that have already been abandoned. In addition, new technology is essential for the development of unconventional sources of hydrocarbon – such as oil sands, tight-gas reservoirs, coalbed natural gas, and even gas hydrates – that will play increasingly greater roles in meeting future hydrocarbon demand.

The effect of new technology to reduce overall cost and improve efficiency can best be illustrated by examining a few specific examples. These include 3D seismic acquisition, advanced drilling methods, time-lapse seismic acquisition, behind-casing petrophysical analysis, and intelligent oil fields.

High-Fidelity Seismic Data and Designer Wells to Access New Reserves

Seismic acquisition grew rapidly in the 1990s as 3D seismic data offered a new way to reduce finding and producing costs. Eventually, most offshore activity was 3D rather than two-dimensional (2D). While this was happening, acquisition and processing of seismic data were achieved more quickly; the overall efficiency in seismic activity improved by about tenfold.

As exploration targets, such as satellite fields, became smaller, the quality of seismic data had to improve to resolve small or ambiguous features. WesternGeco recently introduced high-fidelity Q (mark of WesternGeco) single-sensor seismic acquisition and processing methodology. Rather than grouping signals before processing, each receiver signal is captured for processing individually. This tremendous increase in data allows for correction of surface effects and heterogeneities and results in much higher resolution.

"technology is key to the continuing success of the E&P industry throughout the world."

Yet, despite the tremendous increase in the amount of information processed, WesternGeco has delivered data to operators within days of completing survey acquisition. In contrast with the weeks, months or even years that seismic processing consumed in the past, this rapid delivery means that decisions concerning drilling or development can be made soon after acquisition. The resolution is significantly better than conventional seismic sections, helping to resolve thinner features, and visualising exploration-drilling targets that would otherwise be missed.

Accessing these thin features requires new technologies so that a well trajectory can follow almost any path. Novel downhole motor technology has made directional drilling practical. State-of-the-art measurements-while-drilling (MWD) and

logging-while-drilling (LWD) tools and their immediate interpretation provide the information necessary to steer a wellbore within specific strata. These tools were improved during recent decades to reach their current level of operations.

In the 1990s, rotary steerable systems (RSS) helped operators set new records in extended-reach drilling. This technology facilitates directional control and steering of the bit while continuously rotating the entire drillstring. Steering is accomplished in a unit behind the bit by activating three pistons, separated on the circumference by 120°, in the proper sequence to force the bit in the correct direction.

With the ability to drill in almost any direction, steering based on real-time data becomes important to optimise the path in the reservoir. MWD and LWD tools provide petrophysical data that locate the bit within specific strata. Placing a measurement collar nearer the bit decreases the time lag between finding out where the bit has just gone and drilling ahead. New, far-seeing LWD technology is now helping drillers understand where the bit is about to go, and to detect lithology or fluid interfaces up to 4.5 m away. This helps access hydrocarbon assets in locations that previously were difficult or costly to produce.

For example, in Oman, Petroleum Development Oman (PDO) wanted to drill into a thin rim of attic oil in a Shuaiba carbonate reservoir. Veering off course upward into the mechanically unstable Nahr Umr shale would likely complicate well construction and completion or even jeopardise the borehole itself.

Previous attempts to place a wellbore just below the Shuaiba-Nahr Umr boundary relied on conventional LWD tools. With their shallow depths of investigation, these older tools provided little advance warning that the wellbore was about to cross the boundary between the high-resistivity reservoir and the low-resistivity shale. This frequently resulted in unintentional exits from the reservoir, requiring a turn to steer the trajectory back down to the Shuaiba. This cost time and money.

In addition, the shale loosened by the exits and reentries into the formation created well completion problems, increasing costs even more.

PDO shared information about this difficult drilling task with Schlumberger, who were at the time developing a new tool that it was felt would be vital for PDO's drilling success. This open communication between companies led to the accelerated development of the tool, since it was known that there was a client eagerly waiting to use it.

> "In the past few years, time-lapse seismic monitoring has become an important technology"

PDO was the first company to use the new PeriScope 15 (mark of Schlumberger) directional, deep imaging while drilling service, deploying it in the Shuaiba field. This tool propagates electromagnetic signals and uses a unique array of transmitters and receivers to determine the direction of bed boundaries and water zones up to 4.6 m away from the tool. Real-time measurements from this tool determined that the low-permeability zone lay just 2.5 to 3 m below the top of the Shuaiba reservoir. Guided by PeriScope 15 measurements, PDO drilled the well horizontally for 1,300 m, averaging 1.2 m beneath the Nahr Umr interface. By placing the well so close to the top of the formation, PDO added reserves of attic oil that would otherwise be inaccessible. With 100 percent of its horizontal section placed in the upper zone of the reservoir, this well has produced oil at significantly higher rates than the field average. Results such as these indicate the tremendous value of new technology for accessing reserves previously thought uneconomical.

Advanced Reservoir Monitoring

In the past few years, time-lapse seismic monitoring has become an important technology, particularly in the North Sea. Companies in that area report that they have more than recovered the cost of repeat surveys, also called four-dimensional (4D) seismic acquisition, by locating bypassed oil and improving recovery. The utility of time-lapse seismic surveys rests on the difference in seismic attributes caused by changes in fluid content or porosity. The differences may be caused, for example, by water movement as oil and gas are produced, or by formation compaction.

For example, in the Norne field, offshore Norway, Statoil commissioned a series of high-fidelity Q time-lapse surveys. Because of the rapid turnaround in processing – within a few days of completion of the monitor survey – Statoil had time to adjust horizontal-well drilling plans to avoid a water zone in a planned well, avoiding a costly problem well.

Another source of reserves may be even closer at hand. Existing wells may have hydrocarbon accumulations behind casing that were not accessed by perforating, either because the accumulation was considered uneconomical at the time, because a full suite of logs was not acquired before casing, or because the well is so old that the oil or gas resources were missed by the logging techniques available at the time. Geological compartmentalisation may have isolated resources that the existing completion was expected to drain, but didn't.

Until recently, obtaining detailed petrophysical information in formations behind casing in a well was virtually impossible. After many years of development, Schlumberger introduced a new set of behind-casing logging tools. These tools, introduced starting in 1999, evaluate bypassed pay near existing wells. Measurements are available for formation porosity, density, acoustical properties, lithology, and pressure. Fluid samples and formation dynamics data can also be acquired. Since the wells and infrastructure already exist to access these resources, costs are often minimal, comprising logging and recompletion costs.

In mature fields, additional production or improved economy for produc-

tion may be available simply by optimising production and designing cost-effective workovers in existing wells. A detailed field study in a mature area can distinguish good candidate wells from bad, and may provide guidance for converting more wells into good or excellent producers or for decreasing water cut, often with minimal investment. Then, a skillfully planned workover programme can boost production without the cost of drilling new wells. Time-lapse seismic monitoring can also be used to optimise scheduling of workovers and maintenance.

The ultimate in field optimisation may be achieved through development of intelligent oil fields. These fields have monitoring devices downhole and at surface, a data-gathering system, software with sufficient intelligence to indicate problems, and control devices to act on the information obtained. Elements of such a system are in place at different locations, but there has been no large-scale implementation of real-time data delivery in an intelligent oil field. Companies are still assessing the trade-off between the cost of permanently installed monitoring systems and increased productivity from wells. Many companies are, however, implementing operation support centres, which is an important step toward development of an intelligent oil field.

The E&P industry is often characterised as conservative, taking longer to adopt new technologies than other industries, such as consumer electronics and pharmaceuticals. This is often justified by the huge investments necessary for developing new fields, the long lead times between discovery and first production, and the low margins on oil and gas that were present until recently. However, our technology adoption rate must improve.

Of all research and development projects undertaken by the oilfield services industry today, only one in ten becomes commercially viable. Of the other nine, one or two don't make it because they were overly ambitious from a technical standpoint. The rest fail for one of two reasons: either the service company misunderstood the problem technically and therefore addressed the wrong market, or the operator was not entirely open about its problem and the resulting solution was poorly adapted. Either way, both sides lose.

Operators and the service industry must communicate and cooperate to speed technology development. The example described earlier of the rapid adoption of Periscope 15 technology by PDO shows the advantage of openness for both sides. Greater service company effort and faster operator adoption will have beneficial effects that can be further enhanced by closer cooperation across the industry. Technology development and deployment will be key in controlling future exploration and production finding and development costs.

The twin demands of declining production and increasing consumption must be met with boldness and determination. While the mandate of the service industry is to provide quality tools and services to meet the challenges of obtaining additional oil and gas, operators must be equally bold in applying these technologies to get those resources out of the reservoir.

Strategies of non-OECD Gas Producers in the Atlantic and the Middle East

Hadi Hallouche, Michael Tamvakis and Bryan Train

Introduction

The international gas market is undergoing a quiet revolution, by any standard. Gas is the most environmentally friendly fossil fuel and is the most efficient for power generation. This has increased consumption for gas dramatically, as in the image of the Dash for Gas in the UK. At the same time, domestic production has reached its limitations in many consuming markets. The resulting growth in the international trade of the fuel of the twenty-first century comes at a time of high oil prices and at a time of reform and liberalisation of the gas and electricity markets in many consuming markets, notably the EU.

This international natural gas trade, either through pipelines or in tankers in the form of Liquefied Natural Gas (LNG), has traditionally been a rigid one, due to its regulated market structure and its capital-intensive, front-loaded nature; with Long Term Contracts (LTCs), Take-or-Pay (ToP) provisions, destination clauses and prices indexed to oil prices. The international LNG market has also been a geographically divided one, with Atlantic and Pacific markets virtually distinct from one another.

This is changing, slowly but surely. LTCs, which will remain the backbone of the industry, are becoming shorter in duration with ToP provisions diminishing and destination clauses being phased-out in Europe. Furthermore, the emergence of a short-term and spot trade is increasing in prominence with a large order book for the shipyard industry, including super-tankers (up to 250,000m^3) to fulfil the demand for the long distance transportation of LNG.

The changes in the Atlantic market are interesting. Market liberalisation in Europe is creating a stronger corporate identity for previous utility monopolies on the continent. Upstream liberalisation in some producing countries, like Algeria, is also slowly drawing institutional boundaries between the State – the shareholder – and the National Oil Company (NOC). A major development also in the Atlantic market is the

emergence of the US market, which, like the UK, is a liberalised one with gas-gas competition, a new situation for most producers. The potential for the US market in terms of LNG exports is as uncertain as it is big. Indeed, the USA has been attracting an overwhelming proportion of short-term trade in the Atlantic, including a number of cargoes originally earmarked for the EU market under LTCs that were diverted.

These changes represent new challenges and opportunities for the industry players and call for new strategies. Former monopoly utilities in the EU are moving closer to fields, whilst NOCs are moving closer to the end consumer and the International Oil Companies (IOCs) are taking positions both in liquefaction, regasification and shipping.

Atlantic market producers are heterogeneous in more than one respect, ranging from established players (Algeria, Nigeria, Libya and Qatar), 'new' entrants (Egypt, Oman, Trinidad & Tobago) and potential entrants (Equatorial Guinea, Angola, Venezuela and Iran). These producers' strategies depend on a number of factors, such as:

Resources

The gas reserves that NOCs either own or control differ in importance from oil. Oil reserves for those producers who are members of OPEC are important in that they are one of the variables on which their OPEC quotas, and therefore production, depends. Gas reserves are only important, from a trade perspective, insofar as a Long Term Contract can actually be honoured. From a strategic perspective, countries with larger reserves tend to aim for market share whereas countries with smaller reserves tend to aim for revenue maximisation.

That being said, the relative reserves are, with hindsight, important. Producers with high oil reserves have less incentive to develop their gas reserves, particularly during times of low oil prices. It is this particular point that has been a prime driver leading to the development and commercialisation of gas reserves in countries deemed to be 'gas rich, oil poor'.

Gas rich, Oil poor

Algeria and Qatar are seen as pioneers within gas trade in the Atlantic, the driving force behind this development being the fact that resources were diverted towards gas as a means of generating income. Moreover, this has also been driven by the lower quotas within OPEC of both countries, which are not considered large oil reserves holders in comparison with other members. Indeed Qatar and Algeria rank as ninth and tenth of eleven members in terms of reserves and are, respectively, first and third gas exporters within OPEC. Indonesia, not an Atlantic exporter, has the lowest oil reserves within OPEC and is the second largest exporter of gas within it.

Both Algeria and Qatar with their respective NOCs (Sonatrach and Qatar Petroleum, respectively) recognised that gas and not oil was strategically to their competitive advantage and have sought to develop their trade infrastructure and their market share earlier than others, which makes them today market leaders.

Oil rich, Gas rich: The 'Sleeping Giants'

Iran and Venezuela on the other hand, due to larger oil reserves have benefited from larger quotas within OPEC and thus received higher revenues from oil than those from gas. Logically, this has made the development of natural gas infrastructure less of a priority than the oil upstream. As a result, in spite of their high gas reserves (Iran has the world's second largest reserves and Venezuela has reserves comparable to those of Algeria, OPEC's largest exporter of gas), these two countries' export profile remains limited. Iran is, to date, a net importer and Venezuela is only starting to develop its pipeline and LNG infrastructure. These countries can, in the long term develop strong market shares but in order to do that, they need to utilise their economies of scale – high volumes, low margins – to capture the market share. Interestingly, the countries that Venezuela and Iran will seek cooperation with to develop their gas industry are those very same ones against whom they will compete, e.g. Algeria and Qatar.

Geography

Oil is an internationally liquid market, with transportation only representing a fraction of its landed cost. Gas pipelines, however, are only economic for short distances and relatively high volumes; and LNG end-prices are heavily dependent on cost of transportation, which in turn is dependent on distance to market. Countries with closer proximity to market, and those with a coastline, are better equipped for the natural gas and LNG trade than others. With the high oil/gas price environment that we have today, gulf producers are positioned to sell sustainably to both the Atlantic and Pacific market.

Niche Players

Oman and the UAE as well as Equatorial Guinea and Angola, if and when they will enter the market, are niche players. They have smaller reserves but they benefit from other infrastructure or from proximity to markets. The reserves profile of these countries does not allow them to have a significantly larger market share. Their strategy will therefore be to maximise revenues, most probably through maximisation of output and diversification of gas outlets. Trinidad and Tobago did supply 75 percent of the LNG to the US market in 2004 but with a relatively low R/P ratio (19 years), they are likely, too, to follow the revenue maximisation route.

Pipeline/LNG flexibility seekers

The United States has emerged as an important potential importer in the Atlantic. In fact, it has attracted a large proportion of the short-term, and spot, cargoes that were traded within the last two years. A number of LNG regasification terminals are being built, or have been proposed. This makes LNG cargoes for the USA seem more valuable, if more risky.

For North African players (and even for Nigeria, if the NIGAL project, a pipeline linking Nigerian fields with Algerian export infrastructure through Niger, sees the light), having a portfolio of pipeline and LNG allows them to play the arbitrage game between the EU and the USA. So far, only Algeria has this flexibility with 35 bcm of pipeline exports through the two pipelines to Italy and Spain (and two others planned), and 26 bcm of LNG exports in 2004. With the inauguration of the Greenstream and the Arab Pipeline, Libya and Egypt are also joining this club. Within the Gulf, pipeline/LNG flexibility is also sought, particularly with the Indian market looking increasingly attractive. Iran, which already exports 3.52 bcm of pipeline gas to Turkey, is looking with the Pakistani and Indian governments into the building of the Iran-Pakistan-India pipeline, while having a number of LNG liquefaction plants under planning. Qatar, too, is considering pipeline outlets for its gas, including discussions to build an offshore pipeline to India.

The State, the Economy and the NOC

The State's relationship with the NOC is multifaceted. As a shareholder, the State has some control over the management of the company and its strategy. The degree of independence that the NOC management has differs from one producer to another. The State also has a role of Sovereign power and, as is the case of Algeria under the new hydrocarbons law, as upstream regulator. In this capacity, the taxation, legal and investment regimes in place have an important impact on the company in terms of its commitments/opportunities to invest, nationally and internationally, and how it 'competes' with international companies. In effect, the institutional boundaries between the state and the NOC are important in determining the strategy of the latter.

Foreign policy and the national economy have an important effect on the big picture. Algeria, Iran, Nigeria and Venezuela have large populations and are at a determining stage of their development. Hydrocarbons represent 70 percent, 45 percent, 80 percent and 45 percent of their fiscal revenues, respectively, and 95, 80, 93 and 75 percent of their export revenues, respectively. This is to illustrate the importance of the state company, in particular, and the hydrocarbon sector in general, to the economy of these countries. It is in the economic agenda of many countries to diversify the sources of their revenues. This can translate into either a maximisation of total revenue from hydrocarbons, which can then be reinvested into infrastructure, industry or education; or a quest for market share, with the sustainability, relative predictability and strategic value that it entails. The State's foreign policy and the NOC strategy influence each other.

Vertical and Horizontal Hedgers

Algeria and Qatar's exports in gas will grow, but with new players entering the market, their market share will be challenged. In order to maintain their competitive edge, Sonatrach and QP should go (and are going) closer to the end consumer by investing in shipping and re-gasification capacity. The corporate identity of the NOCs here becomes important as they compete in the international market. For example, Sonatrach is a shareholder in El Ferrol terminal in Spain and has booked capacity in the Isle of Grain terminal in the UK. Qatar Petroleum, through its partnership with ExxonMobil, is a shareholder in the Adriatic LNG terminal in Italy and the South Hook terminal in the UK, to name only these. Sonatrach owns or co-owns six LNG carriers and two on the orderbook. Qatar Petroleum owns, co-owns or operates five carriers and there are reports of up to ninety ships under order for the next decade. These two companies may also take positions in so-called ex-terminal business, i.e. with utilities.

Sonatrach has a competitive disadvantage to QP in the Pacific Market, although its investment in the Camisea field in Peru is a geographical hedge, through which it will capture a small market share in the Pacific market when the LNG terminal is expected to start operations in 2013.

Moreover, countries following a policy of economic diversification have used their gas reserves in order to develop value adding gas intensive industries in the fields of GTL, CNG and Aluminium to name a few. Examples include Nigeria's Escravos GTL facility in conjunction with Chevron and Sasol, Oman's Aluminum and Fertilizer developments and Qatar's Oryx GTL facility. There is a tender process for a GTL project in Algeria due to be awarded in 2006.

Concluding Remarks

The heterogeneity of national producers of gas will have an important impact on the corporate identity of many so-called national oil companies, and vice versa. The very nature of the gas industry, and its growing importance for NOCs in the Atlantic and the Gulf, coupled with the fundamental changes that the natural gas industry is quietly undergoing, is creating a pool of strategies between the potential aggressive market share grabbers, players with high reserves and low exports, the niche players who will seek to maximise revenues with no major market share ambitions, the LNG/pipeline arbitrageurs and the mature players, who will continue to look outside to expand their resource base, to move closer to the end consumer and to capture profit potential in other gas markets. The corporate map of the gas trade industry, particularly the NOCs, is an important subject for observation, especially with the current oil price environment.

Not so long ago I was invited by my gas supplier to enter into an agreement to fix my unit charge for gas for the next five years. I assume that it was a general invitation to all British Gas customers; possibly competitors were making similar approaches.

This has caused me, and no doubt many fellow consumers, to face up to the dilemma confronting industrial and electricity generating users of gas; do we buy on the spot market or do we buy forward? What is going to be the course of gas prices over the years? And of course it has raised the question in my mind – what does British Gas think about these questions? One might think that British Gas is expecting prices to fall back. But we domestic consumers are offered a break clause in the event of a price fall. So what is British Gas up to? Perhaps it is hoping to lock in customers for the long term back to back with its long-term purchase contracts. But this only works if the price of gas is going to rise. If it falls British Gas is stuck with high prices under its purchase contract and a defecting clientele. So do we conclude that British Gas is taking a gloomy view of the path of future gas prices?

Mercifully as I am no longer a part of government or of the oil and gas industry I do not need to worry unduly about the answers to this conundrum. But if I were in either of those places I would be very perplexed.

Broadly speaking the situation seems to be as follows:

- Gas supplies from the UKCS are declining and at a faster rate than quite recent predictions.
- Imports can come in through the Interconnector (whose capacity has been recently upgraded); as LNG (the Isle of Grain terminal is operating and more capacity is on the way); and in due course through new connections with Norway.
- Until these projects are fully operational a cold winter could see demand exceeding supply.
- We have limited stocks.
- We are experiencing some untypical cold weather.
- The spot price of gas has risen dramatically.
- The one month forward and longer-term forward prices have also risen sharply.

In the face of this situation the gas consuming part of industry is extremely anxious, is talking about suspending production or transferring to lower cost countries, and calling on the government to do something about it. The media are stirring it. And the government is trying to calm things down.

Personal Commentary

Charles Henderson

The key fact to keep in mind in assessing this situation is that the UK gas market is uniquely liberalised. If supply looks like falling below demand, prices will rise to suck in imports whether it be through the Interconnector or as LNG; and demand will fall as industrial users of gas switch or suspend production (something they may well do even if they have long-term supply contracts, since it may be more profitable to sell the gas than to produce). And of course the traded market will become upwardly volatile.

All very good in theory, you might say, but in that case why is the Interconnector not full, delivering gas from Europe sucked in by the higher prices? And why are LNG cargoes destined for the UK being diverted to other destinations? There is a school of thought that the answer to the first question is that European gas suppliers are restricting supplies to the UK in spite of the higher prices because over there the markets are not fully liberalised. It is an odd argument, implying either that a cartel is operating to keep prices below the level that could be achieved, or possibly that governments are leaning on the suppliers to restrict exports. I am not convinced. Another more plausible theory is that third party access into the trans-European pipeline systems is being restricted by operators. This may be the natural consequence of such pipelines being full with gas carried for contracted users. Or it could be that pipeline owners are deliberately keeping utilisation of the system below capacity. This is something that the EU Commission is investigating, egged on by the UK government and the Office of Fair Trading.

The second question (why LNG is going elsewhere) must surely be because the USA (post Katrina) and Spain are seeing higher prices than are being bid by the UK. The problems of third party access to terminals would seem in this case to be fanciful.

Industry can probably understand all this and wants the government to do some thing about it. The government cannot see what it can do in this liberalised market, except to try to dispel any panic about the possibility of interruptions in supply, and to prepare all consumers for higher prices in the medium term. I say this because once the LNG terminals and pipeline connections are in place the UK will be taking its prices from a world market for LNG and from a European market for pipeline gas. The latter market is at the moment driven by prices indexed to oil; but it is surely only a matter of time before the two markets become one. Either way, prices in the UK look set to stay high, and there is nothing the government can do about it. Industry of course can take evasive action by negotiating long-term contracts, by hedging in the forward market, or at the extreme closing or relocating plant.

And what is the answer to my own domestic conundrum in the light of all this? Accept a five-year fixed price.

Asinus Muses

Empty Promises

EU countries have agreed to reduce their energy consumption by 1 percent per year from 2007 for nine years, but will not face any court action if they fail. That seems a pretty safe decision for Ministers in office in 2005.

Wind Economy

A large wind farm planned for an offshore area of the Welsh coast has been postponed because it's not economic. The easy solution is for the subsidy to be increased – please wait for further announcements.

Cold Comfort

The IPE has been renamed ICE Futures. They must know something about the Gulf Stream that the rest of us don't.

On the Ball

The EU Commision has at last discovered, so it says, serious problems in the functioning of Europe's energy markets. They will continue their enquiry and will 'identify adequate remedies'. That sounds really encouraging.

Quick as a Flash

Dr LeClerc, President of the New York Public Library, is reported as saying that 'all the paradigms are shifting at the speed of light'. Not bad for a word that has only recently, well relatively, been reinvented by management consultants.

Perpetual Immobility

Did you know that on every weekday more than 1 million vehicles drive into New York where they must deal with 40,000 intersections before they can even find a parking spot. 'Rush hour' already extends for 7 to 8 hours per day, so soon there won't be any time left for working.

On the Horns of a Trilemma

Asinus always looks forward to Shell's global scenarios and the latest one, which takes us to 2025 (if we ever get there) is represented by what looks like a three-bladed propeller with an equilateral triangle imposed on its central shaft. The blades are called 'Low Trust Globalisation', 'Open Doors' and 'Flags', and the points of the triangle 'Market Incentives', 'The Force of Community' and 'Coercion, Regulation'. This represents, amongst other things, the triple dilemma, or 'trilemma', with which we are faced. So that at least solves that.

Coal Unthroned

UK Coal has established that 'the parameters were there for us to enter the wind farm market', i.e. that the subsidies seemed to be sufficient. They are also turning some old mine areas into business parks and shopping centres (where presumably some other satisfactory parameters exist) but all this, says Mr Mace, their Finance Director, is an 'add-on to the coal business'. It just shows what it takes to be a coal miner these days.

Walking the Carbon Trail

Spurred on by BP advertisements Asinus has been trying to calculate how his carbon footprint compares with that of some of his friends, but he turned out to be so technically impaired that he couldn't work out the result from the carbon footprint calculator thoughtfully supplied by BP online.

Birth Pangs

SNEPCO (Shell Nigeria E and P) has recently advertised for an Umbilicals Supply Contract for, amongst other things, five integrated umbilicals. A separate contract will cover umbilical tubes and umbilical terminations. 'Only reputable and sound Respondents should apply for this pre-qualification tender'. It sounds like a great diversification opportunity for struggling Health Service Providers.

Reflections

Asinus has recently been deflected from reaching a critical inflection point in his life, but hopes that BP, in a similar situation with its Renewables Business, will get there satisfactorily.

Common Market

While driving on holiday recently Asinus found that the price of diesel was over 30 percent cheaper in Spain than in the UK, and gasoline just under 30 percent cheaper. French diesel price was about half way between the two and gasoline somewhat closer to UK prices. In France and Spain diesel is cheaper than gasoline, in the UK it is more expensive. All this is of greater or lesser value to the respective Finance Ministries, and almost certainly makes no difference to the environment.

Drug Drillers

Asinus reads with some alarm that the use of, and indeed the manufacture of, methamphetamines is so common on US oil rigs that it's having an effect on the cost of oil production. Mr Walsmith, director of oil and gas training at the Mid-Continent Oil and Gas Training Center pointed out that meth users may go through a Superman stage when they believe themselves to be invincible, which, if you are 'working with hundreds of tons of steel and thousands of pounds of explosive pressure' is, to say the least, a danger to anyone in the neighbourhood.

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