Oxford ENERGY FORUM

A QUARTERLY JOURNAL FOR DEBATING ENERGY ISSUES AND POLICIES

Issue 63 November 2005

We have a varied menu for your autumnal reading, starting with three articles on upstream taxation. This has become, yet again, a subject of particular interest since the oil price has tripled within the past couple of years. Should, or will, oil-producing countries change their tax regime in order to take their share of the available fiscal surplus, or should contractual arrangements remain inviolate? We may be reminded of the arguments in the '60s and '70s about the Law of Changing Circumstances.

Alex Kemp has presented for us the economic justification for upstream tax and shows the effect of the different practical applications. Typically, a production sharing contract will allow the government share of profits to increase automatically when the price increases, but he points out that timing still remains an important variable that needs to be addressed. Systems that depend on conventional royalty and income tax mechanisms tend to be less flexible and, if subjected to later alteration, are more likely to discourage investment. He points out the conceptual problem of windfall tax and also the effect on investment that even an announcement of taxation may have.

Pedro van Meurs also looks, but more specifically, at the different types of government take, first making the point that government take is determined by competition. He defines fiscal systems as progressive with price or regressive/neutral with price. The former receive automatic increases in government revenue, the latter (which he calls 'price upside' countries) provide higher 'windfall' profits to investors when the price increases. In current circumstances there is an investment advantage to price upside countries, although these will tend to move to 'progressive' systems. He concludes that while government take for oil will tend to increase, that for gas will stabilise.

Robert Arnott looks at the same situation but rather in relation to the IOCs. At the extreme they might be facing nationalisation, but this seems improbable for a number of reasons; more likely is a tightening of existing regimes. In the end there has to be a balance for governments between revenues and investment just as for

CONTENTS

OXFORD INSTITUTE FOR ENERGY STUDIES

the IOCs there has to be a balance between the level of profit that can be expected and the right to operate. In a high price environment it is not necessarily easy for either side to get it right.

In place of the usual second 'debate' we have three articles dealing with separate but topical subjects. Most of us will probably have a feeling that US Energy Policy is failing, but may be unaware of the details. The impression that Gazprom is spreading its influence over the gas business may be widespread, but the implications and extent of this will probably be a surprise to many. And surely the disasters created by hurricanes Katrina and Rita must have messages about energy that we should be studying.

Shirley Neff and Amy Myers Jaffe turn our attention to the USA and the Energy Policy Act of 2005. They analyse for us the many areas in which it fails to address the problems facing the USA and they pick out the areas which are most likely to improve the situation. In the end, of course, Congress has to be persuaded to accept proposed changes and the authors' most hopeful conclusion is, perhaps, that the effect of the hurricanes, Katrina and Rita, may jolt the Administration into taking some more useful and relevant decisions.

Jonathan Stern gives us a glimpse of some of the conclusions that he presents in his full-length study of Russian Gas (recently published by OUP as part of the Institute's Gas Programme). He draws our attention to the huge range of Gazprom operations that cover not only gas exploration and production, but marketing both internally and externally, pipeline construction, LNG and even oil. They need to reform Russian systems and their own management and will need to balance the massive requirements of the Russian market with the very different operational needs of a multinational business. It seems that we are all likely to be affected in some way by the results.

We also have a measured assessment by Robert Skinner of the messages that we should be absorbing as a result of the ravages of hurricanes Katrina and Rita. Some of the messages are clearly for the USA, but there are others that apply to the rest of the world. If there is one message that is the most clear it is that there hasn't been sufficient infrastructural investment either in refining, pipelines, electricity or terminals. Governments have in general failed to create the kind of stable regulatory and investment structures that investors must have to carry out their part of the bargain.

Finally, Personal Commentary in this issue is provided by John Mitchell, who muses on what is 'normal' now; whether prices will remain at their current high level or descend again; what will the effect of current high prices be on the economy at large; and what will be the effect of inter-fuel competition and technology in the longer term.

Contributors to this issue

ROBERT ARNOTT is Senior Research Officer at the Oxford Institute for Energy Studies

AMY MYERS JAFFE is the Wallace S. Wilson Fellow for Energy Studies at the James A. Baker III Institute for Public Policy of Rice University.

ALEX KEMP is Schlumberger Professor of Petroleum Economics at the University of Aberdeen

SHIRLEY NEFF is adjunct Lecturer and Research Scholar at the Center for Energy, Marine Transportation and Public Policy at Columbia University

PEDRO VAN MEURS is President of Van Meurs Corporation

JOHN MITCHELL is Associate Fellow, Chatham House

ROBERT SKINNER is Director of the Oxford Institute for Energy Studies

JONATHAN STERN is Director of Gas Research at the Oxford Institute for Energy Studies

Upstream Taxation

Alex Kemp looks at oil prices and government take

Introduction

The dramatic rise in the world oil price has consequences for all stakeholders including investors in exploration and production (E and P), their host governments, contractors to the E and P sector, consumers, and governments in consuming countries. Petroleum production and consumption are subject to substantial taxation and/or profit oil sharing arrangements around the world. In some countries such as the UK and Norway substantial taxes are levied on both activities. The policy considerations for the two activities are different. At the production stage the objective is to secure to the state an adequate share of the economic rents. At the consumption stage the objectives are generally a combination of easy revenue from products the demand for which are price inelastic, the internalisation of external costs such as pollution, and the charging for transport-related infrastructure. The coexistence of multiple objectives with one instrument can readily produce confusion and contradictory positions in policy debates.

A conceptual distinction can be made between economic rents and monopoly profits. The former is compatible with competitive market while the latter emanates from restrictive practices such as by a production cartel. Increases in oil prices can emanate either from cartel behaviour or from changes in the underlying demand/supply balance. In the last couple of years the latter phenomenon has been operative with the key driver being the acceleration in world oil demand above the trend over the preceding decade. While the world market does not conform to the textbook definition of a competitive market the increased returns from production correspond to a change in the underlying economic rents.

The great unknown is whether the price increase reflects a permanent or temporary change in market conditions. The more cautious view is that demand growth will moderate and supply will increase leading to a price fall. In that case the current increased returns will constitute only a temporary windfall. The alternative view is that investment in new productive capacity will be limited and oil prices will continue at relatively high levels.

Implications for Taxation and Profit Oil Sharing Mechanisms

Host governments in all producing countries are keenly interested in obtaining a substantial share of any economic rents from petroleum exploitation. Some contractual arrangements have inherent mechanisms for ensuring that they automatically receive a major share of the benefits from a price increase. From the government's viewpoint a system can be progressive in relation to the price change, meaning that the take increases proportionately more than the price. This is the case with many production sharing contracts, especially those with profit oil sharing mechanisms related to profitability. Typically these are in the form of R-Factor or rate of return based schemes incorporating a formula whereby the government's share of profit oil automatically increases as the achieved return increases.

In general these schemes have the potential to cater for large fluctuations in oil prices such that both parties share in the upside potential (with the government typically receiving an increasing share of successive price increases), and in the downside risks (with the government typically bearing a major share of the price falls). Skill is, of course, required in the design of the schedules determining the respective shares of the parties. Thus an R-Factor or rate-of-return based system which is very steeply progressive and incorporates extremely high marginal rates may discourage cost-consciousness and possibly even incremental investments where the government's share of the incremental return is very high.

> "A conceptual distinction can be made between economic rents and monopoly profits"

Well-designed profit-related contracts thus offer the prospect of being acceptable to both parties in a world of fluctuating prices. Given that they are often designed to last for 30 years or more the prospective range is very wide and, despite these inherent stability-promoting features, renegotiation has sometimes been deemed necessary in a number of cases over the past decade. On closer inspection these have generally emanated not so much from the profit oil sharing terms (unless these were unrelated to project profitability), but from the timing of the benefits from production determined by the cost recovery mechanisms. Host governments have sometimes perceived that the cost recovery provisions were unduly postponing the time when they were able to significantly share in the benefits. This aspect of contract design is just as important as the profit-sharing terms. The issue has, of course, arisen not only in countries employing production sharing contracts but in those where licences with taxes and royalties are employed. A historic example is the UK in the early 1980s when the need for acceleration of revenues led to the introduction of Supplementary Petroleum Duty and then Advance Petroleum Revenue Tax.

In general sophisticated profit-sharing mechanisms whether involving production sharing contracts or tax arrangements, such as the resource

rent tax employed in countries such as Australia, Papua New Guinea, Namibia and the Faroe Islands, offer better prospects for producing shares of the rents acceptable to both parties than those involving more conventional royalties and income taxes. These are generally inherently less flexible in response to substantial movements in the oil price or other factors determining project profitability.

"Well-designed profit-related contracts thus offer the prospect of being acceptable to both parties in a world of fluctuating prices"

In concession systems royalties are generally fixed in the licence but taxes are free standing at the government's discretion. (In production sharing contracts such discretion is normally very constrained). In the event of a major price change, particularly in systems where the marginal rate is not progressively related to the price, there will always be a temptation to make a discretionary change. The result obviously depends on the nature of the change. Recently substantial royalty-related changes have been announced in few countries. These enhance government revenues including those in the near term. Because investment and operating costs are mostly not deductible these are not well-targeted on economic rents. There is then a danger that they may discourage incremental and other high-cost investments which could be viable on a pre-tax basis and which should be encouraged when the oil market is very tight.

This problem will become more acute when the price subsequently falls. There has generally been a natural reluctance by host governments to reduce their take by discretionary action when they are in any case suffering from reduced revenues. The result is greater investment disincentives. Discretionary changes to a highly profit-related tax are generally economically more efficient. When increased as a result of a large price increase, they are less likely to discourage high cost incremental and other investments, particularly when the costs are speedily deductible. But clearly the extent to which project returns are reduced is an important consideration.

The world investment climate covers a wide range of prospects from mature provinces with relatively small fields such as in the North Sea and onshore USA and Canada, and immature areas such as deepwater Angola and Nigeria where there are prospects of very large fields. The opening-up of Libya to foreign investment now offers highly prospective low cost territory. Tax increases have to be seen in this competitive environment. In countries where the expected size of fields is relatively low the net present values (NPVs) will be relatively small as well, though the internal rates of return (IRR) may be quite high if the cycle time to first production is quick. In countries with large fields the NPVs will also be relatively large, and, other things being equal, the host governments can levy higher taxes and still remain competitive.

Recently there has been much discussion of windfall gains resulting from the oil price increases and associated latte of windfall taxes. The concept is not very clearly defined but brings to mind the Crude Oil Windfall Profit Tax introduced in the USA in the 1970s but abolished some time ago. This was directly related to price and was really an excise tax based on the difference between a base price and the market price. It was not well-targeted on economic rents because no account was taken of the investment and operating costs associated with production. A number of base prices were introduced including a relatively high one designed to encourage tertiary recovery. The scheme in practice became highly complex and its unsound conceptual basis caused many problems such as the artificial encouragement to investors to claim that their investments were for secondary or tertiary recovery purposes.

In Russia both the rates of the Mineral Extraction Tax and the Export Duty increase with world oil prices. The marginal rate becomes very high. The non-deductibility of costs is again causing a problem relating to the higher effective rates applied to low productivity and high unit cost projects. Currently the government is examining various proxies for costs (such as well productivity) to ameliorate the burden of the tax on such investments. The conceptually sound way to collect the economic rents would simply be to allow the relevant costs to be deductible.

"Discretionary changes to a highly profit-related tax are generally economically more efficient"

Tax changes also have announcement effects. If they are in the form of increases this will generally have a negative effect on the investment climate, though (less likely), if an uncertainty is felt to be removed by the change, the clarification of the position may also have a positive effect. A tax reduction will generally have a positive effect on the investment climate. Much will depend not only on the effect on investment but on the perception of the likely degree of permanence of the new system. In the current environment there would be a keen interest in knowing whether any scheme was likely to last for some time and whether it would be modified in the event of significant price falls.

Pedro Van Meurs considers the future of the government take

[Government take here will be defined as follows: Government Take = Government Revenues/ (Gross Revenues – Expenditures) x 100 percent. The government take is usually applied with respect to the calculation of a specific project, such as a new oil or gas field. Government revenues include all payments to government, such as royalties, corporate income tax, profit oil and profit gas, etc. Expenditures are capital and operating expenditures. In this article government take is determined on an undiscounted basis.]

Developments during the Last Two Decades

Over the last 20 years the world arithmetic average government take for oil and for gas has typically declined, from high levels of about 75 percent during the energy crisis in the late 1970s to about 60 percent today.

The main reason for the decline of the average government take has been the relative 'over supply' of exploration and development opportunities until recently. This was caused by two separate trends:

- new jurisdictions opening up for investment, and
- increased access to petroleum basins through improved technology.

The government take is determined by competition among governments. In essence, the government take is the 'price' for the 'petroleum properties' that a government has available. A large increase in new opportunities creates a drop in 'price'. Governments have been forced to lower government take in order to attract investment or maintain or expand petroleum production. The decline in government take has been stronger for gas than for oil due to the new pipeline and LNG opportunities and large volumes of 'stranded' gas.

From the early 1980s, important new acreage became available for petroleum exploration and production in the People's Republic of China, the former Soviet Union and Eastern Europe, Venezuela, Argentina, Brazil, Bolivia and Peru, Vietnam and Cambodia, and Saudi Arabia and Iran.

During the last two decades we have also seen many new investment opportunities as a result of improvements in technology. Companies now are able to develop oil and gas discoveries in 2000 metre water depth. New pipeline technology, including deepwater pipelines, has resulted in connecting many new areas to markets, such as Algeria to Europe. LNG developments now make it possible to ship LNG from Qatar to East Asia.

This significant increase in new development opportunities has resulted in a gradual lowering of the government take during the last two decades.

Current Situation

This process is now coming to a halt. Except for Kuwait and Iraq, there are no important jurisdictions left in the world that can still be opened up. Most of the continental shelves and slopes are now accessible. Most petroleum basins in the world are connected to markets through pipelines or LNG shipments. From now onwards, petroleum companies will be forced to 'pick over' the existing acreage in order to identify new exploration and development targets.

At the same time a large number of new 'buyers' of 'petroleum properties' have come in the market. During the last two decades many new petroleum companies from China, Russia, Latin America, Europe, Asia and the Middle East have entered world petroleum exploration and development. Also many small Canadian, Australian and British companies have decided to go 'international'. These new investors bid aggressively in the available bidding rounds in order to acquire new acreage positions.

Will these new trends in conjunction with the high oil prices drive the government take back up?

The Future

There are two types of fiscal systems with respect to high oil and gas prices:

- Systems that are progressive with price, whereby the government take adjusts upward automatically with higher prices, and
- Systems that are regressive or neutral with price, whereby the government take remains about the same or even declines somewhat with higher prices.

"This significant increase in new development opportunities has resulted in a gradual lowering of the government take during the last two decades"

A considerable number of countries have progressive systems. There are two ways in which the upward adjustment in government take is occurring:

'One Way' adjustments. These are systems that are based on cumulative profitability. In these systems a higher government take 'locks in' once certain levels of IRR, profitability ratios or cumulative revenues are being reached. In other words if the oil price should decline again, the government take will stay high. These jurisdictions include:

- IRR based profit oil and gas shares such as in Angola, Russia and Azerbaijan and IRR based profit shares or taxes, such as in Saudi Arabia, the Canadian frontier areas, Australia and Kazakhstan.
- Profit ratio based profit oil and gas shares in Libya, Qatar, Azerbaijan and India, profit ratio based royalties and taxes in Peru and Tunisia,
- The PRT in Algeria.

'Two Way' adjustments. These are systems that are based on price related formula or shares. In these systems the government take goes up when

prices are high but it comes down when prices decline again. This is done through windfall profit taxes, supplemental payments, uplifts or other mechanisms. Examples are the fiscal systems of Alberta, Colombia, Trinidad and Tobago, Malaysia, Pakistan, Thailand, Indonesia, East Timor, Norway and the Netherlands.

Certain countries have service contracts with fees which are not price sensitive, such as in Iran, Mexico and Venezuela. These countries receive the entire price upside.

As can be seen from the above list, there will be an automatic upward adjustment of government take in a large group of important petroleum-producing countries as a result of higher oil and gas prices. In all countries this upward adjustment applies to oil as well as gas, except for Trinidad and Tobago and Qatar where it applies only to oil.

Price Upside Countries. The countries with regressive or neutral fiscal systems are 'price upside countries', where investors will earn a significant 'wind fall' as a result of the price increases.

These countries can be divided into two groups:

- Countries with systems that primarily consist of royalties and corporate income tax. In almost all of these countries there are no fiscal stability provisions and therefore governments are free to impose new petroleum taxes.
- Countries with production sharing agreements whereby the percentage profit oil or gas to government is determined on production levels only, rather than certain formulas. Many of these contracts are subject to fiscal stability provisions.

Countries with royalty-tax systems include the United States (federal as well as state fiscal systems), certain provinces of Canada, the Venezuelan concessions, Argentina and Brazil, onshore Australia and the new licences in the UK.

Countries with production level based production sharing agreements include Congo, Gabon, Egypt, Sudan, Yemen, Bangladesh, certain Indonesian contracts, Vietnam and China.

Trends. The oil supply shortage will induce many countries to have new bidding rounds for remaining acreage or acreage that is being relinquished. The high oil prices and the large number of new companies interested in acreage will result in high bids.

> "Although it can be expected that the government take for oil will start to increase … the government take for gas may stabilise on average"

The high bids and the automatic upward adjustment of the government take in many jurisdictions with progressive systems creates a 'competitive space' for price upside countries. It makes it easier for these countries to adjust their government take upward without becoming less competitive. This will have the following effects:

- In countries that are not subject to fiscal stability provisions, it can be expected that certain governments will review their fiscal terms in order to determine whether the government take should be adjusted upward through new or increased taxes.
- In countries with contracts that are subject to fiscal stability, it can be expected that a higher government take will be established for new model contracts. In some cases, governments may try to renegotiate certain production sharing contracts.
- Price upside countries will consider moving to price progressive fiscal systems.

Some nations are already in the process of reviewing or adjusting their fiscal terms. Venezuela cancelled the royalty holiday on heavy oil development and is currently trying to force investors into the new concession terms. The political unrest in Bolivia is creating an environment where it is attempting to go back to the higher government takes that used to exist in the early 1990s. Trinidad and Tobago is reviewing its terms. Kazakhstan is considering new fiscal terms with a very high government take. In the case of Kazakhstan the proposed increase is so strong that it may be counter-productive. Norway introduced a number of interesting small improvements in its fiscal terms, but this process may now come to a halt.

Although it can be expected that the government take for oil will start to increase, the strong developments in gas pipeline and LNG technology are still creating significant new gas development opportunities. Therefore, the government take for gas may stabilise on average, with some countries leaving government take the same and other countries increasing or decreasing their take on gas.

The speed with which these new trends develop will depend in part on political developments that could create significant new opportunities, such as

- A stabilisation of the security situation in Iraq and an opening of Iraq to new investment based on attractive contracts.
- The re-introduction of production sharing contracts in Russia.
- A strong opening of Mexico, in particular the deep water acreage.
- Resolution of political issues in Iran together with the introduction of more attractive upstream contracts.

Robert Arnott emphasises the importance of striking the right balance in fiscal tightening

Over the past twelve months, as the oil price has risen to heights not seen in real terms since the 1970s, the issues of nationalisation and fiscal tightening have re-emerged as threats to the International Oil Companies (IOCs). In Russia, the fragmentation of Yukos was seen by many as the start of a process by which the Russian government sought to regain control over the oil and gas industry. In Venezuela, the government surprised the oil industry by increasing royalty rates earlier than anticipated and even suggested that the contracts signed during 'Apertura' were in fact illegal. For the IOCs, such actions are cited as major threats to corporate profitability and they are also considered to undermine international investment confidence in the country concerned. However, how important are these recent events to the IOCs and should the IOCs themselves shoulder some of the blame?

It has been well documented that during the 1960s to the end of the 1980s most resource owners nationalised the oil and gas assets which in many cases led to the departure of the IOCs from these regions. These companies desperately needed to find new sources of oil and gas reserves and this was achieved during the 1990s with the opening up of a new political landscape and the development of new technology. With new oil and gas provinces opening up, the issue was not so much lack of opportunity but more lack of capital during a period of relatively low oil prices and corporate cost-cutting. It is only in the past five years, after a period of major industry consolidation that companies have tried to kick-start upstream growth. However, they have found that in this new global economic environment opportunities are constrained and there are new competitors.

In marked contrast, host governments and national oil companies (NOCs) have at last begun to wake up to the fact that the IOCs do not have unlimited opportunity sets, they do not have the option to switch major investments elsewhere and in any event, if they were to go elsewhere there would be plenty of other companies who would step into their place. With this realisation, governments have recognised that they no longer needed to try to attract new investment simply by offering attractive fiscal terms. Indeed with the increased levels of competition there is even a case for more punitive fiscal terms.

Against this background, are the IOCs facing a wave of renationalisation or are fiscal terms simply responding in a natural way to higher oil prices? Evidence to date suggests that fiscal terms are responding to higher commodity prices and that renationalisation remains unlikely. This is because most host governments no longer need to resort to the extreme measure of confiscating oil and gas reserves but can use more sophisticated tools to extract a greater share of the economic rent.

> "The strong nationalist sentiment of the Venezuelan government has also filtered out to the rest of Latin America"

Such tools started to become more commonplace even before the recent rise in the oil price. Production sharing contracts (PSC) which used to be based on simple sliding scales of production at varying thresholds have now in the main been superseded by rate of return based contracts. Such contracts are awarded to the company which offers the lowest rate of return on the concession. This has the merit of effectively capping the reward to the IOC when oil prices are very high and maximising the rent to the host government. The extent to which IOCs are prepared to push down rates of return was highlighted in the recent bidding round in Libya where many companies bid a percentage rate of return of just 7 percent on a number of blocks, very close to their weighted average cost of capital. Therefore even in the event of exploration success, it is very unlikely that these companies will add shareholder value from the concessions they were awarded.

Of course host government tools to control fiscal revenue can be a little cruder. For example, in Russia the government has effective control over the oil transportation network and has introduced an effective super-tax of 90 percent of all profits when oil prices exceed $30 per barrel. In other words, the government not only benefits from higher oil prices but it can also control exports of crude oil. But can this really be described as renationalisation? It is only in the highly publicised Yukos case that such an argument can be made.

Elsewhere in the world there have been calls for renationalisation of oil and gas assets, most notably in Latin America. The influence of the socialist government of Hugo Chávez of Venezuela in this cannot be understated. Even though his government has not renationalised the oil and gas industry, it has accelerated the increase in royalty payments made by IOCs in the syncrude projects and it has indicated that new contracts will contain significantly harsher fiscal terms.

The strong nationalist sentiment of the Venezuelan government has also filtered out to the rest of Latin America and Chavez's cross-border initiatives aimed at spreading the socialist message have recently been stepped up. Calls for nationalisation of the oil and gas industry in Ecuador and Bolivia have spread alarm amongst the international oil and gas industry but none have yet to be fulfilled. In Ecuador, the country actually stopped exporting crude oil in August 2005 as protestors called on the government to nationalise the industry and take a greater share of profits. In Bolivia there are still calls for nationalisation of the oil and gas industry by the mainly indigenous population. In both cases the rallying cries of nationalism have alarmed the governments but they have not yet acted to nationalise

the oil and gas industry for fear that such an act would undermine their heavily indebted domestic economies. Several companies operating in Bolivia have already cut back on expenditure plans fearing that they will lose their asset base at some point in the near future.

Whilst the Latin American examples cited above highlight the potential risk of renationalisation, in reality the outcome has only been a moderate tightening of existing fiscal regimes and in the case of Venezuela an acceleration of harsher fiscal terms that were already incorporated in contracts with IOCs. For most other countries around the world fiscal tightening in PSC rates have not been applied retrospectively to existing concessions, only to new concessions. For example, in West Africa, harsher terms for new PSCs are being introduced with new concessions but existing terms have not been changed.

It is only in tax and royalty concessions, such as the UK North Sea, that existing terms are being changed. In the UK, which has undergone frequent changes in fiscal terms in response to higher oil prices, the additional 10 percent corporate tax rate was added even ahead of the recent increase in oil prices. Frequent changes to the UK tax regime are often cited as being a reason why investment in the region has lacked stability. Elsewhere, in Kazakhstan the corporate tax rate has been increased significantly for oil and gas companies and the region no longer stands out as offering one of the most lenient fiscal regimes in the world. Such a change was perhaps one of the main reasons behind the development delays to the Kashagan field.

Of course host governments must strike a balance between sustaining tax and investment. Those governments that have maintained a strong control over their tax regimes and have not responded to the lobbying of IOCs are the ones that have been most successful in sustaining oil and gas investment. For example, only two years ago the IOCs operating on the Norwegian continental shelf were crying out for an easing of Norway's tax terms in order to attract new investment. The Norwegian government responded in 2004 with only minor changes aimed at taking the exploration risk off newcomers, but in essence it left the tax regime unchanged. Eighteen months later those same companies are quoted as saying the regime is 'satisfactory' and they have commended the government for its 'fairness and stability'.

Elsewhere, even against a backdrop of high oil prices, some countries are actually loosening fiscal regimes in order to attract investment. For a long time, the Indonesian PSC regime was recognised as being one of the harshest in the world with marginal tax rates often as high as 90 percent. However, with declining production and the country now an effective importer of crude oil the government recognised the need to loosen terms in order to attract new investment. Such changes have indeed attracted new entrants but may have come too late to make a real difference to levels of investment going forward.

> "Of course host governments must strike a balance between sustaining tax and investment"

The issue of fiscal tightening is therefore more an issue of balance and one which the IOCs had better face up to soon or risk losing new investment opportunities. This brings me back to my earlier point that although governments are often seen as the pariahs when it comes to fiscal tightening there is some evidence that IOCs do themselves no favours.

During the 1990s, the IOCs instilled a new sense of fiscal discipline in their organisations. Return on capital employed targets were set. Furthermore, as part of the policy of improving profitability, capital was constrained and projects were set relatively high hurdle rates before they were approved. It was not uncommon for companies to claim that they could generate double digit rates of return on projects based on a long-term real oil price of $12 per barrel. Even with higher oil prices, the IOCs still claim that they would not give project consent unless they generated returns in excess of their cost of capital at $25 per barrel. They argue that oil prices are likely to remain volatile and they point out that given the average life of a project from development consent to abandonment could be as long as 25 years it would be fiscally unwise to base investment decisions on current high oil prices.

Whilst such logic is music to the ears of IOC shareholders, it does instil a deep suspicion in the eyes of host governments and the general public of 'profiteering'. Of course, in the current climate of high oil prices, IOCs who maintain a very public stance of screening projects at an oil price that is less than half the spot price are an obvious target for raising additional revenues. No wonder then that in the consuming countries IOCs are now being discussed as being potential targets for windfall profits taxes and in the producing countries they are likely to suffer from higher production taxes.

As in all things in life, it is a question of balance. Yes, the higher oil prices have resulted in harsher fiscal terms for the IOCs and terms which are likely to tighten even further. But equally, the higher oil prices have given the IOCs returns on their investment far in excess of what they could have originally anticipated. To generate returns on capital employed of more than three times the average cost of capital is of course something that every IOC shareholder must dream of. But in a low inflationary environment and against a background of high commodity prices the IOCs must strike the right balance between the requirements of the shareholder and that of the host nation, even if this means accepting lower returns from harsher fiscal terms going forward. Those companies that do not strike the right balance are likely to lose out in the global chase for new development opportunities.

US Energy Policy Act of 2005

Shirley Neff and Amy Myers Jaffe

In the aftermath of the destruction wrought on the US energy patch, especially oil and gas production and refining, by Hurricanes Katrina and Rita, the failure of the long awaited Energy Policy Act of 2005 (EPACT 2005 or Act) to address the country's energy challenges is all too apparent. Even before the storm, the energy bill was characterised more as a grab bag for special interests than as the kind of 'comprehensive' energy strategy needed to address long-term core American economic, environmental and security interests. At the signing ceremony in early August, President George W. Bush noted, 'because we didn't have a national energy strategy over time, with each passing year, we are more dependent on foreign sources of oil.' This observation is true enough. But the Act, which is not expected to stimulate major increases in domestic oil and gas production or to stem in any significant fashion the growing energy demand, will do little to shift the trend line referred to by the American president. By September, the folly of the energy bill hit home with voters. In the wake of hurricane induced fuel outages, gasoline lines, and a huge spike in residential natural gas prices, the new legislation inside the energy bill seemed ludicrously inadequate. As a result, politicians, rather than pointing to the bill's achievements, implicitly admitted failure by rapidly introducing additional measures in Congress as if to immunise themselves from the bill's clear inability to address the gasoline and diesel fuel crisis at hand, let alone the coming winter heating cost crisis.

Some of the more high profile issues during recent years of energy debate were not included in the final 2005 legislation. Opening the Arctic National Wildlife Refuge (ANWR) in Alaska to oil and gas development remained too controversial to survive as a major prong of Congressional action in spite of steadfast support from the White House and Congressional leadership. Nevertheless, ANWR may yet become open to oil and gas drilling as part of a renewed debate on US energy policy if attempts to lodge it in a much larger budget bill survive the legislative process.

The demand control side of the oil equation, most popularly expressed in the search for higher fuel economy standards for cars, sport utility vehicles and light trucks, fell under equally vociferous but more complex opposition politics. Organised labour and its Democratic supporters from manufacturing states led the opposition with the full support of Republicans and industry opposed to mandates of any kind. New York representatives Edward Markey and Sherwood Boehlert have reproposed legislation to raise fuel efficiency standards (CAFÉ) in the USA from 25 miles per gallon to 33 mpg by 2015 but the effort is likely to fall prey to the same political forces that kept café standards out of the EPACT2005.

An increase in gasoline taxes, which has been so effective as a demand constraint energy policy tool in Europe and Japan, was never entertained and has long been considered highly unlikely to find traction inside American political discourse. Instead, under the Act a complex array of token tax credits will be available for a few years to support purchases of fuel cell, hybrid, and advanced lean-burn technology vehicles. But tax credits to consumers remain a symbolic gesture until US industry and policy makers can forge a concrete plan to propel new technology autos into the market. Ford Motor Company's recent call for a national energy summit, post hurricanes, may represent a serious shift in positioning that might bode well for a serious debate of policy options. Detroit's problems – aggravated by dependence on sales of inefficient SUVs – are likely to get attention from Washington and might open up negotiations on more serious reforms for the transportation sector.

Still, while the new act does not address these key issues, some aspects of EPACT2005 have policy merit that will improve the US energy situation. The most significant aspects of the new law involve a clarification and expansion of federal regulatory authority over the interstate electric transmission grid and support for advanced power generation technologies. A dark horse at this point, incentives for new and expanded refining capacity and expanded federal authority on siting of Liquefied Natural Gas terminals could prove useful in future years.

Electricity Transmission and Generation

Changes to federal electricity authorities are the most significant and enduring outcome, and major impetus, of the new energy law. Despite increasing concerns with under-investment in transmission and the lack of regional coordination, as evidenced by the major blackout in the northeast in the summer of 2003, national grid reliability had been heretofore the domain of a voluntary organisation. Establishment of mandatory electric reliability rules for all market participants and creation of a self-regulating reliability organisation, subject to oversight by the Federal Energy Regulatory Commission (FERC), was absolutely essential.

Wholesale power and transmission markets had been undergoing significant restructuring since the early 1990s. The Act attempts to diffuse conflicts between state and federal jurisdictional authorities. On the one hand, the Act grants FERC the authority to site facilities along important national interest electric transmission corridors if the states cannot or will not act. Yet, the Act could have been even more effective, had legislators not stopped short of clarifying Federal authority to mandate utility participation in regional transmission organisations

– a stipulation which proved too controversial.

The bill repealed a 1930s era statute, the Public Utility Holding Company Act (PUHCA), that had severely limited who could own utility facilities without becoming subject to sweeping regulatory oversight. This change is expected to open up a new era of mergers and acquisitions in the utility sector which may either hinder or enhance promotion of market competitiveness in the future. At the same time, traditional fuel utility efforts to undermine competitive access by renewable and cogeneration plants were rejected, but a clear framework for new technologies was denied.

Despite publicity in its favour, the Congress failed to endorse a federal policy to ensure national deployment of renewable power technologies. The Senate had repeatedly passed a renewable portfolio standard (RPS), a federal requirement that utilities purchase a certain percentage of electricity from renewable sources. The Bush administration opposed a federal RPS, in spite of the fact that as many as 21 states have such standards on the books including Texas where President Bush had signed such a provision into law when he was Governor. In a gesture to signal that renewable energy was not forgotten altogether, legislators voted to require the federal government to purchase an increasing portion of its power needs from renewable sources. This provision could be a catalyst for the federal government to establish a standardised credit trading regime to facilitate a national renewable market in conjunction with state RPS programmes.

Unlike Japan and various EU countries, which have demonstrated the importance of implementing long-term policies as a framework for transforming the market for renewable generation, the US federal government persists in authorising only short-term extensions of the otherwise very effective incentives. As has become the pattern, tax incentives for investments in renewable generation were only authorised for two years. The renewable sector in the USA remains heavily dependent on the sustained commitments of a few states.

Coal, the fuel for half of all power generation in the United States, received considerable support in the Act. In conjunction with an extended programme on carbon sequestration, a $2 billion, ten-year R&D programme for coal gasification or other technologies that produce a concentrated sequesterable stream of carbon dioxide was authorised. Significant tax incentives were also provided for construction of a few ultra clean coal facilities, including gasification plans, to commercialise some advanced technologies.

> "Changes to federal electricity authorities are the most significant and enduring outcome, and major impetus, of the new energy law"

Large-scale hydroelectric dams provide between 7 and 10 percent of US electricity generation, depending on drought conditions. In an effort to maintain and possibly increase that production, the bill contains a major reform of the federal licensing procedure for hydroelectric dams and incentives for improving the efficiency of existing facilities and for modifying existing dams to produce electricity. This was important because recreational and environmental groups have been encroaching upon the renewal process of important existing hydroelectric facilities.

The politics around nuclear energy evolved appreciably over the course of debate on energy policy. Initially, the Administration had been focused on solving the long-term nuclear waste disposal programme and extending the useful life of the current fleet of reactors. The Act extended the federal insurance programme, Price Anderson, limiting liability for nuclear power-plant accidents and included a number of measures aimed at enhancing the security of commercial nuclear reactors. A combination of factors, including recognition of the role nuclear power could play in mitigating greenhouse gas emissions, led to increased support for a programme to promote a new generation of civilian reactors. Risk insurance to cover unexpected cost overruns caused by regulatory delays was authorised as well as a production tax credit of 1.8 cents per kwh for the first 6000 MW built before 2021. While no applications for new plants have yet been filed, three petitions for site permits and two for new reactor designs are currently pending and under review at the Nuclear Regulatory Commission.

The Act included energy efficiency standards for fifteen new products, including commercial refrigerators, commercial heaters, ceiling fans, traffic signals, and other home and business products. Effective in 2007, DST will begin the second Sunday in March (instead of the first Sunday in April) continuing through the first Sunday in November (instead of the last Sunday in October). This had been opposed over concern with children going to school in the dark and the lack of synchronisation with foreign airlines. Whether it will actually save any energy remains to be seen. It is interesting to note that fifteen US states have sued the federal government over policies related to energy efficiency appliances, demonstrating that any stipulation, no matter how useful, will find pro-active political opponents.

Fuels and Refining

US fuels policy has been heavily influenced for the past fifteen years by farm state interests seeking a guaranteed market for corn ethanol. With this round, the ethanol lobby succeeded in ensuring a national renewable fuel standard (RFS) as a quid pro quo for eliminating the previously favoured fuel additive methyl tertiary butyl ether (MTBE), which had already been banned in several states because of ground water contamination from leaking underground storage tanks. Under the RFS, the annual volume of renewable fuels would increase from 4.0 billion gallons per year in 2006 to 7.5 billion

gallons in 2012, which represents 4–5 percent of US gasoline demand. The volume will be allocated to all refiners, marketers and importers on a pro rata basis with a credit trading scheme to reduce cost. The full economic and environmental implications will only be revealed in time as evaluations of the net energy benefits of corn ethanol and the emissions and effluent impacts are more fully assessed but some analysts are sceptical that the programme will yield any significant gain in positive net energy supplies.

The dramatic reduction in the use of the fuel additive MTBE will exacerbate the tight refining situation. In response, the Act included a significant financial incentive for refinery expansions of at least 5 percent of capacity to refine oil shale or tar sands. Refiners may expense 50 percent of the investment in the first year for expanding capacity, even building a new refinery. The industry, in frustration over the handling of the MTBE phase-out and new RFS requirement, has underestimated the potential of the tax change. Given current refining margins, we expect some shrewd players will soon capitalise on the tax savings. On the other hand, the Act hit refiners and marketers with implementation of the RFS at the same time as the switch to low sulphur rules at the beginning of the summer driving season in 2006. The rules for the RFS will not be known until shortly before the deadline.

In the weeks since the hurricane damage to major refining capacity along the Gulf Coast, Congress has rushed forward with new legislation offering former military bases as sites, financial risk insurance, and waiving certain environmental laws to encourage expansion of refining capacity. One proposal even has the U.S. Department of Defense building a refinery to supply the military. In reality, any expansion of US refining capacity will be the decision of the private sector. After a few press conferences, most of these proposals will likely fade into the legislative abyss. Saudi Arabia has offered to add up to 800,000 b/d of new export refining capacity in the kingdom and to expand significantly its part-owned US facilities. Kuwait has made similar offers of new refining investment. However, such potentially useful (and probably profitable) largesse will leave the USA more dependent on the Middle East, not less, as is a stated goal of energy legislation.

Oil and Gas Production

While not extending oil and gas development access to ANWR or offshore areas currently under moratoria, the Act included some tax incentives for domestic exploration and clarified some regulatory requirements on federal lands. The Bush administration has been encouraging development on federal lands in the west. The clarifications in the Act coupled with record natural gas prices will likely lead to greater production in those areas. A geological inventory of potential resources in areas currently subject to moratoria or access limitations was also required over bipartisan Congressional objections. The current moratoria on offshore drilling date from the first Bush administration in 1990. Efforts in the weeks since the hurricane damage to open areas off Florida and the east and west coasts can only be described as Quixotic at best. While industry access can be proposed at the federal level, objections from local authorities can be expected by most coastal states to stop any reversal of drilling prohibitions. Eastern Gulf of Mexico is a key target for reopening, and Florida Governor Jeb Bush has made some politically supportive statements to new drilling. But Florida's legislature may still not be cooperative in allowing the U.S. Mineral and Mines Service to restart acreage programmes suspended in 2001.

Depending on whether the USA opens more lands for drilling, the country faces the growing prospects of an increasing shortfall of natural gas supply that will have to be made up by large imports of liquefied natural gas (LNG). This issue was highlighted by the White House and Congress obliged by clarifying the authority of the Federal Energy Regulatory Commission (FERC) to approve the construction, expansion or operation of any facility that imports or processes liquefied natural gas in an effort to get more import terminals off the ground. (Sec. 311) The measure directs the FERC to consult with state governments about the safety of sites for liquefaction or gasification facilities.

The tax incentives and statutory changes affecting the power sector will begin to impact the energy sector very quickly. However, a good portion of the 1700 plus pages of the Act set forth an energy research and development (R&D) agenda, including billions of dollars of authorisations for federal funding support. The U.S. Department of Energy already had unlimited authority to carry out R&D. Yet, given the current budget deficit, Congressional intent aside, full funding is not guaranteed nor is it very likely.

Whether the fallout from the hurricanes has truly sparked the first serious consideration of the where, how and what of energy supply and demand in the USA in decades remains to be seen. Higher gasoline prices had already led to a freefall in sales of sport utility vehicles, seriously shaking the domestic auto manufacturers to their foundations. Comments by Vice President Cheney in 2001, that 'conservation may be a sign of personal virtue, but it cannot be the basis of a sound energy policy' have been replaced by President Bush encouraging people to conserve gasoline by driving less, carpooling and turning off equipment when not in use. High gasoline prices are only the leading indicator. Natural gas and heating oil costs over a long cold winter will bring back memories for some of the 1970s and create a whole new experience for those too young to remember the crisis of 1973. As revellers ring in the New Year in 2006, energy may get so high on the political radar screen that the national policy stasis could be shaken, but it appears it will take more than two momentous hurricanes downing 25 percent of US refining and substantial volumes of national oil and gas production to convince voters to press for a more serious effort at energy policy legislation.

The Future of Russian Gas and Gazprom

Jonathan Stern

Being CEO of any large international energy company is a complex job, but the task facing Alexei Miller – who holds this position at Gazprom – is particularly difficult. His appointment by President Putin in 2001 coincided with the passing of an era for both Russian gas and Gazprom, not just in terms of management, but also in relation to traditional patterns of supply, demand and trade.

Supply and Transmission

As the 2000s unfold, it becomes increasingly apparent that the 'Soviet gas dowry' to the Russian Federation, specifically the investments that were made in production and transmission before 1991, are within sight of the end of their productive lives. Gazprom's production is moving from dependence on three fields (Urengoy, Yamburg and Medvezhe) to a larger number of smaller fields requiring more complex and costly development of gas and liquids, and therefore more complex and costly transportation options. Well over 20 percent of high pressure transmission lines are beyond their design lifetime of 30 years, while nearly 60 percent of the network is over 20 years old. The main domestic tasks for the Russian gas industry and Gazprom over the next 20 years are to replace the production capacity of those fields, combined with large-scale refurbishment of the Unified Gas Supply System (UGSS) bringing that gas from Western Siberia to domestic and export markets.

In the first part of the 2000s, the consequences of decline in the three major fields were masked by the start-up of the (supergiant) Zapolyarnoye field, which was close to its plateau production of 100 Bcm/year in 2004. As a result, Gazprom production – which had fallen during the period 1998–2001 – increased again in the early 2000s. But with Zapolyarnoye reaching its peak, Gazprom's production will level off and decline before 2010. There has been an average rate of production decline at the three major gas fields of more than 22 Bcm/year during the period 1999–2004, and by 2020 Gazprom will need to replace around 200 Bcm of production capacity. Given that the company has a well-established resource base and well-developed supply options, this is by no means a crisis situation. But there is some urgency for Gazprom to establish a clear strategy on the timing of new large-scale supplies, particularly from the Yamal Peninsula.

> "Gazprom's production is moving from dependence on three fields … to a larger number of smaller fields"

Capital investment requirements of $20–25bn for the first phase of the Yamal development made such a commitment impossible in the economic and political environment of the late 1990s and early 2000s; even in 2005, the Yamal fields are not on Gazprom's immediate investment agenda. Lead times for field development and pipeline construction suggest that production of 100 Bcm/year cannot be achieved in less than eight years. Thus even if a decision is taken to begin Yamal development in 2006, the earliest date that the region can be producing 100 Bcm/year would be 2014, and this may be overly optimistic in terms of the logistical challenges and environmental difficulties likely to be encountered in such a remote and ecologically fragile region.

Those who criticise the company for failing to invest sufficiently in new production have not understood that, despite the fact that domestic gas prices have risen sharply in real terms in the early 2000s, Yamal gas could not be sold profitably in Russia at 2005 prices – and possibly not even at prices of $60/mcm foreseen for 2010. (Profitability will depend to a significant extent on the tax regime for Yamal gas). While this justifies the commercial wisdom of Gazprom's decision not to develop Yamal for production in the 2000s – even if this was mainly driven by financial constraints – it does not provide a future supply 'road map' for the company.

To the extent that Gazprom does not move towards rapid, large-scale development of the Yamal Peninsula, it must, by design or default, rely on:

- a larger number of smaller fields, specifically offshore fields in the Ob and Taz Bays, close to the existing pipeline network which could provide around 80 Bcm/year, but with plateau volumes in many fields only able to be maintained for around a decade. Developing these fields could be a crucial part of a low cost supply strategy;
- deliveries from other gas producers which, with adequate incentives, could increase from a 2004 level of nearly 90 Bcm to as much as 150 Bcm/year by the early 2010s, and perhaps more than 200 Bcm by 2020 but only if prices are attractive and access terms are 'reasonable'. Although there is a tendency to refer to 'independent producers' as if they were a significant number of companies, in 2005 only five companies appeared to have the ability to substantially increase gas production for sale to markets west of Siberia: Lukoil, Rosneft, TNK/BP, Surgutneftegaz and Novatek;
- imports from Central Asian countries where Gazprom has long-term agreements in place with Turkmenistan, Kazakhstan and Uzbekistan which envisage the possibility of more than 100 Bcm/year of imports by the early 2010s.

The outcome will depend both on a view of costs, time schedules and levels of security attached to these different options; and the margins available from the different markets for Russian gas – domestic, CIS and

European – which in turn will depend on the prices these customers will be willing and able to pay over the next decade. Independent gas production and imports from Central Asia on this scale would introduce a level of dependence on other suppliers never before experienced by Gazprom, and this will be a big change for the company in the future.

Demand and Prices

During the period 1998–2005, the Russian industrial gas sector was transformed from a massive loss-making nightmare to a modestly profitable business for Gazprom selling at regulated prices. It is possible that sales to residential customers could become profitable within ten years. Further reform of regulated prices is needed not just to remove subsidies to residential customers, and to increase prices to all customers closer to long-run marginal costs, but also to increase cost-reflectiveness (in terms of location and customer demand profile). But full deregulation of (even) industrial prices, with further development of trading and exchanges, will be difficult for as long as Gazprom is the overwhelmingly 'dominant player' in both production and sales.

Lack of detailed data on gas demand and price elasticity means that it is very difficult to estimate the impact on demand of increasing industrial prices, two to three times higher in real terms than five years previously, with a requirement to pay on time, in full and in cash. Thus in terms of price levels and payment enforcement, in 2005 the industry is in uncharted territory. Significant conservation and efficiency measures can be expected to be the result, challenging the traditional assumption that demand will continue to increase at 1–2% per annum indefinitely. The problem is to know when structural change and large-scale replacement of old inefficient plant will begin. To an important extent this will depend on reform in the power sector and whether the new owners of power stations will have sufficient confidence in their property rights to make substantial investments in new, energy efficient, plant. Nevertheless, sales to the domestic market have become profitable for Gazprom – and independent producers – and promise to become more profitable. This will be a big change in the future and, with Gazprom sales amounting to nearly 300 Bcm/year, one with significant financial consequences.

Reform and Restructuring

Gazprom will remain the dominant player in Russian gas production and sales for the foreseeable future, but reform has taken place, and shows every sign of continuing, in the gas sector. The advances in price reform were noted above. In terms of access to networks, in 2004, Gazprom carried nearly 112 Bcm of gas for 35 shippers, although more than 50 Bcm was Central Asian gas destined (mainly) for CIS countries. Despite the fact that probably only a handful of shippers accounted for the majority of the remaining 62 Bcm, this represented respectable progress. Nevertheless much remains to be achieved in terms of non-discriminatory access to networks and the evolution of cost-related

tariffs. In the reform environment of 2005, non-Gazprom producers – both oil companies and independent gas companies – could prosper as long as they did not provoke conflict with Gazprom management (and the Russian government) and stayed within the role determined by the latter which, for the foreseeable future, does not include exports to Europe. While this may not permanently condemn these producers to what the Head of the Russian Anti-Monopoly Service has termed 'vassal status' in respect of Gazprom, it also leaves them somewhat short of operating as independent commercial entities in a non-discriminatory third-party access regime.

"The problem is to know when structural change and large-scale replacement of old inefficient plant will begin"

In 2004, companies other than Gazprom accounted for around 14 percent of production and a similar percentage of gas sales within Russia. The speed with which the market share of non-Gazprom players will increase will depend on the development of:

- regulated prices;
- a transparent and enforceable regulatory regime for tariffs and access to networks and, in its absence, the interest of Gazprom in encouraging other suppliers to develop fields and move gas to market;
- the success of Gazprom in developing competitively priced supply from Central Asia (the more of this gas is available to Gazprom, the less independent gas will be required).

To the extent that Gazprom delays the development of supplies over which it has direct control, it will need to rely on other Russian producers which will take an increasingly large share of the Russian domestic market. Both Gazprom and the Russian government seem to be relatively comfortable with this prospect which would be positive for market reform. Less positive for reform would be a situation in which non-Gazprom production increased substantially, but those producers found their access to market blocked and were forced to sell their gas to Gazprom at the wellhead at regulated prices (minus transportation).

One of the most difficult developments to project is how far and how fast structural reform of Gazprom will develop. The creation of separate subsidiary companies for production, transmission, storage and other activities (legal unbundling) was well advanced in 2005. Break-up (ownership unbundling) of the company is politically unacceptable and this is unlikely to change even after the end of the second Putin presidency. As the 2000s unfolded, Minister of Economic Development and Trade (MEDT) Gref was clearly frustrated at the slowness of Gazprom reform and the lack of cost control, in an environment of sharply rising earnings from domestic and foreign markets. But MEDT was the only powerful government agency which has consistently expressed opposition both to the growing consolidation of the energy sector with Gazprom acquiring oil and electricity assets, and frustration with the slow pace of gas sector reform.

But despite these problems and the continued dominance of Gazprom, those who claim that 'there has been no reform of the Russian gas sector' are completely wrong. Gazprom's corporate structure, financial accounting and transparency have improved immensely. There is third-party access to networks with a regulatory authority, and substantial volumes being transported for third parties to Russian customers. But rights of access to networks become problematic beyond Russian borders, and cease entirely at the borders of CIS countries.

Exports: Pipeline and LNG

Gazprom management, the government and the president are clear that Gazprom will remain the 'single export channel' to Europe for the foreseeable future. The same policy has already been instituted for Asian pipeline exports, well in advance of any such exports actually happening.

By 2005, Gazprom had re-established complete control over Russian gas to *CIS countries* after a period in the late 1990s and early 2000s when it relinquished a large part of this role. Russian gas exports to (especially) Ukraine, Belarus and Moldova will remain extremely important for these countries and intertwined with transit of Russian gas to Europe. Gazprom has commitments to supply around 90 Bcm/year to CIS countries in the mid to late 2000s, of which 60 Bcm/year will be to Ukraine (more than half of which *should* be re-exports from Turkmenistan) and up to another 20 Bcm/year to Belarus.

"those who claim that 'there has been no reform of the Russian gas sector' are completely wrong"

Europe will remain the dominant export market for Russian gas in terms of volumes and revenues for at least the next two decades and probably much longer. Export capacity to European countries including Turkey was around 190 Bcm in the mid 2000s. Refurbishment of the Ukrainian network could add up to an additional 40 Bcm of capacity. The North European Pipeline (through the Baltic Sea to Germany) will add another 27.5 Bcm and eventually twice that volume. Resolution of transit relationships with Ukraine and Belarus (and to a lesser extent Moldova) will remain essential, and the North European Pipeline will not change that situation.

Gazprom's stated intention to complete the line by 2010 could be delayed, but will not affect marketing of additional Russian gas in Belgium and the UK, which can be achieved via the expanded capacity of Interconnector (IUK) and the new BBL pipeline both of which should be completed by the end of 2006. Sales to these markets demonstrate another

aspect of the future of Russian gas exports: confirmation that Gazprom sees a role for short-term contracts based on gas-indexed prices, alongside the traditional long-term oil-indexed contracts. But the costs involved in serving these markets, particularly the UK, mean that they are highly price-sensitive and sales could disappear relatively quickly should prices fall significantly from the levels of 2003–05.

There are substantial uncertainties for Russian gas sales to European markets over the next decade. These are related to the long-awaited development of gas-to-gas competition and pricing, anticipated as a consequence of liberalisation, which have yet to make a significant impact in Continental Europe. A growing surplus of supply over demand in the late 2000s, implementation of the second EU Gas Directive and the EU competition investigation into the energy sector, could give rise to gas-to-gas competition which would drive down European gas prices for a period of years. This would present substantial commercial difficulties for projects such as the North European Pipeline which might be commissioned around that time. On the other hand, should gas-to-gas competition fail to become a reality in Europe with prices remaining linked to those of oil (particularly at the oil price levels of 2003–05), additional sales through new infrastructure would remain attractive. But the outlook for increases in gas demand – and therefore increases in Russian exports – in a higher (oil-linked) price environment, would be significantly reduced.

Asia and North America. The delivery of Russian LNG from the Sakhalin 2 project – with Gazprom finally agreeing to become a 25 percent partner – to Japan, Korea and the west coast of Mexico is expected to start in 2008. There are no shortage of projects aimed at expanding Russian LNG and pipeline gas supplies to Asia, but since 2003 it has been to the east and gulf coasts of North America that Gazprom's LNG attention has been devoted. A liquefaction terminal at Murmansk – using gas from the Shtokman field – became Gazprom's flagship LNG project. Partners will be selected from five companies – three European and two American – to participate in a joint venture with the intention to start deliveries in the early 2010s.

> "There are substantial uncertainties for Russian gas sales to European markets over the next decade"

Despite all these exciting prospects, Gazprom's pipeline and LNG export options in Asia and North America cannot reach significant proportions, in comparison to current European export levels, until the late 2020s at the earliest. But by 2005, Russian and Gazprom gas export horizons had substantially expanded beyond pipeline exports to Europe and this will be a big change for the future of Russian gas, particularly in the 2020s and beyond.

Gazprom: Complex Options and Challenges

The complexity of the options and challenges facing Gazprom in the management of the domestic gas market, and trade – exports and imports – is daunting. There is a clear and urgent need for Gazprom (and the Russian government) to develop strategic priorities, and a significant risk that some of the projects – domestic and export – despite being huge opportunities, could also prove to be significant distractions. The announcement at the end of September that Gazprom had purchased a majority share in the oil company Sibneft, adds another substantial dimension to this complexity and (combined with Gazprom's existing oil interests) means that the company will be producing around 1 mmb/d of oil.

With very substantial gas exports to Europe, an LNG export project to North America under development, aspirations to export both LNG and pipeline gas to Asian countries, not to speak of a wide range of potential investments in a variety of other countries, Gazprom is clearly becoming a powerful multinational – even 'global' – gas company. A key question is whether these international aspirations can continue to successfully coexist with a huge gas pipeline (including distribution) network and social responsibilities to supply gas to domestic customers – the legacy of Gazprom's past as a Soviet, now Russian, gas utility. The vision and skills needed to manage domestic gas transmission and distribution networks and sales, are very different from those needed to develop a 'global gas business' – let alone a global gas *and oil* business – and the contradiction between these two roles may give a clue to the next major phase of reform and restructuring within the Russian gas industry.

Too Many 'Perfect Storms'

Robert Skinner

In late October 1991, a major storm developed off the east coast of North America. It was not given a name because it was the combination of three smaller, weakening disturbances. The storm was made famous by Sebastian Junger's book, *A Perfect Storm* and a Hollywood movie of the same title, and is now a cliché to describe the consequences when three or more factors compound to dramatic and devastating effect.

Analysts and commentators are already using this line in the wake of Hurricanes Katrina and Rita, especially for their impact on the world oil market and perhaps even the world economy. Much has already been written about the 'lessons' of Katrina and some were applied in the response to Rita. But should we really see these as lessons or merely as *reminders*? What do they imply when tight capacity develops in globalised markets and what if anything can governments do about it?

The USGC: Hydrocarbon Heartland of America

The contributing factors to Katrina's tragic devastation have been clear for some time. A direct hit by a hurricane on New Orleans has long been acknowledged as a major disaster scenario for the United States. Other rather mundane reminders, some over two millennia old, include: don't build below the high water mark on loose sand; don't interfere with deltas and marshlands, and if you do, keep spending to ensure the levees and drainage systems are augmented and improved; if you hire experts to advise on such things as levee maintenance and emergency response measures, heed their advice (this also applies to Avian Flu, by the way); friendship alone might not be sufficient qualification for directing the nation's emergency response agency; and when disaster does strike, leave partisan politics at the door.

Hurricanes have disrupted the Gulf Coast industry before and will certainly do so again. Last year Hurricane Ivan provided a preview of what happens when a significant share of oil production is removed at a critical point in the annual demand cycle, especially when light sweet crude capacity is tight. Hurricane Andrew in 1992 and smaller storms in 1998 had already reminded us of this region's critical importance to the North American natural gas market.

> "natural gas could turn out to be the real story of Katrina and Rita"

The hurricane prone Gulf of Mexico and USGC:

- Hosts a third of US oil production.
- Is home to nearly half of US refining capacity; 75 percent of the region's hydrocarbon production and refining are located in the zones swept by Hurricanes Katrina and Rita.
- Receives 60 per cent of the country's oil imports.
- Has the only US terminal (LOOP) capable of receiving the world's largest tankers.
- Receives more than three quarters of Mexico's exports – mostly heavy specialty crude, not easily placed elsewhere.
- Accounts for about a third of US natural gas production.
- Is home to Henry Hub, the key reference point for pricing natural gas.

Key ports such as Fourchon and Venice that provide the region's upstream industry with services and equipment necessary to repair the damage were seriously affected. To top it off, the Gulf Coast has become the default coast for siting LNG terminals.

The facile reminder here might be 'don't put all your eggs in one basket', but unfortunately that old adage is trumped by the imperatives of geology.

Implications go beyond America

Not surprisingly we are told that these devastating storms underscore why the Americans should take climate change more seriously. Here again, some will be selective in which experts to listen to because their findings are discomfiting. But recent research confirms that ocean surface temperatures have increased around the globe since 1970 and the power of hurricanes and cyclones is increasing. In other words Katrina and Rita are merely reminders that we should expect more of the same.

Most attention has focused on the global glamour fuel, crude oil and especially on local shortages of gasoline and diesel. But natural gas could turn out to be the real story of Katrina and Rita. As of late September, year-on-year crude prices increased 30 percent, gasoline 60 percent, but natural gas prices were up 140 percent. High gas prices bite directly in heating, feedstock and process costs and indirectly through higher electricity prices and their effect on prices of distillates and other competing fuels. During the gas bubble of the late eighties/early nineties, storm induced shutdowns along the USGC were managed by drawing on spare capacity, running at close to 20 percent; that hurricanes came at the same time gas had to be put in storage for winter mattered little. But in the late nineties, egged on in part by the National Petroleum Council's upbeat projections of gas supply, the US power sector added over 250 GWs of gas-fired power capacity, just as the bubble was about to burst. Now the growing summer peak in gas demand for power to meet air conditioning demand delays storage build with the result that autumn gas demand is increasingly inelastic to

price. In the winter, gas from storage is more and more relied upon to meet base demand rather than reserved for cold snaps. To make matters worse, gas is the marginal fuel for power generation to meet winter peak power demand. Over 50 percent of heated American homes use natural gas; 31 percent heat with electricity. While not driving your SUV for a few days is an option, not heating your home is not. Higher gasoline, heating and electricity bills will erode consumer spending on other goods. Going into winter with suboptimal gas storage therefore poses major risks. The only saving grace is that a great deal of the industrial demand for gas is located in the area affected by the hurricanes, so gas demand is down offsetting some of the loss of supply.

"most governments must confront the paralysis in decision-making for building and improving energy infrastructure"

Much has been written over the past two years about the world's dwindling spare crude oil production capacity and how what is available is generally too heavy and sour. There is insufficient refining capacity that can convert these increasing volumes of heavy sour crude into the types and quality of products wanted in the market. For the United States, the bulk of that capacity is in the hurricane prone area of the US Gulf Coast. One of Hurricane Ivan's legacies last year was record price differentials between heavy and light crudes – ultimately requiring producers of heavy crude and bitumen, even outside the USA, to reduce their estimates of reserves under the end-of-year price reporting requirement of the SEC.

There are other more serious international repercussions. The hurricanes' effect on world crude oil and product prices is clear. Eventually natural gas prices are affected. The price of LNG in Asia is linked to crude prices. Gas in continental Europe is linked, albeit with several months of lag, to prices of competing oil products. These in turn backwash into the UK market through the Interconnector Pipeline. In the future, we can expect that American natural gas prices indexed off Henry Hub in the US Gulf Coast will have greater influence on LNG prices to Europe through the arbitrage of LNG cargos on the Atlantic. In effect, energy prices around the world are affected. The economies of poor countries that subsidise imported oil (a habit hard to kick, especially at the moment) are further weakened by higher import bills, adding to their debt. Thus, major storms in the US Gulf Coast in a tight global market translate into a contagious tax increase on the rest of the world. It remains to be seen whether the currently robust global economy offers sufficient immunity to the contagion.

Inadequate Investment

We have had too many 'perfect storms' in recent years. In 2000, California was hit by a 'perfect storm' of electricity prices when flawed market reform in the power sector that discouraged investment was compounded by water shortages, tight gas supply and duplicitous gas suppliers and traders. Then in August 2003 a convergence of failures in investment, training and feeble enforcement of regulatory standards led to the massive power blackout over north-eastern North America. Other events in 2003 such as the power blackouts in Sweden, Italy and near misses in other cities, and this year a late winter cold snap in Western Europe that put the natural gas supply system to a severe test – also might have been labelled 'perfect storms'.

Applying this cliché to these events risks concealing their real implications by dangerously implying they were 'just one of those things'. In other words, once we clean up the mess, we can revert to business as usual. That would be a foolish conclusion to draw because for too many years this has meant '*no* business as usual'. And this is the key issue. We should not need reminding that most governments must confront the paralysis in decision-making for building and improving energy infrastructure. This applies to new pipelines, refineries and upgrading capacity, LNG regasification terminals, electricity infrastructure and mass transit systems. With public resistance to LNG terminals on the east and west coasts of America, their default location will be in hurricane country, along the USGC where local populations are accustomed to oil and gas infrastructure. The 'not-in-my-backyard' sentiment has thus given an ironic twist to the otherwise laudable environmental mantra, 'think globally while acting locally'.

"Volatility is here to stay"

The world will have to get accustomed to volatility in energy prices as long as spare capacity along the supply chain is so tight. Volatility is likely to increase in both frequency and in magnitude. Large and growing shares of the world's oil and natural gas pass through strategic chokepoints such as international straits and large diameter pipelines through politically unstable countries. Furthermore, new oil and gas supply will come from large, single installations, including offshore platforms, integrated unconventional oil plants, major refineries, and LNG plants and terminals. As long as spare capacity is thin along or at any point in the supply chain, upsets in such a 'lumpy' system will tend to generate price spikes. And even when adequate spare capacity is restored, most future supply will come on stream in significant lumps, with the potential to cause downward price spikes if not monitored carefully and accommodated in the supply system. Volatility is here to stay.

Is There a Role for Governments?

Some might believe that a kind of international cooperation is needed to prevent this instability. The G8 and IMF finance ministers have called for 'heightened dialogue'. But what precisely would be the nature of this

cooperation? Producer Consumer Dialogue has progressed over the past 25 years and is now active, ongoing and institutionalised and through the Joint Oil Data Initiative tackling a key oil market weakness, namely reliable data. Whether it is doing as much as some would like, is another question. In the wake of the hurricanes, the IEA consulted with OPEC and major producers before releasing strategic stocks to include more product. It soon became obvious that the problem was not crude oil supply but rather product imbalances, so it is likely that consuming governments will review their policies regarding the make-up of strategic stocks. Why finance ministers around the IMF table called for 'transparency in reserves' of oil-producing countries is puzzling – apart from confirming how the 'peak oil' lobbyists have captured politicians' attention.

The last thing the world needs is for governments to drift back into the woolly-headed business of directing investment – above all trying to design some multilateral contrivance to 'share the investment burden'. The record of government intervention in supply management is not glorious. North America could be facing a winter of gas curtailments, interruptions and school closures akin to the winter of 1977/78. That crisis had government fingerprints all over it in the form of price controls that turned off investment. Governments send mixed signals. For example, OPEC has suggested that $50/bbl would be a suitable floor price, giving traders downside price comfort. Earlier this year, Vice President Cheney provided some upside price comfort when he avowed it would take a loss of 5 to 6 mb/d to trigger use of the SPR. Now some governments are accusing industry of price gouging; and yet others are talking of imposing windfall profit taxes. Governments' policies are only as durable as their citizens' contentment with their consequences.

Oil- and gas-producing countries do not need to be told to increase investment. Some major low cost oil producers will develop spare capacity because it affords them credibility, influence and opportunity. But it is inconceivable that a producing country would want to subordinate that decision, namely the sovereign control of the pace of development of its resources, to the outcome of cumbersome, politically charged intergovernmental negotiations. Any formal step in this direction would have the exact opposite results: it would create uncertainty and therefore stall investment until the new rules of the game were known. This would be folly.

> "The record of government intervention in supply management is not glorious"

The cyclical nature of the energy industry does not reflect failure of governments to talk to one another: that they do and must continue. If OECD governments want to help reduce the risk of price swings, rather than hectoring OPEC countries to allow oil companies access to their resources, the G8 countries might ask whether they have done all they can in their own jurisdictions to assure transparent, non-discriminatory access to resources and markets, attractive investment conditions and stable, clear and effective regulatory regimes. This applies right across the energy sector. Governments have had an easy ride of it during the years of energy capacity surplus, when they could cater to lobbies promoting marginal new sources of energy. They now face tough decisions in the fuel sectors that provide over 80 percent of our primary energy. As one seasoned politician and new energy minister once said to this author, 'Energy efficiency and renewables could solve all our problems when we were in opposition; but not when we are the government.' Can politicians simply say that energy price volatility is a fact of life and consumers must learn to live with it? Or do they design regulatory regimes nationally and cooperative schemes internationally that assure investment in spare capacity as a hedge against volatility?

In *The March of Folly*, Barbara Tuchman examined examples of folly in history, from the fall of Troy to the Vietnam War. To earn the label of 'folly', a course of action had to meet three tests: it must have been seen by contemporaries as bad; a better option must have been available and advocated; and it must have been pursued by a group or a government and by successive governments, rather than just one mad man. Katrina and Rita were merely storms reminding us that we may be headed for folly.

Like most accidents, the price explosion of 2004–5 was the result of an unlikely combination of events. In 2004 world oil demand was about 2 mb/d above trend, mainly in China but also in the United States, while non-OPEC supply was 0.5 mb/d below. OPEC through 2003 and early 2004 carefully managed to prevent any excessive build-up of stock in importing countries, then, as prices surged in mid 2004, it became clear that Iraq and Venezuela were producing less than expected. Finally, in 2005, Hurricane Katrina disabled some production and about 2 mb/d of refining capacity in the USA. 'Normally' one could expect these exceptional and unrelated events to unwind and prices to return in a couple of years, as they always have done after previous surges, to something like a 5-year average. Depending on whether one includes 2004 itself, this would be $26–29 or less.

But what is 'normal' now? For the first time in over 20 years there is no structural surplus of crude production or refinery capacity. Reconstruction in the Gulf Coast will not happen quickly because of the shortage of rigs and oilfield service capacity. Iraq and Venezuela are unlikely to realise their production potential within the next two or three years. Five or ten years ahead today's major oil exporters will reach a plateau of production, either because they choose to follow very conservative depletion policies (as Middle East exporters say they do), or because, according to the 'peak oil' school, recoverable reserves are less than advertised. Meanwhile, in the OECD consuming countries, the environmental difficulties of expanding or building new refineries will defy economics. This is the case for the 'new era' argument for permanently 'high' ($50 ± 10) crude prices and related prices for gas.

But if there is this kind of new era on the supply side we cannot sensibly describe it in terms of the oil and gas business alone. Judgement may be deferred, but the laws of economics have not been suspended. The price of oil, and related gas prices, cannot double without having any macroeconomic effect, even though oil and gas are a smaller input to the economy than 30 years ago. There has to be a matching 'new era' in the world economy. Some commentators take comfort from the fact that, so far, a year of 'high' oil prices does not seem to have had much effect on 'core' inflation (which is defined to exclude energy prices, but would pick up increases in wages and prices responding to energy price increases). But households and businesses suffer all of the higher energy costs, not just the 'core'. There is not much scope for using less energy in the short term, and, unless they are fed with inflationary money by their central banks they will cut spending on other goods and services. This reallocation of budgets towards energy will put people out of work and firms out of business and within a year or two pull the consuming countries' economies into recession. They are already at risk because of unsustainable imbalances in saving, investment, government deficits and currencies: correcting these imbalances is likely to add to the downward pressure on the economies. That will reduce the demand for oil, re-create surpluses at the margin of the oil and gas business, and bring prices down, probably quite rapidly, as the fall in demand will coincide with the increase in oil capacity which is going on at the moment. I regard this scenario as the most likely for 2006.

Personal Commentary

John Mitchell

The main alternative, to which many people would subscribe, is that the effect on the world economy will be moderate, demand will fall somewhat while supply increases, and we will in the medium term get into the kind of 'commodity investment' cycle which I described in my book *The New Economy of Oil* (2001) but at lower volumes, and higher prices, than I envisaged. There will be competition in this cycle, because of the mismatch between oil reserves and present production capacity, and the continuing emergence of new sources of supply such as Alberta. Unless OPEC tries and succeeds to impose quotas on *expansion* its role will be limited to providing some kind of safety net – an important, but not trendsetting function.

For medium- to long-term trends we should also look outside the oil industry itself. The price increases of the two oil shocks wiped 10 percent off oil's share of the OECD energy market. Since 1986 the oil share has been stable – slightly declining – at around 40 percent in the OECD, while the price averaged (until this year) $26 (all prices in $2004). An oil price in the $30–40 range will certainly cost oil market share: higher prices will change it more. Nearly half world oil consumption today is outside the transport sector. Higher oil prices will eventually bring on long distance gas supplies to Asia and the USA for which there are many projects. They will bring coal back into power generation, probably even with sequestration of carbon. Nuclear plants will become economic and some will be built. Gas and electricity will replace oil in the industrial sector. If in 2003 oil had shifted out of the non-transport markets in the rest of the world to the same extent that it had already been shifted in the United States, world oil demand would have been 17 mb/d lower.

On top of inter-fuel competition outside the transport sector there will be technology competition in all categories of final consumption. Industries that supply consumers with energy-dependent vehicles, machines, and buildings will compete to reduce their dependence with technical improvements which are known today but have lacked enough economic stimulus and market development. There will be more efficient, possibly hybrid cars, better electronic control of combustion everywhere, all helped by policy-driven regulation aimed either at climate change, environmental, or muddled 'energy security' objectives. The competition that matters will be the competition between the technologies that shape energy demand. Oil supply will be important, of course, but the winners will be looking beyond petroleum.

Asinus Muses

A Question of Taste

Which is the more environmental car? A hybrid using a battery to increase its gasoline induced miles per gallon, or a diesel that already has an equivalent mpg – and both with virtually the same overall CO_2 emissions? It depends on whether you are in the London Congestion Zone or outside it.

Help

If governments are so keen on subsidising sources of carbon dioxide-free energy like wind, water or sun, Asinus is at a loss to know why they can't also subsidise nuclear, even if a reputation for consistency would be dangerous for politicians, or indeed for lobbyists.

Smoke Signals

1. 'People just need to recognise that the storms have caused disruption and that, if they're able to, maybe, not drive … on a trip that's not essential, that would be helpful.'
2. 'Raising taxes on gasoline would be more interference with the free market than we would like to see.'

Pointers for US Energy Policy?

Political Cost

Things change a bit over time, but in August last you would have paid these different amounts to fill your 40 litre tank with gasoline, if you had been travelling around the world.

– In the UK the cost would have been $66
– In the US it would have been $25.6
– In Indonesia it would have been $9.6
– In Iraq it would have been $0.4

A month later it would have been a bit more in the USA and Indonesia; and it would probably have been unavailable anyway in Iraq. Such are the results of taxation and subsidy.

Grass Belt

Fifty or so years ago on a beautiful morning in Oklahoma the corn seemed as high as an elephant's eye. In another ten years it might be elephant grass that will make a farmer's morning equivalently beautiful as he prepares to harvest it for transport to the nearest power station. If one hectare can produce the equivalent of 36 barrels of oil annually, you should be able to calculate how many acres of elephant grass will be needed to satisfy what percentage of electricity consumed by whatever country you live in.

Stretch-hybrids

People in theory favour a hybrid car, and the Toyota Prius, for instance, seems to be selling well wherever it's available. It was predictable, however, that a basic model, however environmentally acceptable, wouldn't satisfy the market for long. Once you are a luxury car or SUV driver you need an SUV or luxury car and so, at least in the United States, the race is on for the super-hybrids. 'We call it lean muscle' said Mr Burns who has designed the Enigma (0–60mph in 4.3 seconds); 'we've got to produce a car that gets a 14-year-old boy excited, we've got to have the smoking, the squealing, the tires popping off'. Is that what's known as environmental development economics?

Hold-up

Nine people were charged recently in Texas for stealing more than $100,000 worth of fuel after being arrested at a gasoline station outside Houston at 2am. At, say $2.50/gallon that would be 40,000 gallons. Were these nine people trying to fill nine tank lorries, or had they arranged for 1000 of their friends to bring their cars along? And how did they get the gasoline out of the underground tanks? It sounds to have been an ingenious heist – unless it banally turns out that they had been at it for weeks.

Licence to sell?

In the latest UK North Sea licensing round a record number of 152 licences were issued. Twenty-four of them, however, were given to new entrants, who no longer have to prove they are financially or technically capable of developing an oil field. It's not clear, therefore, how many of the 24 will do anything other than hope to sell on their licences at a profit to someone who can. Is this what is known as a level playing field?

Driver Rage

In Europe governments have become so involved with pump prices that, when the price of gasoline increases beyond what some lobby group thinks is tolerable, it seeks to, and sometimes succeeds, in blockading refineries, distribution depots or roads in order to force a reduction of tax (i.e. consumer government take). In the USA even when gasoline hits the previously unimaginable level of $3/gallon, it's no use blaming the government, whose 'take' is marginal, and so nobody thinks of blockading the distribution of a product which anyway they can't do without.

SUVs versus the Environment

Nobody seriously suggests that SUVs do the environment any good, but four protesters, who chained themselves to an SUV to make an environmental point, are hoping to argue in court that their action was justified, and indeed necessary, since it was aimed at preventing an environmental catastrophe. Lawyers are ingenious people, but it will be interesting to see if the judge decides that SUVs by themselves are a sufficient agent of catastrophe.

Oxford Energy Forum. ISSN 0959-7727. Published by Oxford Institute for Energy Studies, 57 Woodstock Road, Oxford OX2 6FA, United Kingdom. Registered Charity 286084. Tel: (0)1865 311377. Fax: (0)1865 310527. E-Mail: forum@oxfordenergy.org EDITOR: Ian Skeet. Annual Subscription (four issues) £40/$75/€75.

Indexing/Abstracting: The Oxford Energy Forum is indexed and/or abstracted in PAIS International, ABI/INFORM, Fuel and Energy Abstracts, Environment Abstracts, ETDE and CSA Human Population and the Environment