Mabro, Robert (Ed.)

Periodical Part

Oxford Energy Forum, Issue 69, May 2007

Oxford Energy Forum: A Quarterly Journal for Debating Energy Issues and Policies

Provided in Cooperation with:
The Oxford Institute for Energy Studies, Oxford

Suggested Citation: Mabro, Robert (Ed.) (2007) : Oxford Energy Forum, Issue 69, May 2007, Oxford Energy Forum: A Quarterly Journal for Debating Energy Issues and Policies, ISSN 0959-7727, The Oxford Institute for Energy Studies, Oxford, Iss. 69

This Version is available at:
https://hdl.handle.net/10419/306932

Oxford ENERGY FORUM

A QUARTERLY JOURNAL FOR DEBATING ENERGY ISSUES AND POLICIES

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Oxford Energy Forum **is a debating journal and we always welcome letters and comments from readers adding to, qualifying or criticising views expressed in earlier articles. I am pleased that the articles on nuclear energy published in the previous issue have attracted two important responses which add a new dimension to the debate.**

Charles Henderson and David Robinson both ask a question which was not addressed by the three distinguished authors of the articles on nuclear energy. Charles Henderson puts it succinctly and sharply: Is there a fundamental conflict between the desire for nuclear and [energy] market liberalisation? David Robinson elaborates on the problems that this conflict involves. He identifies five problems, and then wonders whether Western governments will decide that markets are unlikely to induce nuclear development and that intervention will be necessary, or will remain attached to the freedom of markets leaving significant nuclear developments to China and developing countries.

The articles in this issue fall into two sets. The first is about oil/gas developments in a number of American countries; the second is about the topical question of China in Africa. In the first group, Adrián Lajous looks at developments and prospects in Canada, Mexico and Venezuela. He hangs the three stories on one peg: the supply of heavy and extra heavy crudes to the very important US petroleum market. Mexican exports of these crude oil varieties are on the verge of declining; Venezuelan production is falling but exports to the USA have remained surprisingly steady; and Canadian supplies are booming. The question is whether Canada can be expected to make good over a long period of time the likely shortfall of heavy oil supplies from Mexico and Venezuela.

Energy issues in Brazil are assessed by Rogerio Manso, until recently a director in Petrobras. There were remarkable achievements in deep-water offshore oil developments and in the substitution of gasoline by alcohol. Brazil had to respond to an economic crisis caused by its dependency on expensive imported oil in the 1970s and first half of the 1980s. 'Will progress be sustained?' asks Manso. Will Brazil, having switched thanks to remarkable efforts from the oil importer to the oil exporter status, be able to retain this new situation? Or is it in human

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nature to respond more strongly to fear caused by scarcity than to fortune brought about by progress?

Two smaller Latin American countries are covered by Ivan Sandrea (Colombia) and Anouk Honoré (Bolivia). These authors have a different view on the policy toward foreign investment that a developing country should adopt. Sandrea argues that exploration in Colombia responded strongly to generous terms offered by the government to investors. The revenue shares for company and government is on a 50/50 basis. In Latin America the average revenue split is 66 percent in favour of the government and in some cases more than 80 percent. Is Colombia being too generous and is there a risk of a political backlash sometime in the future? Sandrea thinks not.

Anouk Honoré defends the opposite policy followed by Evo Morales, on the grounds that a developing country needs the maximum revenues it can get without jeopardising the development of its oil/gas resources. The mutuality of interests between Bolivia who needs to export gas and its main customers (Brazil and Argentina) who have no other source of significant supplies supports the new contracts signed with foreign oil companies. She addresses in interesting detail the problems posed by uncertainty about future political developments in Bolivia for its main gas customers. It is clear that different structural circumstances and different political ideologies lead to different contractual arrangements. What happens in the longer run is the moot question however. Some crucial circumstances tend to change over time.

China in Africa is a fascinating subject as it involves politics, specific approaches to the foreign investment issue and the much talked about concerns with the security of supplies. Lindsey Hilsum, the correspondent of the UK TV Channel 4 in Beijing, tells us how much some African leaders seem 'to love' China. President Yoweri Museveni of Uganda contrasted Western and Chinese attitudes. The West is conceited he says, and 'ignorant of our conditions' while the Chinese 'deal with you as someone who represents your country…' Of course, the Chinese have their own interests which are primarily energy supplies and the desire to become a global player in the international oil market. Yet, while African governments welcome the Chinese and their soft loans and grants some African groups have serious doubts. The Chinese investors do not create employment. Anti-corruption NGOs worry about Chinese behaviour. Western NGOs question the help given to the Sudanese government, indirectly perhaps, in its actions in Darfur. And there is a movement calling for the boycotting of the Beijing Olympics. Will that gain momentum?

Bassam Fattouh focuses on China in the Sudan. He details Chinese interests in that country, the most important in Africa in terms of oil investment, production and exports to China. The criticisms faced by China are assessed and the so-called policy of non interference critically analysed. Is this a success story? Most interesting is the list of five issues, all related to the political dynamics in the Sudan, which may undermine the Chinese position in the longer run. His conclusion is a harsh reminder that the USA, the UK, France and Japan all tried a similar strategy in the last century and perhaps more recently in Iraq, a strategy that used foreign policy to secure oil supplies. They all failed. Does history hold a lesson for China?

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Oil and Gas Developments in some American Countries

Adrián Lajous assesses Canada, Mexico and Venezuela as suppliers of heavy crude oil to the USA

Canada, Mexico and Venezuela, as oil exporters, have an important feature in common: all three countries supply the USA with significant volumes of heavy and extra-heavy crude oil (25°API or less). US imports of these crude varieties expanded rapidly in the last six years. Their share in total oil imports increased from 25 percent in 2000 to 36 percent in 2006. This overall growth was made possible by a wave of investment in deep conversion capacity in American refineries. Additional coking capacity is being built and will come on stream from now to the year 2010, ensuring further penetration of heavy crudes in US markets.

These heavy crude flows surged in all refining regions. Although Canada, Mexico and Venezuela continued to dominate these markets new players have entered the West and East coasts.

Important changes are now taking place in the sourcing of these imports. In absolute terms the biggest increment originated in Canada. Mexican and Venezuelan supplies will be declining. Canadian heavy crude will eventually flow to the Gulf Coast once pipelines are redirected and expanded. However, the substitution of Mexican and Venezuelan oil imports involves important transitional dislocations, more complex logistics and the adoption of other crude references in coker design. The expected growth in the demand for automotive fuels and the imperative destruction of high sulphur residual fuel oil require further investment in conversion capacity in order to import low cost heavy crude oils.

The USA has traditionally shown a marked preference for hemispheric supplies. Today, half of its crude imports come from this region. Canada, Mexico and Venezuela are the almost exclusive sources of high sulphur, high metal content, heavy crudes. If this share is to be maintained, exports from Canada, Mexico and Venezuela must increase, given the expected growth in oil demand. The expected reduction of Mexican oil exports will be partially offset by incremental Canadian exports that will need to flow all the way to the US Gulf Coast. Although Venezuelan export volumes to the USA have been relatively stable, growing political risks and uncertainties about future production are affecting expectations regarding heavy crude oil supplies.

Economic factors – not only security concerns – drive this hemispheric propensity. Geographic proximity and the availability of deep conversion capacity add value to low quality, low cost heavy crudes that are not general purpose refinery inputs. High asset specificity is required to economically process them. The mutual advantages enjoyed by oil producers and refiners in that structure helped in stabilising export flows. Gulf Coast refiners are naturally concerned by possible reductions in heavy crude availability and changes in quality. Costly facilities were specifically designed for predetermined crude streams, and deep conversion refiners inevitably incur high switching costs when they modify crude slates.

Since the publication of Juan Carlos Boué's study on *The Market for Heavy Sour Crude Oil in the US Gulf Coast, The Pemex/PDVSA Duopoly* (OIES, January 2002) important changes have taken place in terms of market size and structure; crude quality; supply patterns; and pricing. Total heavy crude oil imports increased more than 50 per cent from the year 2000 to 2006. In this period imports from Canada doubled. However, Mexico continues to be the most important supplier of these types of crude. It holds a share of one third while Venezuela and Canada each have 25 per cent of the market. Regional shares vary significantly. Canada is the sole exporter to the Rockies and has 96 per cent of the market in the Mid-Continent. Meanwhile Mexico supplies over half of the heavy crude imported by Gulf Coast refiners and Venezuela one third. In California over 80 per cent of imports of heavy crude is supplied by Ecuador and Brazil, while Angola and Chad jointly maintain a significant market share in the East Coast, where Venezuela has a dominant position. Even more striking is the evolution of price levels and light/heavy price differentials. The average annual price of Maya crude more than doubled from 2003 to 2006 and the annual Maya/ WTI price differential tripled from $5.19 per barrel in 2002 to $15.93 in 2005. At the beginning of the decade, these price levels and price differentials were unimaginable. They promoted the construction of significant coking capacity, the consolidation of the US Gulf Coast refining industry and the absorption of rapidly increasing heavy crude oil supplies.

We now turn to the challenges faced by the three main hemispheric exporters of heavy and extra-heavy crude oil to the USA to help assessing the future prospects of these supplies.

Canada

Canada will soon surpass Mexico as the main supplier of heavy crude to the USA. In 2006, Canadian heavy oil exports rose to 944 kb/d, almost twice the volume of the year 2000. The rapid development of Alberta's oil sands, one of the world's largest hydrocarbon accumulations, will produce growing quantities of bitumen, while Western Canadian conventional heavy oil production continues to decline. Incremental supplies will flow to core markets in the Mid-West, the Rockies and Washington State. They have now reached Cushing, Oklahoma on the Southern edge of PAD II, a critical land-locked area where the price of WTI is formed and

the futures contract physically settled. They will eventually reach the US Gulf Coast, as pipeline constraints are relaxed; and, in the not too distant future, they should secure Pacific Rim markets in California and Asia. Pipeline capacity is the main short- and mid-term binding constraint. Pipelines out of Western Canada are operating at near full capacity and crude flows to the Gulf require the reversal of existing pipelines and the construction of new ones. Conditions of excess supply in the Cushing region have been generated by the inflow of Canadian crude. This has depressed the price of WTI, which is now discounted to unprecedented levels relative to Brent.

Bitumen mining/extraction and upgrading projects under construction or in advanced planning stages, as well as pipeline transport projects, will determine production to 2010. It is expected that production additions could be of the order of 200 kb/d per year up to 2015. How much will be exported in the form of heavy crude remains however an open question. Recall that up to two thirds of the bitumen produced could be upgraded to synthetic crude – of similar quality to conventional light crude – by integrated oil sands mining projects. A fundamental structural issue arises here. Cross border patterns of upstream/downstream upgrading and future developments in vertical integration by producers and refiners after 2010 are not yet fully determined. Questions regarding the composition of the output between heavy and synthetic crudes must also be resolved. Given the scarcity of condensate (C5+) in Western Canada, a significant proportion of bitumen will have to be diluted with synthetic crude instead.

A number of economic, environmental and social issues, and associated uncertainties will condition the expansion path of bitumen production and upgrading. Mining/extraction and upgrading projects face significant economic uncertainties regarding the level of prices and the light/heavy crude oil price differentials in Western Canada and in other relevant markets. Given the high supply costs of these projects adequate returns require high oil prices and upgrading investments can only be justified if high light-heavy price differentials prevail. The management of the corresponding risks is an essential factor in the decision-making process. Pipeline expansion is in turn determined by expected regional market conditions and regulatory approval in both the USA and Canada.

The environmental challenges posed by the development of oil sands are multiple and difficult to accommodate. Bitumen production and upgrading are energy- and water-intensive processes that consume large quantities of these resources. Particularly high gas/steam ratios will divert natural gas from other uses in Canada and from export markets, further reducing flows to the USA. The environmental sustainability of the lower Athabasca River and the management of ground water levels in mining areas require rigorous conservation policies. Mining and upgrading activities will be the largest contributors to greenhouse gas emissions growth in Canada and are not deemed consistent with Kyoto Protocol commitments. The magnitude and nature of land disturbance resulting from mining/extraction operations puts into question the ultimate success of reclamation methods. Waste management requirements should not be underestimated. The fragmentation of boreal forests is a source of growing concern, as well as cumulative environmental impacts.

Mexico

The Mexican oil industry is at a critical juncture. The expansion cycle that began in 1996 is now clearly over. In the last 25 years there have been few significant discoveries and none of them in the giant class. Proved hydrocarbon reserves have fallen rapidly in recent years and reserve replacement rates are dangerously low. The average life of proven reserves is now below the 10 year threshold. Concern over the maturity of the proved reserve endowment grows as probable reserves are concentrated in a region that will not be easily developed. Average finding and development costs are higher than those reported by major oil companies. Lifting and production costs have substantially increased, albeit from relatively low levels. Upstream capital intensity has been rising. Expanding the exploration frontier to high risk, high cost, deep-water structures requires substantial financial and technical resources and it will take a number of years to fully appraise their potential. Additional capital and operational expenditures will have to be allocated to exploration and production. Pemex needs to replace reserves and moderate production decline rates simultaneously. It must do this at a time when it is obligated to invest significant sums in refining and infrastructure maintenance and expansion. Additional financial resources are a necessary but not a sufficient condition to face these challenges. Major changes within Pemex and the eventual involvement of private investment are required.

"In Mexico … the era of easy, low cost, low risk oil has come to an end"

Mexican crude oil production peaked in 2004 and net exports of oil and products reached their highest level a year before. In the next few years substantial efforts will have to be deployed to moderate expected decline rates. In the short and mid terms heavy crude production levels will depend on the behaviour of two super-giant fields in the Bay of Campeche: Cantarell and Ku-Maloob-Zaap. The first of these fields peaked in mid-2004 and the production ramp-up of the second will only partially offset the decline of Cantarell. Fortunately the reduction is going to be gradual. However, its rate will accelerate toward 2010, as production in Ku-Maloob-Zaap reaches a plateau.

In Mexico, as in other important oil provinces, the era of easy, low cost, low risk oil has come to an end. Pemex E&P strategy must now aggressively pursue three distinct

strategic initiatives. The first is to return to its traditional producing areas and rejuvenate some of the mature assets it holds. Brownfield developments offer attractive opportunities. Reducing technological and best practice gaps can make a significant contribution to the growth of reserves and production, improving recovery rates and overall performance.

The second is to rapidly develop the Chicontepec Basin in central Veracruz. Over one third of the country's 3P oil reserves are located in this region and almost one half of total gas reserves. This is a high cost, low recovery, slow growth production area due to low well productivity and high initial decline rates. Projects in Chicontepec will make intensive use of capital, technology, engineering and mid-management resources. They will also have to address complex environmental and social issues, given the high drilling density patterns and extensive surface facilities required.

The third initiative relates to the intensification of offshore exploration, including deepwater areas in the Gulf of Mexico. A better understanding of potential undiscovered resources is called for and Pemex needs to prepare itself for the major challenge that frontier exploration implies. Contrary to the prevailing diagnosis, the binding constraint is not technological, but organisational and managerial. The real challenges are geological, completion and price risk management.

Mexico has become a substantial net importer of oil products and natural gas. This is the result of chronic underinvestment in the refining system and the maturity of proved natural gas reserves. Last year the country imported 38 percent of the gasoline sold in the domestic market, and close to one fourth of the internal consumption of LPG. In 2004 natural gas imports accounted for one third of domestic sales. Paradoxically, although the country is a major crude oil exporter, security of supply concerns have now entered public policy debates. Short-term attention focuses on import dependence and relates both to supply reliability and high prices. The facts that the USA is a growing net importer of the very fuels that it exports to Mexico, and that the North American structural natural gas deficit is rising are causing concerns. Supply constraints and higher prices are forcing Pemex to acquire these fuels from more distant sources. With respect to natural gas Mexico will have to substitute pipeline imports with LNG that originates in West Africa, Russia, Australia and Peru.

"A sense of irony marks the stable flow of crude and oil products between Venezuela and the USA"

Long-term security of supply has come to the forefront in Mexico as the reserve to production ratio has dropped below ten years. The adequacy of proven reserves to sustain current production levels and, more importantly, to guarantee expected future domestic requirements is an issue that arose even though crude oil exports account for more than half of total production. Recently the Mexican Congress assumed the power to set and authorise oil export levels. Instead of determining specific volumes it would be preferable that legislators develop criteria and decision rules for this purpose. Regulating the intertemporal distribution of production from a changing reserve endowment is not an easy task. Equally difficult is to protect the setting of volumetric production and export targets from short-term political expediency and from political passions. Subjecting exports to a reserve adequacy test, that would guarantee future Mexican requirements over a reasonable period, can stimulate exploration activities. If this strong incentive does not increase oil reserves, export levels would have to be adjusted. For Mexico, as for its main trading partners, energy security has become a matter of national strategy.

Venezuela

Uncertainty prevails regarding the behaviour of Venezuelan oil production (particularly after 2003), its current level and mid-term prospects. Production and export statistics have been traditionally unreliable. They have been subject to changing political biases. Production data have been distorted by OPEC quota negotiations. Quota determination and compliance issues have affected their accuracy and consistency. Production accounting conventions have been conveniently modified. At times government and company data differed, reflecting conflicting policy objectives. Official and internal statistical reports have been discontinued. More recently, data quality seems to reflect a certain loss of managerial control. International organisations, US government agencies and other secondary sources release production estimates that significantly differ from those irregularly provided by Venezuelan officials, who claim that capacity has been fully restored to pre-strike levels. The differences are not minor. The current EIA production estimates are 600 kb/d – almost 25 percent – lower than the Venezuelan numbers. Time series also show a similar reduction of output in the period 2000–2006. Although numbers provided by non-Venezuelan institutions suspiciously converge, there is no explicit discussion of sources and methods that could contribute to a better understanding of what is actually happening to production. Indirect evidence suggests that capacity and production levels are being overstated by PdVSA. However, it is not possible to estimate by how much.

Future production to 2010 is likely to stagnate or, more probably, to further contract. It takes at least four years to plan, construct and start up a new upgrading facility in the Orinoco. Although officials have talked of building a mega upgrader it is difficult to believe that PdVSA will find it possible to do it on its own. Given the unresolved issues with current operators in the Faja, they will not be easily convinced of committing additional capital to capacity expansion. The more general deterioration of the investment climate in Venezuela might deter even the most intrepid Asian equity investors. It will take some time and more stable and predictable

conditions before anyone would be willing to assume the risks involved. In the Maracaibo Basin, an oil province that is probably contributing to slightly less than half of Venezuela's production, important investments are required simply to maintain capacity. These very mature fields, as well as many others in the Oriente Basin, will not easily yield incremental volumes. Although drilling in these regions has recovered from the very low levels of early 2002, rig count is still substantially below the peaks reached in 1997. Higher drilling rates will only moderate production decline. Managerial and technical expertise constraints, as well as the underinvestment in field maintenance have effectively limited the recovery of production capacity. Incremental volumes will have to be obtained from the Orinoco Belt, but this will not materialise before 2010.

While Venezuelan production has fallen since 2001, average annual US imports of crude oil from this country only varied within a very narrow range. Even in 2003, after the PdVSA two-month strike, this volumetric flow did not drop significantly. It is only in the fourth quarter of last year and the beginning of 2007 that they have decreased. In 2006 US crude imports from Venezuela were only 100 kb/d – 8 percent – below the 2000–2005 average. Variations in the mix of crudes have been more substantial, as well as in the volume of oil product imports. The crude import mix has become heavier. PdVSA seems to have concentrated its heavy crude exports in the market where it obtains the highest fob prices. It discontinued the formulation of Orimulsion and exported its crude component. The sale of lighter crudes and oil products were redirected to Latin American and Caribbean markets; and Venezuela started to export crude oil to China.

Revenues from crude oil exports to the US have more than doubled since 2003. In 2006 they almost reached the 24 billion dollar mark. Venezuelan export prices increased at a faster pace than that of the Mexican export mix, particularly after 2003. There is now ample evidence that in the past PdVSA deeply discounted crude oil export prices, particularly to its US affiliates. This situation has significantly changed. PdVSA's commercial strategy has become more aggressive and the company has benefited from the rigorous application of netback formulas with its US affiliates in an environment of very high light–heavy price differentials.

A sense of irony marks the stable flow of crude and oil products between Venezuela and the USA. The resilience of their oil links in spite of fundamental institutional change and confrontational political attitudes has been astonishing. The US cannot dispense with Venezuelan oil given global capacity constraints. Venezuela does not have alternative high value markets for its oil as conversion units elswhere are operating at capacity. Under these circumstances the disruption of Venezuelan supplies could easily trigger much higher oil prices, and any attempt by Venezuela to redirect crude flows would imply, at the margin, steep price discounting. What is more difficult to foresee are the final consequences of the policy measures adopted in Venezuela and the position that will be taken by the international oil companies that have been present in that country and by new potential players.

In order just to maintain existing production capacity the State will have to assume greater financial obligations. It is not clear that a seriously weakened technical and managerial structure will be able to execute and efficiently operate large-scale complex projects such as the extra-heavy crude upgraders in the Orinoco Belt. Higher accident frequency and greater unplanned downtime in PdVSA refineries are indicative of severe constraints. Managing the new joint ventures in which the State will now hold majority control will be challenging.

Conclusion

In the short and mid term net exports of oil from Latin America will fall gradually. Only major discoveries and the further development of the extra-heavy crude from the Orinoco can modify this trend. In any case, the impact of these developments on production, should they obtain, is at least five or six years away. The expected shortfall in the Gulf of Mexico will only be partially offset by non-conventional heavy oil from Canada. Refiners, therefore, will need to increase their purchases of heavy crude in West Africa and the Arabian Peninsula. Environmental restrictions in Western Canada would necessarily increase dependence on Middle East supplies. Governments and oil companies will have to work out the geopolitical implications of these supply shifts.

Rogerio Manso considers the search for a new agenda for energy policy in Brazil

The high growth which China and India are now experiencing is well known to Brazilians who are old enough to have lived through the 'miracle years' of the seventies, a booming period for the Brazilian economy, one of sustained growth and industrial development. It was believed then that Brazil would finally release its full potential as one of the large economies of the world, fulfilling Austrian writer Stephan Zweig's prediction of three decades earlier, that Brazil, a country blessed with natural resources and a tolerant society, was destined to become 'the country of the future'. For Brazilians, the future had finally arrived.

The two oil shocks of the seventies had, however, injected the economy with the seeds of economic turmoil. Having adhered to strategies which made it heavily dependent on oil, like substituting road transportation for maritime and rail transport, and short of domestic supplies, Brazil was heavily dependent on oil imports and

foreign capital. The steep increases in oil prices quickly led to a record foreign debt, expanding under the burden of double-digit interest rates. Among further consequences were a moratorium on debt, a decade of economic instability, structural inflation and low economic growth. Oil dependency had transformed the 'miracle 70s' into 'the lost decade' of the 80s.

It is, thus, not surprising that oil self-sufficiency became a top priority. Aside from programmes to increase efficiency and substitute oil consumption by other fuels, Petrobras, the oil monopoly, was empowered to pursue aggressive and innovative strategies to develop the Brazilian continental shelf in a search for new reserves.

The result of this pursuit is a success story, reminiscent of what was achieved by the entrepreneurial spirit of early Brazilian oil pioneers and the bold nationalism of Petrobras' founders, attitudes well represented by the company's motto 'overcoming challenges'. This was translated into a consistent strategy and involved personal commitments, which led to drilling at successive record depths in deepwater areas, turning Brazil into a major frontier for offshore oil production.

With a sense of mission accomplished, Brazil's oil industry celebrated last year the achievement of self-sufficiency, when oil production surpassed petroleum products consumption. Three decades after the oil shocks, the country had, perhaps silently, yet progressively, reached an enviable position among industrialised countries.

Interestingly, expectations had, to a great extent, shifted towards price stability, a goal which many hoped would follow self-sufficiency, however incompatible this wish may be with the open economy of Brazil.

The achievement of the decades-old objective created the opportunity and the need for a new agenda for oil and gas.

There is not enough evidence to support an aggressive programme to position Brazil as a net exporter of oil. With only a nineteen-year reserves/production ratio, Brazil is just ahead of oil mature countries like Norway, Mexico, Russia, the USA and China, in the league of the top twenty world oil producers.

Furthermore, with a robust industrial economy, abundant resources and a large and increasingly sophisticated market, soon to reach 190 million persons, the Brazilian industry should strive to realise any potential surplus of energy by expanding existing capacity.

Even if not aggressively pursuing an export-oriented agenda, it is likely that Brazil will be a net exporter of oil for a reasonable period of time over the next ten years. Both the economic and strategic logic of the oil industry will continue to drive major E&P initiatives in both oil and gas, leading oil production to grow above the forecast domestic market growth rates.

> "In spite of its traditional bias towards hydroelectric projects … Brazilian energy policy is regaining its pragmatism "

To put it in perspective, current production of around 1.8 million b/d is expected to grow at more than 6 percent per year over the next decade. This is higher than the consensus sustainable growth rate for the economy, estimated at 3.5–4 percent per year. Petroleum products consumption should continue to grow slower than GDP, at 3.0–3.5 percent per year.

Reserves of 12 billion barrels, and investments of over US$ 8 billion per year will support this objective, but supply chain bottlenecks still have to be overcome. Missed deadlines and increased project costs have plagued the industry in this second half of the decade, both inside and outside Brazil. And this is not to mention the continuous risks of long environmental licensing processes, an increasingly relevant issue in Brazil. In the long run, these difficulties tend to be solved, thanks to more efficient project management, joint initiatives from government and industry to implement programmes that support the development of domestic suppliers and skilled work forces, and an improved dialogue between industry, government and environmental agencies.

On the gas front, as the pipeline from Bolivia reaches capacity, the substitution of gas for oil products (a consistent occurrence throughout this decade), will largely depend on the pace at which a handful of large offshore non-associated gas fields will be developed and, to a smaller extent, on the introduction of LNG into the gas supply matrix. Two import LNG terminals will start operating in 2009: one on the Northeastern coast and the other in Rio de Janeiro.

Overall, natural gas availability to the Brazilian market, both domestic and imported, should reach a potential of over 100 million cubic metres per day by the next decade, more than twice the volumes currently supplied to the market. A major part of this potential availability is earmarked for electricity generation, where it may serve as a back-up to hydropower on which Brazil is heavily dependent.

In spite of its traditional bias towards hydroelectric projects (only Norway has a higher proportion of hydro in electricity generation), Brazilian energy policy is regaining its pragmatism. While still heavily supportive of new large-scale hydropower projects in the Amazon region, it has become more aware of the environmental impacts and high transmission costs of these projects, which are thousands of kilometres away from the major markets, and the resulting risks of major completion delays. As a consequence, the maximum cost for thermal power generation that the government is accepting has been gradually increasing towards the marginal cost of generation. This is attracting rising interest from independent power generators.

As a stimulus to the gas industry, the government has been removing certain pricing barriers, having recently allowed gas-run IPP projects to follow international gas prices month-by-month. This should allow interruptible

LNG supplies to gas-powered plants and create the opportunity for a more efficient and integrated management of gas- and hydro-powered capacities. Hydroelectric reservoirs may be used to store 'cheap gas', seasonally available at mid-year, in the form of water. This opportunity, almost unique to Brazil, should allow cheaper electricity generation costs, whilst creating additional demand for gas.

If there is a place – and a time – where biomass will strongly impact on oil and gas demand, such a place is Brazil in the years to come. The growth of the light vehicle market will increasingly be fuelled by the double-digit expansion of the ethanol producing capacity which will start replacing gasoline, as happened during the 80s. Sugar-cane products (ethanol and bagasse-generated electricity) today already contribute as much as hydropower to Brazil's energy matrix (just under 15 percent market share, each). As a result, additional volumes of gasoline will be displaced for export, and large volumes of electricity from bagasse may be purchased by the government in place of gas- or oil-powered electricity. Over 2 GW of electricity from bagasse are expected to be offered in a tender in May.

The introduction of biodiesel, and the mandate to blend 5 percent of the product into diesel by 2013 (compared with 2 percent by 2008) will also reduce demand growth for oil products in Brazil. Diesel is the main oil product consumed in the country, and, historically, the one with the most consistent growth.

Even if a regular export flow of crude oil and petroleum products may result for an extended period, it can still be argued (certainly not undisputed) that this is not the consequence of an export-oriented agenda. It is rather the mere result of a short/medium-term imbalance, resulting from the thrust to keep the momentum in oil exploration and development in an environment of favourable oil prices, and of a willingness to ensure adequate supplies to an energy-hungry industrialised country.

With oil and gas contributing more than 9 percent of GDP, the agenda for the sector will necessarily be influenced by the interests of industry and consumers, both of which are keen to have energy supplies developed. The long lead times and uncertainties related to oil exploration and production, and the opportunities for technological advancement, crucial to Brazil's deepwater development, are in favour of the continuation of this drive.

After more than a decade of economic stability, and four years of currency appreciation, the underlying feeling in the country is that Brazil is firmly on a route to higher economic growth, one commensurate with its potential and expectations, much more aligned with that of countries in the BRIC (Brazil, Russia, India and China) league than with that of 'consensus' forecasts. In such an environment, investments in the oil industry should not only support, but also stimulate and generate growth throughout the entire supply chain and the economy.

It can be argued that, in spite of its strategic importance and the enormous level of effort and investment involved, supporting and stimulating future economic growth will not be an agenda as engaging as the one which brought Brazil to self-sufficiency. It is probably in human nature to react more strongly to fear (scarcity) than fortune (progress).

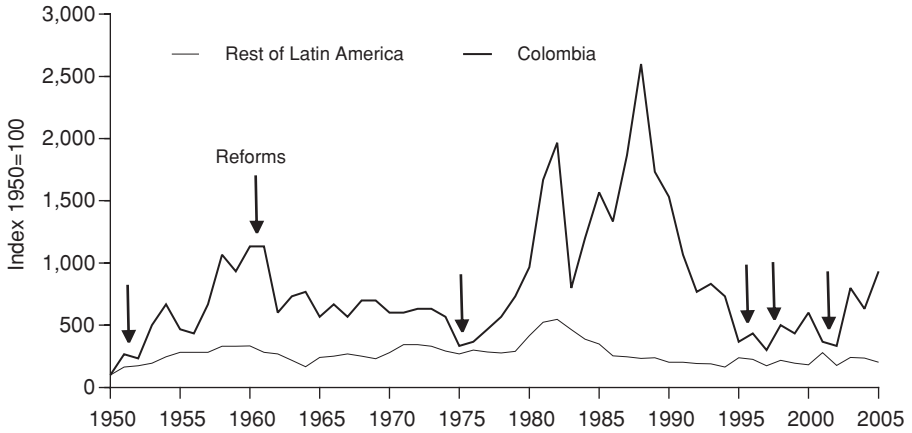
But this blend of pragmatism and flexibility is certainly more robust than the alternatives which currently prevail in the larger Latin American oil and gas producers, where idealism and the political use of state-owned corporations seem to prevail and be leading to significant underinvestment. Although not completely immune to the practices of its neighbours, Brazil is clearly on a different track, one which may lead it faster to the point of fully developing its potential and, hopefully, of being a positive influence in the region.

Ivan R. Sandrea discusses hydrocarbon sector reforms in Colombia and its impact on undiscovered potential

For more than a century, Latin American countries have offered world class opportunities in exploration and production of hydrocarbons under different modalities. Twice as much oil and gas reserves (conventional) have been found in Latin America compared to Africa, despite the fact that both have similar prospective sedimentary areas. However, factors such as political instability, weak institutions, unstable and inconsistent fiscal policies as well as security problems have rarely provided long-term visibility to the regional national oil companies (NOCs) and other operating companies. The reality is that over 60 percent of the prospective sedimentary area remains unexplored and production is mature in all countries (except Brazil), suggesting that the potential of several countries has not yet been fully developed. Given the well-known policy trends in the region, specifically oil and gas nationalism, unwinding of policies and cancellation of contracts without credible plans for a continuous development of the hydrocarbon sector, it is most likely that in the next few years there could still be the same percentage of unexplored areas and less hydrocarbon production. However, at least one exporting country that is usually not on the radar screen – Colombia – has shown progressive hydrocarbon policies and is having some success.

In terms of petroleum history, Colombia has a long-term record of enacting innovative fiscal reforms in the oil and gas sector in response to local and international events. This has been the broad trend even though the country has a similar economic and political history as its neighbours and, since the 1960s, major internal security issues. Since the first concession was

Figure 1: New Field Wildcats drilled in Colombia and in Latin America (indexed 1950)



awarded in 1905 at least eight major reforms have taken place, three before the 1970s and five afterwards. Figure 1 shows the years in which major reforms were introduced and the number of exploration wells drilled (indexed to 1950). Exploration cycles in Colombia look different from the rest of the region, despite common factors such as oil prices, economic cycles, nationalisations, changes in fiscal terms, and wars that affect the international oil and gas industry.

"Colombia has a long-term record of enacting innovative fiscal reforms in the oil and gas sector in response to local and international events"

Prior to the 1970s, reforms in Colombia's hydrocarbon upstream sector focused mainly on the type of contractual arrangements with international oil companies and the formation of the national oil company Ecopetrol. The type of upstream contract in place for a long time was a simple 50:50 production and cost share. E&P activity in the country responded mainly to international developments. However, in 1962 an unfriendly law was enacted which introduced harsher fiscal terms. The result was that exploration activities took a nose dive and oil production fell for more than a decade thereafter.

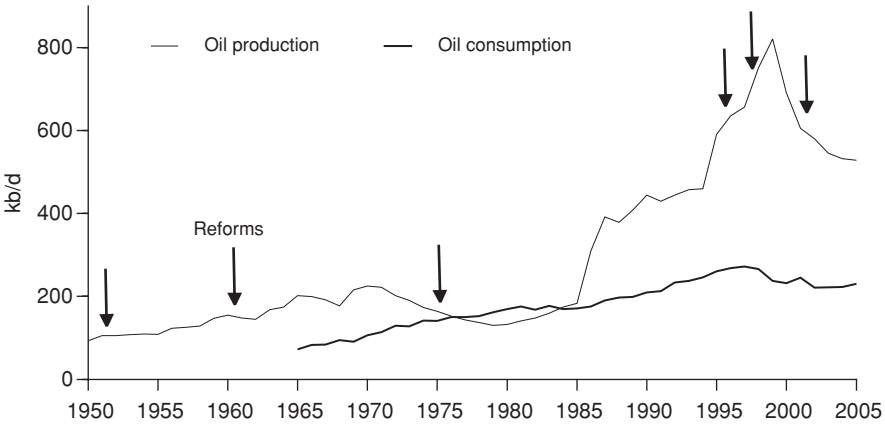
After the 1970s, reforms began to focus more on changes to the tax system as well as adjustments to the contractual terms. In 1974, the concession system, which had been in place for seven decades, was abolished and the 'association' contract was implemented. E&P activity increased sharply leading to the discovery of the first giant fields (Cano Limon in 1983 and Cusiana in 1988) and provided a sound basis for Colombia to become an oil exporter in 1986, a situation that has remained unchanged ever since.

In the early 1990s, a further set of reforms were put in place which focused on favourable terms for inactive assets, in response to low oil prices and domestic security concerns. Several large discoveries were made but more importantly there was a sharp increase in oil production underpinned by developments that were on hold (see Figure 2). Nevertheless, oil production peaked in 1999 (820 kb/d) and ever since has been on a declining trend, in great measure due to the absence of new large discoveries, increasing decline rates in the major fields, and a shift in investment away from the region by international operators.

Facing the prospect of becoming an oil importer in the future and losing export revenues, significant changes in contractual and fiscal terms were introduced in 2000 just after the oil price crash of 1998–9. These were followed by modifications to the institutional structure in 2003.

In broad terms, the new contracts are based on a flexible royalty/tax scheme in which royalties are estimated using a sliding production scale whilst fiscal terms vary depending on the oil price and project type. Total government take is now around 50 percent for the typical project compared to the world average of 67 percent, and highs of 90 percent in some other Latin American countries. The country also has an open door policy and holds regular licensing rounds of different types. Other features include more time for exploration (six years), the contractor or concessionaire can get 100 percent working interest for the duration of the licence and can define the work programme. The government

Figure 2: Oil Production History of Colombia and Years of major Reforms. Thousand Barrels per Day



is essentially getting its share of the production through taxes.

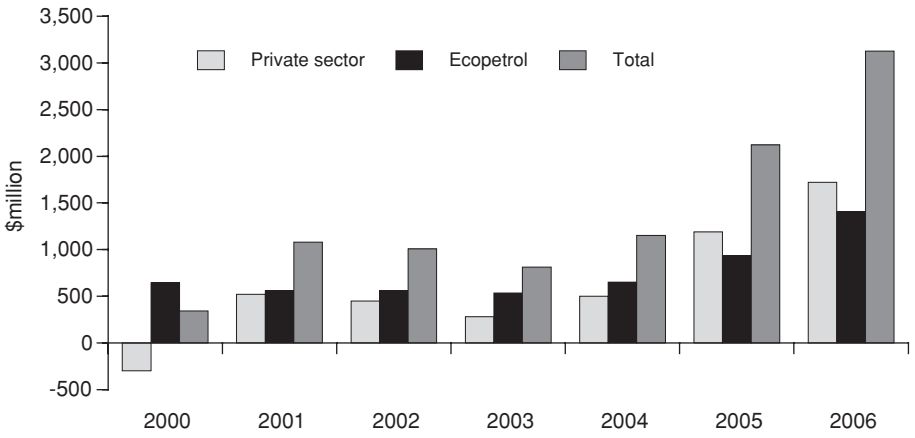
These relatively low levels of government take were considered necessary to compensate for declining E&P activity as well as low number of discoveries and to make the country attractive to foreign investors. There is no doubt that the government take in the new arrangement is generous, and contradicts recent trends in the region, raising questions about potential risks. In this respect, the risks that the Colombian government would reverse its new reforms in the future are considered very low because the oil industry has not been the subject of deep ideological, political and social debate during its history. This may be due to the relatively low importance of oil in the overall economy.

As regards the institutional structure, the NOC is no longer the administrator of the resources. The Agencia Nacional de Hydrocarburos (ANH) is the new independent body responsible for administering the resources. Ecopetrol still remains the largest producer in the country and can still exercise great powers. In this institutional structure ANH as administrator and Ecopetrol as operator report to the Ministry of Mines which is responsible for policy.

"The Colombian government is swimming against the current despite being a net exporter of hydrocarbons"

The Colombian Congress has authorised the government to sell 20 percent of its stake in Ecopetrol in order to fund incremental E&P activity and make new investments in the petroleum infrastructure. The method will be similar to what the Government of Bolivia did in the 1990s; the allocation of the shares will give priority to local pension funds, company workers, cooperative associations and employee funds. Once the demand for these has been satisfied the surplus shares will be offered to the general public. The sale will be conducted in 3Q 2007. It is important to mention that this process has been well received by all political parties and most interestingly it has not been subject to an ideological political debate in the early phases as it was in Bolivia. Under the new institutional structure, the government still retains full sovereignty over the ownership of resources.

Figure 3: E&P Investments in Colombia



All of the above is in sharp contrast to what is taking place in other Andean countries. The Colombian government is swimming against the current despite being a net exporter of hydrocarbons like Bolivia, Ecuador, and Venezuela and, like all of them, has the temptation to seek short-term revenues. Oil and gas importers and self sufficient countries in the region have been relatively more open to reforms and foreign involvement in the upstream sector than oil exporters. Colombia appears to be an exception.

Some of the obvious benefits brought on by the most recent reforms include increasing the number of licences signed, more investment, stabilisation of oil production and rising gas production. In fact, Colombia will export gas to Venezuela, where the size of gas reserves is ten times larger than Colombia's. The prospective areas covered by exploration activities now reach over 30 percent of the total compared to 13 percent in 2000, indicative of a successful acquisition campaign. This is partly due to the fact that the NOC has been able to increase sharply its investment in marginal fields and exploration, and additionally international and local operators have contributed. In 2006 alone, the total E&P investment in the country reached US $3 billion (Figure 3) and more than 50 exploration wells were drilled.

Since the first well was drilled in Colombia a century ago, a total of 10 billion barrels (Bb) of oil and 22 Tcf (Trillion cubic feet) of gas have been discovered primarily in seven basins, in over 200 fields. Of this, 6 Bb of oil and 8.3 Tcf of gas have been produced. Most studies suggest that the hydrocarbon sector is very mature, but given the fact that the prospective area has been barely explored it may still be too early to draw conclusions. Some studies put the total undiscovered resource volume in Colombia at 35 Bb of oil equivalent. The USGS, for instance, believes that, the yet-to-find figure (mean value) could be as much as 6 Bb for oil and 10 Tcf for gas. The new independent agency, ANH, has worked out some scenarios for future discoveries and production increases, and it is also optimistic. The least we can say is that the right framework appears to be in place to have all these dreams come true.

Anouk Honoré asks whether Bolivia's natural gas sector nationalisation was such a bad idea after all

Introduction

In a radical move from the 1990s fairly market-oriented policies, many Latin American countries have turned to leftist governments. After two years of a 'gas war', President Evo Morales was elected in December 2005, and brought sovereignty over oil and gas resources back on the political agenda. Bolivia had been a model student of the policies prescribed by the International Monetary Fund in the 1990s, but these reforms and structural adjustments failed to produce strong and sustainable growth. After more than a decade, Bolivia is the poorest country in Latin America. However, it has a lot of natural gas, a population of only 9 million to consume it, and it lies at the heart of South America surrounded by gas-hungry countries.

Energy, and especially natural gas, policies are an important component of Bolivian political developments. It has been a key factor in the rises and falls of several Bolivian presidents. Natural gas exports are the country's best chance to get much needed money to develop the economy. During his presidential campaign, Evo Morales promised he would use increased oil and gas revenues from resources nationalisation to reduce poverty in the country. On 1 May 2006, President Morales kept his campaign promise and nationalised the oil and gas upstream industries. This was a clear sign that things had changed, but were the impacts as negative as energy analysts described?

One year later, all foreign oil and gas companies in Bolivia have renegotiated their contracts with the government; prices for gas exports have been increased and prospects for new foreign investments are on the discussion table. It seems that President Morales got his way, *and* the gas. So, was all the fanfare and bad press that accompanied the nationalisation really necessary?

The nationalisation story was detailed in a previous issue of Forum (August 2006). We do not address here the question of whether nationalisation was necessary but its implications for countries, mainly Brazil and Argentina, that import gas from Bolivia and on which that country depends for much needed revenues.

What Does this Mean for the Region?

Even though companies have signed agreements and gained legal approval to continue to operate in Bolivia under the new contracts, much uncertainty remains. The major challenge for Bolivia will be to restore confidence in its internal stability and regarding its exports. The perceptions of weak security of gas supply will trigger importing countries to look for alternative sources of supply that will replace additional demand for Bolivian gas. However, despite persisting doubts and uncertainties from companies, analysts and politicians regarding Bolivia's future, gas export developments are under way.

Brazil

Petrobras gas director, Ildo Sauer, told the press in May 2006 that 'Petrobras was not surprised by nationalisation at any time' and 'like it or not, we must admit that he (Morales) is carrying out his plan of government and this was known beforehand.' Only a few weeks after the 1 May nationalisation declaration, the aggressive political atmosphere between the two countries had already dissipated, to be replaced by 'routine' price negotiations. As commercial negotiations go, talks between Bolivia and Brazil on gas issues were (and still are) probably no tougher than some others.

On 14 February 2007, the two countries finally signed a gas supply agreement (GSA). 'The dispute is definitively over,' said Marco Aurelio Garcia, Brazil's chief foreign affairs adviser. The agreement put an end to months of difficult discussions over the price that Brazil should pay for the gas it imports from Bolivia. Brazil agreed to an increase in the price of gas exported from Bolivia to the city of Cuiaba from $1.19/MBtu to $4.2/MBtu. The new price will be adjusted quarterly, in line with international gas prices (and not indexed on oil products). The Bolivian government hopes to get $150 million per year in additional revenues. However, Cuiaba accounts for less than 10 percent of Brazil's gas imports.

"It seems that President Morales got his way, *and* the gas"

No changes to the basic price formula were agreed for Bolivian gas exports to the Brazilian states of Sao Paulo, Parana, Santa Catarina and Rio Grande do Sul. However, Petrobras has agreed to pay the international price for the liquid hydrocarbon fractions in the gas that is delivered. No change will be made to the volumes of gas (30 mcm/d under the take-or-pay contract). Bolivia will also be remunerated for the calorific power of the gas. Petrobras agreed to pay a higher price for Bolivian gas because Bolivia promised to increase the minimum calorific value of its gas in exchange. Although specifics have not been given, it is likely that Brazil will pay around $5/MBtu.

Following this progress, once the GSA was signed with Bolivia, Petrobras announced renewed investments in Bolivia's hydrocarbons sector, which had been stalled in recent years. From 1994–2005, Petrobras spent $1billion on its Bolivian hydrocarbons activities. The company had halted any additional investments in Bolivia's gas sector following the 2006 nationalisation decree, and cancelled the expansion plans of the Gasbol pipeline. However, it is interesting to note that Petrobras had decreased its investments in the country even before May 2006. The May–June social protests in 2005 had already put a first halt to Brazilian plans to increase

Bolivian gas imports. Although the supply to Brazil was never reduced, the social troubles in 2005 created a fear that security of supply could not be guaranteed.

Brazil was unwilling to pay more than $5/MBtu, but it is heavily dependant on Bolivian gas. This situation is not expected to change before 2011, when Brazil begins to fully develop its own gas reserves. Petrobras intends to invest $56.4 billion in its gas sector until 2010, $34.1 billion of which will go towards exploration and production. Petrobras said that the investment plan includes $17.6 billion to be used towards 'developing, leading and ensuring a reliable source of natural gas for the Brazilian market'.

Brazil's potential gas supply diversification lies in two directions: increased domestic production and LNG. However, the increase in gas production in the southeast is in accordance with their domestic strategic plan, which started in 2003 – well before the nationalisation of the Bolivian gas sector. Brazil is aiming for gas self-sufficiency by 2008/9, but this is probably too optimistic as production should not increase dramatically before the early 2010s. For instance, production in the Santos basin (major gas field in the south-east) will not begin until 2009 because of a shortage of sub-sea pipe-laying vessels. Brazilian production should rather be considered as complementary to Bolivian imports.

Brazil also started looking at LNG a while ago and LNG could be used during seasonal peaks to provide between 20 and 30 mcm/d. LNG would be an attractive option, considering that most of the country's population and industry is located close to the south-east coast, as are its major gas fields, but it cannot expect to always get better deals on LNG imports than the price it pays for Bolivian gas. The LNG market is already a sellers' market and is going to be even tighter in the years to come, as rich consumer countries in the Pacific and the Atlantic Basin are already competing for the scarce supply and are prepared to pay the price.

These developments to decrease the dependence on one single source of supply can partly be imputed to Bolivia's social and political troubles. However, in markets where natural gas provides a large share of the energy mix, and where imports rely on one main source, alternative measures should be considered. This is the case, even in the absence of political or commercial tensions with the supplier, in order to ensure security of supply in case of any disruptions that may arise due to unforeseen technical incidents.

"Petrobras will not increase its Bolivian imports above what was already agreed in the current contracts"

Despite very encouraging declarations in February 2007 following the MoU, discontentment in the Brazilian camp over Bolivian gas prices were back on the agenda only a month later. Petrobras chief Jose Sergio Gabrielli announced renewed intentions to reduce the amount of natural gas it imports from Bolivia by 20 percent by 2011. It is more likely that Petrobras will not increase its Bolivian imports above what was already agreed in the current contracts; instead it would look to import gas from other countries and expand production within Brazil. However, the change of attitude by Petrobras over the payment is a new setback in the two countries' already complicated gas relations.

Future relations between the two countries over gas issues will continue to be tough during the months to come, but it is very clear that both parties are dependant on each other, and that both parties would gain by settling the dispute rapidly and starting new talks on their future gas market developments.

Argentina

Relations with Argentina are much easier. Bolivian exports to the country started in 1972 and stopped in 1999, starting again in 2004. Bolivia has been helping the country with gas exports ever since. Argentina plans to continue its Bolivian gas imports and it will also try to boost its own production to help meet its rising demand, now that the situation has eased in the country. In October 2006, Argentina agreed to raise the price of Bolivian gas by 47 percent to $5/MBtu from the previous $3.40 per MBtu, and also signed an historic 27.7 mcm/d gas purchase agreement with Bolivia. Argentina agreed to an increase in order to secure long-term supplies and nearly quadruple imports of Bolivian gas by 2010. The contract is important for Argentina, whose declining reserves have led to cuts in its gas exports to Chile, Brazil and Uruguay in recent years. In exchange, Bolivia is expected to net $520 million annually from the new contract, $220 million more than before.

However, the supply agreement will require sizable upstream and pipeline infrastructure investment. Since the Yabog system is at full capacity, the two countries agreed on the construction of the $1 billion plus Gasoducto del Noreste Argentino (GNA) pipeline. GNA was first announced in November 2003, but was halted following social, political and economic problems in both countries. The 1500-km pipeline was originally scheduled to be operational by May 2006, but uncertainty caused by Bolivia's new hydrocarbons law in 2005 led to the plan being put on hold until recently. It could be constructed in 2 to 3 years, and if both governments have their (optimistic) way, the first phase of the pipeline project should be finished by the end of 2008, when Argentina will import 16 mcm/d, and the final phase at the end of 2009, when imports will rise to 27.7 mcm/d. The project will also include a new natural gas liquids (NGL) separation plant in Bolivia that will supply LPG to Bolivian households.

The construction lead-time seems to be very optimistic considering the technical and financial difficulties, but the new contract with Argentina is a very important step for the Bolivian gas sector. It is reducing uncertainty regarding the future of Bolivian

exports, and could act as a magnet for foreign companies' investments in the country.

Other Projects

Paraguay has been expressing an interest in piped gas from Bolivia since 1996; it could become the third country to import Bolivian gas, after Brazil and Argentina. There is a plan to build a $700 million pipeline to transport 20 mcm/d of gas from Bolivia to Paraguay, and supply gas-fired plants, including a gas-to-liquids installation and petrochemical and fertiliser plants in (or near) Puerto Casado, next to the Brazilian border. The project could cost between $2 and $3.4 billion in total.

If one takes into account only the commercial and geographic aspects, other markets could benefit from Bolivian gas exports. Following Argentina's continuous cuts in gas supplies in the winters, Chile is considering importing LNG from Indonesia or Australia. A pipeline from south Peru to north Chile is also under discussion. However, given the reality of political relations Chile seems unlikely to import Bolivian gas in the near future, but things may change if political relations improve between the two countries.

Another project linking Peru from the Camisea reserves to Argentina, Brazil, Chile, Uruguay and Paraguay is on the table. Peruvian reserves may not be enough to fulfill both its LNG export contracts to North America and the increasing demand from neighbouring countries, which means that there are possibilities for Bolivia to develop new markets for its gas if Peru is unable to fulfill the demand.

The idea of LNG exports has been more or less abandoned for the time being, although it remains a possibility for the medium to long-term future, mostly depending on political conditions.

There is also the 5000 mile pipeline proposed by President Chavez, which would run south from Venezuela through Brazil to Argentina. It is feasible economically and technically, and using Europe–Russia or Canada–USA as examples, it would make sense if one looks purely at the demand/supply situation. Although Bolivia first dismissed the project as impracticable, it is now believed to be committed to it, and could therefore export some of its gas via the pipeline. However, the 5000 mile pipeline is also a long way from being built, and many potential obstacles (for example, finding the estimated $20 billion to pay for it, resolving the environmental concerns of cutting through the Amazon rainforest, dealing with competing interests of individual nations) have raised concerns about whether the public promise of unity can survive the difficulties. Countries involved in such a pipeline would become long-term partners, and the decision to be part of it requires careful consideration, more political than economic or environmental.

Conclusions

Despite discontentment and concerns for the future, companies with long-standing investments in the country complied with the terms the government offered. One year after the Nationalisation Decree and its almost unanimous disapproval by energy specialists and liberal economists (the Nobel Prize laureate Joseph Stiglitz being a notable exception), Bolivia and the companies agreed on new contracts that do not seem to be synonymous with a death sentence for anyone. From the very beginning, President Morales made it clear that he had no plans to develop the gas industry without the participation of foreign investors.

Uncertainties however remain. Companies tend to be averse to political risks unless the rates of return on investment are consistent with a short payback period. Governments of importing countries worried about the security of energy supplies will always seek to diversify the sources of imports and to promote wherever possible domestic production. All that involves long-term risks for Bolivia.

Meanwhile, President Morales saw the new contracts as a big step towards solving the country's social problems. The Bolivian government receives more revenues from higher gas prices and gas tax increases imposed in 2006. In addition, the World Bank cancelled the IDA debt of Bolivia. Having secured extra revenues from gas, his task now will be to spend them wisely, and keep still existing social tensions in check in order to allay companies' and importing countries' fears and attract new investments in the country.

Letters to the Editor

Dear Editor,

In the last Oxford Energy Forum, three articles make the case for nuclear energy. They see nuclear power as the answer to the latest EU energy policy objectives: security, sustainability and competitiveness. Although these articles are not explicit about the role of markets and of governments, I think they reveal a dilemma: while the EU favours liberalisation to promote competitiveness, liberalised markets are not likely to favour nuclear energy. In fact, currently, it is not even clear whether liberalised energy markets are the best way to promote competitiveness, security and sustainability,

The authors do not pretend that the road to nuclear will be an easy one, but they all point to the desirability and virtual inevitability of a growing role for nuclear. It is true that the prospects of the nuclear energy industry have been revived by the good news (for the nuclear industry) of global climate change and of the imminence of peak oil. Nuclear energy generation creates no greenhouse gases and is potentially a way to mitigate the problems related to peak oil.

Adnan Shihab-Eldin summarises the many important obstacles still facing the development of this energy source including: stubborn public opposition; the absence of a solution to the problem of safe and permanent storage of nuclear waste; the safety and health concerns; and above all the

political and military implications of nuclear proliferation. On balance, and in spite of these concerns, the question for the authors is 'when', rather than 'whether' the world will wake up and go nuclear. In other words, the benefits outweigh the costs.

However, there is a dilemma that has been ignored by the authors and by the framers of European energy policy: namely that liberalisation of energy markets does not easily fit with the development of nuclear energy.

- First, it is unlikely that private investors will be able to raise capital to build new nuclear plants without some security of revenue streams. Most new plant built in liberalised electricity markets (mainly CCGT) have had relatively low fixed costs, long-term revenue guarantees, and an expected payback period of less than 15 years. For nuclear plants, with their very high fixed costs and long lives, it is not clear that customers in a liberalised market will provide credible long-term contract guarantees.
- Second, the economic risks associated with a major nuclear accident or prolonged outages are so great that it may be prohibitively expensive to insure against them. In a competitive market, when a plant shuts down, the operator not only stops earning revenue; it is often obliged to buy power to meet its obligations to customers during the outage. The relative size of these risks for nuclear plant would weigh heavily on any investor.
- Third, the development of new nuclear energy technologies involves significant fixed costs that must be spread over a very large number of plants in order to achieve the economies of scale. This has two implications. One is that it does not make sense to build a few nuclear power stations; the economic case requires many to be built. So the risks described above are magnified. Second, if a design fault or security problem were discovered, the public authorities would be obliged to shut down many plants with similar designs.
- Fourth, although the fixed cost of building nuclear plants is very high, the variable costs of running them are typically low. The result is that these plants earn significant rents when the electricity is sold at market prices that will reflect the fuel cost of plant that operate at the margin – for instance the cost of gas for a CCGT. The marginal price of electricity is likely to rise as oil prices rise (since gas prices are usually indexed to oil prices), and as the cost of CO_2 is also reflected in the marginal cost of generating electricity. Once a nuclear plant is built, the margins from energy production are significant. That has two implications. One is that nuclear operators will be under significant pressure from shareholders to avoid outages – an obvious source of public safety concern if this means maintaining them less. And the other implication is that government is tempted to intervene to cap profits on nuclear plant when electricity prices are rising. In Spain, the government recently decided to scrap capacity payments for nuclear plants.
- Fifth, companies will want to limit liability associated with a major accident, or decommissioning. There are many different ways to manage this, but the main point is that these costs are large and uncertain and companies will only invest in nuclear if government caps company liability with respect to both.

The evidence that these problems are serious is that most new nuclear plants are being built in countries like China and India that have not fully embraced liberalisation of electricity, at least not in the sense of allowing markets to determine what plants are built and what they are paid. Yes, there is some evidence of a renewed interest in nuclear plants in Western Europe and North America, but government sponsorship and/or subsidies seem to be central to all these plans. Absent strong government support for nuclear, it is very hard to see privately owned companies building nuclear plants in liberalised markets.

There are different possible responses to this analysis. One is to acknowledge the conflict between energy policy objectives and 'liberalised' market outcomes and to argue that energy and environment are too important to be left to the market. In other words, governments, not markets, should drive our future energy balance. In this case, nuclear may make a come-back in Western Europe and North America, but we should not expect markets to play much of a role.

Another possible response is that markets actually will address these concerns. For instance, if gas and CO_2 prices rise, nuclear energy will become increasingly competitive and large customers may sign long-term contracts for that energy; insurance markets may cover the risks associated with nuclear accidents and the back-end risks; and investors will take the long view, financing the building of plant that requires a very long payback period since the return will justify the risk.

Perhaps the most likely policy outcome is muddling through, trying gradually to liberalise energy markets, while introducing government policies (i.e. national indicative plans) that effectively pre-determine the choice of technology through subsidies and differential regulation. In that case, I think it is sensible at least to admit that markets are no longer determining choice of technology and that we are basically moving back to a more traditional form of regulated utility. If so, then as the risks of investment fall, so should the rewards.

I think the dilemma facing nuclear energy in a competitive electricity market requires us to examine the role of competition and of markets in the EU energy policy trinity of security, sustainability and competitiveness. I suspect that there are many contradictions in this combination of objectives, and that the upcoming debate is about what role markets can and should play in meeting them. My impression is that national and EU government policy and regulations will increasingly determine the choice of technology and that markets will play a diminishing role. If so, we had better remember why liberalisation

seemed a good idea in the first place, namely that governments and monopoly had done a pretty poor job in most countries in delivering low-cost and secure supplies of energy.

David Robinson
Madrid

Dear Editor

I got two impressions on reading the three articles on nuclear power in your February issue. First that we cannot do without a major renaissance of nuclear power if we are to meet the challenge of global warming (with which I agree); and second hope that this will occur. But hope is not going to be enough – even if that hope is shared by an increasing number of previously antagonistic commentators, by politicians and members of the public; and even if all one's concerns about proliferation, waste disposal and safety are fully met.

The question which was not addressed by your contributors is what measures are needed to ensure this hope is realised? Governments can say how supportive they are of nuclear power. But will they make the necessary business decisions happen, and how? In the UK we are particularly subject to the market, and the market is going to need a lot more than signals from the government before it will act. One way or another, however you wrap it up, the government is going to have to give bankable guarantees to the industry, to persuade it to invest. And it is unlikely to want to see a proliferation of designs and suppliers all expending a lot of effort on competing with each other. Are we going to see a stealthy progress of the generating industry back into the Public Sector? (Shades of Network Rail?)

By the same token, if France is serious about nuclear power (which it certainly seems to be) then it is not going to be bullied into the market liberalisation in this sector that the EU is calling for. Is there a fundamental conflict between the desire for nuclear power and for market liberalisation?

Charles Henderson
London

China in Africa

Lindsey Hilsum looks at Africa's joy and misgivings about Chinese investments

There are still a few zebras and elephants in Beijing, not to mention the odd giraffe. Not wandering the streets, of course, but on billboards, remnants of the November 2006 Africa Summit, when the Chinese government feted political and business leaders from 48 African countries in the biggest extravaganza of its kind China has ever held.

African leaders, accustomed to being regarded as representatives of a failed continent – 'a scar on the conscience of the world,' as Tony Blair once put it – loved the attention and flattery. Each leader was greeted by President Hu Jintao in the Great Hall of the People, and by the end of the summit the Chinese had cancelled US$1 billion in debt, while promising another US$3 billion in preferential loans, US$2 billion in export credits, and a new US$5 billion fund for Chinese investment in Africa.

China already lends Africa four times as much money as the World Bank does. With US$1 trillion in reserves, China is awash with cash which can be used to secure long-term energy deals, subsidise Chinese companies expanding into Africa, curry diplomatic favours and buy influence.

The Sierra Leonean Ambassador to China, Sahr Johnny, explained the dynamic in an interview with Channel 4 News just before the Gleneagles summit in 2005, where Mr Blair and his rock star friends Bob Geldof and Bono tried to persuade G8 leaders to make 'saving' Africa a priority. 'The Chinese are doing more than the G8 to make poverty history,' said Mr Johnny. 'They just come and do it. They don't hold meetings about environmental impact assessment, human rights, bad governance and good governance. I'm not saying it's right, just that Chinese investment is succeeding because they don't set high benchmarks.'

President Yoweri Museveni of Uganda, once the darling of western donors but more recently criticised for prolonging his rule and skewing elections, was scathing about his former friends. 'The western ruling groups are conceited, full of themselves, ignorant of our conditions, and they make other people's business their business,' he said, in an interview during the Beijing summit. 'The Chinese deal with you as someone who represents your country, and for them they represent their own interests and you just do business.'

China's primary interest in Africa is energy to fuel to its 10 percent annual growth.[1] According to the US Energy Information Administration, China imports 4 million barrels of oil a day, a figure expected to rise to 11 million by 2030. With the exception of South Africa, the continent's most developed economy, China's top trading partners in Africa are all oil producers – Angola, Sudan, Congo-Brazzaville, Equatorial Guinea, Gabon, Nigeria. Angola is second only to Saudi Arabia in supplying the Chinese market. Chinese customs statistics suggest that about 30 percent of the country's oil imports are from Africa.

China not only wants to secure oil supplies now, but also to establish itself in the long term as a global player in the international oil market. The China National Petroleum Corporation (CNPC), China Petroleum and Chemical Corporation (Sinopec) and the China National Offshore Oil Corporation (CNOOC) are involved in oil exploration, production and refining across Africa. As state-owned companies, they are a tool of Chinese foreign policy. According to Ian Taylor of St Andrews University,

1 This and the following five paragraphs draw on Ian Taylor's article "China's Oil Diplomacy in Africa", *International Affairs*, 2006, vol.82:937–60.

'China takes the long-term view vis-à-vis energy security, rather than the short-term view of private Western companies – a view necessitated by considerations of profits and shareholders.'

CNPC built its first oil refinery outside China in Sudan. Last year, Chinese companies bought exploration rights in Kenya, Namibia and Ethiopia which have not previously been oil producers, as well as increasing stakes in exploration, drilling, production and refineries in well-established oil producers such as Nigeria, Angola and Congo-Brazzaville.

For African governments the rewards are enormous. On the back of Chinese demand, the price for oil, copper and minerals such as platinum has risen to the point where some African countries are experiencing growth rates of 5 percent or more. Moreover, Chinese interest gives them leverage with western and multi-lateral donors they never previously enjoyed.

In 2004, when the IMF refused to lend money to the Angolan government unless it curbed corruption, China's export-credit agency, Exim Bank, stepped in with a US$2bn loan on easy terms – or, as a statement from the Angolan Embassy in London put it, 'no humiliating conditions were imposed.' Angola is widely regarded by businesspeople as one of the most corrupt countries in the world – in 2006, Transparency International, the anti-corruption watchdog, ranked it 142nd out of 163 countries in its Corruption Perception Index.

But the Chinese knew what they were doing. Not only was the Angola loan tied to an initial supply of 10,000 barrels a day rising to 40,000 barrels later, but it was mainly for construction projects to be carried out by Chinese companies. Emerging from 30 years of civil war, Angola has embarked on massive infrastructure projects, with Chinese contractors as the first choice for roads, bridges, fibre-optic links, and even a new airport. For many Chinese firms – state-owned or semi-private – it is their first opportunity to 'go global', step one on the ladder to becoming multinationals with experience of operating outside China.

In a recent press conference in Beijing, the Chinese Foreign Minister, Li Zhaoxing, enthused about the crowds of ordinary citizens who would line the streets to greet him or other senior Chinese officials on their frequent visits to Africa. Perhaps he had forgotten how local party stalwarts used to round up Chinese peasants to hail Chairman Mao when he passed through on his train – woe betide those who failed to show up. While their governments welcome the Chinese, some Africans have their doubts.

"China already lends Africa four times as much money as the World Bank does"

Rebels in the Niger Delta, who have long harassed Shell and other western oil companies in protest at the Nigerian government's failure to distribute oil revenue fairly, recently kidnapped five Chinese oil workers. Michael Sata, an opposition candidate in the 2006 Zambian election, campaigned on an anti-China platform after workers at a Chinese-owned copper mine were shot during a protest over poor wages and working conditions. Elsewhere, Africans grumble that the Chinese import in even unskilled workers so their projects rarely boost employment, while in Zimbabwe cheap Chinese goods are derided as 'zhing zhongs'.

Indigenous anti-corruption groups fear the spreading influence of China. 'We've spent 15 years working on conventions against corruption, and now the Chinese come in and they haven't signed up to any of it,' said Zainab Bangura of Sierra Leone's National Accountability Group. 'I'm worried that African governments will see China as an alternative to G8 countries, because with the Chinese they don't have to worry about good governance and all that.'

Others complain that their governments are failing to get a good deal from their new friends in the east, allowing the Chinese to extract natural resources as the former colonial powers did, without building processing facilities to add value and create jobs in Africa.

But the most voluble protests come from western non-governmental groups campaigning about mass killings in the Sudanese region of Darfur. China is Sudan's biggest trade partner, buying some 60 percent of its exports, nearly all oil. The Chinese have built three small arms factories on the outskirts of Khartoum, the Sudanese capital. According to Human Rights Watch, more than 70 percent of Sudan's oil revenue is used to buy weapons, many of which are used in Darfur. Government-backed militia, known as *janjaweed*, supported by Sudanese army helicopter gunships, have driven more than two million Darfur citizens from their homes while up to 200,000 have died, some in fighting, others from hunger. President Hu Jintao, who visited Sudan in February as part of his fifth tour of Africa, was reported to have put some pressure on his Sudanese counterpart, President Omar al Bashir, but the displaced people of Darfur are yet to see any improvement in their desperate circumstances.

Until now, criticism has not bothered the Chinese, who trumpet a foreign policy based on 'non interference' and 'sovereignty', which means that they will not criticise their African trading partners and oil suppliers because they do not welcome outsiders commenting on their own human rights record.

But in March, a new campaign emerged in the USA calling for a boycott of next year's Beijing Olympics, because of Darfur. 'China's slogan for these Olympic Games – "One world, one dream" – is a ghastly irony, given Beijing's complicity in the Darfur genocide,' wrote Eric Reeves, an American academic. 'The Chinese leadership must understand that if they refuse to use their unrivaled political, economic, and diplomatic leverage with Khartoum … then they will face an extremely vigorous, unrelenting, and omnipresent campaign to shame them.'

Shame and 'loss of face' are potent concepts in China. The Darfur

Olympic campaign, if it reaches a critical mass of support, could just dent China's image at an important and very public moment. Next year's Olympics are seen by the authorities in Beijing as their 'coming out' party, the moment in history when China is restored to its rightful place in the world, similar to the status it enjoyed in the prosperous and powerful Han, Tang and early Qing dynasties.

Courting Africa is part of the strategy to boost China's global diplomatic reach and international standing. Only five African countries retain links with Taiwan – the rest have all turned to the People's Republic. Aware of the importance of 'soft power', China is building Confucius Institutes, where people can learn Mandarin and study Chinese culture, in key African cities. According to Yan Xuetong of the Institute of International Studies, Tsinghua University, while the USA follows an increasingly unilateral course, 'China will maintain its multilateral diplomacy to harmonize relationships with her neighbours, the EU and the developing nations of other regions. Their opposite foreign policies will reduce the political power disparity between China and the United States.'

At the beginning of the twenty-first century, Africa provides China with a strategic opportunity to increase its influence in the United Nations and other international forums, as it tries to match its economic rise with greater diplomatic clout.

It is an opening few African leaders could have dreamed of. After decades of being damned by the West as 'the lost continent', suddenly Africa matters. No wonder African leaders were smiling like crocodiles as they left the Beijing Summit.

Additional research for this article done by Kuang Ling

Bassam Fattouh assesses Chinese oil companies in Sudan

China and Energy Security

China is a relative newcomer to the 'energy security' game. Until the late 1980s, energy security did not constitute a major concern for the Chinese government. This started to change in the mid to late 1980s as a result of economic reform and China's spectacular economic growth which sparked large increases in oil demand. In 1993, China shifted from a net oil exporter to a net oil importer; in 2003, it surpassed Japan as the world's second-largest consumer of petroleum products. International Energy Agency (IEA) data show that between 2000 and 2006 China accounted for almost 40 percent of total growth in global oil demand.

The recent shift to the status of a net importer of oil has raised serious concerns about energy security in China. The option of finding new reserves and boosting domestic production to achieve self-sufficiency in oil is no longer available. Instead, Chinese oil demand is likely to continue to rise at a much faster rate than domestic production. It is estimated that by 2020, China will import nearly 8 million b/d accounting for around 65 percent of its total oil demand.

Faced with this reality, China has embarked on what some refer to as 'oil diplomacy' to enhance energy security. This diplomacy is centred on two main objectives: to secure oil supplies for the country's growing demand and to enhance its position as a major player in the oil market.[1] To achieve these two objectives, China first began a major restructuring of its oil industry in the 1980s. This resulted in the creation of three vertically integrated state-owned oil companies: China National Petroleum Company (CNPC), China Petroleum and Chemical Corporation (Sinopec) and China National Offshore Oil Corporation (CNOOC).

1 See Ian Taylor, 'China's Oil Diplomacy in Africa', *International Affairs*, 2006, vol.82: 937–59

In its attempt to secure oil supplies, the Chinese government has pushed its oil companies to acquire foreign oil assets and secure exploration and development rights all over the world. CNPC, Sinopec and CNOOC, which until recently focused almost exclusively on domestic oil production, have now acquired assets in a large number of oil-producing countries. According to the EIA's China Country Analysis Briefs (August 2006), CNPC has acquired oil interests in 21 countries spanning four continents and intends to spend a further $18 billion in foreign oil and gas assets between 2005 and 2020. The policy of acquisition of oil assets is primarily driven by energy security concerns. Consequently, Chinese companies have been able to engage in aggressive bidding, and accept terms that are not acceptable to private companies. Some observers go further, accusing the Chinese government of promoting state-to-state deals and engaging in political opportunism to secure oil concessions.

Chinese Companies in Africa

In this frantic quest for energy sources, special attention has been given to Africa. China voluntarily waived $1.2 billion in sovereign debt in 2000 and by 2006 it has provided more than $5.5 billion in aid and cancelled the debt of 31 African countries. It has also strengthened its economic links with Africa as reflected in the value of China's trade and foreign investment in the continent. In 2005, trade between China and Africa increased from $20 billion to $40 billion and in 2006 it hit a record of $55.5 billion.

It is important to stress that Chinese interests in Africa have not been confined to oil assets. China has also been active in securing access to different kinds of natural resources.

Chinese Oil Interests in Sudan

Within Africa, Sudan presented a perfect opportunity for Chinese oil companies to consolidate their presence in the continent (as detailed by Luke Patey in a Danish Institute for International Studies publication).

Since the early 1980s, Western oil companies in Sudan started to scale down their operations and by the mid 1990s decided to exit the country. CNPC seized the opportunity and stepped in to displace foreign firms, establishing a leading position in Sudan's oil industry. When CNPC entered in 1996, the country's oil potential was well recognised thanks to Chevron's effort. Chevron, which had entered Sudan in the early 1970s, had made many significant discoveries and established the basis for the Sudanese oil industry. However, after a heavy investment estimated at $1 billion, the company was forced to suspend its operation in 1984 and completely exited Sudan in 1992 selling its concession for $23 million to a Sudanese oil company (ConCorp) whose owner was closely linked to the leader of the National Islamic Front, Hassan Al-Turabi. Chevron's departure was caused by the eruption of the civil war, continuous attacks on oil installations and threats to expatriate employees.

Concorp in turn sold its concession to a State Petroleum Corporation from Canada, which then in 1994 sold its concession to Arakis Energy Corporation, also from Canada. In 1996, Arakis sold 75 percent of its share to CNPC, Petronas, and Sudapet (the national Sudanese oil firm) and formed a new consortium, the Greater Nile Petroleum Operating Company (GNPOC) with Arakis acting as the operator. Arakis however was not able to raise the required finance and decided to sell its share to Talisman Energy (another Canadian company). Oil assets in Sudan were vital for Talisman's global energy portfolio, but after four years of engagement it decided to sell its interest to India's Oil and Natural Gas Corporation Limited (ONGC). Talisman's departure was caused in part by outbreaks of violence, military attacks on oil installations and pipelines and in part by pressure from media and human rights organisations that linked violence to Talisman's activities in Sudan.

China Faces Criticism and the Policy of Non-interference

The Chinese government portrays its strategy of securing oil assets in Sudan as different from that of traditional exploiters. Chinese officials argue that unlike the colonial West, its trade and investment in Africa are contributing to the development of the continent and that China is investing in Africa at times when it has been attracting little investment from anywhere else.

"The Chinese government portrays its strategy of securing oil assets in Sudan as different from that of traditional exploiters"

However, this has not helped insulate China from criticism. During the war between the Sudanese government and Sudan People's Liberation Army (SPLA), China was heavily criticised for helping finance the Sudanese civil war and supplying weapons to the Sudanese government. It is estimated that China has sold the Islamic government in Sudan $100 million worth of weapons and supplied it with jet fighters and strengthened its military air power. During the civil conflict, there were many reports accusing the Sudanese government of using CNPC facilities as a base from which to attack rebels. China is also accused of turning a blind eye to poor governance, corruption and human rights abuses and supporting autocratic regimes. Currently, it is being criticised for adopting a special reading of human rights to block UN sanctions on Sudan for human rights abuses in Darfur.

China's response to these criticisms especially those related to human rights abuses has been to adopt a policy of 'non-interference in state sovereignty and domestic affairs', according to Ian Taylor. This policy can vary from a very general position that China does not meddle in domestic politics to the position that the business sphere should be completely separated from the political sphere. The policy has been well received in Africa and particularly in Sudan since it feeds on Sudanese leaders' suspicions that Western countries wish to force their viewpoints and values on poorer and weaker nations. Others would go further, arguing that criticisms directed at China are hypocritical as Western countries' foreign policy towards Africa was never based on enhancing human rights. As to criticism that China is taking oil from Africa, Bo Xilai, the Chinese commerce minister, responded very bluntly that 'according to statistics, last year, of Africa's total oil exports, China took 8.7%, Europe took 36% and the United States 33%. If importing 8.7% means exploitation, how about 36% and 33%?'

China in Sudan: A Success Story?

It is unlikely that criticism of China's energy interest will alter its strategy in Sudan in the near term. On the face of it, the future is looking bright for CNPC. In the last two years, Sudan has been enjoying a period of relative political stability as regards the North/South conflict thanks to the Comprehensive Peace Agreement (CPA) signed in 2005 between the Sudanese government and SPLA. The CPA stated explicitly that all previously signed oil agreements by the Government of Sudan will be respected by all parties. Thus, it was no surprise that the Chinese government was very fast to welcome the agreement between the warring factions.

The fact that the two parties agreed not to alter existing concessions can be considered as an important achievement. Oil production has so far been concentrated in Southern Sudan. Furthermore, most discoveries are being made in the Southern part of the country while exploration results in the North have not been very promising. To reflect this reality, the CPA included an agreement on sharing revenues from oil sales between the South and the North on a 50–50 basis. To help implement the revenue-sharing agreement of the CPA, the National Petroleum Commission (NPC) and the Assessment of Evaluation Commission, were created in 2005. NPC has also been made responsible for approving new oil contracts and resolving any disputes regarding

existing concessions. In principle, these institutions should give the Government of Southern Sudan a bigger say in determining the future development of Sudan's oil sector.

The above suggests that China's energy interests in Sudan are quite secure and that its policy of enhancing energy security has worked in this country. However, it is still premature to come to such a conclusion. China's position may be undermined by current dynamics within Sudan. These new dynamics are being manifested in a number of ways. First, there is a debate in Sudan on whether the heavy reliance on Asian oil companies is the best strategy for the long-run development of its oil sector. Many argue that Sudan should aim at attracting more international oil companies which are perceived to have the best available technology, follow high efficiency benchmarks, and pursue more responsible social policies. It is also argued that private foreign oil companies would play a more effective role in technology transfer and upgrading indigenous skills. Chinese companies, on the other hand, tend to rely primarily on imported labour from China with little interaction with local employees. Also, Chinese companies play a limited role in the training of local employees, especially from the South.

Second, Chinese officials always emphasise that Chinese oil companies pay greater attention to protecting the environment and engaging with the local community when exploring and developing oil fields. However, the view from within Sudan is quite the opposite. In fact, many argue that the Chinese have been successful because they do not set high benchmarks regarding transparency, environmental standards, and corporate social responsibility. Earlier this year, the Chairman of the Assessment of Evaluation Commission (AEC) Tom Vraalsen declared that oil companies are seriously violating the CPA in more than one area including extensive environmental degradation, failure to compensate for damages caused by oil operations and disregarding the concerns and interests of local communities. The latter issue has caused some resentment especially towards the Chinese.

Third, some governors in the Southern oil-producing states are becoming more affirmative, requesting that oil companies do not bypass them. For instance, in a recent conference, the governor of Jonglei State, which produces oil, announced that 'some of these oil companies should understand that Southern Sudan is no longer a no-mans-land as it was before the CPA, ready for grabbing. There are levels of governments and laws in full operation that must be consulted and respected by oil investors and all concerned.'

"China's position may be undermined by current dynamics within Sudan"

Fourth, the use of private security forces by Chinese oil companies has also been causing tensions and raising eyebrows. Many officials are arguing that there is no need to have separate security for companies. Since the war is over, oil assets should be kept under the protection of the State.

Fifth, recently there have been many calls for greater transparency in management of oil revenues and improving the functioning of the NPC. For instance, the European Coalition on Oil in Sudan (ECOS) announced in its 2006 Conference that the 'NPC is the most important mechanism towards the realization of equitable oil distribution and revenue utilization.' However, the NPC has been dysfunctional due to political differences among the various parties. Although sharing revenues is an internal Sudanese matter, foreign companies can not insulate themselves from this debate as they are responsible for generating and channelling the rents to the central government.

These issues are unlikely to go away and most probably will intensify, especially in the next few years when Southerners decide in a referendum in 2011 whether they wish to partition from the rest of Sudan. This raises a series of important questions: what will be the future of CNPC (and other Asian national oil companies for that matter) if Southern Sudan decides to vote for partition and independence and decides to terminate the oil concessions signed by the Northern Government? If this happens, would China consider this decision as a sovereign act and respect the new government's decision? Or will such a decision alter China's policy of non-interference in domestic affairs?

Conclusion

Despite early successes China's current energy interests in Sudan are far from being secure and events may still prove the weakness of its energy strategy in Africa in general and Sudan in particular. In fact, this raises a more fundamental question about China's general energy security strategy. First, Chinese companies control a small amount of production outside China. In fact, the amount of oil obtained from Chinese concessions in Sudan is quite low, representing less than 5 percent of Chinese total demand in 2006. Second, given China's rapid growth in oil demand, ownership of assets in Africa will not help achieve the objective of diversification as China will remain highly reliant on imports from the Middle East. Third, ownership of assets does not secure low oil prices or help insulate the Chinese economy from price hikes or price volatility. Finally, it is not clear whether China can avoid the fate of other companies and continue to exercise its control over foreign assets in periods of crisis or fundamental political changes which Sudan is likely to face in the near future.

The emergence of the internationally active Chinese oil companies acting as agents of their home state's foreign policy to secure energy security is merely a variation on an old theme. The United States, Britain and Japan tried a similar strategy in the last century and failed. Now it is apparently China's turn to learn this lesson the hard way.

Asinus Muses

The story of a botch-up

From g-clic to meta-g-clic

Forget about the global climate crisis (g-clic); it's over already. We are rapidly moving, however, into what may be worse – a meta global climate crisis (meta-g-clic). In this phase the main causes of climate change are no longer simply the excessive use of energy but the very policies applied to arrest climate change. The treatment can worsen the disease.

Uncontrolled proliferation

The first component of meta-g-clic is the climate change diagnoses themselves. The uncontrolled proliferation of climate change reports have become responsible for a huge increase in the demand for paper, printing materials and energy. Are these reports printed in tiny type on recycled paper? No, they are ultra-lavish publications weighing a ton. Do the hundreds of climate scientists arrive at their meetings by bike and sit around debating all night in complete darkness? Of course not; the lights are always blazing in their glittering labs and international conference palaces.

Biofuel mania

All that, however, is quite mild compared with the next component of meta-g-clic – biofuel mania. According to its partisans, biofuel reduces CO_2 emissions because, unlike fossil fuels, biomass fuel materials absorb CO_2 while they are growing. To put it more simply: it is better to burn recently existing vegetables rather than ex-vegetables (fossils). In theory, and occasionally in practice, this is possible. But in the USA the mania takes the form of using maize (corn) to make ethanol with the intention of feeding all-american cars like all-american children, with the liquid equivalent of cornflakes.

Less energy; more money

Unfortunately for this plan, the conversion of vegetables into biofuels also needs energy most of which comes from burning fossil fuels. Scientific experts on the question (such as David Pimentel and Tad Patzek) conclude that ethanol production requires 29 percent more fossil energy than the (non-fossil) energy which the ethanol fuel delivers. So this 'solution' to the energy problem involves producing energy using even more energy. Why would anyone do anything so mad? Because the corn-friendly federal and state governments in the USA subsidise the growing of fuel-maize and the ethanol itself. Hence environmental madness is transformed into fat profits for maize farmers and biofuel producers. Ethanol demand is driving up corn prices in both the USA and Mexico, where poor households have found themselves having to pay double the normal price for their staple diet – maize tortillas. In addition, human carnivores are also finding their grocery bills rise since the the cows, sows, fish and fowl they eat are fed with the same maize which is fed to the cars. The car companies, under pressure from President Bush, are shifting towards making only omniverous (hybrid) rather than gasoliniverous cars and are also claiming an innovative part in the greening of the motor economy and the american way of life.

EU vs. OU

In Europe there is a parallel story of increasing imports of palm oil, partly as an ingredient in another biofuel, biodiesel, which is destined to play a major role in the EU's latest promises to use 10 percent of biofuel by 2020. All this is meant, of course, to reduce the EU's carbon hoofprint (or footprint as the humans quaintly say). The result? Hectare after hectare of tropical forest felled and peat deposits burned off to make way for new palm plantations in Malaysia and Indonesia, both leading to more, not less, CO_2 emission, and to the near extermination of the poor Orang Utan (OU) which is becoming for conservationists the tropical equivalent of the polar bear.

Trade-off or genocide: a question of vocabulary

Daniel Yergin says that once ethanol production reaches 10 percent of US gasoline consumption 'you really do run into the fuel-versus-food tradeoffs'. What to the economist is an innocent sounding 'tradeoff', to the world's longest running Head of State is 'genocide'. The rejuvenated Fidel Castro has accused the promoters of biofuels (especially Bush) of planning to use so much agricultural land for biofuel that 3 billion people will die of starvation. Hugo Chavez, previously sympathetic to biofuels, now shares his friend Castro's opinion. This is not his only recent change of mind: Asinus particularly regrets that he has recently substituted his habitual description of George Bush as 'the devil', who apparently has complained, with 'a donkey'.

Who is behind biofuel mania?

All critics of biofuels get denounced as agents of the oil companies. Asinus, however, suspects that it may be oil interests which are actually the biofuel advocates. How else do you explain that not long ago some biofuels seemed to be part of a quite reasonable strategy against global warming. Yet in no time they have become a synonym for irrationality and are getting blamed for higher food prices, higher CO_2 emissions, and the near extinction of important species. Such a complete botch-up must surely be part of a plot to sabotage the new rivals to petroleum at an early stage. And who would you expect to be behind that?

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: Robert Mabro. Annual Subscription (four issues) £45/$85/€65.

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