The UK restarted LNG imports in July through a new terminal on the Isle of Grain.

(18.8 tcf/0.53 tcm). President Hugo Chávez has pledged to increase natural gas production, all of which is currently consumed domestically.

Western Europe

Like the US, western Europe faces the challenges of continued declining production, rapid growth in demand, uncertain and escalating gas prices, and the need for large investments in the infrastructure and to increase and diversify imports. However, European gas markets have an additional layer of complexity not found in the US: the requirement to reduce carbon emissions. Under the Kyoto Protocol, the EU is obligated to reduce its greenhouse gas emissions 8% from 1990 levels by 2008-2012. How the obligation is implemented could dramatically change the energy market structure and impact the use of all fossil fuels, including natural gas.

Currently imports are coming in via pipeline from Russia, Algeria and Libya, and as LNG from numerous sources. Belgium, France, Italy and Spain are planning increases in LNG import capacity, The Netherlands is considering LNG imports and the UK recently restarted them.

UK consumers have suffered from soaring prices caused by diminishing gas reserves in the North Sea, but future imports could bring wholesale gas prices down within two years. The potential gas surplus emerges from a series of massive import schemes. LNG imports from Algeria restarted in July 2005 after two decades through a new terminal in the Thames Estuary and two further terminals are under construction in Milford Haven, Wales. The British LNG market is of great interest to energy traders who are betting that a transatlantic short-term market in LNG and price arbitrage will develop between the American and British markets.

Meanwhile, gas equal to a fifth of the UK's annual demand will start flowing through the world's longest sub-sea gas pipeline in October 2007. Covering 1200 kilometres this is being built between Norway's Ormen Lange gas field and Easington on the east coast of England. Indeed, Norway is boosting gas production to make up for lower oil production. In addition to Ormen Lange it is developing the Snøhvit field in the Barents Sea. Snøhvit will export 200 bcf/5.67 bcm annually as LNG, mainly to the United States but also to Europe, principally to France and Spain, when it goes onstream in October 2006.

Norway will start LNG exports in October 2006 with gas from the Snøhvit, Albatross and Askeladd fields in the Barents Sea being piped to a receiving and processing plant (pictured under construction) on Melkøya Island outside Hammerfest, before being shipped by LNG tanker.

Iran's importance as a gas producer is growing.

Eastern Europe and Central Asia

Sitting astride this part of the world is Russia, the world's largest natural gas producer, exporter and holder of reserves (1694 tcf/48 tcm). Its pipeline exports to Turkey, eastern, central and western Europe reached 148 bcm in 2004, accounting for 29% of global pipeline trade. Work was due to start at presstime on building an additional northern European pipeline leaving the country at Vyborg with deliveries starting in 2010. Russia is also exploring options to export natural gas via pipeline to China and South Korea, and will start LNG exports from Sakhalin to Japan in 2008.

Turkmenistan has the region's second largest reserves (102 tcf/2.9 tcm) and is evaluating a pipeline to Afghanistan and Pakistan. Meanwhile, the Caspian Sea – bordered by Azerbaijan and Kazakhstan as well as Russia and Turkmenistan – is the focus of external interest from China, India, Japan and the US for its promising oil and gas reserves.

Qatar is gearing up to become the world's top seller of LNG – tankers load at Ras Laffan port.

The Middle East

Despite having the world's second largest reserves of natural gas (970.8 tcf/27.5 tcm), Iran imports gas from Turkmenistan because its major population centres are in the north, far from its reserves in the Gulf. Now Iran's importance as a gas producer is growing and it is set to become a net exporter. Pipeline exports to Turkey started in 2002 and alternative routes for an extension of the pipeline into Europe are being studied. A pipeline to Armenia is under construction with exports due to start in 2007, but a proposed pipeline to Pakistan and India remains on the drawing board. Instead, Iran will start LNG exports to India in 2009. LNG exports to China are also planned.

Qatar has the third largest gas reserves (910.1 tcf/25.78 tcm) and is gearing up to surpass Indonesia, Malaysia and Algeria to become the world's top seller of LNG. Not only does Qatar own the majority share of each LNG joint venture, but it will also own delivery ships and stakes in import terminals in Europe and the United States. Qatar is also making substantial investments in gas-to-liquids (GTL) projects (see *International Gas* April 2005 issue).

Saudi Arabia is in the number four reserves position but, rather than joining the race to export LNG, the Saudi government is developing the domestic gas market to fuel the growing petrochemical industry and free oil resources for export.

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South Korea is currently the number two LNG importer. The Incheon receiving terminal is pictured.

Asia

For decades the Asian region was self-sufficient in gas supplies. Indonesia pioneered and dominated the regional market for 25 years through its state-owned energy company, Pertamina, and is currently the world's top exporter of LNG. Malaysia holds the number two position, while Australia and Brunei are also major LNG exporters. Australia will boost capacity when the Gorgon project starts operations in 2010. But with demand surging suppliers from outside the region are entering the market.

The interest in Asia by suppliers has been driven by the booming economies of China and India, which need to supplement their domestic energy resources. India started LNG imports in 2004, while China's first import terminal is due to start operations in 2006 with a second following in 2007 and more are planned. Both countries are investing in overseas gas projects as well as looking at ways to boost domestic production. China's 4000-kilometre east-west pipeline linking the gas fields of the Tarim and Ordos Basins with east coast markets entered full service in December 2004, while the latest find in India's Krishna-Godavari Basin could almost double the country's natural gas output.

The traditional gas consuming countries of Japan, Korea and Taiwan have realised that in this tightening gas market they no longer have the upper hand in sales negotiations and need to aggressively pursue international supplies. Japan is the world's largest LNG importer, while South Korea is the number two importer, but they may be overtaken by the US by 2015. Moreover, with increased competition for supplies some predictions have LNG prices rising 75% over the next five years.

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Malaysia's gas production has doubled over the last 10 years and it is currently Asia's number two producer after Indonesia. The E11 production platform offshore Sarawak is pictured.

While natural gas trade in Asia historically has centred on LNG, pipelines may provide an alternative in the future. As a share of overall primary energy, Asian countries consume far less gas than Europe or North America, in part due to the lack of an integrated international gas grid. Pipeline imports are limited to Singapore, which receives gas from Malaysia and Indonesia via three pipelines, and Thailand, which receives gas from Myanmar.

Malaysia and Thailand are building a pipeline linked to a gas-fired electricity generation plant in Thailand, and the Thai government plans to expand the natural gas distribution network to reach more power plants and industrial consumers. India and Myanmar have a project on the table to lay a pipeline for transporting natural gas from offshore Myanmar to India via Bangladesh, but this has stalled due to the transit conditions set by Bangladesh. A link from Russia to the Chinese pipeline system has also been proposed.

Nigeria LNG, whose shareholders are the Nigerian National Petroleum Corporation, Eni, Shell and Total, is expanding its Bonny plant with a sixth train.

Africa

Africa is a net exporter of natural gas, primarily from Algeria, Egypt, Nigeria and Libya, and in 2004 exports accounted for 52% of the continent's production of 145 bcm. Exports were split roughly 50/50 between the pipeline and LNG modes and the latter accounted for about 22% of LNG traded

in the world. Many countries in Africa flare associated gas and have significant untapped resources, and liquefaction is the key to globalising stranded natural gas resources, especially in sub-Saharan Africa.

Nigeria aims to eliminate the flaring of associated gas by 2008 and has a range of gas projects in hand. The Escravos GTL plant is being developed and the West Africa Gas Pipeline will export gas to Ghana, Togo and Benin, while LNG capacity is being expanded. Nigeria LNG is expanding its Bonny plant and front-end work recently began on the Brass LNG project, which is due to start operations in 2009. Two other new LNG plants – West Niger Delta and a floating LNG plant – have been proposed.

Other African countries, notably Angola, Algeria, Egypt and Equatorial Guinea are expanding natural gas production and building LNG capacity.

While Angola is a major international oil producer, it lacks the infrastructure to harness its natural gas resources and the majority of gas produced is flared with some reinjected for oil production and minor LPG production. The state-owned oil company, Sonangol, has partnered with Chevron to develop an LNG facility near Soyo in the north of the country. This is due to start operations in 2007 and BP, ExxonMobil and Total are joint investors in the project, contributing gas from their deepwater facilities. New discoveries could boost Angola's gas reserves, possibly to as high as 25 tcf/0.7 tcm and make it a major contributor to the Atlantic Basin trade.

Also due to start operations in 2007 is an LNG plant at Punta Europa, Equatorial Guinea. A consortium including the state-owned Compania Nacional de Petróleos de Guinea Ecuatorial (GEPetrol), Marathon Oil, Marubeni and Mitsui is building the plant.

Algeria is Africa's largest gas producer (but number two in the reserves stakes behind Nigeria) and was the very first commercial LNG exporter with the start-up of the Arzew GL4Z plant in 1964. It also exports by pipeline. The bulk of Algeria's gas exports go to Europe with some to the US and Tunisia and a small amount to Korea. At the end of 2004 Algeria had 160.4 tcf (4.55 tcm) of proven natural gas reserves, but the country's recoverable gas potential may be as high as 282 tcf (7.9 tcm).

Egypt will soon emerge as a major African exporter fuelling Europe's expanding demand for natural gas. The Spanish firm Unión Fenosa has built a two-train liquefaction facility at Damietta and shipped its first cargo at the beginning of this year. Unión Fenosa will take 60% of the LNG output itself for use at the company's power plants and distribution to other users in Spain and elsewhere in Europe.

The second LNG export project (Egyptian LNG), at Idku, began production ahead of schedule in May 2005, with a second liquefaction train expected to be operational later this year. Gaz de France (GdF) was to have been the main off-taker

Algeria is Africa's largest gas producer and it exports by pipeline (a compressor station is shown) as well as LNG.

Currently a major oil producer (the Girassol FPSO is pictured), Angola will start exploiting its gas resources in 2007.

for Idku, but the LNG project's first train came onstream before the Fos-Cavaou terminal on France's Mediterranean coast was ready to receive the gas. BG Group agreed to buy 36 cargoes of LNG over the next 18 months from GdF. BG plans to ship the cargoes to the US LNG terminals at Lake Charles, Louisiana and Elba Island, Georgia, although it retains the flexibility to deliver to other terminals.

Egypt also exports natural gas via pipeline to the Middle East. The first phase of the Middle East Gas Pipeline Project was completed in January 2004, linking Aqaba in Jordan to Egypt's gas distribution network. The second phase will extend approximately 360 kilometres from Aqaba to a power plant in northern Jordan, and the pipeline could be extended to Syria and Lebanon by 2006.

Libya's reincorporation into the international community in 2003 has created the potential for it to become another large African exporter of natural gas and there is keen international interest. It has been exporting LNG to Spain since 1970 from its Marse el-Brega facility, but lack of technical capacity and capital has limited its exports. These amounted to 460,000 tonnes in 2004 and were taken by Engas, the Spanish utility.

A second export chain started in October 2004 with the opening of the Greenstream pipeline to Italy as part of the Western Libyan Gas Project – a 50/50 joint venture between Eni and Libya's National Oil Corporation.

Libya's proven natural gas reserves at the end of 2004 were 52.6 tcf (1.49 tcm), but the country's gas resources are largely unexploited (and unexplored), and thought by Libyan experts to be considerably larger, possibly 70-100 tcf (2-2.8 tcm).

Finally, South Africa and Tanzania have taken major steps to diversifying their energy sources. In June 2004 Sasol started gas imports via pipeline from Mozambique to substitute for some of the coal feedstock used at two plants to make chemicals and diesel for industrial customers. The following month Tanzania opened a pipeline supplying domestically-produced gas to an electricity plant and industrial users in Dar-es-Salaam.

Conclusion

The world's primary energy consumption increased 4% by 424 mtoe in 2004 and China accounted for nearly half of this. Indeed, its energy demand has increased 65% in the past three years, while India's has increased 20%. But the competition for energy resources is far from limited to China and India.

In the scramble for energy resources we are seeing a new vertical integration as governments and companies seek to invest in all aspects of energy development. The continued development of an international natural gas market will be a key element in the race for resources.

As illustrated by events to date, the development of this global gas market will be uneven and difficult as the age-old problems of political corruption and instability, inadequate tax and legal regimes and the slow pace of energy sector reforms plague projects.

One thing is clear – the era of discrete gas markets is ending as suppliers and customers in Africa, Asia, Europe and the Americas become steadily inter-connected.

Terence H. Thorn was the Chairman of IGU Working Committee 9 in the 2000-2003 Triennium and is President of JKM Consulting in Houston, Texas. He may be contacted at tthorn@txthorns.net.

Commercialising Methane Hydrates

By Iain Esau

The international push to try to find a way of commercialising the world's abundant methane hydrate resources is gathering pace as high crude oil and gas prices bring added pressure on researchers to make some major technological breakthroughs.

Japan, Canada, the USA and India are the driving forces behind efforts to bring to market the huge amounts of energy stored in hydrates – essentially one methane molecule surrounded by a cage of six water molecules in the form of ice – as well as the "free gas" usually found below the hydrate layer. If just a small fraction of the natural gas associated with hydrates could be exploited the economic benefits would be enormous.

Most of the world's hydrate resources lie under the oceans with the remainder locked in continental high latitude, permafrost areas in North America, Europe and Asia as well as Antarctica. They are generally found in waters deeper than 300 metres, where bottom water temperatures approach 0° Celsius, and up to 1100 metres below the seabed. In onshore polar regions gas hydrates can be found between about 150 and 2000 metres sub-surface.

Gas hydrates may take the form of thick layers, thin veins or nodules, or they may fill reservoir pores.

Resource estimates vary wildly due to the lack of drilling work on hydrates, but the US Department of Energy (DOE), a traditionally reliable and conservative source of data, reckons that reserves of oceanic hydrates could amount to an immense 49 million tcf (1.37 million tcm) while the consensus is that continental resources amount to about one quarter of this figure, some 12 million tcf (336 million bcm).

This is far larger than reserves of conventional gas which stand at a comparatively paltry 13,000 tcf (364 tcm), less than half of which is deemed commercial, although higher gas prices and improving technology are improving this percentage.

Combining the offshore and onshore hydrates gives a reserves figure which is double the reserves of all known fossil fuels – oil, gas, coal, oil shale – put together.

The key hydrate research and development programmes to date have been carried out in Canada, Japan and the USA, although there is every expectation that India and China, whose fast-growing economies are in desperate need of more domestic energy, will spring some surprises.

Canadian studies

In 1998 a research programme on Richard's Island in Canada's North West Territories, led by the Geological Survey of Canada (GSC) and the Japan National Oil Corporation (JNOC), proved that the Mallik gas hydrate field, originally discovered by Imperial Oil in the early 1970s, was one of the most concentrated gas hydrate occurrences in the world.

The partners subsequently decided that the next step would be to carry out further hydrate R&D onshore before transferring this knowledge to the more challenging offshore environment. So in 2002 a five-nation research team began work at Mallik to see whether the theories of how to exploit methane hydrates would prove to be viable in practice. Again led by the Canadians and Japanese, the team included scientists from Germany, India and the USA as well as three commercial oil and gas companies. The results were a major success with methane extracted from hydrates from over 1000 metres beneath the ground.

Full-scale field experiments tested the response of the Mallik reservoir to both geothermal stimulation (or heating) and depressurisation and in each case hydrates broke up or disassociated and

released methane. In essence, the groundbreaking test demonstrated the technical feasibility of methane production from hydrates.

Canada's GSC is now leading a new hydrate R&D effort with a special emphasis on assessing whether gas hydrate exploitation could form the basis for sustainable economies in the country's northern and coastal communities.

Some Canadian specialists believe production of gas hydrates will become a reality in the next 15 to 20 years, possibly sooner, with most expecting that first production will be from an Arctic region of Alaska, Canada or Russia where concentrated gas hydrate deposits lie above deeper conventional oil and gas fields. However, offshore production, perhaps from Japan or India, could possibly accelerate at faster levels.

As the Mallik programme proved, heating or depressurisation of hydrate reservoirs is likely to allow gas flow to the surface and the expectation is that the highest production rates will probably be achieved by using the two techniques in parallel. Another possibility would be to inject methanol or ethylene glycol into the hydrate-rich pay zone to allow it to dissociate and release its valuable methane.

In some cases if a well is drilled to exploit the free gas underlying a hydrate zone, it could have the added benefit of reducing the pressure within the overlying gas hydrate layer, which would then cause dissociation.

Free gas associated with methane hydrate accumulations is likely to contain between one-eighth and one-half of the methane contained in the hydrate.

Japan's offshore work

In the offshore environment, Japan is at the forefront of efforts when it comes to commercialising hydrates.

Based on information gleaned from six wells drilled off Japan during 1999 and 2000, the Ministry of Economy, Trade and Industry (METI) unveiled plans in 2001 to shoot seismic in the Nankai Trough and then analyse the resulting data for the tell-tale signs of the presence of hydrates, a bottom simulating reflector (BSR).

Using this seismic data, and building on the Mallik work, more than 30 wells were drilled in Japanese waters in 2004 by Japex and Teikoku Oil. The Nankai Trough lies south of Japan and its gas hydrate stability regimes and sediment types are said to be identical to those at Mallik.

The drilling campaign was part of the government's ongoing Methane Hydrate Exploitation

"Burning ice" was one of the features of the Japan Gas Association's Gas Pavilion at EXPO 2005. The artificial methane hydrate combustion demonstration was part of an exhibit introducing the general public to the potential of methane hydrates. EXPO 2005 was held in Aichi Prefecture (Nagoya), Japan, between March 25 and September 25. The Gas Pavilion was operated on behalf of the JGA by Toho Gas Co., the local gas company in the Nagoya area.

Programme, or MH21, whose key aim is to test and develop new technologies for offshore hydrate drilling and production. In 2006 the MH21 consortium will home in on those offshore hydrate structures which it believes should be the focus of production tests. These would be carried out sometime between 2007 and 2011.

The Japanese government currently estimates that its deep water sediments harbour some 261 tcf (7.4 tcm) of gas, sufficient to power the economy for a century or so, and its ultimate aim is to begin commercial production of methane hydrates by 2016.

Leading MH21's research efforts are the National Institute of Advanced Industrial Science and Technology (AIST), the Engineering Advancement Association of Japan and JNOC.

Alaskan projects

The Japanese have also been heavily involved in an onshore hydrate research programme in Alaska led by US oil company Anadarko Petroleum, together with oilfield service companies Maurer Technology and Noble Corporation and with support from the US Department of Energy. The aim of the project was similar to Mallik although it met with mixed results.

On Alaska's North Slope hydrate resources have been estimated at almost 600 tcf (16.8 tcm). Oil companies active in Alaska, including Anadarko and BP, are currently considering building a pipeline to take 125 tcf (3.5 tcm) of conventional gas to the main US markets so exploitable methane from hydrate could be fed into this line.

The Alaska project aimed to help identify, quantify and predict production potential for hydrates located on the North Slope and spudded the first well, called Hot Ice-1, in early 2003. However, operations had to be suspended three months later due to an earlier-than-expected Arctic thaw.

Activity revived in early 2004 with the well drilled from Anadarko's innovative, patented "Arctic Platform" which was designed to reduce the environmental effects of such an operation. The platform, sited south of the Kuparuk field, is a lightweight aluminium structure elevated above the tundra on steel legs and similar in design to offshore drilling rigs. Unfortunately no gas hydrates were encountered in this well and although the project provided a wealth of information, it wound down in early 2005.

However, BP is leading another Alaskan study to determine the size and shape of the hydrates reservoir in Prudhoe Bay, and is also carrying out work at Milne Point in the state. In early 2005 it completed the first phase of a three-stage hydrate programme, which delineated and characterised more than 12 discrete gas hydrate accumulations within the Milne Point area. By the end of the third quarter of 2005, BP may have drilled one or more wells through the hydrate zone and begun a long-term production testing.

Observers believe US efforts to commercialise methane hydrates are probably at the same stage

BP is carrying out a hydrate programme at Milne Point in Alaska.

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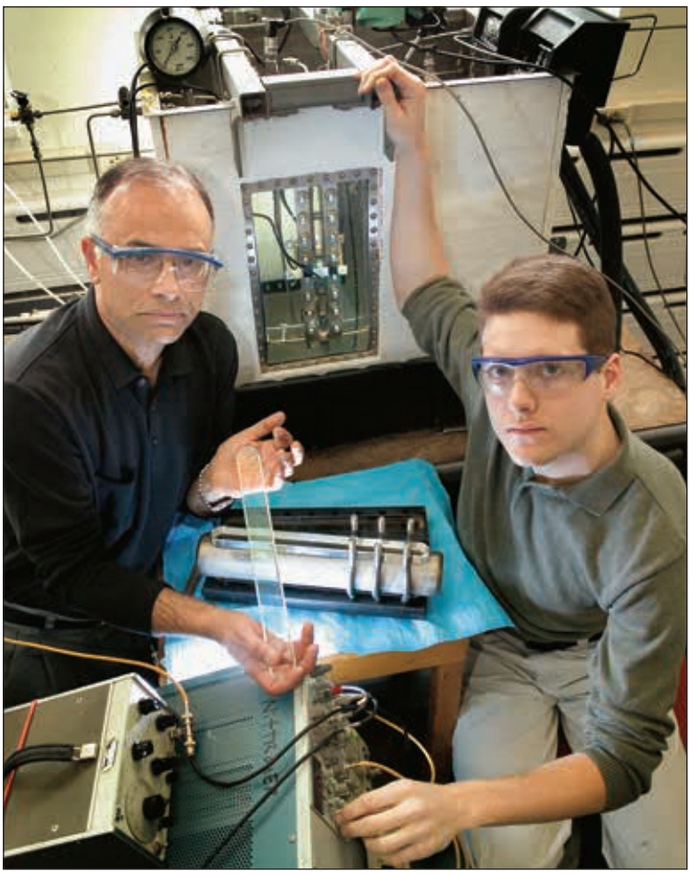


Scientists including Devinder Mahajan (left in the picture) at the US DOE's Brookhaven National Laboratory have recreated the high-pressure, low-temperature conditions of the seafloor in a bench-top apparatus for the study of the kinetics of methane hydrate formation and decomposition. Unlike other high-pressure research vessels, the Brookhaven apparatus allows scientists to interchange vessels of different volumes, study even fine sediments, and visualise and record the entire hydrate-forming event through a 30-centimetre window along the vessel. In addition, mass-balance instrumentation allows the Brookhaven group to collect reproducible data in the bench-top unit. Even better, Mahajan says, they can study the kinetics in actual samples of sediment that once contained hydrates – as close to the natural conditions as it is possible to get in a laboratory.

that coal-bed methane (CBM) research was at a decade ago. CBM is now being widely produced.

Onshore hydrate production would probably take place in parallel with oil and gas production from a conventional hydrocarbon field because these types of deposits are usually found near one another in the Arctic.

This point is proven by operations in Russia where the conventional Messoyakha gas field is also believed to have been producing methane from a hydrate layer since the 1960s, a finding that four decades ago first triggered research into this quixotic but staggeringly abundant resource.

Prospects around the world

In Russia the key hydrate plays are now thought to be western Siberia, Lena-Tunguska province and the Timan-Pechora basin, as well as several sedimentary basins in north-east Siberia and the Kamchatka peninsula.

Back in the 1960s Russian scientists believed that, given the right pressure and temperature, hydrates could also exist in ocean sediments as well as Arctic areas and this premise was confirmed when they were discovered in the Blake Ridge off the USA's Atlantic seaboard. Further finds then followed in the Black Sea, off Guatemala, Costa Rica, Mexico and in the Gulf of Mexico. Gas hydrates are also thought to exist in the Sea of Okhotsk off eastern Russia and the Mediterranean Sea.

India has made significant hydrate discoveries with New Delhi's National Institute of Oceanography reported to have mapped 218,000 tcf (6150 tcm) of oceanic gas hydrates. The Director General of Hydrocarbons is aiming for pilot production of gas hydrates in 2006 or 2007 and commercial production as early as 2008/2009. India believes its best prospects are in the Arabian Sea, the Krishna-Godavari and Cauveri basins off the east coast and the Andaman Sea.

South Korea plans to spend $225 million over the next decade to explore gas hydrate deposits off its east coast, while Indonesia's government has found significant reserves off southern Sumatra and Java and in the Sulawesi Sea.

China is ploughing money into hydrate resources in certain areas of the South China Sea and the East China Sea.

Further potential may lie off the Philippines, Sri Lanka, Malaysia, Vietnam and Pakistan, with lesser amounts thought to lie off North Korea, Taiwan, Bangladesh, Thailand and Brunei.

The substance has also been found in inland seas such as the Caspian Sea and Lake Baikal where pressures and temperatures are ideal.

More recent activity has discovered hydrates off Chile, Norway, the Niger Delta off Nigeria and Canada's Pacific coast at depths of some 850 metres.

But care is needed

Methane hydrates may seem to be an energy panacea to a world reliant on fossil fuels, but most involved in their study believe it would be wise not to forget the role this abundant resource appears to have played in climate change.

Recent studies indicate that methane hydrate reservoirs are constantly changing in response to natural changes in the environment. In particular, sea level changes can cause pressure fluctuations in methane hydrate layers resulting in the release into the atmosphere of methane – a highly potent greenhouse gas. Earthquakes and submarine landslides can also cause methane releases.

In addition, extracting gas from hydrate formations would have an impact on the formation itself and its surrounding area, and, in offshore areas, it could produce seabed instability.

One way to partly alleviate the effect of methane released during hydrate production could be to inject carbon dioxide into the hydrate zone to stimulate output.

The Alaska North Slope appears to be suited for a trial of this novel production technique because significant gas hydrate deposits have been identified in the area which also holds potential CO_2 sources.

Iain Esau is the London correspondent of Upstream *newspaper.*

Natural Gas in China

By Zhang Han and others

This article is based on a paper by Zhang Han and completed with editorial data and remarks including a box on IGU and China (*see pages 126-127*).

China: a country known for its ancient civilisation, Confucianism, the Great Wall, kung fu, the world's largest population and a rich range of languages and cuisines. During the last century people have also added foreign invasions, a transition economy and colossal economic growth to this picture. Indeed, China's economy is currently the world's fastest growing.

With its 9.6 million square kilometres of land and water China covers about 7% of the globe, being the world's third largest country. It possesses substantial natural resources including coal, iron ore, petroleum and natural gas.

China's rapid economic growth has propelled it into the global number two position after the US in terms of energy consumption and production. China currently accounts for 14% of the world's primary energy demand and this share will rise. Coal provides two-thirds of the country's primary energy but natural gas will play a bigger role in the future, highlighted by the new west-east pipeline and the start of LNG imports.

Although the economic growth brings prosperity, it also forces the country to face several challenges, such as a shortage of raw materials, environmental pollution and lack of skilled personnel. The biggest challenge, however, is energy and China's energy policy is geared towards balancing continued growth with security of supply and environmental sustainability.

Vital role of coal

China has the world's third largest reserves of coal and more modest oil and gas reserves (*see Table 1*), which explains coal's dominating share of the country's primary energy consumption (*see Table 2*). China is also a major coal exporter, which has helped to offset to some extent the fact that it has been a net oil importer since 1993. But although coal has fuelled the country's development, it has been at the price of severe environmental problems, particularly in terms of air pollution.

One aim of China's energy policy is diversification to increase the share of natural gas, hydro and nuclear, as well as developing renewable sources such as solar, geothermal, wind and wave power. International cooperation is being increased and Chinese petroleum companies are developing supply sources outside the country. Energy-saving technologies are also being encouraged. However, coal will continue to play a central role, especially since coal exports have doubled and the climbing prices generate large profits. These measures are thus combined with a drive to use it in a cleaner way. Coal washing is being increased (from 30% to 50% under the 2001-2005 Five-Year Plan), environmental protection strengthened and coal liquefaction technology developed.

LEFT
Table 1.

CHINA'S PROVED RESERVES AND PRODUCTION

	Proved reserves at end 2004	*Share of world total*	*Production in 2004*
Coal	114.5 billion tonnes	12.6%	989.8 million tonnes oil equivalent
Oil	17.1 billion barrels	1.4%	3.49 million b/d
Gas	2.23 trillion cubic metres	1.2%	40.8 bcm

Source: BP Statistical Review of World Energy 2005

But natural gas will grow in importance

While the use of natural gas in China stretches back 2000 years, when it was transported in bamboo pipes, its current share of the country's primary energy consumption is low by international standards. The world and Asian averages for the share of natural gas are 24% and 10.3% respectively, well above the Chinese level of 2.6%. Until recently gas was principally used as a feedstock for fertiliser plants and to operate oil and gas fields, with approximately one-third used domestically and for electricity and district heat generation. However, the domestic and power generation usage of natural gas is growing at a fast pace. Chinese energy policy aims to boost the share of gas by developing downstream markets, in particular by building new gas-fired plants to generate electricity, expanding transmission and distribution networks, increasing domestic production and starting LNG imports. In the medium-to-longer term gas could also be imported by pipeline from Russia.

China's main gas deposits are divided between offshore fields beneath the East and South China Seas and onshore fields in the centre and north-west of the country. Coal-bed methane resources are also being developed. Domestic production has more than doubled in the last decade from 16.6 bcm in 1994 to 40.8 bcm in 2004, while proven reserves increased from 1.67 tcm to 2.23 tcm over the same period. There are significant potentials in all of the country's major gas fields and investments are focused on the infrastructure to bring this gas to market.

A key project has been the development by PetroChina of a 4000-kilometre pipeline connecting the gas fields of the Tarim Basin in north-west China and those of the Ordos Basin in central China with Shanghai on the east coast. The Shanghai-Ordos section was completed in October 2003 and the Ordos-Tarim section in August 2004, with full commercial operations starting that December. The pipeline has a diameter of 40 inches (1016 mm), a flow rate of 12 bcm a year and supplies markets in east-central China and the Yangtze River Delta.

Just over half of China's oil reserves are offshore – an FPSO facility operated by Kerr-McGee sails from dry dock at Dalian to Bohai Bay.

PetroChina has also expanded capacity between the Ordos Basin and Beijing by building a second pipeline to serve the five provincial and municipal markets of Shaanxi, Shandong, Hebei, Tianjin and Beijing. It was completed in July and has a flow rate of 12 bcm a year.

Retail distribution was opened to foreign investors during 2003 without geographical, quantitative or ownership restrictions, and most new city gas networks are being developed by

CHINA'S PRIMARY ENERGY CONSUMPTION 2004

Million tonnes of oil equivalent (mtoe)

Coal	963.5	68.3%
Oil	323.9	23%
Hydro	74.2	5.3%
Gas	37.1	2.6%
Nuclear	11.3	0.8%
Total	1410	100%

Source: BP Statistical Review of World Energy 2005.
Note: Commercially traded fuels only, including Hong Kong.

LEFT
Table 2.

PetroChina is the main subsidiary of China National Petroleum Corporation (CNPC), which is the country's largest oil and gas producer accounting for approximately 70% of natural gas production and 60% of oil.

private sector companies with the local government as a minority partner. Natural gas is also distributed in the form of CNG and LNG. Indeed, Beijing has one of the largest fleets of CNG-fuelled buses in the world.

According to a study by the International Energy Agency (IEA), China's gas demand could reach 220 bcm by 2020 with electricity generation and city gas distribution each accounting for 28.5%, chemical feedstock 19% and other industrial uses 24%. Domestic production is forecast at 150 bcm leaving 70 bcm to be imported.

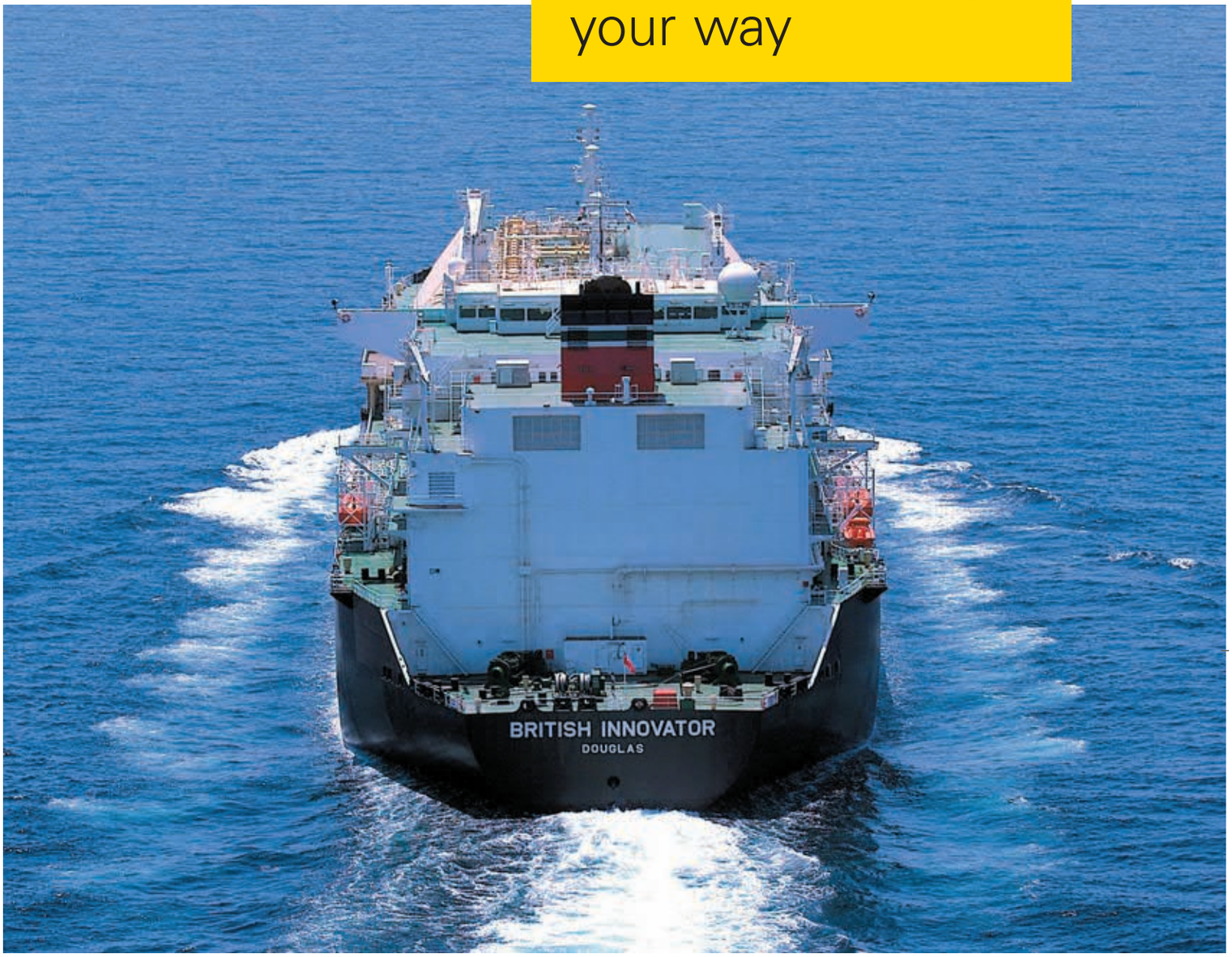
LNG imports start

China's first two LNG reception terminals are under construction in the Guangdong and Fujian provinces, two more have been approved and there are proposals in various stages of development for many more. So far China National Offshore Oil Corporation (CNOOC) has made the running, with investments not just in the import terminals but also in the supplying projects. However, PetroChina and Sinopec are working on proposals as well.

Both companies are interested in building plants in Rudong in the Jiangsu Province. Additionally, PetroChina is evaluating projects in Dalian in Liaoning Province and south-west China's Guangxi Zhuang Autonomous Region, and Sinopec aims to build a terminal at Qingdao in Shandong Province, which would be supplied by Iran.

LNG imports are due to start in mid-2006 through the Guangdong terminal. This will have an initial capacity of 3.2 million tonnes/annum (mta) and is being built in Ping Tou Jiao, on the Dapeng Peninsula in Dapeng Bay. CNOOC has teamed up with a consortium of Guangdong Province companies, BP, Hong Kong Electric & Light and Hong Kong & China Gas to develop the terminal. It will be supplied under a 25-year deal by Australia's North West Shelf Venture in which CNOOC has a 5.3% stake.

More flexible gas supply is heading your way



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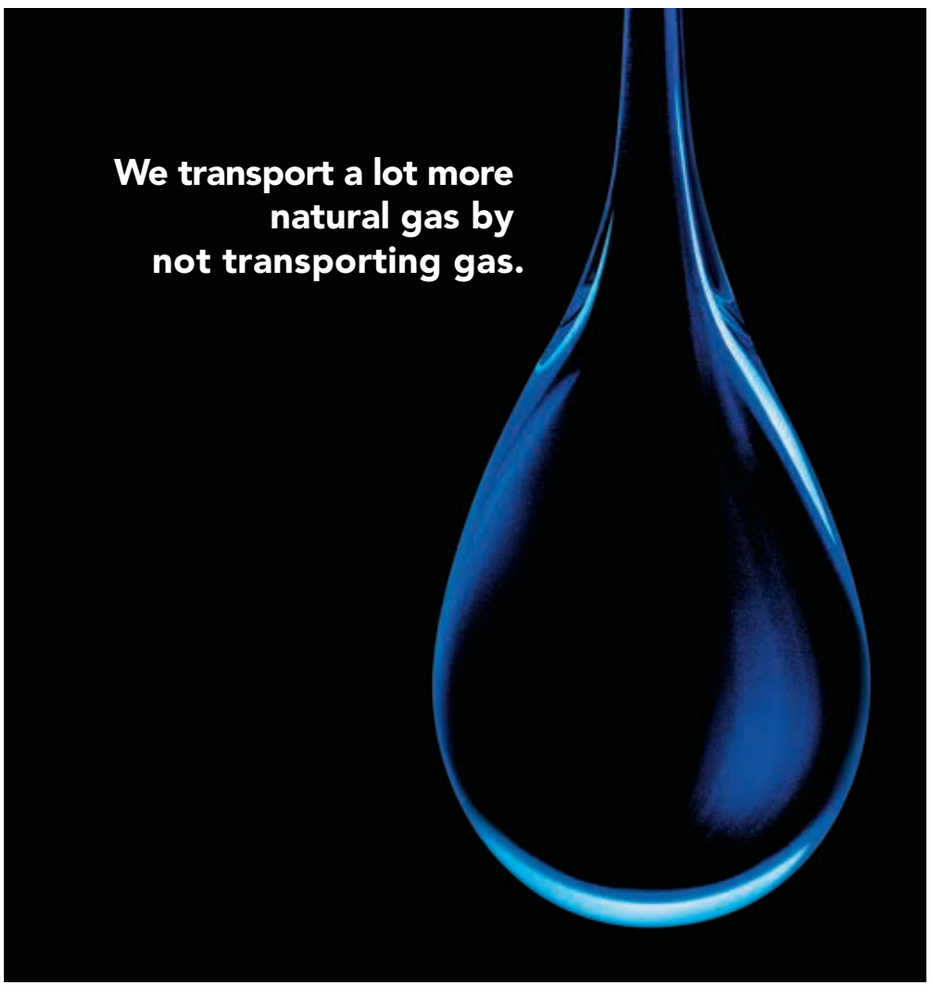
So far CNOOC has made the running in LNG import projects. ABOVE The then CNOOC President, Wei Liucheng (who is now Governor of Hainan Province), celebrates the signing of an equity agreement with Australia's North West Shelf Venture. The latter already supplies LNG to Korea and Japan (BELOW) and deliveries to China are due to start in 2006.

Guangdong's first phase covers the LNG import terminal, storage tanks, regasification plant and a pipeline network. A trunkline will supply Pingshan, Dongguan, Guangzhou and Foshan, while branches will supply Hong Kong and six power stations. The second phase will add 2 mta of capacity and extend the transmission pipeline to serve other cities in the Pearl River Delta including Zhuhai, Zhongshan, Jiangmen and Heshan. This is due for 2008 completion.

The Fujian LNG terminal is being built at Putian in Meizhou Bay as a joint-venture between CNOOC and Fujian Investment and Development Corporation. It will have an initial capacity of 2.6 mta with Phase II expansion under planning. Operations were scheduled to start in late 2007 using supplies from Indonesia's Tangguh project in which CNOOC has a 16.96% stake. However, Tangguh's start-up has slipped to 2008 so unless Fujian's start-up is delayed too, it will have to be supplied by interim supplies of spot LNG cargoes.

Fujian is intended to supply two major new power plants, Songyu II in Xiamen and Nanpu in Quanzhou, together with the five coastal cities of Fuzhou, Xiamen, Quanzhou, Zhangzhou and Putian.

In a world that needs more energy and lower emissions, natural gas has a vital part to play. It's abundant and clean-burning, can be produced and transported safely, and is increasingly important in generating electricity. Right now, most of the world's natural gas travels relatively short distances to reach the consumer.



But most large gas fields are far from the countries that need the gas. As world gas demand grows, the challenge is to deliver it economically, across increasingly vast distances. The answer is a piece of basic science. And a significant technological breakthrough. First, the science. If you cool any gas, it shrinks. If you cool natural gas to -260 degrees F, it turns into a liquid – and shrinks to one six-hundredth of its volume. So it can be shipped. It's called Liquefied Natural Gas. The industry has been developing it for years. But engineers at ExxonMobil have now transformed the scale on which LNG can be produced, shipped, and turned back into gas. Through partnerships such as our important joint venture with Qatar Petroleum, we can use this scale to bring new economies. This is good news for U.S. gas consumers. But the significance goes well beyond America. Natural gas is one of the world's cleanest fuels. It's also one of the fastest growing. In fact, experts predict that, by 2020, it will meet 25% of the world's total energy demand. And, as one of the world's largest suppliers of it, we're doing all we can to get it where it needs to be. *exxonmobil.com/energychallenges*

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The Energy Delta Institute is a joint initiative of Gasunie, the University of Groningen and Gazprom.

The two approved projects are in Shanghai and Zhejiang. For the latter CNOOC has teamed up with Zhejiang Provincial Energy Group and Ningbo Power Development to develop a terminal with an initial capacity of 3 mta, most of which will feed a new power plant in Ningbao. A second phase would double capacity. Australia's Gorgon project was the front-runner to win the supply contract but its start-up has been delayed to 2010, while the Zhejiang terminal is planned for a late-2008 start-up. CNOOC is now considering Malaysia and Qatar as alternative suppliers.

In Shanghai, CNOOC is working with Shenergy Group to develop an LNG terminal with an initial capacity of 3 mta to open in 2008 rising to 6 mta in the second phase. CNOOC also has proposals for similarly-sized terminals in Hebei, Jiangsu, Shantou (Guangdong) and Tianjin.

China's LNG imports are likely to be around 18 million tonnes in 2010 and would need to reach 63 million tonnes (equivalent to 70 bcm) by 2020 under the IEA forecast demand scenario unless pipeline imports start.

ORGANISATION AND AUTHOR

Ms Zhang Han was employed at the Beijing Coal Corporation in different commercial fields. During her Bachelor study she worked as chief editor of Beijing Technology and Business University Weekly and took a management assistant post in the Western Shanghai Group automobile business outside campus. In 2004 Ms Zhang Han obtained the degree of Master of Science at the University of Groningen (The Netherlands) and carried out a research project on innovation studies for Avebe Group (The Netherlands). Currently she is employed as market developer for the Energy Delta Institute (EDI) where she worked on a document about the energy situation in China on which this article is based. The complete document "About China – A Brief Introduction for Energy Experts" can be downloaded from EDI's website: www.energydelta.org.

The Energy Delta Institute is a joint initiative of N.V. Nederlandse Gasunie, the University of Groningen and OAO Gazprom. EDI is an international business school and research centre for natural gas. With its extensive network EDI wants to support organisations around the world to obtain knowledge and skills necessary to develop an economically viable gas market and a sustainable gas industry. Therefore EDI provides training and performs research, particularly focused on economical, managerial and geopolitical issues that are relevant for all people working in the gas industry of today and the future. EDI offers the ideal opportunity to discuss and share experiences with its partners, amongst others Shell, Gasunie, Gazprom, Accenture, LogicaCMG, Clingendael, the University of Groningen, the Gubkin State University for Oil & Gas, the Moscow State Institute for International Relations (MGIMO), Oxford, Yale and Stanford. EDI is unique, because of its combination of the business experience of its gas partners and the theoretical knowledge of its academic partners. For more information contact: info@energydelta.nl.

IGU AND CHINA

The challenges China faces in her search for energy are recognised by IGU, as is reflected by the activities described below.

● WGC2003 and the 2006 follow-up "Bridging to the Future"

A Chinese team led by Dr Li Jingsheng of Tong Ji University presented their proposal for a city design 100 years in the future as part of the Sustainable Urban System Design (SUSD) competition at the 22nd World Gas Conference in 2003 in Tokyo. The main conclusions from the Chinese delegates were: a large improvement in energy resource use (four to eight times) is needed; cities should have a cellular structure; and energy and urban design should be integrated.

A team from China will also be involved in the next phase of the project called "Bridging to the Future". This team has already attended a workshop in The Netherlands about the Dutch situation in order to share visions and methodology with the other international teams, and will present its contribution at WGC2006. The Chinese team is examining Qingpu, one of 20 districts that make up the province of Shanghai. It is a suburban growth centre containing eight towns and covering a total area of 670 square kilometres, 17% of which is water.

● WPC 1st Youth Forum

In October 2004 IGU President George Verberg spoke in Beijing at the WPC 1st Youth Forum for an audience of young professionals in the petroleum industry.

With the theme "Youth and Innovation – the Future of the Petroleum Industry", the Forum proved successful on a number of fronts. It showed the younger generation that the petroleum industry is an important part of the wider energy industry, and it encouraged them to join the industry. It also encouraged them to support the WPC in conducting its sustainable development strategy and achieving its aim "to promote the management of the world's petroleum resources for the benefit of mankind".

Mr Verberg emphasised the importance and challenge of being a global player in the world of gas. There is a lot of potential for the gas market to expand. Supply sources will be diverse. One-third of all the people in the world (some two billion) do not have access to any kind of energy. To manage the increasing demand for energy, and gas in particular, close cooperation between regions and diverse expertise is a must. It is very challenging for a youngster to be a part of accomplishing this huge project in many, diverse areas such as: the legal, political, environmental, technical and, last but not least, financial fields.

● PGC C

IGU's Programme Committee C covers the development of gas markets and its Asia case study has a special focus on China. The study will break down the Chinese market into different areas in order to look at the outlook for gas demand and the key drivers for the further market development. On the supply side it will look at issues such as the reliability and security of supply, the interplay between local resources and imports, and pipeline and LNG infrastructure. It will also analyse gas sector regulation. Finally, the study will make recommendations for further development in this region.

PGC C reported on work to date during its April meeting in Noordwijkerhout, The Netherlands. The key elements for the China case study are the following. The East Asia region is traditionally a strong import area, where China with her huge population and strong economic growth is the biggest developing gas market. The main driver for this demand growth is the power sector. This sector has grown by 570% in volume in the last decade, some 60% of the total growth in the region. In China most of the energy resources are far away from the market, and there is a lack of infrastructure. On the supply side both domestic and import projects are being developed. The energy market in China is based on centralised planning with five-year plans. PGC C takes the

view that an efficient market system requires regulation rather than centralised planning.

PGC C will continue its work on this case study. The analysis will be presented in Amsterdam during the World Gas Conference in June 2006. A first report was due to be sent to IGU Council members before the meeting in October in Tianjin City, China.

SP Gas to Power

The Special Project Gas to Power has been set up in view of the pivotal role that power is likely to play in the development of new gas markets and the realisation that it will take enormous effort to achieve the projected growth. It aims to identify possible obstacles and address them by inviting governments and the power industry to discuss them jointly with the gas industry.

In China gas has to compete mainly with coal. The common view is that gas is not competitive against coal-fired production under current regulation/policies and tariffs that ignore the external environmental costs related to pollution. The drivers for gas-fired power are there, but the government has to make policies to enable the growth for gas-fired power. Government can be seen as the "owner" of the long-term interest of China. To facilitate the LNG projects the government should encourage power purchase agreements, guarantee minimum generation hours with appropriate tariffs and make use of the environmental issues in favour of gas-fired power plants.

The interfaces between the power and gas industry and the government are essential to let it all happen.

The petroleum industry can offer the younger generation challenging careers. This was the message that speakers including IGU President George Verberg brought to the WPC 1st Youth Forum in Beijing.

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Our customers benefit from our complete range of technically-advanced gas management products and systems to meet their needs in all market segments from transmission to residential. They know all our products comply with recognised standards and are specially designed and manufactured to suit their individual requirements in any country.
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At the core of all energies

Managing Pipeline Integrity

By Juan A. Díez de Ulzurrun and Peter A. Cistaro

"Pipeline integrity" is a phrase that has come to the forefront of concern for companies providing the infrastructure to deliver natural gas from production fields to the end user. But what does this phrase mean to the transmission and distribution companies delivering natural gas, and the national legislative bodies that provide oversight with respect to public safety?

The following two articles provide insight into the implementation of pipeline integrity management systems by European gas transmission companies, and how the issue of pipeline integrity has been approached in the United States with its implications for distribution companies.

Pipeline integrity is a key issue for companies providing the infrastructure to deliver natural gas from production fields to the end user.

Pipeline Integrity Management System (PIMS)

In the 2000-2003 Triennium IGU's Working Committee covering Transmission (then WOC 4), through Study Group 4.2, defined a "Frame of Reference Regarding the Pipeline Integrity Management System". The purpose of the document was to provide a management tool as well as a means of demonstrating safety compliance to regulatory authorities and the general public.

PIMS is a safety management system dedicated to pipeline integrity, which is integrated into a company's overall management system. It covers all the resources and activities provided by each natural gas operator to control the hazards associated with its onshore pipelines and related equipment. Typically PIMS involves:

- The adoption of high technological standards in construction, including materials;
- Carrying out proactive measures to prevent external interference, corrosion and other failures, ensuring that the pipeline system is maintained fit for purpose;
- Working out emergency procedures;
- Investigation of incidents;
- Personnel training; and
- The definition of roles and responsibilities of personnel.

PIMS follows the plan-do-check-act (PDCA) cycle of activities with the stages being: policy and planning; implementation and operation; inspection and corrective actions; and management review.

Some of the standards to be considered are:

- EN 1594: Pipelines for maximum operating pressure over 16 bar (232 psi);
- ISO 13623: Petroleum and natural gas industries – pipeline transportation systems; and
- National pipeline standards.

The activities and resources integrated into PIMS are classified and organised into 10 processes (*see Figure 1*) of which 1 and 2 are primary processes,

3 to 9 are auxiliary processes to primary ones and 10 is a global coordinating process.

Emergency procedure

As part of the planning involved in PIMS, transmission companies have developed emergency procedures that allow them to manage emergency scenarios in order to guarantee health and safety for workers, safety for the general public, protection of the environment and continuity of supply. The emergency procedure or emergency response plan should be available to both company staff and relevant people outside the company (such as contractors).

The objectives of the emergency procedure are to:

- Eliminate, in the shortest possible time, everything that can compromise the safety of people and the protection of the environment;
- Avoid the enlargement of the incident;
- Take into account the cases where it is necessary to interrupt the gas supply and its duration; and
- Do what is necessary to maintain or restore the gas supply.

To achieve these goals the emergency procedure must include the following:

- Activation of the emergency instructions: General criteria;
- Responsibilities: The emergency procedure defines the role, responsibility and interrelation of personnel who shall be involved in the management and control of abnormal situations including emergencies;
- Arrangement of personnel, means of transport, means of communication;
- Arrangement of equipment and materials, their requirements and documentation necessary during the emergency;
- Liaison with authorities;
- Gathering and updating of information relevant to emergencies; and
- Personnel training: The training programme refers to the standard operational instructions for operation and maintenance of pipelines and plants.

ACTIVITIES AND RESOURCES INTEGRATED INTO PIMS

Equipment
Operation-Maintenance
Training
Purchasing
Communication
Safety
Environment
Quality
Standards, Technology and Regulations Watch
System Management

The emergency procedure or response plan should be continually monitored and reviewed to improve the behaviour and the efficiency of the emergency response.

Training

Many of the activities involved in PIMS demand skilled personnel. Training, either on the job (OJT) or off the job (OFFJT), is thus a very important part of the implementation of PIMS in the transmission companies. The training programmes equip

LEFT
Figure 1.

Marking the right of way in Alberta, Canada.

It is essential that PIMS is integrated into a company's overall management system.

employees and contractors with the skills required to carry out PIMS activities and allow them to maintain their level of skills.

The OFFJT training programmes are carried out in training institutes or in the offices of the transmission company. Some examples of the contents of these programmes are: welding practice for welders, prevention of third party damage, leakage detection and how to patrol a pipeline route.

OJT training is performed by allowing the pupil to do some tasks under the supervision of a skilled employee. An example of this kind of training is the regulator's inspection. Qualifying for this generally takes almost five years without the help of other employees.

Performance indicators

Safety management control is improved by reviewing systems and procedures, and transmission companies can check the effectiveness of PIMS through the use of performance indicators. This is done by analysing the causes of incidents, trends and common mode failures.

A way of doing this is to identify the potential failure causes, such as third party damage, corrosion, construction defects and material defects, and to carry out a root analysis of each of them. This root cause analysis will include the prevention and detection measures that can be taken to avoid damage and eventually failure of the pipelines, as well as "defences" (not managerial controls but ways of defending the pipe in a static manner through design and construction techniques) involved in the integrity of the pipe.

The prevention and detection measures and the "defences" are performance elements that act on the performance indicators. The identification of the performance indicators and the respective performance elements allows the PIMS to be set up. They can then be used to check its effectiveness and to highlight the critical points that need to be improved. Use of performance indicators also facilitates benchmarking between transmission companies and improves the investigation of incidents.

The identification of possible causes of pipeline failures has been improved through the use of incident databases and one of the most important is maintained by the European Gas Pipeline Incident Data Group (EGIG). The objective of this initiative is to provide a realistic picture of the frequencies and probabilities of incidents in gas pipelines.

The major gas transmission system operators in western Europe participate in EGIG. The number of participants, the extent of their pipeline systems and the exposure period involved guarantee that it is a reliable and valuable database, and one that is relevant to pipeline design, operating and maintenance practices in Europe. But probably the main feature of the EGIG database is that it can be used to monitor the safety record of gas transmission systems.

EGIG publishes an extensive report every three years and the latest one (the fifth) covering the period 1970-2001 was presented at the 22nd World Gas Conference in Tokyo in June 2003. Because of their interest, the conclusions from the fifth EGIG report are included:

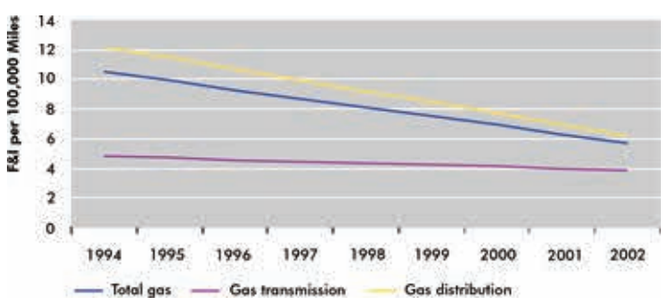
- In the period 1970 to 2001 no incident

involving a natural gas transmission pipeline caused fatalities or injuries to the general public.

- The cumulative exposure of the pipelines of the participating companies reached 2.41 million kilometre-years.
- The overall frequency of incidents involving an unintentional gas release over the period 1970-2001 was 0.44 incidents per year per 1000 kilometres of pipeline. However, this fell significantly over the latter years of the period. The updated EGIG figure for 1998-2002 was 0.21 incidents per year per 1000 kilometres of pipeline.
- The overall failure frequency was 0.44 per year per 1000 kilometres of pipeline with a 95% confidence interval of ±0.003.
- The failure rate has decreased by a factor of 5 over the past 32 years.
- There is a trend to use large diameter pipelines (>42 inch [1067 mm]) in combination with a higher grade of material (X65 and X70).
- The major cause of incidents is still external interference (50%), followed by construction defects/material failures (17%) and corrosion (15%).
- A greater depth of cover gives a significantly lower frequency for failures caused by external interference.
- The largest proportion of incidents is detected by the general public, while the second highest detector is patrol survey.
- In only a small minority of incidents did the leaked gas ignite (4% on average), but one should note that this figure depends on many parameters.

BELOW
Figure 2.

TRENDS IN FATALITIES & INCIDENTS



Source: US National Bureau of Statistics

Conclusion

It is essential that each gas transmission company integrate PIMS into their company management system. PIMS must follow the principles of policy and planning, implementation and operation, inspection and corrective actions, and management review. PIMS must focus on safety, protection of the environment and continuity of supply.

All company staff and relevant people outside the company should participate in PIMS, and to achieve this objective all of them must be properly trained. This will allow the transmission companies to maintain a good safety record.

A distribution company's perspective

The natural gas pipeline industry has an excellent record with respect to public safety (*see Figure 2*), but individual high profile pipeline incidents can create an impetus to mandate additional safety enhancements. This has been the case in the United States, where recent pipeline incidents (involving liquid and gas transmission) have resulted in loss of life and spurred a concerted regulatory effort to bring all the public safety initiatives of the natural gas industry into a unified pipeline integrity programme. While efforts to date have been concentrated on gas transmission pipelines, the focus is now shifting to distribution pipelines.

Pipeline integrity management has been codified in the US for gas transmission facilities, creating the need for each company to have an Integrity Management Plan (IMP). The IMP requirements apply to gas transmission pipelines in high consequence areas (HCAs), areas where a

Association of Hungarian Gas Distribution Companies

The Association of Gas Distribution Companies (GE) was founded by its members in 1991. The EU-compliant Law on Gas Supply came into force on January 1, 2004, and created suitable conditions for opening up the natural gas market in Hungary. The regulatory authority is the Hungarian Energy Office.

GE has the following member-companies:

Southern Lowlands Gas Supply Co. (DÉGÁZ Rt.)

South Transdanubian Gas Supply Co. (DDGÁZ Rt.)

North Transdanubian Gas Distribution Plc. (ÉGÁZ Rt.)

Budapest Gas Works Co. (FOGÁZ Rt.)

Middle Transdanubian Gas Supply Co. (KÖGÁZ Rt.)

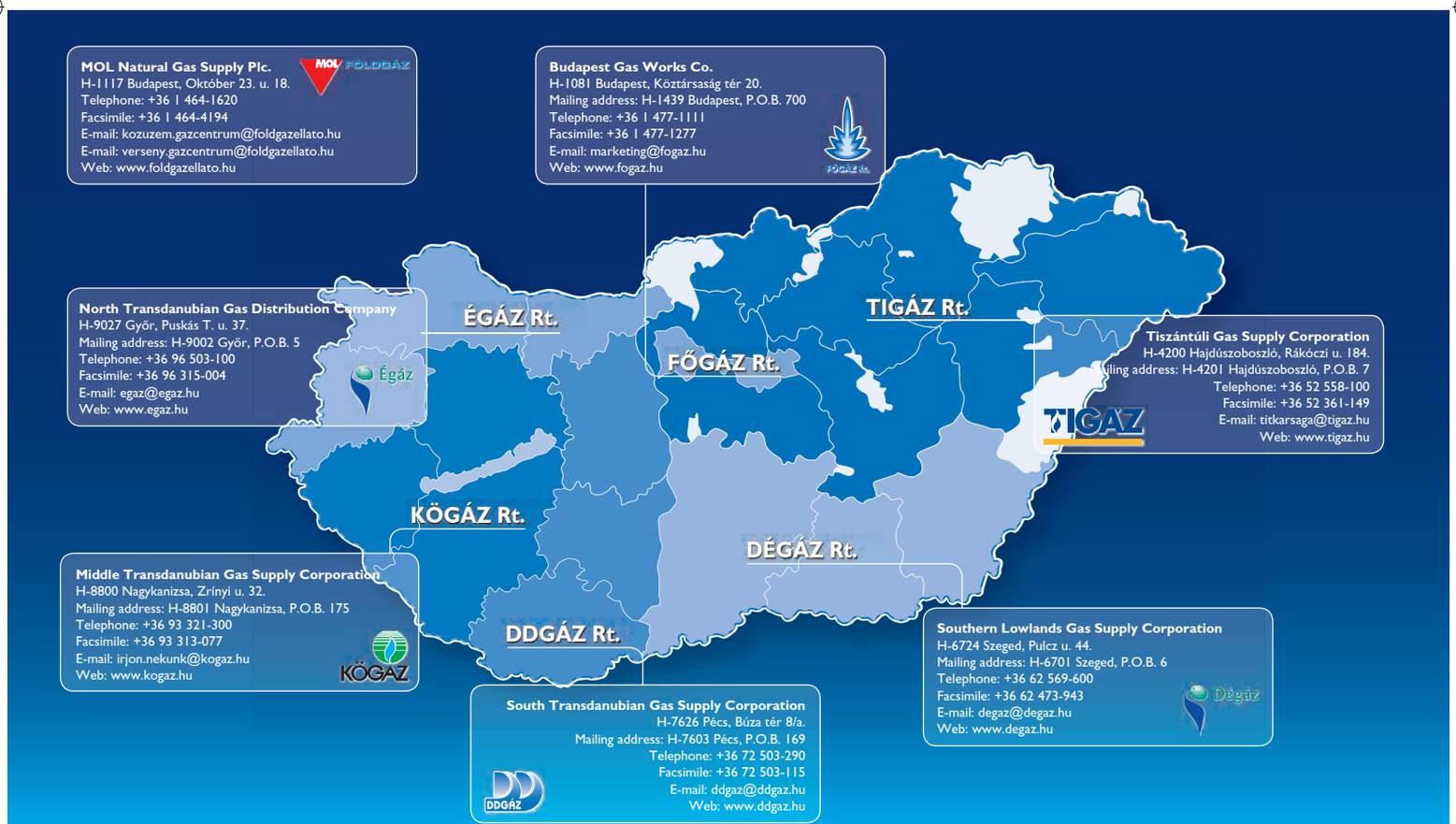
MOL Natural Gas Supply PLC

Tiszántúli Gas Supply Co. (TIGÁZ Rt.)

In Hungary the annual primary energy consumption exceeds 26 million tonnes of oil equivalent (MTOE). Natural gas plays an important role in energy supply and its share in primary energy consumption exceeds 40%. The bulk of natural gas (80%) is imported, mainly from Russia. In Hungary natural gas consumption exceeds 14 billion m3 per annum and more than 95% of this is re-sold by GE's member companies. In Hungary there are 3.2 million natural gas consumers, 97% of which are partners of GE's member companies.

The Association of Gas Distribution Companies formulates a coordinated opinion regarding professional questions connected with the activities of its member companies in the gas industry. Closely cooperating with the Ministry of Economy and Transport, the Hungarian Energy Office and organisations for consumer protection, GE takes an active part in the gas industry legislative procedures. GE is represented in several international professional organisations (IGU, Eurogas, DVGW, GEODE, Marcogaz).

In compliance with EU Directives, the different types of activities of natural gas companies have been separated. The gas distribution companies have obtained licences for public utility supply, natural gas distribution and trading and access to cross-border transmission pipelines. MOL Natural Gas Supply PLC has licences for public utility wholesale, trading and access to cross-border transmission pipelines.



PIPELINE INFRASTRUCTURE IS BROKEN DOWN INTO TWO DISTINCT SYSTEMS BASED ON FUNCTION – TRANSMISSION AND DISTRIBUTION	
Transmission	Distribution
Long linearity transporting natural gas over large distances for redelivery by distribution pipelines	Grid in relatively compact geographic area with multiple connections and smaller lines to individual customers
Large diameter (12 to 48 inch [305 to 1219 mm] or more)	Large range of diameters (0.5 to 48 inch [12.7 to 1219 mm] or more)
High pressures (500 psi to 1,200 psi [34 to 83 bar] are common) which cause high stress levels in the pipe wall typically over 20% SMYS (specified minimum yield strength)	Low pressures (0.5 psi to 100 psi [0.03 to 6.9 bar] are common) which cause very low stress levels in the pipe wall
Welded steel construction	Varied range of materials (cast iron, steel, polyethylene)

RIGHT
Table 1.

pipeline failure will have a large impact on public safety.

Some of the proscribed elements of an IMP include:

- Identification of HCAs;
- Baseline assessment of pipelines by internal tool inspection ("smart pig" technology) or pressure test or direct assessment to address the threats of external corrosion, internal corrosion and stress corrosion;
- Provisions for remediating conditions found during an integrity assessment;
- A process for continual evaluation and assessment;
- Provisions for adding preventive and mitigative measures;
- A performance plan that includes performance indicators;
- A management of change process;
- A quality assurance process; and
- A communication plan.

Can a gas transmission IMP be applicable for a distribution IMP?

Efforts are currently in progress between the regulatory agency and the gas industry to evaluate the effectiveness of current distribution safety-related practices, and, if warranted, to develop the requirements for a gas distribution IMP.

A key concern has been the potential for the blind imposition of the integrity baseline assessment techniques (internal inspection, pressure test, or direct assessment) developed for transmission facilities onto distribution facilities, which have substantial physical and operational differences (*see Table 1*).

Internal inspection (smart pig technology) is devised for very long inspection runs where there are minimal restrictions to the passage of the inspection tool. However, a distribution system is comprised of many short sections of pipe with a large number of impediments to an internal smart pig inspection (changes in diameter, short right angle directional changes and physical intrusions i.e. taps). These physical restrictions preclude the utilisation of an internal smart pig inspection.

A periodic pressure test presents a different set of challenges for a distribution system with numerous customers on a single gas line on a city or municipal street. These customers would have to be temporarily cut off from service during the test period. The prospect of isolating customers, testing and restoring service on a block-by-block basis becomes impractical.

Direct assessment requires the use of multiple indirect survey techniques to determine potential areas of corrosion. Once again, a distribution system under continuous pavement, with multiple service connections and an assortment of construction material (cast iron, bare steel, coated steel, plastic), will often preclude a technically- and cost-effective implementation of the indirect survey techniques.

What can be utilised to provide a reasonable distribution integrity programme?

When addressing this issue, it is important to bear in mind that distribution systems by design operate at low pressures and corresponding low stress levels in the pipe wall. Thus a distribution failure is primarily confined to leakage, rather than a rupture, and distribution integrity becomes an issue of managing leakage through:

- Detection and remediation of leaks;
- Preventative measures against operational causes of leakage;
- Identification and remediation of potential leakage due to system material condition; and
- Preventative measures by the design of new facilities.

The following represents a compilation of leak management practices used in the US, many of which are already mandated.

Detection and remediation of leaks

- Periodic gas leakage surveys over the entire distribution system (mains and services).
- Frequency of survey tied to material type. Plastic and cathodically protected steel every three years, while cast iron and unprotected steel every year.
- Leakage surveys tied to weather conditions. During the winter frozen ground impedes gas venting to the atmosphere, detection prior to, or during, conditions of frost is prudent.
- Leakage surveys tied to system material/condition. For example, cast iron is subject to movement due to frost penetration, thus a leakage survey during freeze/thaw cycles needs to be considered.

In the US the pipeline integrity focus is now shifting to the distribution sector.

- Classification of leaks and prioritisation of repairs. Leak classification allows for differentiation between leaks that may develop into a safety concern to the public, while allowing for deferral and monitoring of minute leaks.

Preventative measures against operational causes of leakage

- Participation in One-Call Damage Prevention programmes. Construction activity is a leading cause of facility damage and leakage which, because it normally involves severing of the distribution line, poses a high potential for impairing the safety of both the public and the construction personnel. Participation in a cooperative programme where anyone can make a notification to gas utilities of proposed construction allows for the mark-out of gas facilities to prevent damage.
- Post construction leakage surveys when distribution facilities may be impacted. An example is cast iron that may be impacted by soil movement associated with a sewer line construction.
- Monitoring of gas quality on a periodic basis to minimise the potential of internal corrosion (maintaining a dry gas environment).

Identification and remediation of potential leakage due to system condition

- Periodic review of leakage location, frequency and cause can identify areas where corrosion or graphitisation is particularly aggressive on bare steel or cast iron.
- Inspection and evaluation of pipe upon exposure for external and internal condition can further assist in identifying areas where pipe may be prone to future leakage.
- A systematic analysis of past leakage becomes the basis for a gas utility to identify areas for prudent pipe replacement to avoid future leakage.

Preventative measures by the design of new facilities

- The use of plastic and cathodically protected steel has supplanted previous distribution construction materials because of their demonstrated performance to deter future leakage.
- Ensuring that careful construction practices are utilised also provides deterrence of future leakage.
- Continue to explore new materials that may increase strength and resistance to damage and leakage.
- Continue to explore in-situ pipe retrofit technology that can mitigate development of future leaks.

Conclusions: Where are we headed?

The codification of an Integrity Management Plan for gas transmission pipelines in the US represents a springboard, or basis, for evaluating and potentially developing a Distribution Integrity Management Plan.

The cooperative dialogue between regulatory agencies and industry representation should recognise the physical and operational differences between the transmission and distribution systems. This same dialogue will explore and evaluate the effectiveness of the above-listed activities and other activities already being performed by gas distribution operators to ensure operational safety for the public.

The anticipated result would be a requirement for gas distribution operators to develop a Distribution Integrity Management Plan that incorporates and unifies multiple safety-related activities into a process. This management process should incorporate the safety-related activities relevant to the individual distribution system into a systematic methodology to evaluate and improve system performance for public safety.

Juan A. Díez de Ulzurrun is General Director of Iberdrola and Chairman of WOC 3 (Transmission), while Peter A. Cistaro is Vice President, Gas Delivery of PSEG and Chairman of WOC 4 (Distribution).

In Pursuit of a Second Supply Route

Finland is one of the few countries in Europe not having a natural gas grid directly linked to the European grid. The natural gas consumed in Finland is imported solely from Russia. Dependable supplies have always been a high priority for Finland. To date, there have been no problems and natural gas has flowed uninterruptedly to Finland for over 30 years. Nevertheless, this has not removed the need for efforts to find a second source of natural gas supply. The availability of a choice of routes along which natural gas can be sourced and transmitted would significantly enhance the conditions to increase natural gas consumption. Connecting the Finnish natural gas grid to the grids of the Baltic States would provide the impetus to draw on existing and potential natural gas storage facilities.

An effective way to reduce carbon dioxide emissions in energy production is to replace fossil fuels such as coal and peat with natural gas. These solid fuels are still very much used in Finland, especially in combined heat and power (CHP) production, even in the immediate catchment area of the existing natural gas grid. One of the principal long-term aims of developing the Finnish natural gas grid and market is for natural gas to replace the use of coal and peat wherever possible, especially in CHP production. This is why it is vital for Finland to secure a second natural gas supply channel.

Balticconnector – a shared vision

The natural gas grids in the Baltic States have a long tradition of working together. This also applies to cooperation with Lentransgaz, the Russian transmission company delivering natural gas both to the Baltic States and to Finland. Intense cooperation on the operative front provides a sound platform for a quality, dependable supply of natural gas.

Balticconnector is the new vision of the form of future cooperation shared by the key natural gas companies in the region. When put in place, ***Balticconnector*** will create a new natural gas transmission system stretching from the Inchukalns natural gas storage facilities in Latvia via Estonia to Finland. It will link the Finnish, Estonian and Latvian natural gas grids and enable Latvia's natural gas storage capacity to be used to meet the needs of all three states.

The principal natural gas companies in the region, Gasum Oy, AS Eesti Gaas, JSC Latvijas Gaze and OAO Gazprom, are studying the possibility of establishing a new jointly-owned company, which would assume responsibility for developing the new transmission system. Achievement of this aim calls for the construction of a pipeline link (DN 500, 80-120 kilometres) between Finland and Estonia, new compressor capacity (15-25 MW) and the integration of existing transmission pipelines (DN 700) in Latvia and Estonia as part of the transmission network operated by the envisaged new company.

Plans show that use of this transmission route could raise imports of natural gas to Finland to around 20 TWh a year, equivalent to over some 25% of Finland's entire consumption of natural gas between 2008 and 2010.

GASUM – THE LEADING GAS COMPANY IN THE BALTIC SEA AREA

Gasum Oy is responsible for the import, wholesale and transmission of natural gas in Finland. Subsidiaries Suomen Kaasuenergia Oy and Helsinkikaasu Oy engage in the local distribution of natural gas, whilst Gas Exchange Ltd is active in the secondary gas market.

The services of Gasum Group comprise all aspects of natural gas use from construction of the transmission and distribution network to equipment deliveries and maintenance.

Gasum uses modern gas transportation network monitoring and controlling systems and a web-based customer service system.

Gasum's owners are Fortum (31%), Gazprom (25%), the Finnish state (24%) and E.ON Ruhrgas (20%).

Gasum Group in numbers:

- Turnover €653 million
- Balance sheet total €526 million
- Permanent employees 182
- Natural gas sales 4,78 million cubic metres
- Transmission pipeline 1000 kilometres
- Distribution pipeline 345 kilometres

Share of natural gas in Finland

- 11% of total energy consumption
- 13% of electricity production
- 37% of district heat production
- 17% of industrial fuels

www.gasum.fi

The Gas Industry in the New EU Countries – The Slovak Republic

By Pavol Janočko and Milan Sedláček

This article looks at the reshaping and privatisation of the Slovak Republic's gas sector as an example of a post-communist country which has made the transition to a market economy during the process of EU accession.

Natural gas accounts for one-third of the Slovak Republic's primary energy consumption (*see Table 1*) and is set to grow in significance as coal is displaced for environmental and economic reasons. Domestic gas resources are minor, meeting around 3% of consumption, and most gas is supplied by Russia.

The key player is Slovenský Plynárenský Priemysel (SPP), one of the largest Slovak companies and one of the most important international gas transportation companies in Europe. The strategic importance of SPP arises from its geographic location between Russia's gas fields and consumers in western Europe. SPP owns and operates the facilities for transport and distribution of natural gas. It is an integrated company active in the whole gas chain except for exploration and production. The limited production in the Slovak Republic is carried out by Nafta Gbely.

By the end of 2004 the total length of the Slovak gas pipeline network was more than 25,000 kilometres, of which about 2,400 kilometres were transit pipelines. The transit system consists of four parallel pipelines with by-pass loops to boost capacity in certain areas and branch-offs to the Czech Republic and Austria. The capacity of the transit system is now 94 bcm annually. Approximately 20% of western European natural gas consumption is imported from Russia, primarily via SPP's pipelines.

In the domestic market SPP currently supplies about 7 bcm of natural gas to some 1.3 million residential users and over 50,000 business and industrial users. SPP has access to 1.8 bcm of storage capacity in various storage facilities in Slovakia and the Czech Republic. Most of these facilities are located in the former natural gas reservoirs owned by three separate companies. These are Nafta Gbely, in which SPP holds an equity interest; Pozagas, in which SPP and Gaz de France own equity interests of 35% and 30% respectively, with the remaining 35% stake belonging to Nafta Gbely; and SPP Bohemia, in which SPP owns a direct equity interest of 50%.

The Slovak gas sector is represented in IGU by the Slovak Gas and Oil Association (SGOA). This Association ensures the active participation of Slovak gas industry experts in IGU bodies such as the Working and Programme Committees. The mutual exchange of knowledge under the IGU umbrella is of high importance for Slovakia. Moreover, economic globalisation makes international cooperation among countries and companies involved in the gas business increasingly important, and SGOA sees the IGU framework as ideally suited to this. Slovak delegates were active participants in the 2003 World Gas Conference in Tokyo, and are looking forward to WGC2006 in Amsterdam.

RIGHT
Table 1.

PRIMARY ENERGY CONSUMPTION IN THE SLOVAK REPUBLIC 2004

	*MTOE**	*SHARE*
Natural gas	6.1	32.8%
Coal	4.2	22.6%
Nuclear	3.9	21%
Oil	3.5	18.8%
Hydro	0.9	4.8%
Total	18.6	100%

* million tonnes of oil equivalent
Source: BP Statistical Review of World Energy 2005

Transit as driver for gas penetration

The key driver for the relatively high share of natural gas in Slovakia's total primary energy consumption is the country's role in gas transport. Thanks to this the majority of Slovak municipalities have access to a gas supply.

The development of the transit system dates back to the late 1960s and early 1970s when the then Soviet Union started to open export markets for its gas production. The first exports started in 1968 when the Brotherhood pipeline between the Soviet Union and Czechoslovakia was commissioned. This delivery pipeline was extended to Austria the following year. Subsequent deals with other western European countries and the former Yugoslavia resulted in the need for a transit pipeline through Czechoslovakia and construction was started in January 1971. This first transit pipeline was opened in January 1973.

The 1973 oil crisis encouraged western European countries to diversify their energy sources and increase natural gas deliveries from the Soviet Union. This necessitated a second transit line to raise capacity to 37 bcm a year. Construction of two further lines and the by-pass loops increased transport capacity to the current level of 94 bcm per year.

Distribution network

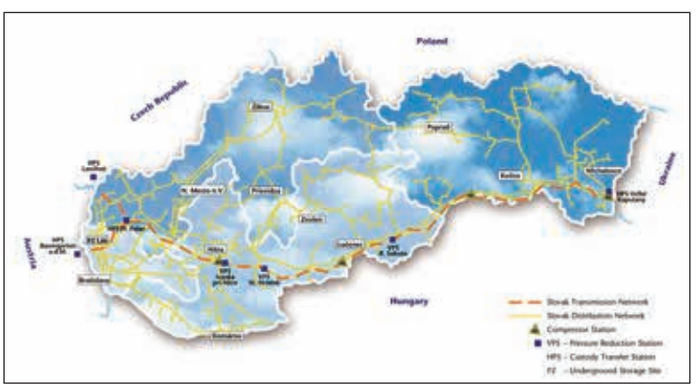
Over the last decade the distribution pipeline grid has been substantially expanded. The number of municipalities connected to the gas network in Slovakia is currently about 2200, compared to 624 in 1993. This coverage represents 74% of the country's total of 2924 registered municipalities. The length of the domestic pipeline network in operation now exceeds 30,000 kilometres, while in 1993 it was only 10,278 kilometres. Today Slovakia has one of the most developed gas networks in Europe. As a result of the systematic network expansion there has been a significant growth in the number of customers, which has increased to nearly 1.5 million.

The Slovak gas transmission network.

Domestic gas policies and regulation

Slovakia has undertaken substantial reforms in natural gas policy since 1999. These reforms fall into three basic categories: the removal of subsidies, restructuring the gas industry and introducing competition.

In the economies in transition, like Slovakia in 1999, the natural gas market was generally characterised by an artificially low gas price, which did not even cover the cash costs incurred by the importer. Furthermore, non-payment problems combined with the low price negatively affected the resource allocation at the consumer level, due to over-consumption of natural gas and potential over-investment in technologies using natural gas as input or as fuel. The natural gas market needed



Three-quarters of Slovakia's municipalities are connected to the gas distribution network.

An aerial view of the compressor station at Jablonov nad Turnou.

substantial regulatory reform before consumers could pay a cost-reflective price. As in other transitional countries, the most important distortions were:

- Cross-subsidies;
- Politically motivated gas price regulation;
- Absence of an independent regulator;
- Absence of a foreign investment;
- Poor corporate governance; and
- Strong political influence on the gas sector.

In 1999 the tariffs set did not allow SPP's distribution and supply business to recover its costs. This situation was both economically inefficient and unsustainable if the company were to stand on its own feet, a fact that was acknowledged by the government. Given the potential problems that could arise for the Slovak economy if SPP's distribution and supply business prices were to increase to an economically sustainable level in one step, it was agreed by the government that prices should be increased gradually over a period of two years.

The Slovak government in 1999 was committed to regulatory reform that would eliminate the need for cross-subsidies. The Law on Network Industries, providing the general framework for regulatory reform, was approved by the Slovak parliament in 2001 and an independent regulator was set up in October 2001. The regulator oversees the Slovak gas industry in accordance with a published regulatory framework. According to the new legislation, the regulator is now setting domestic gas tariffs at a level such that SPP can cover all

reasonable costs and make a fair return. This eliminates the need for cross-subsidies.

In 2002 SPP was partially privatised. In 2003 and 2004 the new set of legal norms created a legal framework fully compliant with the requirements of EU directives. The key elements include:

- A liberalised open market, where industrial consumers have the right to choose a gas supplier;
- Regulated gas distribution on the basis of a price-cap method;
- Regulated transmission including the transit of gas; and
- Implementation of the entry-exit tariff method for access to the grid.

Slovakia is the first of the major transit countries for Russian gas to implement the entry-exit system for gas transit including the regulation of tariffs, which are now publicly available.

Ownership and management of the gas industry

Gas industry ownership and management in Slovakia has gone through significant changes in recent years. SPP, the key player, has been partially privatised. During the privatisation, it was agreed that there are specific areas where the strategic investor can bring advantages to SPP over the long term. These are:

- Maintaining and developing the integrity of SPP's transit business;
- Supporting the regional development of SPP;
- Exploiting new business opportunities;
- Improving services to SPP's customers;
- Supporting the long-term competitive position of SPP; and
- Security of supply.

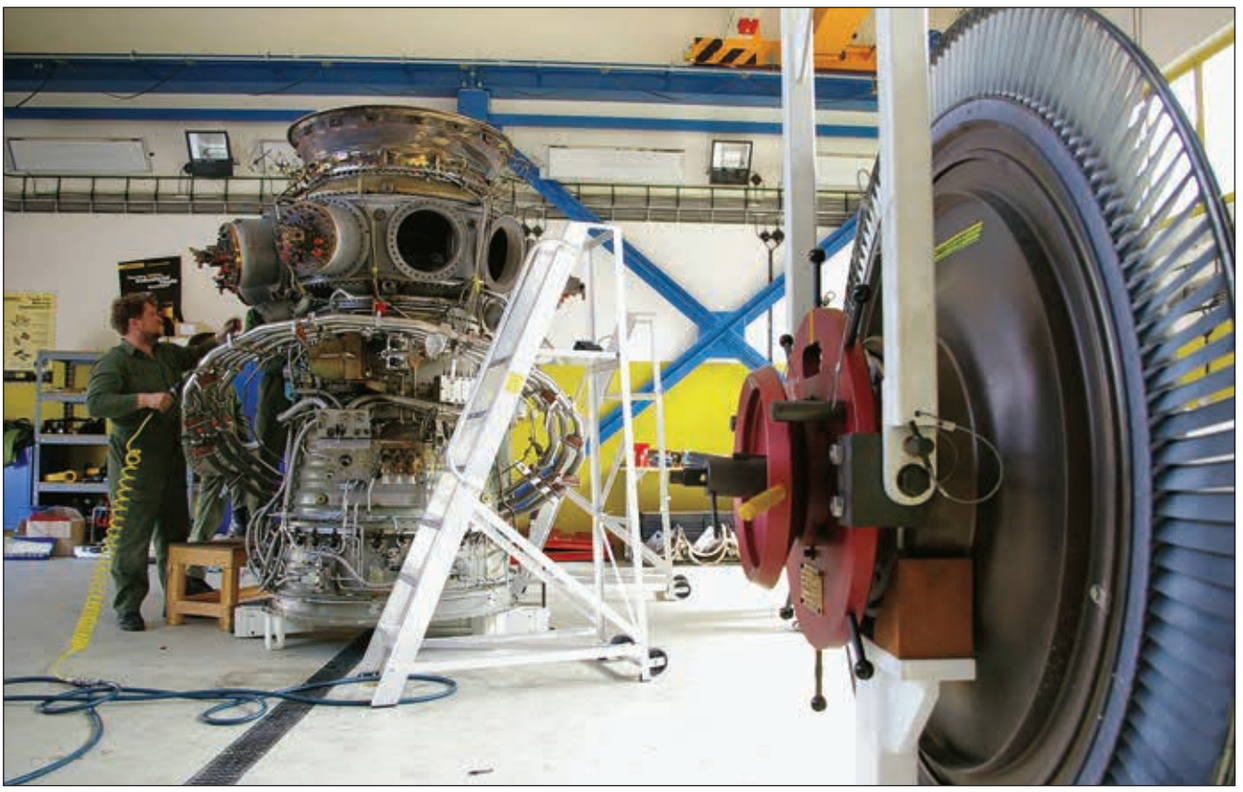
Currently the Slovak Republic holds approximately 51% of the shares in SPP, with Gaz de France and Ruhrgas holding approximately 24.5% each.

Lessons learned from the process

Each of the countries in central Europe has undertaken substantial reforms in natural gas policy since 1990. These reforms fall into three basic categories: the removal of subsidies, restructuring the gas industry and introducing competition.

Slovakia also introduced competition into the gas market in order to fulfil the requirements of the EU natural gas directive. This includes liberalisation of the market, which involves unbundling accounts to separate gas transmission, storage and distribution,

Slovakia has one of the most developed gas networks in Europe.



Maintenance is carried out on a Cooper-Rolls turbine.

and providing transparent rules for third party access. Liberalisation is emphasised by the strict regulation of gas distribution by the independent regulator as well as the regulation of transit activity.

Slovakia's policy objectives included ensuring a reliable supply of gas to meet domestic needs, protecting the population from unfair prices, promoting energy efficiency and competitiveness in industry, and attracting revenue to the state budget through privatisation and taxation. These objectives were pursued simultaneously and the process was dynamic and hectic, but the final result was a successful restructuring of the gas sector.

Further challenges

In 2004 the volumes in the gas transmission segment continued to rise reaching 82.7 bcm compared to 72.7 bcm in 2003. However, the sales of natural gas in Slovakia dropped by 4.4% to 6.5 bcm. This drop took place mainly due to climatic conditions, but was also due to the fact that customers invested in energy efficiency. For 2005 there are major challenges ahead. One main issue will be the compliance of SPP's corporate structure with the EU directive. Legal unbundling will be the most visible result. SPP is also being geared towards one of the most important goals with a major shift from being focused on operations and technology to becoming a more customer-oriented company.

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Publications and Documents Available from IGU

As a non-commercial organisation promoting technical and economic progress in the gas industry worldwide, IGU offers its publications free of charge and you are invited to order the IGU publications currently available from the Secretariat. (All documents are A4 format unless stated otherwise.)

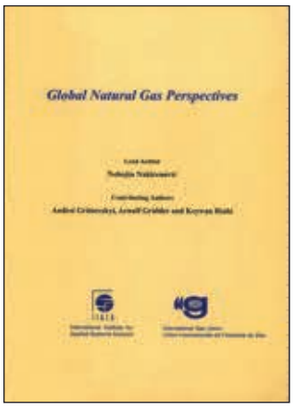
2003-2006 Programme

- Strategic Guidelines as approved by the IGU Executive Committee in Tatranska Lomnica on April 10, 2003, (4 pages)*.
- Triennial Work Programme as approved by the IGU Executive Committee in Cape Town on October 28, 2003, (59 pages)*.
- Summary of Triennial Work Programme, (14 pages).
- TWP 2003-2006 session on the 22nd World Gas Conference 2003, (DVD and video).
- Exhibition WGC 2006, leaflet introducing the World Gas Exhibition in Amsterdam, (3 pages).

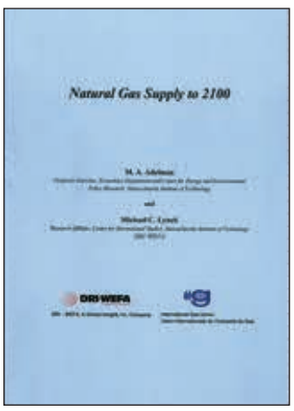
2000-2003 Programme

- Triennium 2000-2003, TCC Final report, IGU October 2003, (132 pages).
- Triennium 2000-2003, NOC Final report, IGU October 2003, (30 pages).
- 22nd World Gas Conference Tokyo 2003, (DVD).

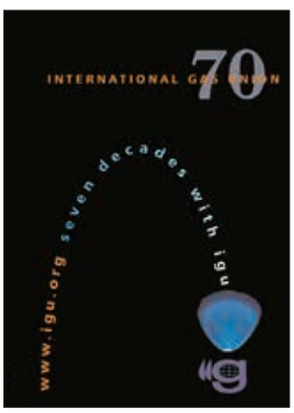
Scientific and technical papers and documentation



- Global Natural Gas Perspectives, Nebojša Nakićenović e.o., IIASA, IGU, October 2000 (71 pages 18 x 25.7cm). This booklet presents research based arguments as to how natural gas appears to be suited to provide a bridge from the current energy system to a new era of more environmentally sound energy systems.



- Natural Gas Supply to 2100, M. A. Adelman and Michael C. Lynch, DRI-WEFA, IGU, October 2002 (51 pages 18 x 25.7 cm). This booklet outlines the authors' assessment of a long-term supply curve for natural gas using recent estimates of costs and known reserves.

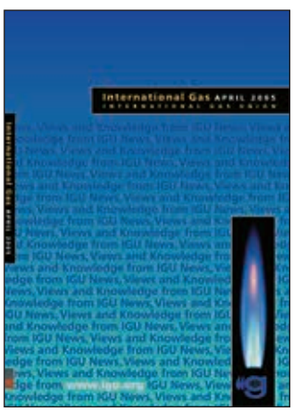


- Seven Decades with IGU, ISC 2003, (186 pages). IGU's 70th anniversary fell in 2001 and at the next World Gas Conference in 2003 this book was

launched containing articles on the organisation's history as well as on current and future issues facing the international gas industry.

- Proceedings of the 20th World Gas Conference, Copenhagen 1997, (CD Rom).
- Proceedings of the 21st World Gas Conference, Nice 2000, (CD Rom).
- Proceedings of the 22nd World Gas Conference, Tokyo 2003, (2 CD Roms).

- IGU Triennium 2000-2003 WOC 2 Basic activity study, Worldwide UGS Database, (CD Rom)**.
- International Gas, ISC April 2005 (152 pages). The third issue of the IGU Magazine.

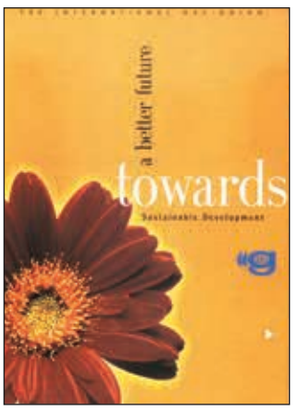


IGU organisational information

- IGU Articles of Association, as approved by the IGU Council September 18, 2002, (28 pages A5).
- IGU Guiding Principles for Sustainable Development, October 2003, (12 pages A5). This leaflet contains the recently updated and approved recommendations to IGU Members and the global gas industry regarding responsible behaviour in this context.

- News, Views and Knowledge on Gas – worldwide, (3 pages). This general brochure gives a concise introduction to the organisation together with its Vision and Mission.

- A Better Future Towards Sustainable Development, (5 pages). This brochure highlights IGU's position in promoting natural gas as a part of the solution to climate change.



- IGU Organisation Chart 2003-2006, (3 pages).

* Can also be downloaded from the IGU website

** Can also be downloaded from the IGU collaboration portal

The publications, brochures, DVDs and CD Roms can be ordered (as long as available) from:

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or from the Coordination Committee Secretariat

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2005

October 17-20
IGU Council Meeting
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October 28-29
IGM 96th Session
Ghent, Belgium

November 28-December 9
Conference of the Parties (COP) 11
Montreal, Canada

2006

February 20-21
Asia Gas Partnership Summit
New Delhi, India

February 22-23
IGU Executive Committee
New Delhi,
India

May 1-2
IGM 97th Session
Opatija, Croatia

June 5
IGU Council Meeting
Amsterdam, The Netherlands

June 5-9
23rd World Gas Conference
Amsterdam, The Netherlands

October 8-11
3rd World Forum on Energy Regulation
Washington DC, USA

October 26-28
IGU Council Meeting
Peru (exact venue to be confirmed)

November 7-9
10th International Conference and Exhibition on NGVs
Cairo, Egypt

December 8-9
UATI/UNESCO Seminar Energy for Everybody
Paris, France

2007

April 24-27
LNG-15
Barcelona, Spain

November 9-15
World Energy Congress (WEC 2007)
Rome, Italy

2008

March 26-28
IGU Executive Committee
Port of Spain, Trinidad and Tobago

Date to be confirmed
World Petroleum Congress (WPC 2008)
Madrid, Spain

You can find links to many of the above events by visiting www.igu.org and clicking on "Events". Under "Energy-related Events" in the drop-down menu you can also find a link to the WEC Events Calendar displaying a multitude of energy-related events.

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- Regular transfers to the Public Treasury of revenues derived from the sale of the share of crude oil accruing to the State, after deduction of all costs;
- Regular audits of corporate accounts by renowned national and international firms.

Cameroon is a member of the Extractive Industries Transparency Initiative (EITI), an international forum created to achieve transparency in the management and judicious utilisation by governments, of revenues derived from extractive industries. It is also a member of the Monitoring Committee to implement the principles of this initiative in Cameroon.

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Les projets gaziers au Cameroun

Le gouvernement camerounais, à travers la Société Nationale des Hydrocarbures s'attèle, depuis 2002, à faire entrer le Cameroun dans le cercle des pays gaziers. Ces actions vont d'ailleurs s'intensifier autour de quatre chantiers principaux :

Les gaz associés.

En 2006, il s'agira de mettre en place une législation afin de favoriser la récupération de ces gaz générés lors des opérations de production pétrolière, et leur mise en valeur, au lieu de les brûler ou de les rejeter dans l'atmosphère. A cet effet, un Consultant a été retenu à la suite d'un appel d'offres international, avec pour mission d'élaborer l'avant projet de Loi et son Décret d'application.

Le projet d'exportation de gaz naturel vers la Guinée Equatoriale.

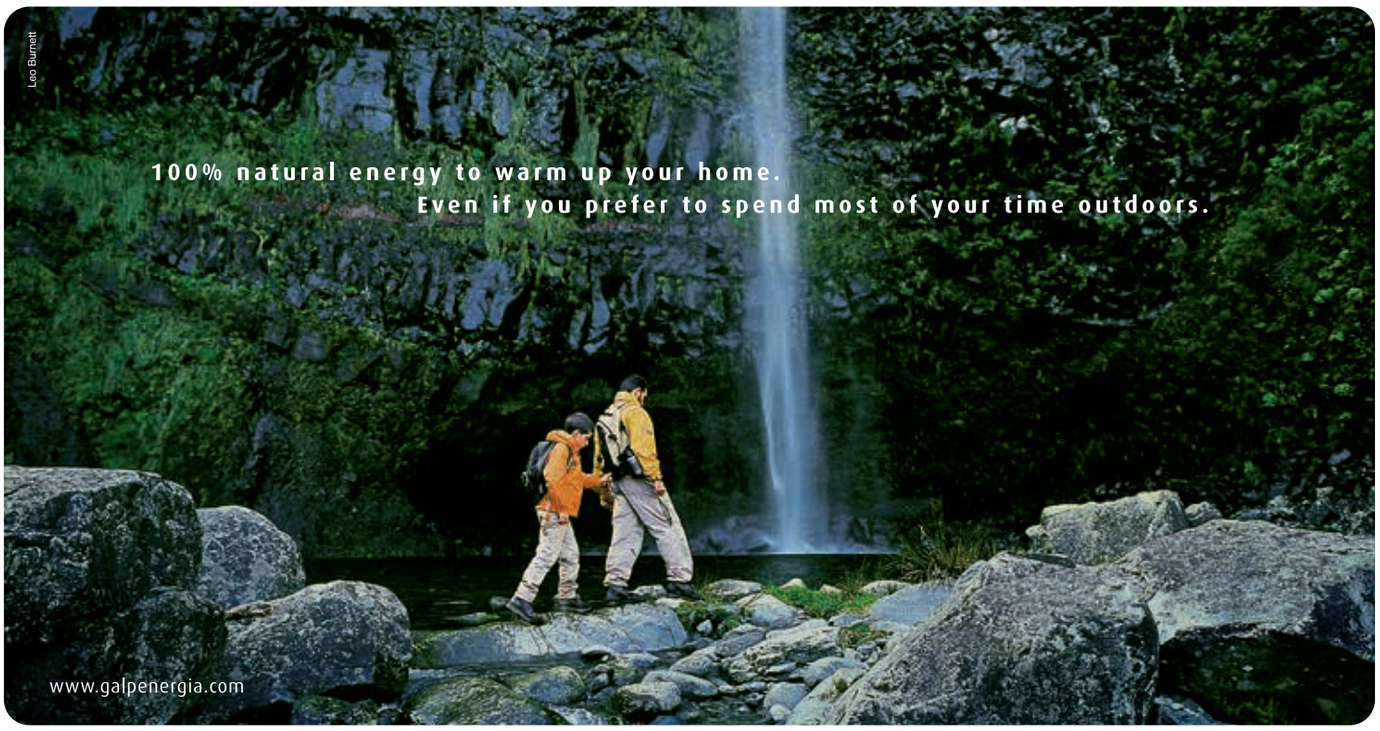
Il prévoit l'exportation du gaz naturel des champs camerounais vers une usine de liquéfaction en Guinée Equatoriale à l'horizon 2007. Sur autorisation du Chef de l'Etat, les négociations vont être menées avec les partenaires techniques Shell et Total, et avec la République de Guinée Equatoriale et son partenaire Marathon.

Le projet de distribution du gaz de pétrole liquéfié (GPL).

Après le bouclage des aspects techniques en septembre 2005, cette année va consacrer l'aboutissement des volets juridique et financier du projet, notamment les statuts de la société et son actionnariat.

Le Projet Centrale Thermique de Kribi, plus que d'actualité.

Dans ce registre, outre le bouclage des contrats de partage de production et de vente de gaz, l'année 2006 verra le démarrage des études de développement du gisement et le lancement des appels d'offres pour l'approvisionnement et la construction des installations de production de gaz.



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Success through partnership

Egyptian LNG

US$880m

Project Finance Facility
Train 2

Mandated Lead Arranger

Egypt 2005

CJSC Sevmorneftegaz/ OAO Gazprom

US$166.60m

GIEK Covered Credit, Commercial Loan and L/C Facility
Mandated Lead Arranger

Russia 2005

Oman LNG LLC

US$1,305m

Term Loan and L/C Facility

Mandated Lead Arranger

Oman 2005

Skikda LNG Transport Corporation

US$114.75m

LNG Vessel Financing Facility

Sole Mandated Lead Arranger & Bookrunner

Algeria 2005

Sabine Pass LNG L.P.

US$822m

Term Loan Facility

Co-Arranger & Co-Documantation Agent

US 2005

NGC Pipeline Company

US$198,56m

Project Finance Facility
Cross Island Pipeline

Mandated Lead Arranger

Trinidad/ Tobago 2005

Pertamina

US$310m

Project Finance Facility

Lead Arranger

Indonesia 2005

Qalhat LNG

US$688m

Term Loan and L/C Facility

Mandated Lead Arranger & Bookrunner

Oman 2005

Qatar Liquefied Gas Company Ltd II ('Qatargas II')

US$3,600m

Project Finance Facility

Mandated Lead Arranger

Qatar 2004

South Hook LNG Terminal Company Ltd.

GBP 420m

Project Finance Facility

Mandated Lead Arranger

England/Wales 2004

OAO Gazprom

US$1,100m

Secured Medium Term Loan Facility

Mandated Lead Arranger

Russia 2004

Egyptian LNG

US$950m

Project Finance Facility
Train 1

Lead Arranger

Egypt 2004

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