Task Force 1 Holds its First Meeting

By Manu Kohli

The first meeting of Task Force 1 was hosted in London by BP on November 18 & 19, 2009. Welcoming participants from the Chair, Ieda Gomes expressed her gratitude to TF1 members and the Advisory Committee for taking time out of their busy schedules to share their thoughts and considerable experience. The two-day event was attended by 19 TF1 members with an additional three people dialling-in.

After introductions from the participants, Ho Sook Wah, Coordination Committee Chairman, made a brief presentation about the IGU and Triennium objectives. He also mentioned the importance of IGU in promoting cooperation between its members and raising issues which are relevant and current to the gas industry as a whole.

The meeting aimed to deliver the following objectives:

- Position the talent issue in the gas industry by inviting experts to make topical presentations;
- Obtain input on the survey and questionnaire to be launched in 2010; and
- Provide a timeline and single points of accountability (SPAs) for the Triennium activity culminating with the presentation of the final report at the 25th WGC in June 2012.

The participants in the meeting were very enthusiastic and engaged actively with the task at hand. Brief presentations were made by Anita Hoffmann, Partner at Heidrick & Struggles, Daniel Paccoud, Managing Director of the French Gas Association (AFG), Pierre Bismuth, Senior Advisor – Human Resources at Schlumberger, and Khaled Abubakr, Managing Director of Taqa Egypt. The presentations looked at the challenges of attracting and retaining talent and developing leadership in the gas industry. They also described the industry's response to issues related to manpower and made some suggestions on managing these challenges.

ABOVE Participants in TF1's first meeting pose for a group shot before starting work and OPPOSITE relaxing after the business sessions.

In the words of Daniel Paccoud: "I have always been interested in human resources and am particularly sensitive to the fact that gas companies generally do not take enough care of their talent. The reason lies in the drive for immediate profit, and training is often considered by the financiers simply as a cost. It is almost impossible to convince them that it is actually a long-term investment. They think that when the time has come, they can recruit somebody without any problem. But that is not the case! If every company does the same, after several years there is nobody available on the market and it could be too late to train somebody. This is the reason why it is necessary to plan many years ahead."

A lot of time was also spent on discussions related to a survey that TF1 will be sending out to the broader IGU membership to understand the human resource challenges being faced by the industry and provide a compilation of best practices. The aim of the Task Force is not to present the demographics of the industry but to identify key challenges faced with respect to human capital and offer practicable strategies for the future. The survey will provide both a snapshot of evolving demographics as well as qualitative information on the perspective and selling points of the gas industry.

As Rod Kenyon, TF1 Vice Chairman explains: "The Task Force will be addressing some key issues around talent and human resources, and we must ensure that the industry presents an attractive employment prospect for young people."

The final world goes to TF1 member Jon Butterworth, who is National Operations Director for National Grid: "This group allows many of the players in the world gas business to review as one team how we can improve and embed the calibre and quality of staff that will be required for the future success of the world's changing aspirations for cleaner fuel. If we don't recruit the right talent our great industry will suffer."

The next TF1 meeting will be hosted in Prague by RWE on March 30-31.

Manu Kohli is the Secretary of Task Force 1.

WOC 4 – Distribution Starts its Activities

By Alessandro Soresina

With the echoes of the great success of the 24th World Gas Conference in Buenos Aires still in the air, it was only a month later that WOC 4 started its activities for the new Triennium. The Committee's work will culminate in the 25th WGC that will take place in Kuala Lumpur in June 2012.

WOC 4 may be a "traditional" IGU Technical Committee – indeed, gas distribution is the part of the gas chain with the highest visibility to customers – but it has not stood still. In the last decade, in response to market liberalisation and other factors arising both from within and outside the industry, the Committee has been progressively evolving and adapting itself to the changing environment.

For the 2009-2012 Triennium WOC 4 has divided its work into three study areas, each covered by a Study Group:

- Gas Distribution Safety Management Systems;
- Smart metering systems: characteristics, technologies, costs; and
- Unaccounted for gas (UFG): identification, measurement, calculation and management.

The work of the three Study Groups builds on the experience and competencies of WOC 4 members, and will involve a global survey together with analysis of best practices in the gas industry and in other industrial sectors. The aim is to produce the traditional Committee report for the WGC as well as specific tools that can be of benefit to the distribution community. During the Triennium WOC 4 will also organise a number of workshops addressing distribution issues related to the work of the Study Groups. These workshops will be open to the general public.

Meeting report

WOC 4's first meeting of the new Triennium was hosted by A2A S.p.A. in Milan, Italy, November 4-6, 2009. Thanks to the active participation of 34 members it was a great success.

During the first day of the meeting there was a general introduction to IGU, the 2009-2012 Triennium and the Triennial Work Programme, with the support of Coordination Committee Secretary, Ungku Ainon, who joined WOC 4 for the occasion. This was followed by presentations of the Italian experience in the three study areas. These presentations included speeches by members of the Italian Energy Authority, which covered the evolution of regulation

WOC 4 members and accompanying persons pose for a group photo at the gala dinner.

as regards the items under discussion.

The rest of the meeting mainly concerned the work of the three Study Groups, which agreed their internal organisation, defined study areas, settled the basis of the questionnaire that will be circulated after the next meeting, planned Triennium activities in general and agreed action points prior to the next meeting.

The scope and objectives of the three Study Groups are detailed below.

WOC 4 members and accompanying persons during the "technical tour".

SG 4.1 *Gas Distribution Safety Management Systems*
Leader: Ben Lambregts, Liander, The Netherlands
Objective: SG 4.1 will review processes and methodologies used to develop safety strategies for managing gas distribution pipeline systems. It will also draw up the basic steps to implement a Safety Management System together with a list of key performance indicators and a set of units to measure the indicators.

SG 4.2 *Smart metering systems: characteristics, technologies, costs*
Leader: Kim Vrancken, Eandis, Belgium
Objective: SG 4.2 will review the various technologies and smart index solutions available, and will identify the best practices in metering activities. It will also draw up a basic cost/benefit calculation model to be used by distribution companies to evaluate the opportunity of introducing smart metering systems in their networks.

SG 4.3 *Unaccounted for gas: identification, measurement, calculation and management*
Leader: Barbara Jinks, GHD, Australia
Objective: SG 4.3 will address the concept of UFG – including its definition, the identification of its main components and the definition of a set of units to measure or calculate it – and review approaches adopted for its management. The Study Group will also design a tool that can be used by distribution companies to approach measurement or calculation of UFG in their distribution networks.

The business sessions were complemented by an unconventional technical tour giving participants the opportunity to discover the talents of the renowned engineer and artist Leonardo da Vinci. They saw key examples of his work in Milan, above all, his fresco "The Last Supper".

WOC 4's next meeting will take place in Bochum, Germany, May 5-7, by the kind invitation of Stadtwerke Bochum. It will follow a one-day workshop on smart metering organised by the Committee. This will take place in Bochum on Tuesday May 4 and will be open to the general public.

WOC 4 currently has 65 members (some of them as corresponding members) and new members are still more than welcome to join the Committee.

Alessandro Soresina is the Chairman of WOC 4. For more information, please contact him at alessandro.soresina@a2a.eu or the Secretary of WOC 4, Mario Pelizzoli at mario.pelizzoli@a2a.eu.

Biomethane as a Substitute for Natural Gas

By Nuno Afonso Moreira

As a relatively clean and abundant fuel, natural gas is well placed to meet rising energy demand. But it is still a finite fossil fuel, and those countries which have to import it face security of supply issues. Introducing biomethane made from domestic renewable sources into the energy mix can play an important role in enhancing energy security and reducing emissions of greenhouse gases. Focusing on Europe, this paper assesses the potential for producing biomethane through the quantification of available biomass.

Natural gas consumption

Since 2000, the world's consumption of primary energy has been growing at an average annual rate of around 2.5%. In 2008, the last year for which statistics were available at presstime, the increase was 1.7%, bringing total consumption to 11.3 billion tonnes oil equivalent (toe). The EU accounted for 15.3% or just over 1.7 billion toe.

Energy consumption in the EU has been growing much more slowly than the global rate, with an average annual increase of 0.19% since 2000. Indeed, during the last two years of the period it fell – by 2.3% in 2007 and 0.23% in 2008.

Looking at the trends per fuel, consumption of coal and nuclear power has declined (on average by -0.54% and -0.04% a year respectively), while oil consumption has risen at an average of 0.11% a year, although there was a significant drop between 2004 and 2007. Natural gas has seen the biggest growth rate, with an average annual increase of 1.37% and an overall increase between 2000 and 2008 of 11%.

The EU's natural gas consumption in 2008 was 441 million toe, and the UK, Germany and Italy stand out as the biggest consumers, with 84.5, 73.8 and 69.9 million toe respectively.

Key factors driving increased consumption of natural gas have been high oil prices and the environmental benefits of switching to gas from other forms of fossil energy. However, if foreign gas replaces domestic coal then the issue of security of supply – which affects all imported fuels – comes into play. Moreover, natural gas is ultimately finite even though global reserves – with an estimated life of 64 years [2] – will last longer than those of oil.

BELOW
Table 1.

TYPICAL COMPOSITION OF SYNGAS AND BIOGAS, AND THEIR CALORIFIC VALUES

Parameters	*Syngas*		*Biogas*
	Initial characteristics	*After methanisation*	
CH_4 (% vol.)	1.7	54.8	65
CO_2 (% vol.)	7.3	43.3	35
CO (% vol.)	37.2	0.2	–
H_2 (% vol.)	50.2	1.6	–
H_2S (ppm)	–	–	<500
LHV (MJ/Nm3)	10.769	19.814	23

Note: LHV = lower heating value.
Source: See bibliography over ref. 6 for syngas and ref. 7 for biogas.

Biomethane

Biomethane is produced from biomass to the specifications of natural gas. Thus there is no technical incompatibility with the existing transport infrastructure and appliances, while having a competitive gas market helps ensure a commercial environment conducive to the introduction of biomethane. Like natural gas, biomethane can be used in vehicles, domestic and industrial appliances, or to produce electricity and heat.

Large-scale European production of biomethane would reduce energy dependence and reinforce security of supply, a key objective of the EU. It also offers significant potential to reduce

SECTOR, RESOURCE AND DESCRIPTION OF BIOMASS AND CONVERSION RATIOS

Sector	*Resource*	*Description*	*Conversion technologies*	*Conversion ratios (biogas m^3/tonne)*	*Conversion ratios (Syngas m^3/tonne)**
Agriculture	Agricultural residues	Dry lignocellulosic	Gasification		1560
	Livestock waste	Wet cellulosic	Digestion	20**	
		Dry lignocellulosic	Gasification		1560
	Energy crops	Dry lignocellulosic	Gasification		1560
Forestry	Wood fuel	Dry lignocellulosic	Gasification		1560
	Forest residues	Dry lignocellulosic	Gasification		1560
Industry	Industrial residues and waste	Dry lignocellulosic	Gasification		1560
		Wet cellulosic	Digestion	400***	
		Landfill waste	Digestion	450***	
		Sewage sludge	Digestion	400***	

*See bibliography over ref. 3. **See bibliography over ref. 5. ***See bibliography over ref. 2.

ABOVE
Table 2.

greenhouse gas emissions being a biofuel (obtained from renewable sources) and regarded as neutral with respect to CO_2 emissions.

There are two processes by which biomethane can be produced, one involving biogas and the other syngas *(see Table 1)*. Biogas is obtained by anaerobic digestion of organics, and its composition is mainly CH_4 and CO_2. The upgrading to biomethane is done through the disposal of hazardous compounds and the removal of CO_2.

Syngas is obtained from the gasification of solid biomass, and is upgraded to biomethane by increasing the methane content. The initial gas has low levels of methane and high concentrations of CO and H_2, being reformed into methane with a catalyst, and purified by the removal of CO_2.

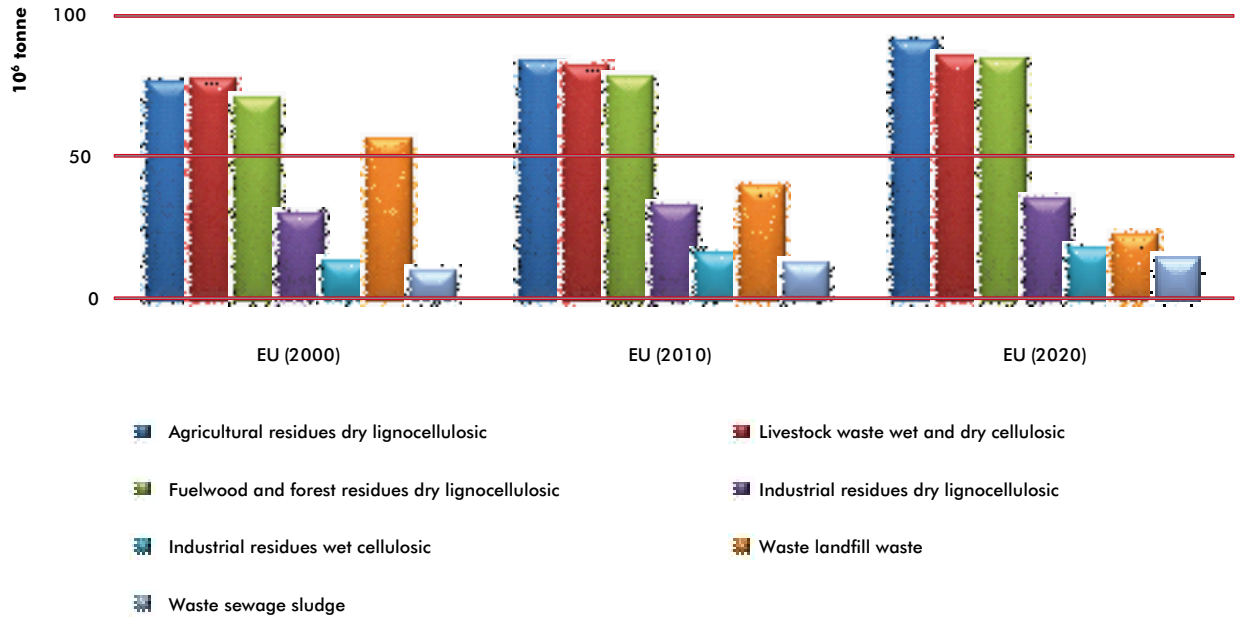
Raw biomass used in the production of both gases is quantified in *Figure 1 (overleaf)*, while *Table 2* gives the conversion ratios into biogas or syngas by sector and resource. The efficiency of producing biomethane from biogas is 65% [5] and from syngas it is 22% [6]. Thus, based on the quantities of biomass produced in each sector and using the conversion ratios for each technology, we can estimate the production potential of biomethane in Europe. We have identified a potential of 28 million toe for 2010 and 27.6 million toe in 2020 *(see Table 3)*.

BELOW
Table 3.

POTENTIAL PRODUCTION OF BIOMETHANE IN EUROPE IN 2010 AND 2020

		Potential ($10^9 Nm^3$)	*Efficiency (%)*	*LHV (MJ/Nm^3)*	*Potential biomethane ($10^9 MJ$)*	*(10^6toe)*
2010	**Biogas**	31	65	23	458	10.942
	Syngas	303	22	11	718	17.137
				Total	**1176**	**28.079**
2020	**Biogas**	25	65	23	373	8.91
	Syngas	330	22	11	783	18.695
				Total	**1156**	**27.605**

BIOMASS PRODUCTION IN EU IN 2000, AND ESTIMATED PRODUCTION IN THE YEARS 2010 AND 2020



Source: Shepherd W., Shepherd D. W., Energy Studies, 2008.

ABOVE
Figure 1.

Conclusions

Europe has to address increasing environmental, security of supply and economic pressures on the energy front. There is a clear need to develop sustainable alternatives as part of a comprehensive energy policy, and Europe's high potential for biomass production should be explored.

Biomethane can be part of the measures and policies adopted and can make a major contribution to reducing the consumption of fossil fuels and replacing them with renewable energy sources.

Nuno Afonso Moreira, who works for Sonorgás in Portugal, is the Leader of Study Group 5.1, Working Committee 5 – Utilisation.

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IGU's New Programme Committee Starts Work

By Marc Hall

The image of natural gas as the fuel of choice is currently facing major challenges. Based on this premise, a new Programme Committee on Marketing (PGC E) has been formed from IGM (originally Intergas Marketing and latterly the IGU Marketing Committee). The role of PGC E is to identify and develop ideas, tools and products for the successful promotion and sale of natural gas.

During the 2009-2012 Triennium, the Committee will divide its work into three Study Groups covering the following areas:

- Natural gas and renewables;
- Marketing campaigns; and
- Image of natural gas.

The work of the Study Groups will be based mainly on success stories, evaluating the key drivers behind them. The deliverables at the end of the Triennium will be to provide a deeper knowledge and understanding of how to promote the numerous advantages of natural gas in comparison with other fuels.

PGC E currently has 40 members and two corresponding members. The first session of the new Committee was hosted by Bayerngas in Munich, Germany, December 2-4, 2009. It was attended by 20 members and marked a successful start of work by a highly motivated team.

Meeting report

During the two-day session, there were presentations on the IGU structure and Triennial Work Programme, different speeches from marketing experts and also a thorough discussion on the scope and objectives of the three Study Groups:

SG E.1 Natural gas and renewables

Leader: Uwe Klaas, German Technical and Scientific Association for Gas and Water (DVGW), Germany

PGC E members pose for a group photo during their first meeting of the Triennium.

This mobile CNG filling station was inspected during the technical visit.

Objective: This group will identify the position of natural gas in combination with renewables in the future energy market, and focus on marketing strategies for those technologies.

SG E. 2 Marketing campaigns

Leader: Urs Zeller, Swiss Gas Industry Association (VSG), Switzerland
Objective: This group will analyse the business behaviour in marketing across different sectors. A questionnaire will be organised to collect the necessary information.

SG E.3 Image of natural gas

Leader: Hansch van der Velden, GasTerra, The Netherlands
Objective: This group will analyse the positive and negative perceptions of natural gas. It will then develop guidelines for improving the image of natural gas.

As part of the session a technical tour was organised to inspect the world's first self-sufficient mobile CNG filling station, which was developed in cooperation by BayernServices and Schandl. This filling station works permanently without any power connection. Furthermore it does not need a gas pipeline connection since it is equipped with gas containers. It is therefore especially qualified for sites needing flexibility and those in remote areas.

PGC E's next meeting will take place in Amsterdam by the kind invitation of Gasunie, GasTerra and EnergieNed, June 2-4.

New members are still welcome to join the Committee.

Marc Hall is the Chairman of PGC E. For more information, please contact him at Marc.Hall@bayerngas.de or the Secretary of PGC E, Barbara Schmid at Barbara.schmid@bayerngas.de.

Equatorial Guinea LNG

Equatorial Guinea LNG Holdings Limited and its subsidiaries (EG LNG) delivered more than its first cargo on May 24, 2007. EG LNG delivered a promise to the government and the people of the West African nation of Equatorial Guinea to be a reliable supplier of LNG, to develop its staff with an emphasis on recruiting and training nationals, and to be a responsible corporate citizen. By continuously striving to achieve these objectives, EG LNG delivers maximum value to Equatorial Guinea and its shareholders.

About EG LNG

EG LNG's shareholders comprise Marathon Oil Corporation (60%), SONAGAS G.E. S.A., the national gas company of Equatorial Guinea (25%), Mitsui and Co. Ltd (8.5%) and Marubeni Corporation (6.5%).

Close alignment between the Government of Equatorial Guinea and private shareholders enabled the EG LNG Train 1 project to be one of the fastest LNG projects ever from conception to first cargo. It was also completed on budget and ahead of schedule. EG LNG Train 1 features a nameplate capacity of 3.7 MMTPA, two LNG storage tanks of 136,000 m3, and a 350-metre suspension bridge – the first LNG pipe rack suspension bridge in the world.

Culture of performance excellence

One of EG LNG's fundamental values is ensuring that all employees, contractors and extended team members go home safely…every day. EG LNG's dedication to the safety and health of its workforce has helped the company realise more than 3.5 million man hours without a lost time accident.

EG LNG's performance is focused on continuous improvement and striving for excellence in all its operations. During 2009, EG LNG achieved world-class operational availability, with slightly over 1.5 % unplanned downtime.

Potential to expand into a regional gas hub

There are significant offshore gas resources in Equatorial Guinea as well as in the Gulf of Guinea, all within a 100-kilometre radius of EG LNG. An integrated team of the EG LNG shareholders is working alongside the government of Equatorial Guinea to utilise these gas resources not only to reduce gas flaring in the region, but to monetise the gas in the most profitable way possible. As soon as viable projects are developed from these resources, EG LNG will seek to plan, execute and operate these projects with the same success as Train 1, making sure that coordination between future trains and the existing business are adequately addressed.

Building Guinean capacity: A vision for sustainability

EG LNG is committed to the professional development of its national workforce at every level. This commitment includes on-the-job training, mentoring and continuing education. Thirty-one national operator trainees, who completed a two-and-a-half-year technical training programme, partially at a US vocational college, and are now working alongside expatriate colleagues in the operations and maintenance departments. As an integral part of EG LNG's vision for long-term sustainability, development of Equatoguinean senior management and staff is a key company objective.

EG LNG is also committed to building the capacity of the local small and medium enterprise (SME) sector. More than $100 million was spent on national content during construction of Train 1, far exceeding targets set at the beginning of the project. Building on this effort, emphasis during the operations phase has been placed on further developing the capabilities of existing contractors through vendor training, forging partnerships between local and multinational contractors, and improving access to capital for small and medium enterprises by working directly with local banks.

EG LNG is committed to design, implement and support sustainable community and social projects in collaboration with the government and people of Equatorial Guinea. Focusing on education, health, youth empowerment and agriculture, EG LNG has been at the forefront of several social projects which have improved living standards to the benefit of both urban and rural populations. Stakeholder engagement and collaboration are at the core of EG LNG's community relations strategy. Building on relationships in the Equatoguinean community and a dedication to corporate social responsibility, EG LNG continues to expand the scope of its social projects to better serve Guinean needs and build Guinean capacity.

Equatorial Guinea LNG Train 1, S.A.

EG LNG

- ***OUR MISSION*** *is to utilize fully and efficiently the LNG capacity of Train 1, to develop our staff with an emphasis on recruiting and training Nationals, and to be seen as a responsible corporate citizen*

- ***OUR VISION*** *is to establish a reputation as a reliable supplier of LNG to our customer, operating a regional LNG hub, and to deliver maximum value to Equatorial Guinea and our shareholders*

- ***OUR VALUES*** *include ensuring all employees, contractors and extended team members go home safely … everyday. EG LNG has realized 3+ million man hours without a lost time accident*

- ***OUR PERFORMANCE*** *means striving for continuous improvement. During 2009, EG LNG achieved 96% operational availability*

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Presenting IGU's New Charter Members

As the Secretary General reported in his message in this issue, three new countries are now represented in IGU. Here the Charter Members for Equatorial Guinea and Timor-Leste give overviews of the gas industry in their countries, while the following article looks at Angola LNG.

Sonagas of Equatorial Guinea

By Juan Antonio Ndong Ondo

Sociedad Nacional de Gas of Equatorial Guinea (Sonagas GE) is a state-owned company established in 2005 by the Government of the Republic of Equatorial Guinea to develop the country's natural gas resources.

The company seeks to monetise surplus gas associated with crude oil production and to develop non-associated gas. In addition to domestic activities, it is also allowed to participate in projects outside Equatorial Guinea.

Currently Sonagas GE and its partners Marathon EG, Noble Energy, Mitsui and Marubeni produce LPG, methanol and LNG. On the international front, negotiations are underway with Société Nationale des Hydrocarbures of Cameroon (SNH) and Nigerian National Petroleum Corporation (NNPC) for the purchase of gas to be processed at the LNG plant on Bioko Island.

Sonagas GE collaborates with the World Bank-led Global Gas Flaring Reduction Partnership (GGFR), contributing projects that help to reduce the flaring and venting of natural gas.

As part of its plans to develop gas activities in Equatorial Guinea, Sonagas GE is planning to:

- Draft a Gas Master Plan that will enable the best utilisation and monetisation of existing gas resources and the implementation of additional gas projects in the country;
- Strengthen cooperation with certain countries of the sub-region, in order to utilise the gas being flared in their respective producing fields;

ABOVE
Juan Antonio Ndong Ondo, General Manager of Sonagas GE.

RIGHT
Equatorial Guinea is working to reduce flaring.

- Construct gas-fired power plants to: (1) increase the domestic electricity supply, (2) offer the possibility of supplying electricity to neighbouring countries via subsea cable; and
- Expand the market for domestically produced LPG and natural gas to other countries in the sub-region and to the rest of Africa.

Future perspectives

Equatorial Guinea's strategic position in the Gulf of Guinea offers the potential to become a hub, and Sonagas GE aims to establish an integrated sub-regional system for surplus gas utilisation and monetisation. The project would be based on the construction of pipelines to gather surplus gas from the producing fields of the sub-region for processing on Bioko Island. As a result, a consortium called 3G has been established in Equatorial Guinea with the state directly holding 15%, Sonagas GE 50%, E.ON Ruhrgas 25%, Union Fenosa Gas 5% and Galp Energia 5%.

On the domestic front, given the discoveries of recent years and the current proved potential of gas resources nationwide, Sonagas GE has a new proposal to develop a petrochemical industry using gas as a feedstock. This forms part of the overall gas master plan for the country, and projects such as the production of urea, ammonia and polypropylene are envisaged.

Juan Antonio Ndong Ondo is the General Manager of Sociedad Nacional de Gas of Equatorial Guinea (www.sonagas-ge.com).

A Brief Overview of the Gas Industry in Timor-Leste

By Alfredo Pires

As a new country Timor-Leste has not had an established gas industry. However, the exploration and production of the gas fields in the Joint Petroleum Development Area (JPDA) in the sea between Timor-Leste and Australia has incited

HE Alfredo Pires, the Secretary of State for Natural Resources, at the launching of the bathymetric survey of the Timor Sea.

Timor-Leste and Petronas signing the Memorandum of Cooperation for the feasibility study of a pipeline and LNG plant in Timor-Leste.

new interest from both the government and the private sector in gas developments.

Timor-Leste's first gas producing field is Bayu Undan, which lies some 250 kilometres off the country's south coast and 500 kilometres north of Australia. The field contains around 4 tcf (112 bcm) of gas (P50) and produces at the rate of 1 bscf (28 mcm) per day. About 50% of the gas produced is piped to Darwin LNG for liquefaction and export to countries such as Japan. The first LNG export was in 2006.

Since then the Government of Timor-Leste has taken proactive measures to develop the country's gas business. The government is looking to establish an LNG plant with a capacity of up to 20 mtpa, which would be supplied by pipeline from the existing and potential offshore gas fields in the Timor Sea, and has been cooperating with a number of international partners.

Together with Petronas of Malaysia, the government commissioned a joint feasibility study for the pipeline and LNG plant. The result of the study is very positive both technically and commercially.

The government is working with PTT of Thailand to develop a master plan for gas utilisation, which will include the potential for petrochemicals and LPG.

In 2008, Timor-Leste signed a Memorandum of Understanding on LNG supplies with Korea. Furthermore, the government has also worked in cooperation with a Korean consortium, which comprised Kogas, Samsung, LG and STX and others, to carry out the first ever bathymetric survey of Timor-Leste's whole offshore area in an attempt to find the best route for piping gas from the Greater Sunrise field in the Timor Sea to Timor-Leste.

The Greater Sunrise field contains approximately 7.67 tcf (215 bcm) of gas and 300 million barrels of condensate.

Alfredo Pires is the Secretary of State for Natural Resources in the Government of the Democratic Republic of Timor-Leste.

Angola LNG, Not Just Another Gas Project

By António Órfão, Jean-Eric Molinard, Bent Svensson and Mauricio O. Ríos

If there is one project that the oil and gas industry will probably remember for years to come, it is Angola Liquefied Natural Gas or Angola LNG.

What makes this project special is not that it takes place in Angola, a strategic and important oil-producing country in western sub-Saharan Africa, or that it is about LNG for that matter.

What makes it unique is that this project is poised to become the major gas flaring reduction project in the world. Comparing to other LNG projects around the globe, the primary source of supply during the early years of operation will be gas associated with crude oil production as opposed to supplies from non-associated gas fields. This is gas that is currently being flared due to the lack of a market, but now Angola and the companies operating in the country will commercialise it.

And in today's climate change context – in which most companies or countries are looking for opportunities to increase energy efficiency and reduce greenhouse emissions – Angola LNG is no small feat.

This multi-billion dollar project, located near the town of Soyo in northern Angola, will be on-stream in early 2012 producing 5 million tonnes of LNG per year (about 6.8 bcm/year) primarily targeted at Atlantic Basin gas markets.

The Angola LNG project will gather associated gas in water depths of up to 1,500 metres initially from five blocks, and it will also develop previously discovered non-associated gas fields in two blocks to supplement the associated gas produced with oil. The gas production from these seven blocks will be transported by three high-pressure pipelines to the LNG plant onshore for conditioning and extraction of natural gas liquids (NGLs) before the remaining gas is liquefied to LNG. The first cargoes of LNG are expected to be delivered in February 2012.

Angola is an important oil producer with offshore fields such as Girassol.

WHY IS GAS FLARED?

"Hard" Causes

- Distance from significant gas markets
- Reliability of supply from associated gas
- Gas infrastructure constraints (lack of, or access to it)
- Gas composition
- Risks of gas re-injection in oil reservoir

"Soft" Causes

- Limited institutional, legal and regulatory frameworks for gas, including associated gas
- Ineffective fiscal terms (gas price, equity share, tax structure, etc.)
- Underdeveloped domestic market for gas/products (LPG, CNG, methanol, power, etc.)
- Funding constraints and need for coordinated actions by multiple stakeholders

Angola LNG will also serve as the anchor investment for an industrial park and will provide energy and feedstock for an emerging petro-chemical industry. Significant investment incentives – including a tax holiday of up to 15 years – are available for a variety of investments in Soyo, an undeveloped corner of the country which is being transformed by a massive world-class project.

The gas flaring challenge

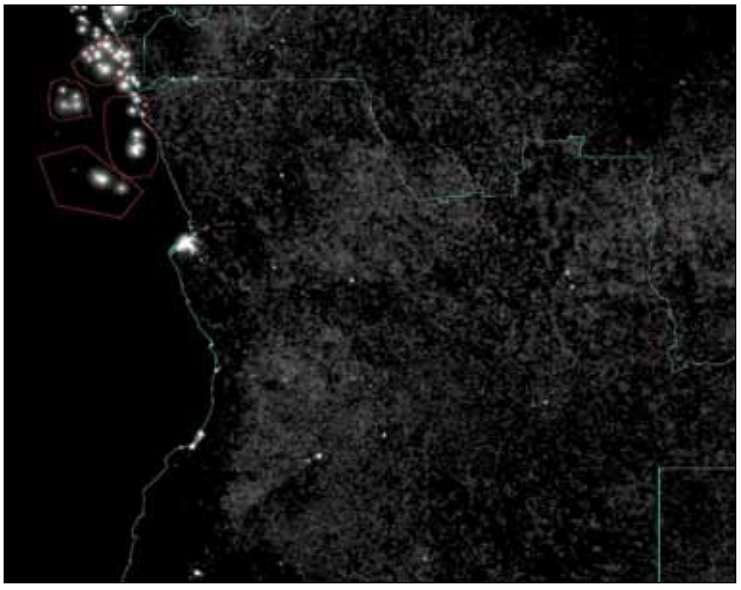
It is estimated that globally about 150 bcm of natural gas are being flared and vented annually. This amount is equivalent to 25% of the United States' gas consumption or 30% of the European Union's gas consumption per year.

Gas flaring wastes resources and harms the environment, and that's why it is important to step up the efforts to reduce flaring and increase gas utilisation. Gas flaring also deprives developing countries of an energy source that is cleaner and often cheaper than others available, and reduces potential tax revenue and trade opportunities.

Gas flaring also has a global impact on climate change by adding the equivalent of some 400 million tonnes of CO_2 in annual emissions. Furthermore, it is estimated that some 100 bcm of methane is vented or lost through fugitive emissions in the oil and gas sector each year. As methane is a more potent greenhouse gas than CO_2, this adds the equivalent of over 1 billion tonnes of carbon dioxide annually.

Altogether, annual emissions from flaring and venting (1.4 billion tonnes) are equivalent to more than twice the potential yearly emission reductions from projects currently submitted under the Kyoto Protocol's clean development mechanisms.

According to latest available satellite data (2008), the major flaring region in the world is Russia and the Caspian Sea (about 60 bcm), followed by the Middle East and North Africa (about 45 bcm). Sub-Saharan Africa (about 35 bcm) is the third-biggest flaring region, followed by Latin America with some 12 bcm of gas flared



A satellite view of gas flares (circled in red) in Angola for 2008 based on data collected by the US Air Force Defense Meteorological Satellite Program and processed by the NOAA National Geophysical Data Center.

annually. And the ranking of flaring countries shows Russia leading the list, followed by Nigeria, Iran and Iraq. The other six countries that make up the top 10 flaring countries for 2008 are Algeria, Kazakhstan, Libya, Saudi Arabia, Angola and Qatar. (See *Table 1* for more country data).

SATELLITE ESTIMATES FOR TOP 20 FLARING COUNTRIES

Volumes in bcm	*2005*	*2006*	*2007*	*2008*	*Change from 2007 to 2008*
Russia	55.2	48.8	50.0	40.2	-9.8
Nigeria	21.3	19.3	16.8	14.9	-1.9
Iran	11.3	12.1	10.6	10.3	-0.3
Iraq	7.1	7.4	7.0	7.0	0.0
Algeria	5.2	6.2	5.2	5.5	0.3
Kazakhstan	5.8	6.0	5.3	5.2	-0.1
Libya	4.4	4.3	3.7	3.7	0.0
Saudi Arabia	3.0	3.3	3.4	3.5	0.1
Angola	4.6	4.0	3.5	3.1	-0.4
Qatar	2.7	2.8	2.9	3.0	0.1
Uzbekistan	2.5	2.8	2.0	2.7	0.7
Mexico	0.9	1.2	1.7	2.6	0.9
Venezuela	2.1	2.0	2.1	2.6	0.5
Indonesia	2.7	3.0	2.4	2.3	-0.1
USA	2.0	1.9	1.9	2.3	0.4
China	2.8	2.8	2.5	2.3	-0.2
Oman	2.5	2.2	1.9	1.9	0.0
Malaysia	1.7	1.8	1.7	1.9	0.2
Canada	1.2	1.6	1.8	1.8	0.0
Kuwait	2.5	2.5	2.1	1.8	-0.3
Total top 20	142	136	129	119	-10
Rest of the world	20	21	19	22	3
Global flaring level	162	157	148	140	-7

Note: From a study commissioned by the World Bank-led GGFR partnership and carried out by the US National Oceanic and Atmospheric Administration (NOAA).

According to the satellite estimates, Angola flared about 3.1 bcm in 2008. This project will aim to reduce gas flaring in Angola by some 75% over the next few years, with a reduction in CO_2 emissions equivalent to 9 million tonnes per year.

Project sponsors

Angola LNG is an integrated gas utilisation project encompassing offshore and onshore operations to monetise gas resources from blocks located offshore of Angola.

The Angola LNG Project partners are Chevron (36.4%), Sonangol (22.8%), Total (13.6%), BP (13.6%) and ENI (13.6%). Chevron and Sonangol serve as co-project leaders. All current sponsors of Angola LNG are partners in the World Bank-led Global Gas Flaring Reduction partnership (GGFR), and have expressed a commitment to reduce gas flaring to minimum levels whenever economically possible.[1]

Sonangol is the owner of all associated and non-associated gas for development purposes under Angolan law and will provide these resources to the project. Approximately 28 mcm per day of associated gas combined with non-associated gas will be collected and transported from offshore production facilities to an LNG plant to be built on a 240 hectare site south of the Congo River on Kwanda Island, near the town of Soyo, in the Zaire Province of northern Angola.

The gas (associated and non-associated) will be transported to onshore processing facilities through pipelines, which will be buried along their entire onshore length. The plant will initially have one train and the expected production will be 5 mtpa of LNG and related gas liquid products as well as supply of up to 3.5 mcm/day for Angola's domestic gas needs. LNG will be exported via tankers to the Gulf LNG Energy (GLE) regasification facilities in the United States with

1 See *International Gas*, April 2009, pp200-207 for an article on the GGFR.

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The project is expected to facilitate continued offshore oil development by providing a long-term commercial regional solution for associated gas. It is expected to provide significant benefit and stimulus to the local and national economy and is accordingly of strategic importance to Angola. The project is also of substantial importance to the other sponsors as it will provide a long-term solution for surplus associated gas from several blocks which cannot otherwise be managed on-block.

Furthermore, the NEPAD (New Partnership for Africa's Development) Spatial Development Initiative has identified the Bas Congo corridor (comprising northern Angola, the Bas Congo province of the Democratic Republic of Congo and southern Republic of Congo) as one of the most promising new development clusters in Africa. The reason is the region's combination of rich energy resources, including the Angolan gas fields and the vast hydro-electric potential of the Inga site on the Congo River, combined with rich mineral deposits and the potential for the further development of industries such as aluminium smelting, magnesium, phosphates and fertilisers, petrochemicals and cement.[2]

History and key milestones

In 1997 Sonangol and Chevron (then Texaco) initiated a joint feasibility study to assess utilisation of associated gas being flared or anticipated to be flared from the deepwater blocks under development south of the Congo River.

In late 1999 Sonangol selected the LNG project as the preferred option, after studying and considering other alternative potential gas utilisation opportunities such as gas-to-liquids and power generation.

Then, in 2004, the project sponsors to the Participation Agreement developed and entered into a Memorandum of Understanding on regulatory framework, corporate structure, fiscal matters and related project issues.

Finally in December 2007 the project sponsors – Chevron, Sonangol Gás Natural, Total, BP and ENI – reached a Final Investment Decision (FID), and signed an investment contract with the Ministry of Petroleum and Sonangol EP. At the same time the investors signed the agreements for the supply, sale and regasification of the gas.

Globally that same year at least 14 LNG projects were meant to reach FID, but only two did: Pluto in Australia and Angola LNG.[3]

Project commercial structure

Angola LNG has established four independent companies, all with shareholdings in current working interest proportions. These companies are:

- Angola LNG Limited (ALNG): ALNG is the principal entity for executing the project. It holds the rights granted to the sponsors and owns the assets of the project.
- Angola LNG Operating Company (OPCO) or Sociedade Operacional Angola LNG: OPCO will develop and operate the LNG plant and non-associated gas fields, together with the associated gas and non-associated gas pipeline networks.
- Angola Gas Pipeline Company (SOMG) or Sociedade de Operações e Manutenção de Gasodutos: The right/obligation to operate the pipeline networks will be granted initially to OPCO and then contracted to SOMG under a Pipeline Service Contract to operate at cost on a no-profit/no-loss basis.
- Angola LNG Supply Services LLC (ALNGSS): ALNGSS will conduct the downstream activities for the project.

2 US-Africa Infrastructure Conference on Regional Strategies: The Case for a Resource-Based Spatial Development Programme, September 28, 2006, presentation by Mintek.

3 Presentation by KMPG Angola, February 2008.

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Potential success factors of Angola LNG

In this section, we will briefly describe other major aspects of Angola LNG that show not only why it is such a unique project but also why it is a feasible and viable one, starting with the political willingness and financial readiness of all project sponsors involved.

As noted earlier all current sponsors of Angola LNG are partners in the World Bank-led Global Gas Flaring Reduction Partnership, created in 2002 during the Summit of Sustainable Development in Johannesburg. As GGFR partners, they have expressed a commitment to reduce gas flaring to minimum levels whenever economically possible. The goal of GGFR is to facilitate dialogue and cooperation between governments and companies so that they can find synergies and joint resources to reduce gas flaring and unlock the value of wasted natural gas.

Sources for the project

The primary gas supply source for the project is associated gas. Non-associated gas will be utilised to provide supply when there is inadequate contracted associated gas to fill the LNG plant capacity. This supply hierarchy is aligned with the strategic objective of the project's sponsors to protect oil operations by providing offtake for surplus associated gas.

It is expected that this combination of associated gas and non-associated gas will adequately supply the plant during a 30-year period. All blocks have committed to an initial seven-year production profile. Studies are still underway to identify a start date for the non-associated gas phase.

Once the gas is processed, 3.5 mcm will be delivered to Sonangol every day as part of the project's domestic gas commitment. The first LNG cargo is to be produced in 2012.

During liquefaction the liquids will be extracted. This is a critical component of the revenues (approximately one-third). While the domestic butane is to be sold to Sonangol, the LPG and condensates are for export sales.

Associated gas pipeline network

The associated gas pipeline network is to be constructed by the associated gas block operators under the terms of their concession/licence agreements. The network will operate on a "blended" basis with regard to the management of contaminants (principally CO_2) in the commingled stream specification at entry to the LNG plant. Implementation of the offshore sections of the associated gas pipeline network will be carried out by the block operators.

ALNG Ltd and Sonangol are the only two shippers holding pipeline capacity on the network as agreed in the Gas Transportation Agreement. ALNG's firm transportation capacity will be the total capacity in each line, less what has been reserved for Sonangol, who may later elect to sublet its capacity in the network to other shippers under commercial terms to be agreed between such parties and Sonangol.

LNG plant

The LNG plant and associated facilities to be developed include the following major activities:

- The development of the LNG plant, installation of a construction camp and associated facilities on Kwanda Island; and
- The operations staff residential housing project.

The site location was chosen from four options identified in the Soyo area. The chosen site on Kwanda Island represented the "best shipping" site and was selected on the basis of: lowest environmental and socioeconomic risk; lowest safety/operability risks; highest conformance to World Bank guidelines; and technical suitability.

In choosing the Kwanda Island site, it was recognised that site preparation would need to commence prior to the FID if the overall project schedule was to be maintained due to the require-

Dredging operations underway for the Gulf LNG receiving terminal in Pascagoula, Mississippi.

ment to dredge and reclaim significant land and sea (river) areas. The dredging and reclamation contract was awarded to a consortium consisting of a joint venture between Boskalis International and Jan de Nul Dredging in September 2006. Dredging work has progressed well and the last sand placement was made in May 2008.

The LNG plant front end engineering and design (FEED) was based on a sponsor-provided outline basis of design. The overall LNG plant design also incorporates provision of up to 11.2 mcm/day of non-project pipeline gas delivered to Sonangol's planned associated gas pipeline network.

Bechtel was chosen as the engineering, procurement and contracting (EPC) firm following a competitive technical, commercial and economic bid evaluation. The LNG plant process design is based on the ConocoPhillips Optimised Cascade Process and a licensing agreement was executed between ALNG Ltd and ConocoPhillips.

Project sponsors also agreed to build housing units required for the EPC phase workers on Kwanda Island (about 6,500 workers including management and services personnel).

In addition to the main LNG plant and construction worker housing, project sponsors agreed to build a residential housing complex for the Angola LNG workforce who will be responsible for operating and maintaining the LNG plant.

Marine transportation

For Sonangol its participation in shipping is a strategic requirement and therefore efforts were made to integrate into the project shipping arrangements using a consortium sponsored by Sonangol. In June 2007 it was agreed to charter seven LNG carriers for the project:

- Four time charters to a consortium comprising Mitsui, NYK Line and Teekay Shipping for the construction of four 160,400 m^3 LNG carriers to be delivered in the second half of 2011 from the Samsung Heavy Industries shipyard; and
- Three time charters consisting of 160,500 m^3 LNG carriers from a consortium consisting of

Sonangol Shipping Holding Limited together with Chevron Shipping as its operator. The Sonangol ships are to be constructed by Daewoo Shipbuilding and Marine Engineering.

Regasification terminal

The target market for Angola LNG is the United States. Regasification capacity has therefore been secured at the GLE terminal being constructed in Pascagoula, Mississippi, where Sonangol is one of the shareholders and ENI has contracted capacity. The shareholders in the GLE terminal are Sonangol (20%), Crest Group (30%) and El Paso subsidiary Southern Natural Gas (50%), with the latter acting as operator. Site preparation activities commenced in 2008.

Product sales and offtake

As part of the project's life cycle, there is the opportunity of selling NGL products (LPG and C5+) to sponsors as well as selling domestic butane to Sonangol.

ALNG will enter into a sales and purchase agreement with ALNGSS to agree the terms and conditions for the products offtake.

Conclusion

While the international community is examining ways for reducing greenhouse gas emissions and moving toward low-carbon economies to mitigate the impact of climate change, natural gas is increasingly becoming an attractive and important component of the energy mix in countries around the world.

As some industry representatives have noted over the past few years, natural gas is becoming a "bridge fuel" until other alternative sources of energy, like wind or solar, become sufficiently reliable and cost-effective.

One of the major attractions of natural gas is that it is the least polluting amongst the fossil fuels. Yet, in several oil and gas producing countries, vast amounts of natural gas are still being flared or wasted as demonstrated by the global satellite estimates mentioned earlier.

In order to address this wastage, the World Bank Group is supporting important initiatives that contribute toward reducing CO_2 emissions and improving energy efficiency. One of these initiatives is the GGFR.

GGFR partners have established a collaborative Global Standard for gas flaring reduction. This Global Standard provides a framework for governments, companies, and other key stakeholders to consult with each other, take collaborative actions, expand project boundaries and reduce barriers to associated gas utilisation.

While the GGFR has already achieved some important milestones, a significant reduction of global gas flaring still needs to be achieved in order to have the desired impact.

Initial achievements already demonstrate that gas flaring and venting reduction efforts are not only relevant in today's energy context but also viable as demonstrated by several countries and companies, and desirable for their obvious environmental and economic benefits.

Angola LNG aims to unlock the value of currently wasted natural gas by improving energy efficiency, expanding access to energy and contributing to climate change mitigation, hence promoting sustainable development.

Once operational, Angola LNG should serve as a vivid example of what countries and companies can do to reduce gas flaring within a collaborative effort between public and private sector stakeholders.

António Órfão is CEO of Sonangol Gás Natural, a subsidiary of Sonangol EP. Jean-Eric Molinard is Advisor to the Global Gas Flaring Reduction Partnership (GGFR), Bent Svensson is GGFR's Programme Manager and Mauricio O. Ríos is GGFR's Communications Officer. For more information on Angola LNG, visit: www.angolalng.com, and for more information on global gas flaring, visit: www.worldbank.org/ggfr.

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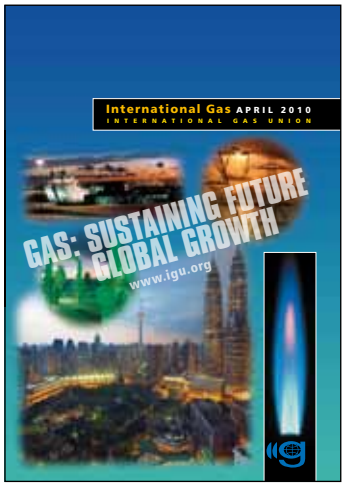
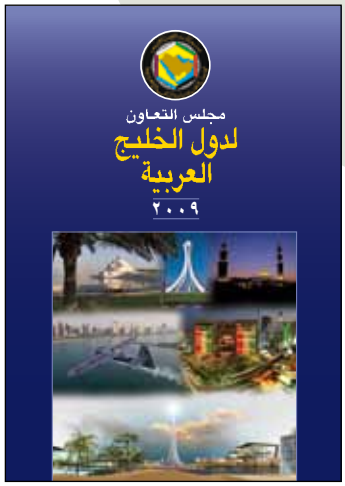




The Prospects for Gas Market Integration between Russia and China

By Timothy Boon von Ochssée and Irina Mironova

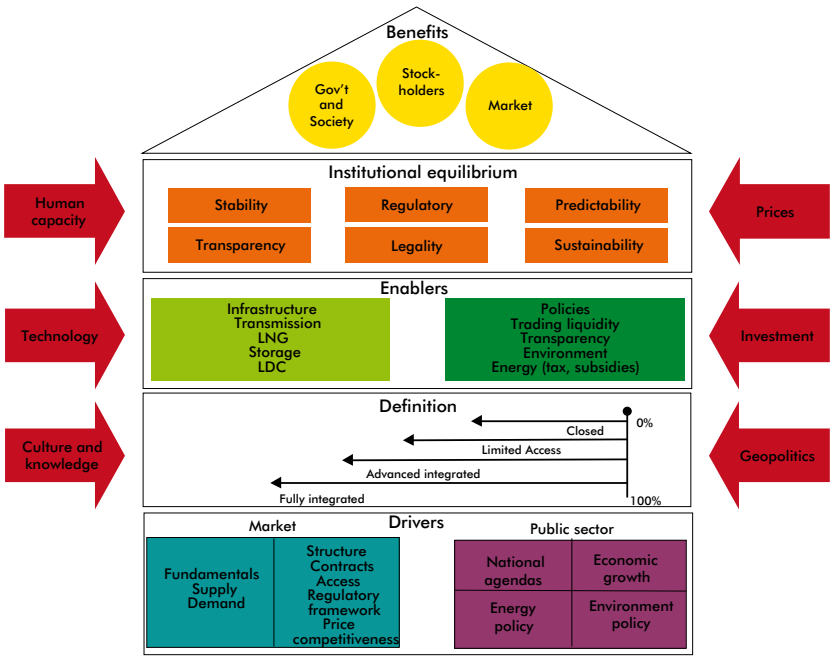
1 Introduction

This paper is a review of the main challenges facing gas market integration (GMI) between Russia and China. With vast gas reserves in the Far East, Eastern and Western Siberia, there is ample resource potential in Russia to satisfy Chinese gas needs for several decades. For Russia, GMI would offer diversity in exports, in the form of a very large potential new gas market. It would also help fuel domestic gas development, with exports to China cross-subsidising the development of local distribution networks and pipeline interconnections in a campaign designed to economically develop Russia's Siberian and Far Eastern provinces. Oil and gas supplies from Russia are a more stable source of supplies for China than imports from Africa or the Middle East.

In technical terms and as far as financing is concerned, the projects are very ambitious. If its eastern gas export programme were to materialise, Russia's gas pipeline exports would have the potential to impact the interregional gas balance from Asia to Europe. From the perspective of IGU's GMI model *(see Figure 1)*, which was presented at the World Gas Conference in Buenos Aires, the Russian-Chinese projects are a compelling and interesting case in point. Projects designed to bring Russian gas to needy Chinese markets have been on the drawing board for

THE IGU GMI MODEL

The GMI model is a simple, basic roadmap showing how supplier(s) and buyer(s) can evolve from a closed market to a fully integrated market. Given market and public sector drivers behind any given project, a project will advance to some level of integration guided by so-called enablers and policies. Next, an institutional equilibrium involving regulatory issues, transparency, legal and contractual issues, etc., assures that governments, markets and stockholders benefit optimally from the level of market integration. Meanwhile, external forces such as price signals, technical and geopolitical barriers, as well as the availability of financial resources and human capacities can impede and weaken market integration, or they can stimulate and strengthen it.



BELOW
Figure 1.

Sakhalin in Russia's Far East is one of the country's new gas provinces.

years, yet no trade has materialised between the countries. The idea of exporting eastwards, i.e., a diversification of export markets to China, if it is realised, would be a major break from a past in which Gazprom was captive to European gas markets. Moreover, many in Moscow believe that Russia is resilient enough to couple both the EU energy markets and those of Asia to the growing Russian export economy.

This paper is organised in such a way that the IGU model serves as a "lens" through which to see the China-Russia case. Section 2 is a background overview of Russia's gas export ambitions in the East. Section 3 is a brief sketch of the opportunities and challenges for gas in China. Since geopolitics plays an important role in the background of this case, section 4 briefly reviews the most important relevant aspects of the geopolitical relationship between Russia and China. Section 5 summarises the main bottlenecks to the Russia-China energy relationship, in particular as far as natural gas is concerned. The conclusion looks at the implications for gas market integration.

2 Russia's eastern gas export ambitions

Russia's gas resource base and export priorities

Of the few major gas suppliers in the world, Russia is the largest, holding some 43.30 tcm of gas reserves, which is roughly a quarter of the world's total conventional gas reserves. There are three categories of major gas fields located in various provinces: (1) major gas fields which are in decline; (2) those which have reached a plateau production profile; and (3) the "new" gas fields, often in new gas provinces at a considerable distance from Russia's current infrastructure. While for decades the bulk of Russia's gas production has been provided by the Nadym-Pur-Taz area in Western Siberia, the gas resources located in Russia's Eastern Siberia and the Far East have yet to be touched.

Indeed, multi-trillion cubic metre gas deposits are concentrated mostly in what Gazprom has declared the four main centres: Krasnoyarsk, Irkutsk, Sakha and Sakhalin. The bulk of production for Russian domestic consumption and exports is expected to come from Sakha and Sakhalin,

MAIN POTENTIAL MARKETS FOR RUSSIAN NATURAL GAS IN THE ASIA-PACIFIC REGION

Source: Gazprom.

ABOVE
Figure 2.

while the former two will play a marginal role. Yet all of Russia's gas production and that of the former Soviet Union has been developed for export to European markets, from resources located in the Western areas of Siberia and European Russia west of the Urals; this predisposes Russia's gas exports to flow westwards rather than eastwards.

Russia's prioritisation of gas resource use is as follows: 1) domestic use of gas, including power generation and potentially, gas-based industries; 2) exports by pipeline to European gas markets; and 3) pipeline exports to Asia and LNG exports. The European gas markets will remain a key source of important revenues for Gazprom and the Russian State for many years to come. For now, especially in the aftermath of the 2008-2009 economic crisis, Gazprom appears to be watching and waiting when it comes to an investment commitment to the eastern gas export markets.

The "Eastern imperative"

As early as the 1970s and 1980s, Soviet visions arose of exporting large volumes of oil and gas to China and other Asian markets. During the 1990s, a three-stage development concept had already emerged, the first being regional gas development around Irkutsk, the second stage encompassing wider Eastern Siberian development and only the third envisaging exports. The institutional basis for gas development in Eastern Siberia and the Far East changed fundamentally in 2002 when the Russian government issued a decree instructing the Russian Ministry of Energy and Industry and Gazprom to draw up a programme for a unified system of production, transmission and distribution of gas in Eastern Siberia and the Far East, taking into account the possibility of exports to China and other Asia-Pacific countries. The Russian Ministry of Industry and Energy's *2007 Eastern Gas Programme* focuses on major resource development in these centres. Imperative in the Russian view is the development of eastern gas provinces in order to develop the economies of the mostly thinly populated areas of Russia's Far East. In fact, export issues are inseparable from the discussion of Russian regional development, because it is the money from foreign counterparts invested upstream that will assist local infrastructure development which is one of the top priorities in Russian energy policies.

Pan-Russian integration

Russia's export priorities for its western gas resources will remain focused on European markets and, of course, the domestic gas market. Satisfying domestic Russian gas demand, mostly in western or European Russia, is an important

political priority for Moscow.[1] The same need drives the development of the country's eastern gas resources, which would be followed by the construction of links to integrate them with the western regions. This would expand Russia's gas production and transport infrastructure into a network of interconnected pipelines and production sites stretching from Europe to China and the Koreas, at least in theory.

The important role of China as a buyer

Regional, domestic integration by expanding the Unified Fuel System (UFS) is one dimension of the equation, while cross-border connections with emerging markets such as China represent another.[2] A number of pipeline projects are slated to bring Russian gas from Krasnoyarsk, Irkutsk, Sakha and Sakhalin to China by pipeline, with the so-called Altai pipeline in Western Siberia (crossing the Russian-Chinese border between Mongolia and Kazakhstan), and two pipelines entering China from Russia's Far East *(see Figure 2)*. The key point in this discussion is that domestic gas market integration for Russia's Far East can be developed only if exports to Asian markets materialise as well, in particular exports to China.[3] The reason is simple: only exports to China are able to finance the long-term development of these resources since domestic Russian gas demand in Russia's Far East is likely to be insufficient[4] to warrant full development of these resources.

1 Although there is another objective of reducing the share of gas in the primary fuel mix in Russia's western regions, where currently gas accounts for as much as 55%.

2 In parallel, the establishment of LNG export options in Sakhalin and later in Shtokman will expand the scope for commercial latitude to include a global dimension for Russia.

3 The 2003 Russian Energy Strategy placed significant emphasis on the development of Far Eastern gas resources, with the possibility of expanding production up to 106 bcm by 2020 and, during the same year, aiming for the region to become accountable for 15% of total Russian gas exports.

4 According to Stern, the gas market in East Siberia and the Far East is expected to grow to 27 bcm in 2020 and 32 bcm in 2030, which could rise to 41 and 46 bcm, respectively (when account is taken of the rising demand of gas processing industries) [Stern and Bradshaw 2008, pp. 253-254].

3 The potential of gas in China

Just as in the case of oil imports, China is a relative newcomer to the natural gas market as far as imports are concerned when compared with South Korea or Japan. The electricity crisis of 2003-2006 and the doubling of the national economy since 2000 largely reflect the rise in consumption of natural gas by an average 14% per year. China became a net oil importer in 1993, and since the early 2000s has had enormous impact on world oil prices thanks largely to its double digit economic growth. China possesses gas reserves of 1.88 tcm[5] and since 2007 domestic Chinese consumption has exceeded production.

Coal is China's most important fuel, accounting for 70.2% of primary energy consumption in 2008. Some 55% of coal is used for power generation, 26% by industry, 4% by residential uses and 15% in other end-uses. Gas only had a 3.6% share of China's energy mix in 2008, although consumption grew from 27.2 bcm in 2000 to 76.1 bcm in 2008.[6] Nevertheless, the domestic Chinese market remains at a formative stage. Over the past years China has carried out a number of reforms in electricity pricing to make gas more attractive to power producers. As energy production costs rose rapidly across the board in China during the late 1980s and early 1990s, leading to increasing financial losses for energy producers, the Chinese government allowed prices to rise to internationally comparable levels.

Despite the predominance of coal in the energy mix, the reason why China potentially stands to be

5 The bulk of China's reserves are found in central and western parts of the country, primarily in Sichuan in central China, the Ordos Basin of Shaanxi, Inner Mongolia, Ningxia, Qinghai and Xinjiang in the western, Central Asian part of the country. China also possesses abundant reserves of coal-bed methane (CBM). However, despite favourable development policies, development of CBM in China has lagged behind that of other countries such as the US and Australia. Further gas reserve discoveries were made in 2006 and mid-2007 by CNPC (Sinopec) and CNPC, respectively, amounting together to some 1 tcm [Fridley 2008].

6 China's reliance on coal as an energy source stems from the fact that it has huge coal reserves of 114.5 billion tonnes, some 13.9% of the world's total.

The SCO's members are China, Kazakhstan, Kyrgyzstan, Russia, Tajikistan and Uzbekistan.

a major growth market for gas is that the use of coal for power generation, even at current levels, is no longer environmentally sustainable for China's urban areas. China's long-term plan for natural gas development was laid out in the *National Energy Policy and Strategy* report from the State Council's Development Research Centre in 2004 and in other documents of the Council, which recommended substituting natural gas for coal, primarily in power generation and in residential use. It restated an earlier goal set for the 10th Five Year Plan (2001-2005) of raising natural gas to 10% of China's energy mix in 2020, based on expectations of economic growth. In China, the power sector had reduced investment in the late 1990s due to mild economic growth, so that when economic growth took off in the early 2000s it faced a 35 GW shortfall in 2004. Environmental considerations thus also play an important role, with Chinese aims to improve air quality around Chinese cities.[7]

A framework agreement regarding two gas pipeline projects was signed between Gazprom and China National Petroleum Corporation (CNPC) during the visit of Russian Prime Minister Vladimir Putin to Beijing in October 2009. One project is from Western Siberia and the other from gas fields further east, with a projected 60 bcm per year of Russian gas to be exported to China by 2015. This is somewhat less than half of what Russia exports to European gas markets. However, this agreement roughly repeated a memorandum of understanding of 2006 (adding time frame but no price formula), thus little real – if any – progress has been made in gas relations between the two countries. On the one hand, from a Russian perspective the degree of uncertainty in demand for Russian gas in China is great because of China's abundant coal reserves, while on the other hand China's determination to increase the use of gas in its energy mix for environmental and health reasons appears firm.

4 Geopolitical relations between Russia and China

Central Asia and the SCO

Russia and China are Eurasian neighbours, and they share a common interest in limiting and eroding US influence in Eurasia. Both countries have established the Shanghai Cooperation Organisation (SCO) as part of an effort to regu-

7 Indeed, the Chinese government has made cleaner air in China's cities a major energy policy priority; air pollution was a major concern during the 2008 Olympics in Beijing.

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late common interests in Eurasia together with their Central Asian neighbours. From the Russian perspective, the SCO is part of persistent efforts to adapt its foreign policy to the post-Soviet environment, including realignment with respect to China and at the same time Central Asia. Indeed, the SCO functions as a consolidating factor in the Russian-Chinese relationship by offering a vehicle to manage their affairs, acting as a forum for compromise and agreement either through official programmes or tacitly. The SCO has steadily grown from a multi-lateral security framework to include energy cooperation as well.

During the 2007 SCO summit in Bishkek, Kyrgyzstan, the SCO leaders agreed to create a "unified energy market" that would bring energy resources from member states rich in oil and natural gas to those that need such resources to promote their development. Observers and a communiqué signed by the parties hinted at an SCO Energy Club: a combination of interests reflecting the fact that the Central Asian countries, Iran and Russia have energy resources while China requires these resources in order to sustain its economic growth. Putin had lobbied hard for such an agreement ahead of the summit, saying that greater energy cooperation would be a powerful impetus to regional projects in the interests of all SCO member states.

Indeed, in milestone meetings involving the organisation's members as well as SCO observer countries in 2006 and 2007, the list of priorities in the organisation's agenda reflected the importance member states now give to energy, transportation and telecommunication links inside the SCO framework, rather than just cross-border security issues. This was further supported by the 2009 summit in Ekaterinburg, where the key role of energy in economic recovery was acknowledged. Moreover, during the 2010 Peace Mission (joint counterterrorism exercises), particular attention will be paid to measures to protect energy infrastructure.

Other actors

US unilateralism has merely driven both countries closer together since the early 2000s, but not as part of a natural alliance. The two countries' energy relationship should thus largely be seen as part and parcel of the geopolitical balance between them and the US. Had the US pursued a more "Kissinger-style" policy of playing both Eurasian powers off against one another, their energy relationship may well never have materialised.

With regard to Europe, the question is whether the EU will consider Russia as a strategic supplier or whether, both as a supranational entity and at a member state level, it will try to move away from Russian gas imports as much as possible. This could provide Russia with the rationale for further reflection as to whether it should change its Europe-oriented plans and divert part of the reserves to the Chinese market (e.g., gas from Western Siberia to China via the Altai pipeline).

Bilateral relations

As opposed to the difference in market ideology between the EU and Russia, Russia and China share the same views on the role of the state in the economy, especially in the energy sector.[8] For Russia, China's more state-driven approach to energy relations may be more expedient for achieving a mutually beneficial energy relationship than is the case with the EU. China's transition to a more market-oriented economy has been much

8 China and Russia share three elements in their industrial strategies: state-directed long-term economic development, state mobilisation of resources to achieve these goals within the framework of a market economy, in part through ownership of key market-players (or national champions) and political authoritarianism. Both China and Russia look to the state to play a key role in adapting their economies to challenges with the rest of the world, and they appear to be converging on views as to how to develop their economies in general and their bilateral relations in particular [Ferdinand 2007]. However, this does not always prevent misunderstandings from occurring in Russian-Chinese relations. Moreover, Gazprom's approach / monopoly might ultimately undermine the implementation of formidable projects, such as the Eastern Gas Programme [Poussenkova 2009].

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more gradual than has been the case for Russia. Moreover, both countries view the US presence in Central Asia with suspicion and pursue policies to limit US reach in the region.

Yet there are reasons why both Russia and China may also find themselves at loggerheads from a geopolitical perspective:

- The first important obstacle is socio-psychological interaction between the citizens of both countries. Russia mistrusts China, fearing a long-run Chinese take-over of Russia's eastern-most provinces, where many of Russia's oil and gas riches lie.[9] China's staggering economic growth, its large population and growing military power are thus seen as a major threat to Russia's territorial integrity in the East. On the other hand, a lack of knowledge is making the situation more complicated on both sides. For example, not every Chinese (even in the border regions) knows about the border issue settlement, but everyone knows about the aggressive policies of Russian tsars. Indeed, in some towns Russian tourists are advised to stay inside during the hours of darkness for safety reasons.
- Although stronger Chinese-Russian ties could present greater challenges to other states through the set-up of some type of Beijing-Moscow condominium over Central Asia, several factors, which go beyond the scope of this paper, make the formation of such a bloc an unlikely prospect.
- The Chinese-Russian relationship is in a way an "axis of convenience", an inherently limited partnership conditioned on its ability to advance both parties' interests. Kotkin argues that the relationship may allow China to extract strategically important natural resources from Russia and extend China's regional influence, but it affords Russia little more than the pretence of a multi-polar world in which Moscow enjoys a central role.

5 Obstacles to Russian-Chinese gas market integration

Despite the apparent drive within the SCO to develop common energy interests and open intentions on both the Chinese and Russian sides to develop a more salient energy – and particularly gas – relationship, no gas export projects have yet materialised. This is all the more striking if one considers the staggering potential of both supply and demand for gas in Russia and China, respectively. Obviously, the scale of investment required to develop regional market integration, i.e., building upstream production facilities, transport pipelines and pipeline networks, compressor facilities, etc., is a major technical, organisational and financial challenge, on top of the fact that these investments are largely greenfield ones. Having said that, a number of other obstacles specific to Russian-Chinese disagreements over gas-related issues have impeded real, on-the-ground progress in this regard, most importantly these consist of the following:

- *Pricing issues:* From the outset, pricing has been a serious point of contention between Russia and China for Russian gas sales to China. During the seller's market years of 2004-2008, Russia had been pressing for an oil-indexed price in its negotiations for gas supplies to China, prices on a par with the prices it charged its European customers. In the aftermath of the international financial and economic crisis of 2008-2009, which has led to a buyer's market for gas at large, China's position has improved markedly vis-à-vis

9 Their relationship is characterised by pervasive mistrust, rooted in historical grievances, geopolitical competition and structural factors [Lo 2008]. Eastern parts of Russia such as the Far East have already seen a large influx of Chinese migrants – in fact, some are talking about the Russian Far East being de facto part of the north-east Asian economic community [Larin 2008]. Indeed, tensions exist over illegal Chinese immigration into Russia, as well as the inability of Chinese authorities to halt the spillover of pollution from China into Russia. The Russians worry in particular about the long-term implications of China's exploding population for Russia's demographically and economically stagnant eastern regions [Weitz 2008].

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The Turkmenistan-China pipeline began operations on December 14, 2009. From left in the foreground, Chinese President Hu Jintao, Kazakh President Nursultan Nazarbayev, Turkmen President Gurbanguly Berdymukhamedov and Uzbek President Islam Karimov turn on the flow of gas at the Samandepe gas field in Turkmenistan.

Russia, especially with the dampening effect the crisis has had on shorter-term LNG prices. During 2008, China's willingness to pay market-based prices for LNG from Australia and, recently, Qatar, had come to Russia's negotiating advantage. For China nevertheless, LNG has only been a marginal source of gas limited to its most affluent cities and urban centres, such as Shanghai and Guangdong. It is unlikely that LNG can satisfy all of China's gas needs, particularly in heavy industry, petrochemicals and power generation, which leaves quite some room for pipeline gas flows from Russia and/or Central Asia. Central to China's pricing demands vis-à-vis Russia has been a stronger linkage between gas and coal prices rather than oil indexation.

- *China's opening into Central Asia:* China has pursued a gas import and pipeline construction deal with Turkmenistan as well as Kazakhstan and this has a major impact on potential volumes from and deals with Russia, which would have to compete with Central Asian volumes. Indeed, the Chinese choice of Central Asian gas through the Turkmenistan-Uzbekistan-Kazakhstan-China pipeline (for simplicity, the Turkmenistan-China pipeline) instead of Russian gas through the Altai pipeline (for China's West-East pipeline) from Western Siberia seems to have improved China's bargaining position vis-à-vis Russia and have diminished the prospects for the Altai pipeline. The Turkmenistan-China pipeline stretching from eastern Turkmenistan to Xinjinang Province in China was put into operation on December 14, 2009 and is to reach a designed capacity of 40 bcm by 2013-14. China looks to Central Asia as a potential long-term source of both oil and gas and has been developing closer relations with the region through investment and political exchange as it increasingly sees the region as its own "back yard". China's manoeuvring into Central Asia provides China (and the Central Asian countries in their own negotiations concerning their gas exports to Russia) with leverage over Russia. China's presence and activities in Central Asia come as a major geo-strategic challenge for Russia, which itself relies on the region for some of its gas exports. While export flows from Central Asia to China clearly further market integration in general, they do represent

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The Chinese prefer direct access to upstream resources and CNOOC is a shareholder in the Tangguh LNG project in Indonesia (ABOVE) which supplies the LNG terminal at Fujian (BELOW).

a challenge to the specific case of market integration between Russia and China.

- *"Designated" fields:* The Chinese clearly prefer direct access to upstream resources and direct construction of infrastructure rather than adopting the Russian model of selling the gas at the border of the importer. Indeed, China aims to own and purchase gas in and from specific or "designated" fields. This comes as a problem for Russia, since Russia does not want to cede direct control and ownership over its resources to China, or any other foreign party for that matter. In European gas markets, Gazprom has the opportunity to expand its presence in Europe, by selling gas directly downstream through wholly-owned subsidiaries or partnerships with downstream energy companies (i.e., mid-streamers[10]). In the Chinese case, however, Chinese government-controlled companies, such as CNPC, are likely to want to purchase gas directly at the Russian-Chinese border as

10 Consider also the GMI case study on energy relations between Russia and Germany in the IGU Magazine, April 2008, pp. 138-142.

well as seeking upstream ownership and/or control of Russian gas resources. There appears to be little prospect for Russian downstream control in the Chinese gas market.

- As IEA analysis points out, resources and infrastructure alone do not provide a sufficient precondition for the start of gas trade – the demand factor is the one which justifies the investment along the gas value chain. International experience shows that it is crucial to develop the gas-consuming market before the arrival of the gas. In the Chinese case, this means that for the Western route there would be a solution in the form of the West-East pipeline. However, now the gas for it is supplied by Turkmenistan. For the Eastern route this means that the demand is yet to be ascertained.

Even though potential gas market integration between Russia and China faces substantial obstacles, they are manageable. There is no impediment that seems truly insurmountable; it is rather a question of creating the right framework for the financial and organisational resources needed to make market integration work in this case.

6 Conclusion: implications for gas market integration

We can conclude that Russia has ambitious plans to gasify its eastern regions and to embark on an eastern export campaign. The advent of Russian LNG production and the rise of new markets, such as China and India, amongst others, are opening new possibilities and opportunities for Russia. The country is well-positioned geographically to capitalise on a diversity of markets, spanning from Europe in the West to Asian markets in the East. For Russia, this would provide much needed security of demand. Russia's emerging gas export strategy towards China would be a landmark initiative involving a new gas market and untapped gas resources.

Russia would be able to affect the gas supply balance across various continents by pipeline in a manner that mirrors the interregional effects of LNG, thus becoming the "Qatar" of pipeline gas by tapping into different markets simultaneously as Qatar has begun doing, i.e., by means of a multi-market LNG-based strategy.[11] Despite the apparent logic of Russia's gas export programme as described above, Gazprom's plans may perhaps be overambitious, born out of boldness more than ideas backed by commercial feasibility. There are also project-level risks in this regard, risks which many cross-border projects in the gas industry are plagued by. Russia still faces considerable challenges in developing its potential eastern exports as greenfield projects.

China has been importing gas since 2006. For China, Russia could be a source of stable, predictable and affordable gas flows. The potential for gas demand in China is present at a very large scale even though it must still compete against plentiful coal reserves. Environmental exigencies are pressuring Chinese policy-makers to turn to gas, amongst other sources.

The role of geopolitics cannot be ruled out of the China-Russia case, alas for the gas market integration potential both countries have. China and Russia have a number of common interests in Central Asia pertaining to security, economic and energy issues. The SCO serves as a platform for furthering these interests. Other actors such as Europe and especially the US also have an impact on this region. Bilaterally, Russia and China have had tensions in the past, and Russia mistrusts Chinese intentions in the Far East and fears its rise as a dominant force in Eurasia. Despite many common interests, therefore, the countries are not necessarily natural partners.

A number of obstacles remain to be surmounted, including pricing issues, the sharing of risk and benefits along the gas value chain between both parties and mutual reciprocity issues such as a Chinese desire for upstream control.

11 See the GMI case study on ExxonMobil and Qatar Petroleum in the IGU Magazine, October 2008, pp. 184-192.

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Perhaps most importantly, the changing balance of power in terms of Eurasian gas flows that China has created by venturing into Central Asia in the search for gas supplies also affects Russia-China relations. This Chinese venture has directly impacted the potential for Russian gas in China, as it increases China's leverage vis-à-vis Russia.

The obstacles are certainly manageable, they can be overcome and are not fundamental. At issue is whether China and Russia can implement an agreement when it is reached. The situation for China and/or Russia may change as well. For example, in a not too distant future, China's gas needs may be such that it must turn to Russia and become more amenable in its pricing demands, especially if China is to displace coal in its energy mix. For now, the move towards an integrated Asia-Pacific gas market by means of Russo-Chinese gas trade may well remain a leap too far for some time to come. The financial and economic crisis of 2008-2009 will most certainly have a further impact on both gas demand in China and the financial feasibility of the projects.

From a gas market integration perspective, and especially from the vantage point of the GMI model, the Russia-China case is similar to the Iran-Pakistan-India one.[12] Both cases involve one large potential supplier in the proximity of large emerging gas market(s), where there is a rising need for gas. Yet in each case different external challenges act as inhibitors, barriers to what is essentially an obvious, potentially beneficial relationship for both sides. Geopolitics often plays

12 For an edited version of this case study see the IGU Magazine, April 2009, pp. 234-253.

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a pivotal role in this regard, especially in the Russia-China case. This case demonstrates that once again the GMI model can be used to strengthen the analysis of consumer-producer relations and the relevant obstacles.

This is an updated version of a paper prepared for IGU's Gas Market Integration Task Force during the 2006-2009 Triennium. Timothy Boon von Ochssée is a researcher with the Clingendael International Energy Programme (CIEP), The Hague, The Netherlands, and is currently studying for a PhD at the University of Groningen. Irina Mironova is a former intern at CIEP and a research master student at the University of Groningen. The authors would like to thank Tom Smeenk at CIEP for his valuable comments on an earlier version of this paper.

AUTHORS OF IRAN-PAKISTAN-INDIA CASE STUDY

In previous issues of the IGU Magazine we have published a number of edited case studies prepared by the Task Force on Gas Market Integration which was set up for the 2006-2009 Triennium. A case study on the Iran-Pakistan-India pipeline project appeared in the April 2009 issue of the IGU Magazine, pages 234-253, but its authors were not credited personally. For the record they are Sheikh Nadeem Shahryar, Head of Business Development at Sui Northern Gas Pipelines Limited in Pakistan, and Timothy Boon von Ochssée.

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