



Also, specific presentations were programmed on the following issues:

- An overview of the Chinese gas market;
- Mechanisms for gas price formation in Russia and plans to align domestic with international gas prices; and
- Coordination of information with other Committees, specifically with PGC D.

The main messages of the Amsterdam meeting in terms of the work of the Study Groups are detailed below.

SG B.1 Supply and demand to 2030

The main drivers, threats and opportunities for each region were agreed. It was also agreed that a first draft with the figures resulting from the application of the identified drivers would be available for the next plenary meeting. The evaluation of the impact on future supply and demand from the interaction of drivers and threats is the main challenge SG B.1 is facing.

SG B.2 Gas price formations and trends

It was agreed that the first draft report would be ready at the beginning of September so it could be circulated among Study Group members before the next plenary meeting.

SG B.2 has identified seven different gas pricing mechanisms applicable today around the world; in some regions more than one mechanism are applied. The Study Group still needs to analyse important issues such as the price formation mechanisms which are likely to prevail and to what extent sustained high gas prices could destroy or reallocate gas demand.

An updating of the data on gas prices collected in 2005 to analyse the situation in 2007 is in progress.

SG B.3 Regulation and future industry structure

SG B.3 is working following the lines of the storyboard agreed during the Study Group leaders' meeting held in Madrid in June 2007. Some shared conclusions are:

- Competition is a desirable goal but it is essential making it work without interfering in the operation of the markets; and
- Regulation does not inhibit investment as long as the assets which must be subject to regulation (natural monopolies) are clearly identified and the regime setting out the parties invited to invest and the investment rewards is established.

Next meeting

At presstime, PGC B's third plenary meeting was due to take place in Kyoto, Japan, September 17-19, a venue selected to facilitate the attendance of the largest possible number of Asian delegates. The meeting structure is similar to that of the second plenary, which was held in Washington DC in September 2007. It has been organised to combine the activities of the Committee with visits to Japanese gas and energy institutions and thus offer delegates the opportunity of finding out more about the Japanese gas industry.

● Programme Committee C – Developing Gas Markets

PGC C held its fourth meeting on the resort island of Penang, Malaysia, February 20-22. The event, hosted by the Malaysian Gas Association, brought together members from a diverse number of countries – including Brazil, Bulgaria, Korea, Malaysia, Pakistan, the Russian Federation and Trinidad & Tobago. There were five Russian representatives from Vniigaz and JSC Gazprom.

Moderated by Chairman Dr Mohd. Farid Amin, the meeting updated Committee members on existing and planned cross-border gas pipelines connecting supply sources to emerging gas markets, and on planned LNG import facilities. The meeting also deliberated on the issues and challenges aimed at developing strategic options for developing gas markets and advancing gas utilisation in South, West and Central Asia (covered by Study Group C.1), South America (SG C.2) and South East Europe (SG C.3).

WE ARE DOING THIS FOR **LIFE**



In putting out gas flares in Nigeria, we are pursuing policies that support life, through improving the nation's energy and environmental challenges.

Brass LNG Limited
19, Bishop Abayode-Cole Street, Victoria Island, Lagos-Nigeria
Tel: 01-2700435, Fax: 01-2703315





PGC C members together with Datuk Abdul Rahim Haji Hashim, IGU Vice President (front row, fifth from right) and Ho Sook Wah, CC Vice Chairman (front row, sixth from right)

Lively and frank discussions took place on key issues and challenges such as gas and geo-politics, including the future of energy nationalism, energy supply security, energy mix and accessibility of energy resources, as well as sustainable gas pricing in developing regions. A long-term gas supply-demand outlook for countries in South America through 2030 was presented and discussed by representatives from Vniigaz.

Two key themes surfaced from the discussions:

Firstly, promoting gas market integration required more than just physical capital or cross-border gas pipeline inter-connections to build an integrated gas market. Equally important were programmes that promoted regional energy cooperation and investment in social and human capital in order to create a more sustainable and enduring framework upon which to build an integrated regional gas market.

Secondly, geo-political factors are increasingly important as a driver in influencing the realisation of projects, especially in areas where there are either a number of competing proposed projects plying the same transshipment route, or where gas reserves are within reach of several large consuming markets.

The above themes are true for all the three regions and there ought to be a greater recognition of “inter-dependencies” between countries and regions and the need to forge greater regional cooperation to enhance security of energy or gas supplies. To give two examples, South East Europe is an important corridor for gas flowing from the Caspian and Middle East westwards into Europe, while Central Asian gas is likely to flow to one of three major gas markets – viz., Europe, China or the Indian sub-continent.

Future plans

At presstime, the next PGC C meeting was due to be hosted by ENI in Milan, Italy, September 8-12. Members will be working towards completing the first draft of the reports.

● **Programme Committee D – LNG**

PGC D and its three Study Groups held their last meetings in Brugge, Belgium, March 18-19. Fluxys LNG hosted and the meetings were followed by a technical tour of the Zeebrugge LNG terminal on March 20.

PGC D members including the Chairman, Secretary, Vice Chairman and leaders and

Fuelling the Future



A new dawn is casting its light on the Sultanate of Oman.
At Oman LNG, the power to realise aspirations and build lives is our prime objective. From Oman, we have embarked on a mission to provide the world with a new source of energy, a cleaner alternative to fuel, a brighter future.

Established by a Royal Decree in February 1994, Oman LNG is one of the fastest LNG projects ever developed. With one of the most technologically advanced LNG plants in the world, it is the largest investment project undertaken in the Sultanate of Oman. Most importantly, it heralds a new chapter in Oman's development and diversification of the national economy.

Oman LNG's contributions to society include: Providing schools with computers, dental clinics, laboratories, sunshades and water filters • Contributing to the national economy • Funding the construction of residential units for the community • Sponsorship of training programmes for young Omanis... and many more projects

Oman LNG. Giving people, communities and nations the energy to move forward, to grow and progress.



الشركة العمانية للغاز الطبيعي المسال ش.م.ع.

Oman LNG L.L.C.

ص. ب 560، ميناء الفحل، الرمز البريدي 116، سلطنة عُمان. المكتب الرئيسي - هاتف: 24609999 (+968)، فاكس: 24609900 (+968).
مكتب مجمع قلهاة - هاتف: 25547777 (+968)، فاكس: 25547700 (+968). الموقع على شبكة الإنترنت: www.omanlng.com

P.O. Box 560, Mina Al-Fahal, P.C. 116, Sultanate of Oman. Head Office - Tel.: (+968) 24609999, Fax: (+968) 24609900.
Qalhat Complex Office - Tel.: (+968) 25547777, Fax: (+968) 25547700, Website: www.omanlng.com



PGC D members in session in Brugge (ABOVE). The meetings were followed by a technical tour of the Zeebrugge LNG terminal (BELOW).

secretaries of the Study Groups were in attendance.

March 18 was dedicated to work and discussion sessions for each of the three Study Groups. The following day, PGC D held its plenary meeting during which the progress of each Study Group was reported in a thorough manner to all members, followed by a question and answer session.

The Vice Chairman, Alaa Abujbara, gave an update on the Committee report “The Worldwide LNG Industry at the end of 2008” and presented the draft answers to the 2030 Natural Gas Industry Outlook study. Following the latter presentation, there was a productive discussion on the way forward and how best to meet the deadline while maintaining the most up to date. Hiroshi Hashimoto, a natural gas analyst from IEA, attended the session to discuss and ensure consistency with the work of PGC B and IEA. Action items included Study Group Leaders developing draft response to questions posed to each of their groups by the 2030 Outlook Study Team.

At presstime the next PGC D meeting was due to be held in Malaysia, September 16-19.

SG D.1 LNG quality and interchangeability

An article by the Study Group leader Martin Josten providing an interim report on SG D.1’s progress was published in the last issue of the IGU Magazine (see April 2008 issue pages 128-136).



Concept to Reality

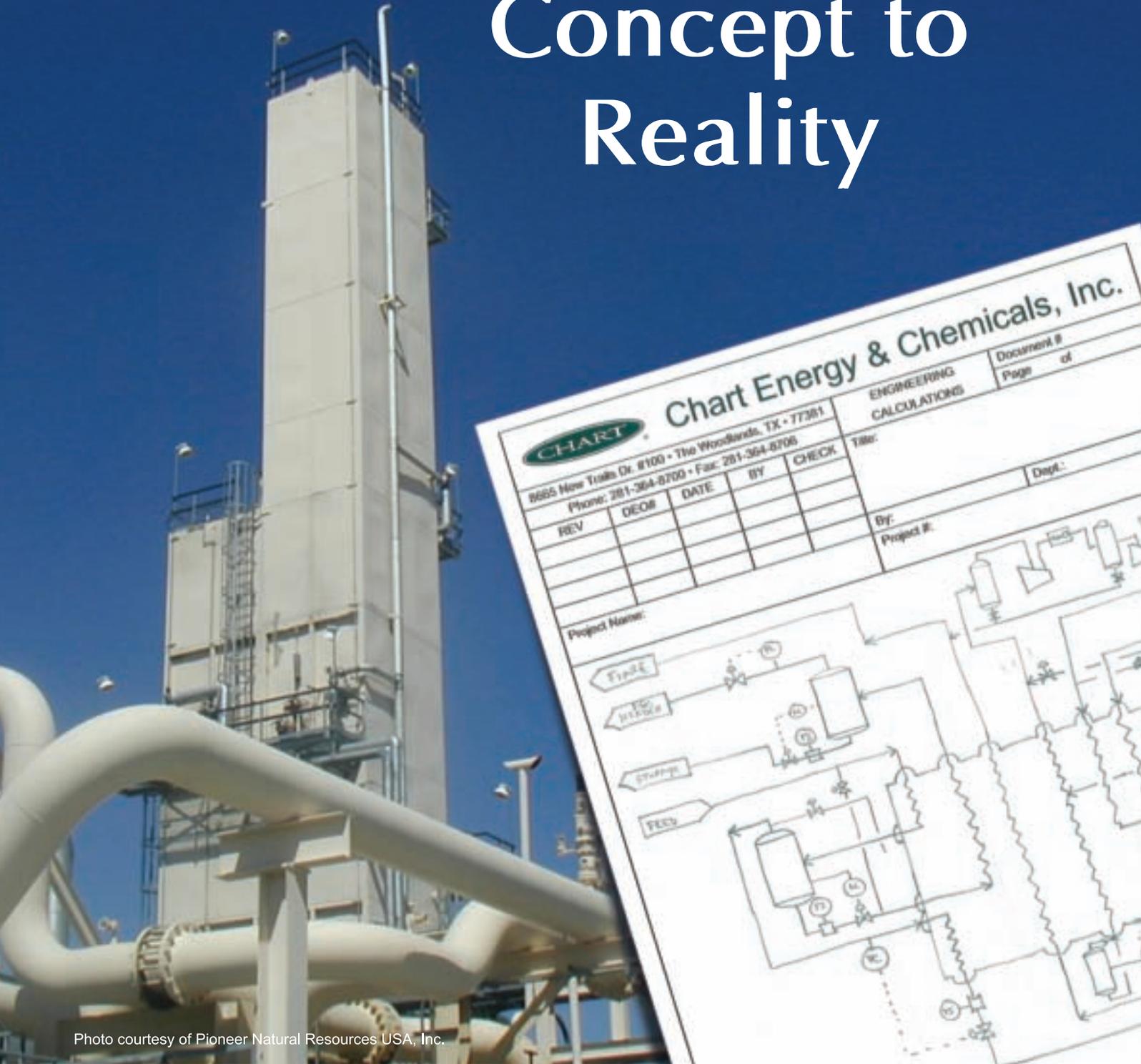


Photo courtesy of Pioneer Natural Resources USA, Inc.

Chart Energy & Chemicals is a world leader in the design, engineering and fabrication of custom process systems requiring unique or proprietary cryogenic technology.

Whether your application is LNG liquefaction, Nitrogen Rejection, Hydrogen Recovery, Dehydrogenation or any other Hydrocarbon process, Chart has an innovative, cost-effective solution for you.



Energy & Chemicals, Inc.

www.chart-ec.com

Serving the global Energy and Chemical markets with innovative process equipment and custom engineered systems.



At the last meeting of SG D.1, 13 members and one invited speaker were present. Initial drafts and outlines were prepared for each section of the Triennium report. A detailed presentation on the subject of LNG tank rollover prevention was given by Dominik Uznanski of GdF. His presentation will be uploaded to the PGC D area of the IGU website.

The section drafts will be collated into a single draft of the whole report, and it will then be circulated for comment among the Study Group members. The completed draft will be presented at the next meeting, at which any gaps will be identified and improvements made. Subject to approval from the PGC D Chairman, a questionnaire will be sent out with the aim of updating and completing the survey of member country gas specifications which was begun by SG D.1 in the previous Triennium.

SG D.2 LNG contract clauses for a more flexible global LNG market

At the last meeting of SG D.2, 16 members took part in an exchange of views between LNG buyers and sellers. The session focused on the standpoint of sellers as regards flexible LNG trading in the future market with the following presentations:

- Qatargas, Abdulla Al-Hussain, "Global LNG spot and diversions in 2007";
- PT Badak, Munir Amsjari and Subagyo Hadiwandowo, "Indonesia energy overview, Badak LNG facilities, LNG sales contracts";
- Gazprom, Dr Vladimir Safonov, "The scientific support of Gazprom's LNG projects"; and
- Cheniere Energy Inc., Lowell Bezanis, "LNG and the US gas market".

The Study Group has also revised the topics of chapters 3 and 4 of the report relating to price formulae, duration, flexibility, incoterms and destination clauses. A mid-term report will be prepared for the next meeting.

SG D.3 Creative solutions for new LNG facilities

The Study Group's fourth meeting carried on with the presentation, analysis and discussion of the

creative solution topics using the structure agreed upon in the first meeting:

- Short description of the creative technology, status of what is known in the public domain or within the organisation.
- How does the technology connect to the issues?
- Gap analysis.
- How can we close the gap?

The intention was to gauge whether creativity was still needed in those areas or whether no significant gaps were present and thus allow the Study Group to focus on the areas necessary, continuing as much as possible in clusters for more concrete in-depth results. All the topics were clustered into several groups and benchmarked against existing technologies. This allowed for some interesting high-level insights and some bold statements on the evolving creative technology.

Presentations given so far include:

- Floating storage and regasification units (FSRU);
- LNG floating production, storage and offloading (FPSO) vessels;
- High capacity tug boats;
- Small/mini scale LNG;
- Carbon capture and storage (CCS);
- Shuttle regas vessels, floating LNG storage;
- LNG offshore transfer systems;
- Regas technologies, on/offshore;
- Integrated facilities;
- Onshore liquefaction;
- LNG storage onshore;
- Shipping;
- Arctic LNG;
- LNG pipelines;
- Gravity-based structures (GBS) and platform-based LNG plants; and
- Modularisation.

The Study Group is currently focusing on writing up its findings per clustered group of creative technologies and working towards a coherent and crisp story on the creative solutions for new LNG facilities in the future.

"Is your LNG supply chain ready for the future?"



vigilantplant.®

The clear path to operational excellence

Making critical plant information fully visible is just the beginning of the vigilant cycle. Seeing clearly gives you the knowledge necessary to anticipate the changes required in your process. Knowing in advance brings you the speed and flexibility to optimize your plant in real time. And by acting with agility, you are able to adapt to the ups and downs of the LNG supply chain. VigilantPlant excels at bringing out the best in your plant and your people - keeping them fully aware, well informed, and ready to face the next challenge.

SEE CLEARLY

Process Gas Chromatograph



- Field-proven experience in online analysis
- 1 CPU covering up to 30 streams
- Built-in selectable BTU calculations

KNOW IN ADVANCE

Safety Management



ACT WITH AGILITY

"Uptime only" Production Control System



- Securing uninterrupted natural gas supply
- Ultra reliability
- Keeping you informed of even remote plant

- Avoidance of critical condition by single window operation
- TÜV certification
- Integration across Control and Safety

Find out more about Yokogawa and its process automation solutions at :

www.yokogawa.com/iab/industries/lng

YOKOGAWA 



Progress Reports from the Task Forces

This chapter contains news and information from IGU's two Task Forces.

● Task Force Research and Development

The fourth meeting of TF R&D was held in Buenos Aires, Argentina, March 13-14, and was attended by 19 members.

A joint meeting with the Technical Programme Committee of the IGU Research Conference (IGRC) was held the day before to discuss how to ensure the success of IGRC 2008, which will be held in Paris, October 8-10. There was a common desire to widen the audience of IGRC by introducing business-oriented sessions, including emerging technologies (in addition to R&D). In particular two new initiatives, the CEOs' Round Table and the innovations exhibit were discussed.

WG 1: Prove the strategic values of R&D to company and its stakeholders

Leader: H. Watanabe

R&D strategic values are the core of the work of the Working Group. However, their definition needs a double input from:

- R&D people, examples of R&D or technologies which have offered decisive solutions in the past (such as polyethylene pipes and LNG membrane tanks) are being gathered by Task Force members; and
- Business people throughout the gas chain, their challenges in the short term (five years) to longer term (10-20 years). A short questionnaire will be addressed to the Chairs of the Working and Programme Committees and manufacturers associated with the natural gas industry to complete this input.

In parallel, a report on regional gas industry R&D practices is in preparation. A framework had been issued and two countries have already drafted their regional reports.



TF R&D is making the final preparations for IGRC 2008, which will be held in Paris at the Cité des Sciences et de l'industrie.

WG 2: Significantly increase gas R&D investment

Leader: Marc Florette

The objective of this Working Group is to address an R&D message directly to the CEOs of gas companies and to make R&D a positive issue for financial analysts, regulators and investors. From the four CEO interviews organised between March 2007 and October 2008 came the idea of organising a CEOs' Round Table during the opening session of IGRC 2008. The following participants have agreed to debate on how R&D shapes 21st century gas companies: Bob Catell, Chairman of National Grid (US), Gérard Mestrallet, Chairman and CEO of Suez (France), Bernhard Reutersberg, Chairman of the Management Board of E.ON Ruhrgas (Germany),

Mark Dodson, CEO of Northwest Natural (US), and Mr Maeda, Executive Vice President of Tokyo Gas (Japan).

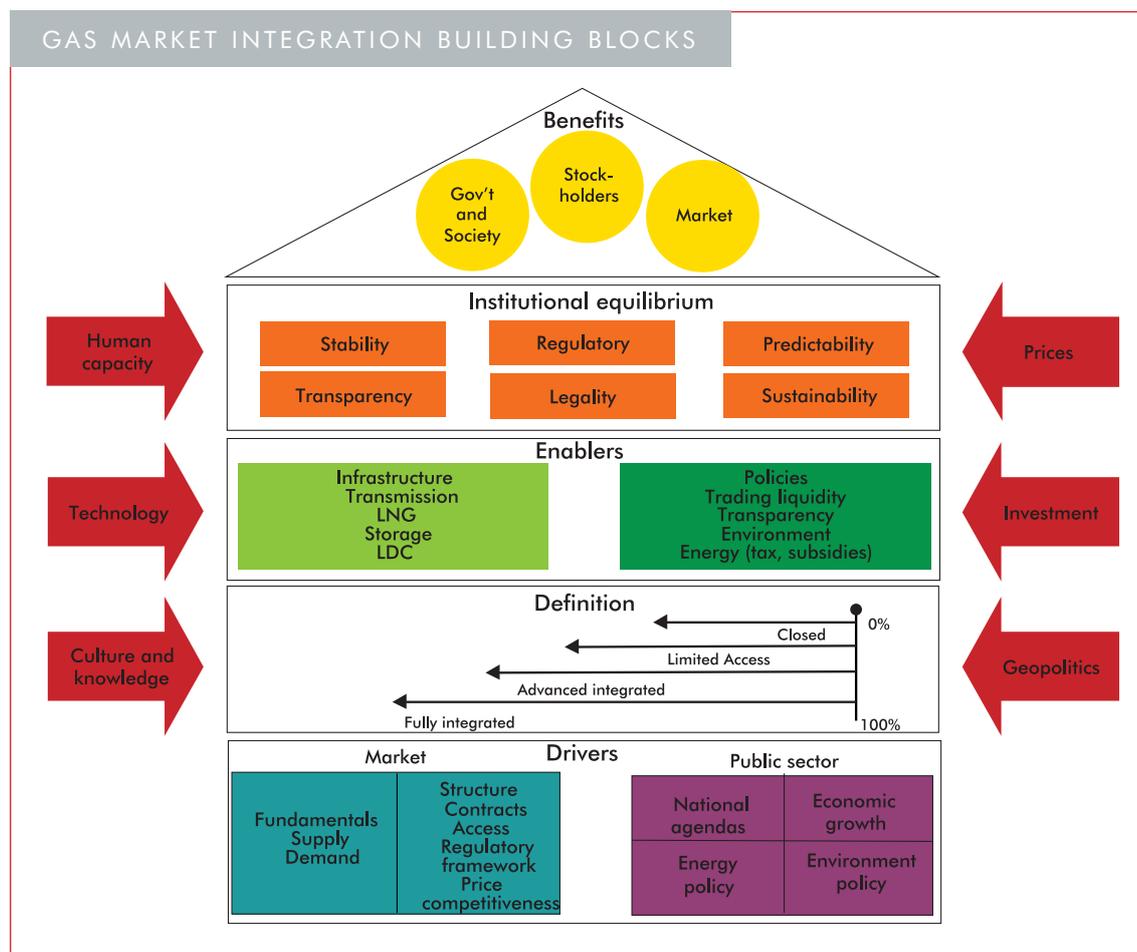
In parallel and in order to promote R&D in general gas forums, a generic R&D presentation has been prepared so that Task Force members deliver a common message all over the world.

WG 3: Support and contribute to the success of the next IGU Research Conference

Leader: Christian Beckervordersandforth

To achieve the target of 500 delegates to IGRC 2008, a marketing team led by Sam Bernstein has been set up and a marketing plan has been prepared with the following key points:

- Specific marketing documents have been



LEFT
Figure 1.



TF GMI delegates at their fourth meeting in San Francisco.

produced, including a letter of invitation sent with the registration programme;

- Targets for delegates per country have been set and country leaders have been designated, mainly TF R&D members and GERG board members who are promoting IGRC 2008 by direct personal contact with their own business network.

Moreover, all Task Force members have been involved in inviting highly innovative companies to apply for the innovations exhibit.

Next meeting

At presstime TF R&D's fifth meeting was due to take place in Toronto, Canada, September 4-5.

● **Task Force Gas Market Integration**

The fourth meeting of TF GMI took place in San Francisco, USA, on March 25, with the following members attending:

Jorge Dumanian, Javier Fernández, Robert Howard, Calliope Webber, Khairulanwar Zakaria, Maxim Potapov, Sergei Pankratov and Geert Greving. Dietmar Spohn, Ryo Fukushima, Nadeem Sharyar and Ridza Shariff sent their apologies.

The meeting started by reviewing the milestone document for the Triennium. The group reviewed

the job done so far in the first three meetings and the objective agreed for San Francisco's meeting. To date the group has met the schedule agreed at the Lima CC meeting at the beginning of the Triennium.

The group presented and discussed the new version of the mind map, Version 2.1 with structure corrections over the old one already presented (see *Figure 1*).

Another document used in the discussion was the definition of the step-by-step process to identify the degrees of gas market integration. The theoretical definition was completed and the group committed to supporting it with comments and examples via e-mail prior to the next meeting in September.

The last document was the Strategic Guidelines for Gas Market Integration. The group worked on defining the main structure of this document.

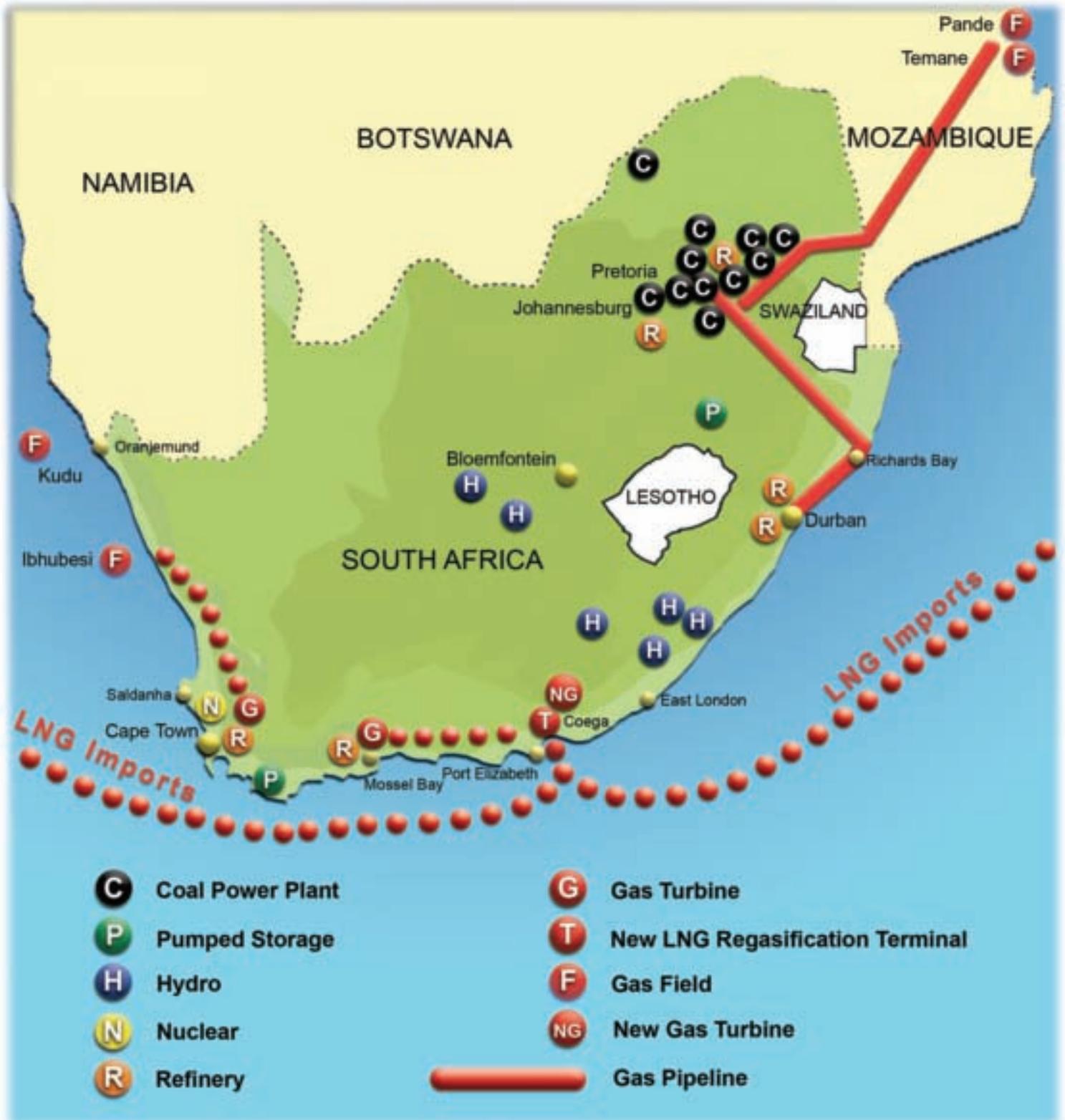
The group also reviewed the status of the papers being prepared by different members of the Task Force:

- ExxonMobil and Qatar – this paper on the integration between an IOC and an NOC was approved and is published in this edition of the IGU Magazine (see pages 184-192).
- USA, Mexico, Canada – the main structure of this paper on North American integration was presented and was approved by the group. The paper will be written before the next meeting.
- Asian integration through LNG – the final paper will be presented by the next meeting.
- South East Asia integration – the main structure was presented and the final paper will be presented by the next meeting.
- The group shared a conference call with members from Pakistan regarding information about the paper focused on Iran-Pakistan-India integration.

New papers were proposed and committed to by TF GMI members and the main structures will be presented at the next meeting.

Connecting countries. Connecting markets.

We continue to join the dots.



A CEF Group Company
www.cef.org.za



Annex – Addresses

IGU Presidency

President
Mr Ernesto López Anadón
Repsol YPF S. A.
Roque Sáenz Peña 777 –
Of. 1202
C1035AAC – Buenos Aires
Argentina
Tel: +54 11 5071 5771
Fax: +54 11 4323 1774
E-mail: elopez@repsolypf.com

Vice President
Mr Datuk Abdul Rahim Hj Hashim
Petronas
Tower 1, Petronas Twin Towers
KLCC, 50088 Kuala Lumpur
Malaysia
Tel: +60 3 2051 5100
Fax: +60 3 2051 5004
E-mail: rahimhs@petronas.com.my

Coordination Committee

Chairman
Mr Roberto D. Brandt
BG Group plc
“Fit for the Future” Project
100, Thames Valley Park Drive
Reading, Berkshire RG6 1PT
United Kingdom
Tel: +44 118 993388
Fax: + 44 118 9293651
E-mail: rbrandt@metrogas.com.ar

Vice Chairman
Mr Ho Sook Wah
Petronas Permata
Jalan Institusi, Kawasan Institusi
Bangi
43000 Kajang
Selangor Darul Ehsan
Malaysia
Tel: + 60 3 8732 7700
Fax: +60 3 8925 8757
E-mail: hosw@petronas.com.my

Secretary
Mr Andrés E. Kidd

IAPG
Maipú 645, 2°
(C1006ACG) Buenos Aires
Argentina
Tel: +54 11 4717 0035
Fax: +54 11 4717 6445
E-mail: andrew@ifisa.com

Working Committee 1

Chairman
Mr Vladimir Yakushev
VNIIGAZ, Gazprom
142717, Moscow Region
p.Razvilka, VNIIGAZ
Russia
Tel.: +7 495 3559886
Fax: +7 495 3991677
E-mail: V_Yakushev@vniigaz.
gazprom.ru

Vice Chair
Mr Kamel Eddine Chikhi
Sonatrach Exploration Division
BP 68 M Boumerdes 35000
Algeria
Tel: +213 24 81 63 97
Fax: +213 24 81 63 98
E-mail: kamel.chikhi@ep.
sonatrach.dz

Secretary
Mr Sergey A. Leonov
VNIIGAZ, Gazprom.
142717, Moscow Region
p.Razvilka, VNIIGAZ
Russia
Tel.: +7 495 3559667
Fax: +7 495 3993263
E-mail: s_Leonov@vniigaz.
gazprom.ru

Working Committee 2

Chairman
Mr Vladimír Onderka
RWE Transgas Net, s.r.o.
Pražská 158
642 00 Brno

Czech Republic
Tel: +420 547 123 198
Fax: +420 547 123 173
E-mail: vladimir.underka@rwe.cz

Vice Chair
Mrs Hélène Giouse
Gaz de France
14-16, rue Touzet-Gaillard
TSA 9.000.6
93 486 Saint-Ouen Cedex
France
Tel: +33 1 7186 1610
Fax: +33 1 7186 1616
E-mail: helene.giouse@
gazdefrance.com

Secretary
Ms Petra Grigelová
RWE Transgas Net, s.r.o.
V Olšínách 75/2300
P O Box 166
100 00 Praha 10 – Strašnice
Czech Republic
Tel: +420 267 97 44 77
Fax: +420 267 97 6949
E-mail: petra.grigelova@rwe.cz

Working Committee 3

Chairman
Mr Helge Wolf
E.ON Ruhrgas AG
Huttropstraße 60
45138 Essen
Germany
Tel: +49 201 1845010
Fax: +49 201 1845197
E-mail: helge.wolf@eon-ruhrgas.
com

Vice Chair
Mr Eric Dam
N.V. Nederlandse Gasunie
Postbus 19
9700 MA Groningen
Concourslaan 17
9727 KC Groningen
The Netherlands
Tel: +31 50 521 2800
Fax: +31 50 521 1962
E-mail: e.dam@gasunie.nl

Secretary
Mr Uwe Klaas
DVGW Deutsche Vereinigung des
Gas- und Wasserfaches e.V.
Bereich Gasverwendung
Josef-Wirmer-Str. 1 – 3
53123 Bonn
Germany
Tel.: +49 228 9188821
Fax: +49 228 9188996
E-mail: klaas@dvwg.de

Working Committee 4

Chairman
Mr Jeremy Bending
Network Strategy Gas Distribution/
National Grid
Gallows Hill
Warwick CV34 6DA
England
Tel: +44 1926 653309
Fax: +44 1926 656553
E-mail: jeremy.bending@uk.ngrid.
com

Vice Chair
Mr Alessandro Soresina
AEM S.p.A
Via Balduccio da Pisa, 15
20139 Milano
Italy
Tel: +39 02 77205057
Fax: +39 02 77206575
E-mail: alessandro.soresina@
aem.it

Secretary
Mr Robert Thomas
Network Strategy Gas Distribution
/National Grid
Gallows Hill
Warwick CV34 6DA
England
Tel: +44 1926 655801
Fax: +44 7973 809914
E-mail: robert.m.thomas@uk.
ngrid.com

Working Committee 5

Chairman
Mr Jean Schweitzer

Danish Gas Technology Centre
Dr. Neergaards Vej 5B
DK-2970 Hørsholm
Denmark
Tel: +45 4516 9600
Fax: +45 4516 9601
E-mail: jsc@dgc.dk

Vice Chair
Mr Tatsuo Kume
Osaka Gas Co.
11-61Torishima 5 chome
Konohana-ku Osaka – 554-0051
Japan
Tel: +81 6 6465 2008
Fax: +81 6 6465 2021
E-mail: tatsuo-kume@osakagas.
co.jp

Secretary
Mr Aksel Hauge Pedersen
DONG Energy, Renewable
A.C. Meyers Vænge 9
2450 København SV
Denmark
Tel: +45 4031 0022
Fax: + 45 4480 6665
E-mail: akhpe@dongenergy.dk

Programme Committee A

Chairman
Mr Knut Barland
Statoil ASA
PB 308
5501 Haugesund
Norway
Tel: +47 91 11 30 48
Fax: +47 52 77 22 10
E-mail: kub@statoilhydro.com

Vice Chair
Mr Juan Puertas
Gas Natural SDG, S. A.
Plaça del Gas, 1
08003 Barcelona
Spain
Tel: +34 93 402 5327
Fax: +34 93 402 9300
E-mail: jpuertas@gasnatural.com

Secretary
Mrs Kari Lindøe Hunsbedt
Statoil ASA

PB 308
5501 Haugesund
Norway
Tel: +47 48 08 02 94
Fax: +47 52 77 25 67
E-mail: kalin@statoilhydro.com

Programme Committee B

Chairman
Mr Pedro Moraleda
Gas Natural SDG, S. A.
Avda de América, 38
28046 Madrid
Spain
Tel: +34 91 589 3170
Fax: +34 91 589 3476
E-mail: pmoraleda@gasnatural.
com

Vice Chair
Dr Colin D. Lyle
Gas Market Insights Ltd
30 Grove Crescent
Kingston upon Thames
Surrey KT1 2DG
England
Tel: +44 77 3856 3856
Fax +44 20 8546 4700
E-mail: cl@gmi.eu.com

Secretary
Mr Francisco Schar
SEDIGAS
Edificio ENAGAS – Paseo de los
Olmos, 19
28005 Madrid
Spain
Tel: +34 91 709 9581
Fax: +34 91 709 9583
E-mail: fjschar@sedigas.es

Programme Committee C

Chairman
Mr Mohd. Farid Mohd Amin
Petronas
Level 75, Tower 1, Petronas Twin
Towers
KLCC, 50088 Kuala Lumpur
Malaysia
Tel: +60 3 2331 4613
Fax: +60 3 2331 2950



E-mail: faridm@petronas.com.my

Vice Chair

Mr Antonio Luiz Fernandes
dos Santos
Petrobras

Av. Almirante Barroso, 81
32nd Floor
20031-004 Rio de Janeiro – RJ
Brazil

Tel: +55 21 3229 4589

Fax: +55 21 3229 4590

E-mail: aluizfsantos@petrobras.
com.br

Secretary

Mr Rashdan M. Radzi

Petronas

Level 75, Tower 1, Petronas Twin
Towers

KLCC, 50088 Kuala Lumpur
Malaysia

Tel: +60 3 2331 4655

Fax: +60 3 2331 2950

E-mail: mrashdan_mradzi@
petronas.com.my

Programme Committee D

Chairman

Mr Seiichi Uchino

Tokyo Gas Co. Ltd

1-5-20, Kaigan, Minato-ku

Tokyo 105-8527

Japan

Tel: +81 3 5400 7622

Fax: +81 3 3578 8365

E-mail: s-uchino@tokyo-gas.co.jp

Vice Chair

Mr Alaa Abu Jbara

Qatargas Operating Company Ltd
P O Box 22666

Doha

Qatar

Tel: +974 485 7556

Fax: +974 473 6122

E-mail: aabujbara@qatargas.
com.qa

Secretary

Mr Yutaka Shirakawa

Tokyo Gas Co. Ltd

1-5-20, Kaigan, Minato-ku

Tokyo 1058527

Japan

Tel: +81 3 5400 7580

Fax: +81 3 3578 8365

e-mail: yutaka-s@tokyo-gas.co.jp

Task Force Research and Development

Chairman

Mr Marc Florette

Gaz de France

361, avenue du Président Wilson
BP 33 93211 Saint-Denis La

Plaine

France

Tel: +33 1 49 22 50 59

Fax: +33 1 49 22 49 49

E-mail: marc.florette@

gazdefrance.com

Vice Chair

Mr Mel Ydreos

Union Gas Ltd

777 Bay Street, Suite 2801

P. O. Box 153

Toronto, ON M5G 2C8

Canada

Tel: +1 519 436 4597

Fax: +1 519 436 5392

E-mail: mydreos@uniongas.com

Secretary

Mrs Marie-José Fourniguet

Gaz de France

361, avenue du Président Wilson

BP 33 93211 Saint-Denis La

Plaine

France

Tel: +33 1 49 22 59 75

Fax: +33 1 49 22 51 03

E-mail: marie-jose.fourniguet@

gazdefrance.com

Task Force Gas Market Integration

Chairman

Mr Jorge Doumanian

Grupo Gas Natural-Gas Natural

BAN (Argentina)

Jaime Balmes N° 8 –704

Colonia Los Morales Polanco

11510 México D. F.

Mexico

Tel: +52 55

52792401/52792402

Fax: +52 55 52792400 Ext:2401

E-mail :jdoumanian@gnm.com.
mx

Vice Chair

Mr Dietmar Spohn

Stadtwerke Bochum GmbH

Postfach 10 22 50

D-44722 Bochum

Germany

Tel: +49 234 960 2000

Fax: +49 234 960 2009

E-mail: dietmar.spohn@

stadtwerke-bochum.de

Secretary

Mr Javier Fernandez Gonzalez

Grupo Gas Natural-Gas Natural

SDG, S. A. (Spain)

Jaime Balmes N° 8 – 704

Colonia Los Morales Polanco

11510 México D. F.

Mexico

Tel: +52 55 52792478 / 790446

Fax: +52 55 52792400 Ext:2401

E-mail: jfernandez@gnm.com.mx

National Organising Committee

Chairman

Mr Eduardo Ojea Quintana

Alicia Moreau de Justo 846

2° Piso – Of. 18

(1107) – Buenos Aires

Argentina

Tel: +54 11 4343 6932

Fax: +54 11 4342 5082

E-mail: eduardo_ojea@hotmail.com

The EDF Group is an integrated energy supplier operating in a wide range of electricity and gas related businesses: power generation, transmission and distribution; gas production, transportation, storage; energy sale and trading. It is the main operator in the French electricity market and holds strong positions in the other three principal European markets (Germany, United Kingdom, Italy) making it one of the leading electricity groups in Europe, and a recognized player in the gas market.

In the electricity sector, it has the premier generation fleet in the world (more than 128,000 MW) and customer portfolio in Europe (more than 37 million customers). With 58 nuclear power plants in operation for a total of 68,000 MW, it is the clear world leader in nuclear generation. The Group is also the leading electricity network operator in Europe, giving it a sound business model, equally balanced between regulated activities and those open to competition.

In the gas sector the EDF Group is present mainly through EDF Energy (United Kingdom), EnBW (Germany), Edison (Italy), EDF SA (France and Belgium) and EDF Trading (pan-European trader). In 2006 it handled a volume of approximately 27 bcm in Europe (EDF-Trading not included).

The Group is preparing for an increase of its gas needs to 40-45 bcm/y in the medium term, both to deliver combined gas/electricity offers to its Customers and to supply its own gas-fired power plants. The EDF Group is building a portfolio to supply and optimize its sourcing via a pan-European approach in long-term gas procurement (purchase and throughput contracts and equity gas) and investments in logistic assets (LNG, pipes, storages). It is pursuing a complementary approach based on historical Edison's projects in South-East Europe (SEE) and on new projects in North-West Europe (NWE).

In NWE, EDF is developing the LNG Terminal project in Dunkirk, France (at least 6 bcm/y in the first phase that should take place in 2012). EDF and EnBW signed an agreement with the German company IVG for the storage of natural gas in underground salt caverns under construction at Etzel from 2010 onward (400 mcm). EDF Trading and RasGas have signed a medium-term (4.5 years) LNG supply agreement for deliveries in Zeebrugge of up to 4.5 bcm.

In SEE, Edison co-sponsors the Rovigo offshore LNG Terminal in the Adriatic Sea due to start in 2008 and has secured LNG sourcing from Qatar for 6.4 bcm/y. Edison is also involved in the development of two leading pipeline projects: IGI (8 bcm/y) between Greece and Italy and Galsi (8 bcm/y) between Algeria and Italy.

Some links make a perfect chain when you put them together

Unión Fenosa Gas is involved in every stage of the liquefied natural gas chain

Unión Fenosa Gas controls every part of the gas process. Being involved in the whole process, enables it to offer a high quality integrated service that enhances the supply guarantee.

Unión Fenosa Gas has consolidated itself as a trustworthy partner in the development of important infrastructures, due to its investment capacity, fulfillment of commitments and its prospects of growth.

ISO 9001

NATURAL GAS COMMERCIALIZATION



LIQUEFACTION



MARITIME TRANSPORT



REGASIFICATION



COMMERCIALIZATION



DISTRIBUTION



34 91 207 97 97 (Spain)
ufgascomercializadora@uef.es

 **UNION FENOSA** gas

Blue seas thinking.

We're always ready to lead where others would prefer to follow.

At Hamworthy we're industry leaders in innovative technology and design. Whenever we introduce an innovative solution, we aim to surpass the standards of quality, flexibility and reliability already established.

For Hamworthy people, innovation is not a buzzword to be thrown about or a goal in itself. Quality and innovation are the products of searching for the most appropriate and efficient solution to any problem.

As a recent example of this, Hamworthy Gas Systems AS has worked together with leading Norwegian LNG fleet operators and developed onboard regasification plants for both glycol water heated and cascade types, contracted for operation in USA and Brazil. These solutions provide safe, commercially competitive and environmentally friendly alternatives to traditional LNG receiving terminals.

To find out more visit www.hamworthy.com

Please see us at Sea Japan 2008, Tokyo, 9 - 11 April, Stand No. C-30

We're always  **Hamworthy**

FEATURES

This issue's feature section starts with "Korea – Playing a Leading Role in the World Gas Industry" to mark the country's hosting of the 2008 Council meeting. Articles follow on LNG shipping, the Asia-Pacific LNG market and pipeline developments. Then we have a report on a special workshop organised by Working Committee 5, Marcogaz and GERG on micro CHP technology, and updates on biomethane and GTL developments, followed by the second in a series of case studies from the Task Force on Gas Market Integration. In this issue we look at a successful example of IOC-NOC cooperation. The last feature considers the prospects for a gas OPEC. As usual, we round up with a description of the publications and documents available from IGU and the events calendar.

Platts: Spot European gas prices break records

Spot European gas prices hit all-time highs in the first half of 2008, on the back of record oil prices, according to energy information provider Platts.

The wholesale price of an annual gas supply contract at the benchmark UK National Balancing Point reached 90 pence/therm (about \$18/MMBtu), more than four times the 20 p/th price level common during 2000 to 2003.

The price has been driven higher by the link, common in long-term European gas sales contracts, between the cost of gas and the cost of oil. Oil was around \$20 to \$30/barrel in 2000 to 2003, but hit \$135/barrel in 2008.

The graph shows that the NBP gas price now far exceeds the 70 p/th annual prices seen in late 2005/early 2006 when the UK suffered a major “supply crunch” as North Sea reserves ran down before new import facilities came into operation.

That short-term supply/demand problem was overcome in late 2006 when Norway opened the new Langeled pipeline to the UK and the Netherlands opened the new Balgzand Bacton Pipeline to the UK, leading to a brief dip in annual gas prices.

But explosive oil price growth has since sent gas prices firmly back on an upwards path, offering greater rewards for North Sea producers and suppliers of LNG to Europe, but new challenges for energy intensive industry and governments battling to keep prices down for household customers.

Platts reporters produce daily news, commentaries and market assessments about the spot European gas markets.

Platts covers the UK NBP, the Dutch Title Transfer Facility, the Belgian Zeebrugge hub and since 2007 new, growing hubs such as the French PEG Nord, the German BEB and EGT hubs and the Italian PSV.

Platts real-time news and pricing services, daily market reports and fortnightly newsletters provide full coverage of fast moving spot markets and provide the background that makes sense of market trends.

Our daily European report in 2008 adopted the new name Platts European Gas Daily. We have added price conversions of European gas prices to the standard \$/MMBtu US gas price as LNG brings trans-Atlantic markets closer together.

And new “project tracker” tables give up-to-date lists of important storage, LNG and pipeline infrastructure projects being planned across Europe.

For further information on Platts gas price assessments and market reports please tel +44 207 176 6111 or visit www.platts.com

Annual UK gas price



Source: Platts

KEEP PACE WITH THE SURGING DEMAND FOR NATURAL GAS INFORMATION.



Price volatility, regulatory changes, new players, and rising production costs are contributing to uncertainty in the natural gas market.

Track the news, prices and trends most likely to affect you with help from Platts. Sign up today for a complimentary trial and access some of the industry's most authoritative news, pricing and data services.

Platts services help you gain the insight and tools you'll need—whether for strategic planning, forecasting and decision making across corporations, or information for governmental and financial institutions. Our Editorial and market expert teams work around the clock to ensure that you have the most timely, unbiased and accurate news across the global natural gas markets. Our products, which range from industry news and natural gas prices to market fundamental data and forecasting services, can be delivered in a variety of ways to suit your individual needs.

ENERGY TRADER • EUROPEAN NATURAL GAS REPORT • GAS DAILY • GAS MARKET REPORT
GAS OUTLOOK RESEARCH SERVICE • HISTORIC PRICES • INTERNATIONAL GAS REPORT
INSIDE FERC • LNG DAILY • M2M GAS • NATURAL GAS ALERT • PLATTS ENERGY ADVANTAGE
PLATTS FORWARD CURVE NATURAL GAS • UK GAS REPORT

Sign-up today for a trial to Platts natural gas publications

North America

1-800-PLATTS8 (toll-free)
+1-212-904-3070 (direct)

Latin America

+54-11-4804-1890

Europe/Middle East/Africa

+44-20-7176-6111

Asia-Pacific

+65-6530-6430

platts

www.platts.com



Korea – Playing a Leading Role in the World Gas Industry

By Hae-jung Oh



Hae-jung Oh: KGU collaborates closely with IGU.

The Korea Gas Union (KGU), the host of the IGU Council meeting of 2008, has been a Charter Member of IGU since its establishment in 1986, representing the Korean gas industry. Since then, KGU has collaborated closely with IGU to promote technical exchanges and progress in the gas industry, participating in various activities such as those of the Executive Committee, Task Forces and Working Committees of IGU.

KGU hosted the IGU Council meeting in 1999 in Jeju, the LNG-13 Conference and Exhibition in 2001 in Seoul and the 7th Global Congress on Information and Communication Technology in Energy in 2005 in Busan. KGU has also hosted several WOC meetings throughout the country. Now, Korea has been chosen for the second time as the venue of the annual IGU Council meeting, which is being held in the ancient city of Gyeongju, September 22-25.

The new administration of the President of Korea, Myung-bak Lee, has been actively pursuing various energy policies to cope with an urgent need to secure wider-diversified and greater energy supplies since his inauguration in February this year. With these policies at hand, the Korean industry welcomes IGU members from around the world to Gyeongju, hoping that this will accelerate its development and strengthen ties with the world gas industry.



The 2008 Council meeting is being held in Gyeongju, whose historic areas have been declared a UNESCO World Heritage Site.

● **Status of the Korean natural gas industry**

Korea is the second largest importer of LNG in the world. Almost all natural gas demand is currently met by imports in the form of LNG because of minimal hydrocarbon reserves in the country, though Korea National Oil Corporation (KNOC) began producing a small quantity of natural gas from the Donghae-1 field in the East Sea early in 2004.

Import of LNG began in 1986 after the founding of the world's largest state-owned LNG importing company, Korea Gas Corporation (KOGAS), which was driven by a policy to reduce the country's dependence on oil.

Natural gas is Korea's fourth-largest energy source, supplying 13.9% of primary energy consumption in 2007, following oil (43.5%), coal (25.4%) and nuclear (14.9%). The balance of comes from firewood and others (1.8%) and hydro (0.5%).

KOGAS's sales of natural gas in the domestic market totalled 35.13 bcm in 2007, up 8.3% over 2006, with some 60% sold to city gas companies

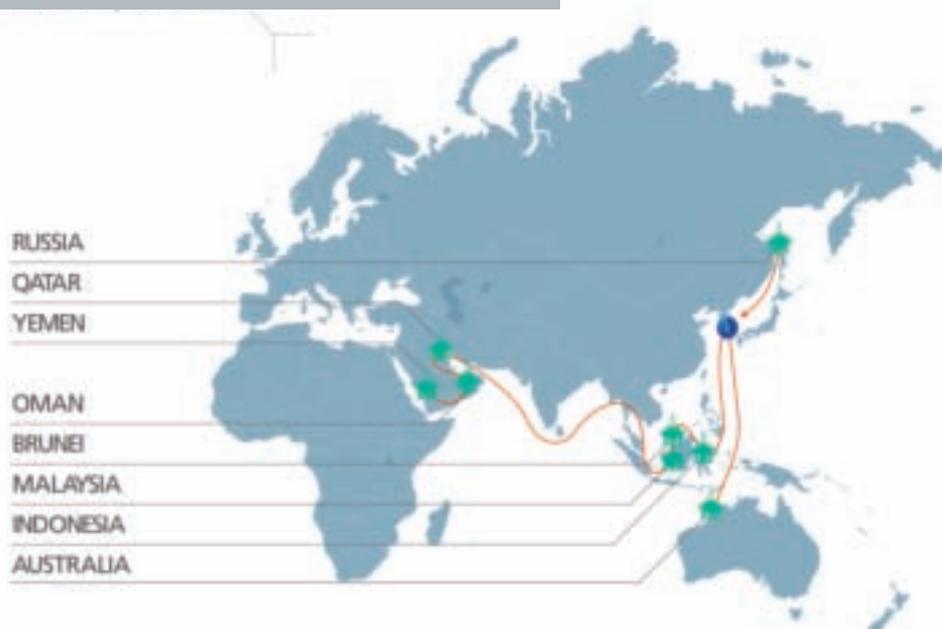
and the remainder to power generation companies. The gas sold included domestic production from the Donghae-1 field and some from stored reserves, but the bulk was imported.

The first import contract of LNG was from Indonesia's Arun project and currently most LNG imports are from Indonesia, Malaysia, Oman and Qatar, with smaller volumes coming from other exporters. In 2007, KOGAS imported a total of 24.76 million tonnes of LNG (34.17 bcm). Qatar was the top supplier at 8.11 million tonnes, followed by Malaysia with volumes of 6.12 million tonnes. Imports from Oman fell 5% to 4.83 million tonnes, while Indonesian volumes dropped by roughly 24% to 3.84 million tonnes.

New long-term contracts were signed in 2005 with Yemen LNG, Sakhalin Energy and Malaysia's Tiga LNG, and in 2007 with Qatar, in an effort to diversify gas supplies.

Besides KOGAS, the privately-owned companies, POSCO and K-Power, are importing 1.15 million

KOREA'S NATURAL GAS IMPORT SOURCES



Korea currently purchases natural gas from six countries under long-term contracts and will add imports from Russia's Sakhalin II project and Yemen LNG when they start production.



KOGAS operates one of the biggest LNG receiving terminals in the world at Incheon. It entered service in 1996.

tonnes of LNG a year from Indonesia's Tangguh consortium. All the gas received at POSCO's terminal, which was built in 2005 in Gwangyang, is used to supply power plants operated by POSCO and K-Power.

Korea's long-term LNG contracts now cover a total of 17 projects in eight countries.

The natural gas industry of Korea is divided into two sectors: wholesale and retail. KOGAS deals with the wholesale business sector and the city gas companies work in the retail sector. KOGAS is the main importer of natural gas and supplies it to power plants and local city gas companies via receiving terminals and the main pipeline network.

KOGAS operates three receiving terminals at Incheon, Pyeongtaek, and Tongyeong as well as the country's natural gas pipeline system which covers 2,721 kilometres. It plans to build 150 kilometres of new pipeline by 2010, and to

construct Korea's fifth LNG terminal by 2013. Samcheok City, which is located on the East Coast, was selected as the priority negotiating partner for the candidate city and the decision on the final site is to be made later this year.

KOGAS has a monopoly in the storage, transportation and wholesale business, while in the retail sector the city gas companies have local monopolies in supplying natural gas or manufactured gas (LPG-air) to final consumers through local distribution pipelines. There are 33 city gas companies nationwide, 30 being natural gas companies and the remainder manufactured gas suppliers.

As for the share of city gas demand by final consumption in 2007, residential use was 50.7%, industrial use 27.2% and commercial use 22.1%. The city gas demand in Korea is much larger than the power sector demand, mainly due to the

unique seasonality issues with high demand in winter for heating. The consumption of city gas has exceeded that for power generation since 1997, and it was 57% of total gas demand in 2007.

In a move to eliminate factors that limit competition in the gas industry and to pursue privatisation, the Basic Plan for Restructuring the Gas Industry was announced in 1999. A decision on introducing competition into the gas industry will be made later, following sufficient discussion among interested parties.

● Changes in the gas industry environment

The natural gas supply structure in Korea is expected to be diversified through the promotion of pipeline natural gas (PNG) following the discovery of gas fields in the East Sea.

Donghae-1 is Korea's first natural gas field. It was discovered in 1998 by KNOC, which is the primary company involved in exploration and production (E&P) of natural gas in Korea, and began producing gas in 2004. Though it contributes only 2% of the country's demand, it helps balance the supply and demand for the winter season.

The move into gas production was made using Korea's own technology and is expected to enable local companies to accumulate know-how applicable to exploring overseas gas production and to promote the import of gas in PNG form.

● Gas field E&P research

With current high oil prices, the E&P business has become more important and the new Korean government has made energy a top item on the foreign policy agenda, encouraging gas companies to secure partnerships for resource development as in the oil sector.

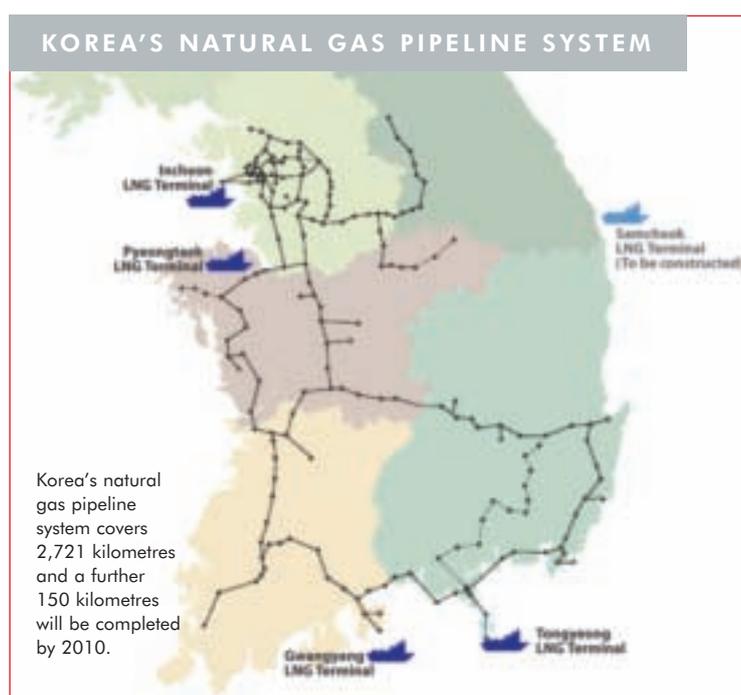
KOGAS is actively participating in international projects through equity participation in overseas LNG projects which export LNG to Korea. It purchased a 1.2% stake in Oman LNG in 1997 and a 3% stake in Qatar's Ras Gas 1 in 1999, which yielded total profits of 418 billion won (\$418

million) from 2001 to 2007. It also has an 8.9% stake in Yemen LNG, which is expected to produce 6.7 million tonnes of LNG per annum from 2009 for 24 years.

In addition, KOGAS has invested in natural gas projects in Myanmar and has secured a foothold in the south-east Asian gas market. More recently, it succeeded in the bidding for a marine gas field exploration and development project located in the joint petroleum development area (JPDA) of East Timor and Australia in 2006, and signed a deal with Uzbekneftegaz to develop a large-scale natural gas field in Surgil, western Uzbekistan in February this year.

As for oil and gas, a total of 286 resource development projects in 53 countries around the world are underway by Korean consortia, mostly led by KNOC. As a result, the self-sufficiency rate for oil and gas increased to 4.2% of total demand in 2007 from 3.2% in 2006.

The government has a plan to push its energy self-sufficiency rate up to 40% by 2030 according to the preliminary long-term national energy policy plan.





The Donghae-1 gas field is located in Ulleung Basin offshore Ulsan.

The country's first Energy Basic Law was enacted in 2006 and the National Energy Committee, presided over by the President of Korea, was established in the following year. It has four sub-committees and I was appointed to the Energy Policy Committee, working on the founding of the national energy basic plan. The overseas resources development business will continue to expand with the aforesaid energy policy to maintain national energy security.

● **R&D for alternative energy resources**

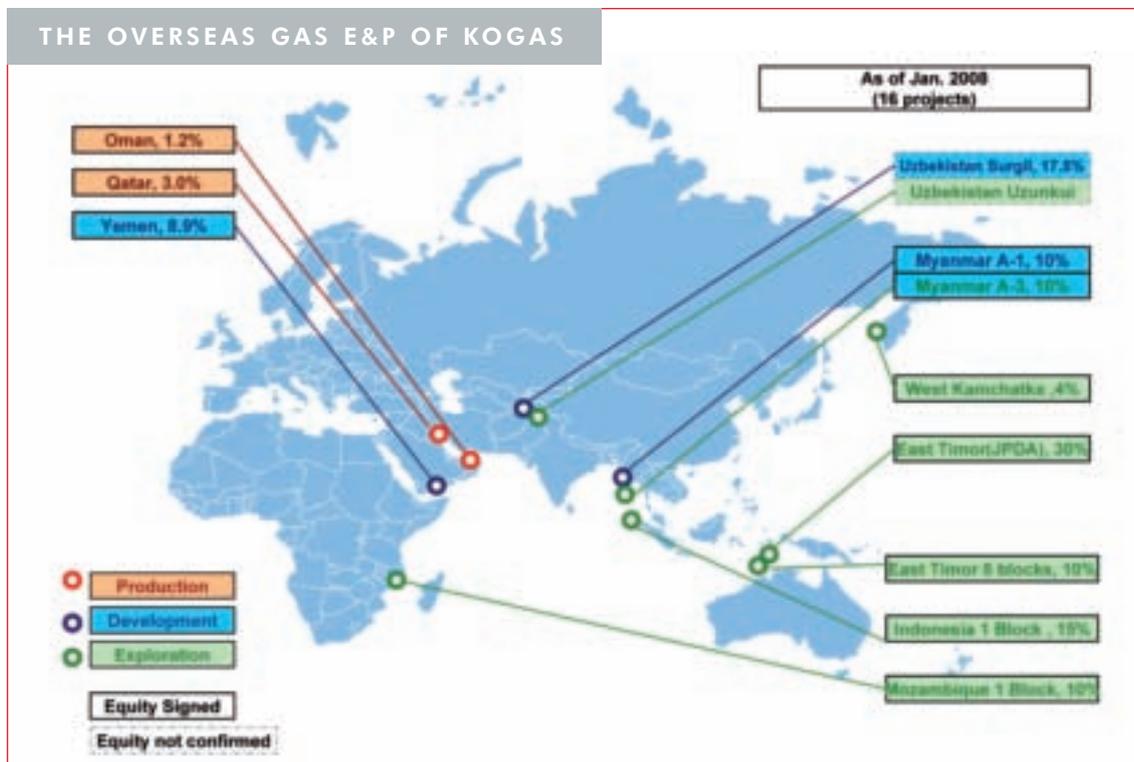
Korea is striving to develop a new high-efficiency and environment-friendly energy source. The government devised a master plan in 2005 under which Korea would make the transition from a fossil fuel-based economy to a cleaner hydrogen-based one. The government continues to develop new and renewable energy sources according to the plan for a smooth shift to the hydrogen economy.

Korea explored gas hydrate deposits in the East Sea and successfully separated the gas in 2007. Gas hydrate, a mixture of gas and water molecules, usually methane which indicates a potential as a future energy resource, is found deep underwater where cold temperature and extreme pressure cause natural gas to condense into a semisolid form. When brought to the surface it can be processed into liquid natural gas. The only other countries to have reported finding such deep-sea gas pools are China, India, Japan and the United States.

The gas hydrate sample extracted proved to be of top quality, comparable to 99% methane gas. It was Korea's first discovery of a gas hydrate deposit in its waters since starting the three-stage project in 2005.

The deposit in Korea's East Sea, estimated at 600 million tonnes, could meet Korea's natural gas needs for roughly 30 years. The government intends to promote the development of a manufac-

THE OVERSEAS GAS E&P OF KOGAS



turing technique for the commercialisation of gas hydrates after 2015, on the basis of technical cooperation.

Korea is also leading the technology for producing dimethyl ether (DME). After conducting research into the DME manufacturing process using natural gas as raw material, KOGAS was successful in the development of related technology for the fourth time in the world.

DME is a synthesised compound made from the chemical reaction between H_2 and CO from natural gas, coal, etc. It is non-toxic, easy to handle and versatile. Work in Korea on developing the technology to produce DME from natural gas and CO_2 began in 2000 to reduce greenhouse gases.

Korea's first DME production pilot plant with a daily production capacity of 50 kilograms was constructed at the Incheon Terminal in 2003. A demonstration plant with a daily production capacity of 10 tonnes is currently under construction and is expected to be completed this year.

By December 2009, DME commercial plant with a capacity of 3,000 tonnes per annum using local technologies will be in operation, and there are plans to construct DME plant with a capacity of 1 million tonnes per annum by 2012.

● Localisation project for LNG technology

With promotion of a project to develop local LNG technology, Korea has become the third country in the world (following France and Japan) to secure all core technologies for the 9% nickel-type and membrane-type storage tanks.

Furthermore, Korea is currently undertaking an LNG carrier cargo containment project, called KC-1, to modify and adapt LNG storage tank technologies to LNG cargo containment technologies.

Korean shipbuilders are very competitive internationally with world-class shipbuilding capabilities. Seven Korean shipbuilding companies, including Hyundai Heavy Industries (HHI), Samsung Heavy Industries (SHI) and Daewoo Shipbuilding and



In 2007, Korea became only the fifth country in the world to sample gas hydrates offshore after successful cores were taken by the drillship *Tamhae 2*.

Marine Engineering (DSME), rank in the world's top 10 shipbuilders. According to research by the shipbroker Clarkson, Korea ranked first in the three main indicators, namely new order volume, construction volume and order backlogs in 2007: new order volume with 40.4%, construction volume with 34.04% and order backlogs with 36.2% of the world market.

The KC-1 system will be applied to the vessels for forthcoming LNG imports of which the delivery is forecasted around 2011. The project for next-generation LNG carriers will help the country to secure another national competence.

● Prospects

According to the Mid-term Energy Outlook 2007-2012 of the Korea Energy Economics Institute (KEEI), LNG demand in Korea is expected to show a stable growing trend, with an annual growth rate of 6.2% between 2007 and 2012.

In terms of final energy demand, fuel switch from oil to city gas will continue. Oil's share will fall from 55.5% in 2007 to 52.3% in 2012, and city gas and electricity are expected to fill this gap. As a result, the city gas share will rise from 10.3% in 2007 to 11.4% in 2012.

For the overall composition of the primary energy demand by energy source, LNG is projected to account for a high proportion of the primary energy demand, reaching 34.5 million tonnes in 2012. According to KEEI's long-term energy outlook, the share of natural gas in total energy consumption is expected to grow to 15.9% in 2030, vs. 13.9% in 2007, while the share of oil will decline to 35.6% from 43.5% in 2007 due to high oil prices, substitution with alternative energy resources and enforcement of environmental regulations.

With this growing demand, the Korean gas business will remain a critical part of the world gas industry. There will be more opportunities to take advantage of this growing market and I hope you may see them with your own eyes during the IGU Council meeting this year and during the IGU Research Conference in 2011, which will also be hosted by Korea. The Korean gas industry wishes to strengthen its cooperative ties with the world gas industry, taking a step together for a better world.

Hae-jung Oh is the Secretary General of the Korea Gas Union and a member of both the IGU Council and Executive Committee for the 2006-2009 Triennium.

RELATED LINKS

Korea Energy Economics Institute	www.keei.re.kr
Korea Gas Corporation	www.kogas.or.kr
Korea Gas Union	www.kgu.or.kr
Ministry of Knowledge Economy	www.mke.go.kr

Höegh LNG - A key player in the LNG industry



design and visualizations by www.maritimecourse.no

FINDING THE BETTER WAY

www.hoeghlng.com

LNG FPSO

OFFERING A COMPLETE OFFSHORE LNG VALUE CHAIN

Production and Liquefaction - Transportation - Regasification - Market Access

HLNG's objective is to be a significant, independent owner and operator of vessels providing maritime transportation and related services for delivering natural gas. We will focus our activities on business opportunities where HLNG provides added value to the customer and be competitive, by leveraging its industry experience, quality in operations, innovative solutions and business relationships.

- A highly skilled organization with a wide range of competence gained through LNG operation since 1973
- Currently operating a fleet of five LNG carriers and with two innovative Shuttle and Regasification Vessels (SRVs) on order
- Merging competence, innovation and technology development
- A fully integrated company with in-house fleet management

INNOVATIVE PROJECTS

LNG FPSO – Floating Production, Storage and Offloading

SRV – Shuttle and Regasification Vessel

DWP – Deep Water Port floating terminals

FSRU – Floating Storage and Regasification Unit

Arctic LNG – LNG trades under development in the Arctic



SRV



DWP



FSRU



ARCTIC LNG



HÖEGH LNG



LNG Shipping Enters New Era of Global Expansion

By Mike Corkhill

With global trade in LNG forecast to increase by 10% per annum through 2015 at least, an unprecedented level of shipyard activity is underway to provide the LNG carriers (LNGCs) that will be required.

South Korean shipyards are now firmly established as the leading builders of the growing number of LNGCs currently being constructed to transport clean-burning gas to hungry global energy markets. Of the 61 LNG ships completed worldwide during the 2006-07 period, Korean yards built 42, or 69% of the total. A further 60 new LNGCs have been or are due to be commissioned by the end of 2008 and the Korean share of this total will be close to 80%. This year's output of LNG ships will set a new record

unlikely to be matched for some considerable time, if ever.

With the exception of four vessels delivered by Hanjin Heavy Industries in the late 1990s, all the LNG ships built in Korea to date have been constructed at three shipyards – Hyundai Heavy Industries (HHI), Daewoo Shipbuilding & Marine Engineering (DSME), and Samsung Heavy Industries (SHI). These three yards also happen to be the world's largest shipbuilders and all three have refined, streamlined and increased their production capabilities to the extent that, at the moment, no other yards can build large LNGCs, container ships and oil tankers as quickly, efficiently and competitively as this Korean triumvirate.

However, even the most efficient shipyards have faced an inexorable rise in shipbuilding costs in recent years, due to escalating raw material and wage costs. The average price of a conventional, steam turbine-powered, 145,000 m³ LNG carrier has increased by almost 50% over the past five years, from \$150 million in 2003 to \$220 million



Celestine River, one of the 32 LNGCs delivered in 2007, discharges the inaugural commissioning cargo at the new Sabine Pass terminal in the US Gulf.

today. Such a price tag makes LNGCs amongst the most expensive, sophisticated vessels afloat.

China delivered its first LNGC earlier in 2008 and Chinese shipyards have aspirations to rival Korea in LNG ship construction over the longer term. However, despite the promise of reduced production costs at Chinese yards, the position of established players in LNG ship construction is not easily usurped. HHI, DSME and SHI are unlikely to be troubled at the top of the LNGC constructors' league table for many years to come.

Hyundai delivered its inaugural LNGC in June 1994, Daewoo its first in August 1999 and Samsung its first in January 2000. The initial ships were built for domestic shipowners and the carriage of Korea's LNG imports, but the yards did not wait long before going out to tender for LNGC orders in the international marketplace. Success came quickly and Korea secured the crown from Japan as the leading constructor of LNGCs early in this decade, at about the time it moved ahead of the same country to become the top shipbuilding nation.

● The Asian players

The completion of an LNG ship by a Spanish yard in December 2007 brought to an end, for the foreseeable future, the construction of LNGCs in Europe. Only Korean, Japanese and Chinese shipyards have LNG ships on order. HHI, DSME and SHI are no longer the only Korean builders of LNGCs, Hanjin Heavy Industries having re-entered the arena and STX having secured a breakthrough order. In addition, Hyundai's affiliate Samho yard has three LNGCs on its orderbook.

Japanese shipyards, which built 15 of the 61 LNGCs completed during the 2006-07 period, have found it difficult to compete with Korea for international business of late. The majority of the recent LNGC orders in Japan have been for vessels for Japanese owners, most notably those that will be employed in the carriage of cargoes on behalf of the country's utility companies. Increasingly, these utilities are taking ownership stakes in the ships, in tandem with the traditional Japanese shipping companies.



Of the 61 LNG carriers delivered during the 2006-07 period, Daewoo completed 18.



Yards like Mitsubishi Heavy Industries (MHI) and Kawasaki Heavy Industries (KHI) are assured of continued involvement in the sector, not least because Japan remains the world's leading importer of LNG by a wide margin and because the leading Japanese shipowners – MOL, NYK and K Line – have enjoyed considerable success in establishing a strong presence in the international LNG trades, including in the Atlantic Basin.

To date, Hudong-Zhonghua is the only Chinese builder of LNG ships. The yard's recently completed first vessel and the four on order are all earmarked for the carriage of domestic LNG imports. China is in the process of constructing a string of coastal LNG import terminals and the shipping requirements associated with these projects will ensure a steady flow of new ship orders for Chinese yards in the years ahead.

Although Hudong-Zhonghua has experienced teething problems in the construction of its first series of LNG vessels, the ship delivery delays that are being experienced can be attributed to the traditional learning curve the shipbuilder faces as it takes on the construction of a sophisticated new type of ship for the first time. As with most other nations that have ever built LNG ships, there is no doubt that in future Hudong-Zhonghua and other Chinese yards seeking to jump on the LNG bandwagon as it gains momentum will begin to win orders for LNGCs in the international marketplace to complement newbuildings for domestic projects.

● Spherical slippage

Until a few years ago the majority of ships in the in-service LNGC fleet had Moss spherical tank containment systems. The robust nature and trouble-free performance of the aluminium cargo tanks, coupled with the absence of any filling level restrictions or a requirement for a secondary barrier, are the main selling points of the containment system.

Today, however, the drive to contain costs throughout the LNG supply chain does not favour

spheres. Spherical tanks are more expensive to construct than the competing membrane tank systems and the Suez Canal tonnage dues for spherical tank LNG vessels are significantly higher than those for membrane ships. In addition, it is much more difficult to increase the cargo-carrying capacity of Moss ships due to the need to rejig the tank fabrication process. In contrast, for membrane ships it is simply a case of providing additional insulation boxes to accommodate any extension of cargo tank dimensions.

As a result, spherical tanks have fallen out of favour. Today, only 40% of the 275 LNG ships in service have spherical tanks and that share will drop over the next two years as the current order-book is delivered. Approximately 14% of the 110 LNGCs on order have been specified with spheres. Amongst the world's shipyards, only KHI in Japan remains fully dedicated to the construction of Moss ships. All the initial ships built by Hyundai were spherical ships but the last such vessel was delivered in 2006, since when the Korean yard has concentrated solely on membrane tank ships.

KHI and MHI have recently introduced designs for new spherical tank ships with an increased capacity of 177,000 m³ and steam turbine propulsion systems stated to be 15% more efficient than existing turbines. Spherical tank ships remain popular in safety-conscious Japan and the introduction of these new designs, known as Pacificmax, is likely to find favour amongst those Japanese utilities looking to build their LNG shipowning portfolios with new vessels optimised for the Asia-Pacific LNG trades.

● Popular membranes

Virtually all the non-spherical tank LNG ships have a membrane tank containment system provided by GTT of France. GTT offers two types of design – the GTT Mark III system which has a waffled stainless steel primary barrier and the GTT No 96 system which has a so-called Invar alloy primary barrier comprising a thin sheet of 36% nickel steel. Both

— FOR US IT'S NATURAL

PROTECTING LIFE THROUGH OUR
ENVIRONMENTAL SERVICES —
IT'S IN OUR NATURE.

www.lr.org/marine

Lloyd's
Register

LIFE MATTERS

Coral reef in the Red Sea, Indian Ocean – a rich and diverse ecosystem, with many species found nowhere else.

Services are provided by members of the Lloyd's Register Group. Lloyd's Register is an exempt charity under the UK Charities Act 1993.



Korea's Big Three shipyards have been right on schedule with the delivery of the new Q-flex ships for the carriage of Qatar's super train cargoes.

systems enjoy a high level of popularity. A third GTT membrane system – CS1 – is an amalgam of the Mark III and No 96 designs. However, early development problems have limited the application of the CS1 design to three LNG ships delivered one year ago by the French shipyard Chantiers de l'Atlantique, now Aker-Yards.

Because membrane tanks are unhindered by internal support structure, the risk of damage to the containment system's primary and secondary barriers and insulation panels caused by cargo sloshing forces is a key consideration in the operation of such ships. Cargo tanks are designed with chamfered tops to minimise the cargo free surface area and, in addition, GTT and the classification societies recommend that for current newbuildings tank fill levels should not be allowed to drop below 70% during the loaded voyage or exceed 10% on the ship's ballast leg. These measures have generally proved effective in minimising cargo sloshing damage.

Another membrane containment system problem has emerged in recent years. A handful of

ships built with the GTT Mark III system at Samsung have experienced some vapour leakages through the Triplex secondary barrier following delivery. Triplex is a composite material designed to retain the LNG cargo for a specified time in the event of a primary barrier failure. On no occasion did a containment system on these ships experience a leakage of LNG.

Investigations have revealed that the problem arose due to inadequate procedures for the application and curing of the bonding adhesive between the Triplex and the insulation panels. GTT has issued new guidelines on bonding procedures which, although only recently promulgated, appear to have overcome the problem.

● The bigger the better

A notable recent development in LNG shipping has been the delivery of the first of a significant number of large LNG carriers being built for the carriage of LNG from six new large trains under construction at Ras Laffan in Qatar. Each of the liquefaction plants will be capable of producing 7.8 million



Guangdong Dapeng LNG Company Ltd. (GDLNG) is a Sino-foreign joint venture energy company between CNOOC Gas & Power Ltd., BP and off-takers. Since it was established in 2004, GDLNG has successfully built and is operating China's first LNG terminal and natural gas trunk line.

The Guangdong Province and Hong Kong with its nearly 100 million people and world renown industry and commercial infrastructure makes our market arguably one of the world's best LNG and NG growth markets.

Launched with a 25 year, 3.7m tons per annum LNG Sales and Purchase Agreement, Australia's single largest export contract, GDLNG continues to grow with new customers and supply with an important clean energy solution.

Since commercial operation started in September 2006, GDLNG has successfully received and delivered more than 5 million tons LNG.

Our vision is to become a great international company known for our innovation, professionalism and success in providing clean, safe and reliable energy.



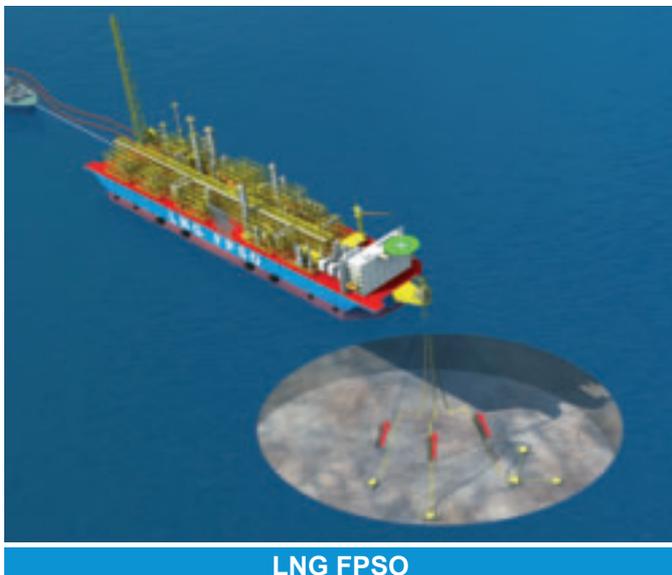
www.dplng.com

SBM SBM Gas & Power OFFSHORE

SBM Offshore proposes a strong and reliable partnership in the development of your LNG business. Our background as the long-term pioneer in offshore loading/offloading terminals and the leading owner/operator of FPSOs has enabled us to develop a series of solutions for the advancement of offshore LNG ventures worldwide:

- Floating LNG Production
- Floating LNG Re-gasification
- Cryogenic Offshore Offloading & Loading (COOL™) systems.

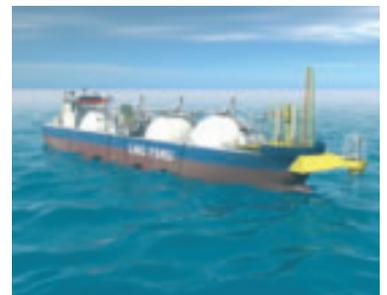
SBM Gas & Power has been created to bring these solutions to the market as part of the LNG value chain.



LNG FPSO



LNG FSRU



LNG Export / Import Terminal



www.sbmoffshore.com



tonnes of LNG per annum. The new vessels are the largest LNG ships ever built by a wide margin.

The complement comprises 31 Q-flex size ships of 216,000 m³ and 14 Q-max vessels of 265,000 m³ in capacity. As the Q-flex ships are some 40% larger than a conventional-size LNG ship and the Q-max vessels 60%, the new vessels will enable considerable economy of scale benefits to be realised. HHI, DSME and SHI are sharing the construction of the 44 ships and have been right on time with their busy schedule of ship deliveries. In contrast, the construction teams responsible for the new trains at Ras Laffan will be unable to complete the first units according to the original schedule. Indeed, as a result of delays in the completion of several new liquefaction plants worldwide, the LNG market will experience some excess ship capacity during the course of 2008-09.

At presstime, the three Korean shipyards building the Q-flex and Q-max ships had so far commissioned 18 Q-flex ships, all completed within the eight-month period from end-October

2007 to end-June 2008. These ships represent 3.9 million m³ of new LNG shipping capacity. Furthermore, the delivery of the first Q-max ships is scheduled for later this year. All 44 Q-flex and Q-max ships are due to be in service by 2010.

● Propulsion innovations

The advent of the Q-flex and Q-max ships also heralds an important breakthrough in LNG carrier propulsion. LNGCs have traditionally relied on steam turbines to propel them and are the last sector of commercial shipping utilising these power plants. Although they are not very efficient compared to diesel engines, steam turbines have suited LNG ships because they can be run on natural gas that boils off from the LNG cargo during the course of the voyage. They are also very reliable propulsion systems, a key consideration for an LNG project operator.

In the current era of high energy prices, however, new drivers are determining the choice of LNGC propulsion systems. Qatar Gas Transport



The 154,500 m³ *Provalys*, the first LNG ship with a dual-fuel diesel electric propulsion system, entered service in late 2006.

Company, the owner of the Q-flex and Q-max ships, has opted for conventional diesel engines for the vessels in tandem with onboard reliquefaction plants that process cargo boiloff and return it to the cargo tanks as LNG. In this way, LNG cargo outturns can be optimised.

Q-flex and Q-max ships are relatively wide-bodied vessels with a draft not that much greater than conventional-size LNG carriers. This hull configuration has suited the choice of a pair of diesel engines for each ship, coupled with twin shafts, propellers and rudders. The propulsion system is completely new to the LNG sector and early feedback from the engineers on the initial Q-flex ships has been very positive.

In fact, very few of the new LNG carriers ordered in recent years have been specified with steam turbines. The other new LNGC propulsion system, which has been chosen for conventional size LNG carriers, is dual-fuel diesel electric (DFDE). The first three ships with DFDE systems were built in France and have now been in service for over a year. Here again, feedback from operational service has been good and, in more recent months, the first DFDE LNGCs from Korean shipyards have been entering service.

The configuration of four dual-fuel diesel engines per ship, linked to the electric drive system, provides a high degree of propulsion system redundancy and allows cargo boiloff to be utilised as a propulsion system fuel. The overall package enables the ships to benefit from the propulsive efficiency of diesel engines and, despite the 10% premium on the newbuilding cost of a DFDE ship, to realise considerable cost savings over the working life of the vessels.

DFDE systems also take up considerably less engine room space than steam turbines, enabling up to 5% more cargo to be carried for a given set of hull dimensions. The combination of DFDE propulsion and membrane cargo tanks has enabled ship designers to increase the cargo-carrying capacity of a so-called conventional

size LNGC, to the extent that ships of this type now on order fall within the 155-175,000 m³ range, up to 30% greater than the norm at the start of this decade.

● **Exciting future**

The advances in ship production capabilities and the breakthroughs in ship size and propulsion systems have been the most notable aspects of an LNGC fleet expansion programme. However, they mark only the start of an exciting new raft of developments in LNGC technology. Because natural gas is a valuable, clean-burning fuel in great demand, the LNG supply chain is being extended in ways that were undreamt of at the start of this decade. Upstream, LNG floating production storage and offloading (FPSO) vessels are now being built to bring marginal deposits of gas at offshore locations to market. For the receiving end small, coastal LNG carriers that will enable the delivery of gas to remote communities and industrial facilities not connected to pipelines are under construction.

In addition, LNG regasification vessels (LNGRVs) and LNG floating storage and regasification units (FSRUs) are bringing gas to locations much more expeditiously than would have been possible if a shore import terminal had to be built. Further out on the horizon are Arctic ice class LNG ships that will be required to exploit the large Russian gas reserves in the inhospitable waters of the Barents and Kara Seas.

LNG shipping stands poised at the start of a new era in global expansion, in much the same position that tanker shipping found itself 35 years ago. Global shipbuilding activity represents the current key element in the equation while offshore LNG and coastal LNG distribution constitute the next chapter in this rapidly developing story.

Mike Corkhill is the Editor of LNG World Shipping and LPG World Shipping, two journals published by Riviera Maritime Media (www.lngworldshipping.com).

Wärtsilä

Wärtsilä introduces 4-9 MW high efficiency gas engine for gas compression, lowering fuel costs up to 40%

Wärtsilä Corporation is introducing its popular Wärtsilä 34SG gas engines to the gas compressor market. Having outputs of 4050–9000 kW (5430 to 12,070 bhp) these gas engines offer considerable lifecycle cost improvement for compressor owners and operators. Typical applications are for gas pipelines, re-injection and for gas storage.

For a typical 9000 kW (12,000 hp) compressor drive installation, owners with a Wärtsilä 34SG gas engine driver can expect to lower their fuel costs by around 20 to 40%, compared with other prime movers currently on the market. The cost savings will be even bigger when compared with existing, older compressor drives, making upgrades an attractive prospect.

The Wärtsilä 34SG engines are available in three versions: The 9-cylinder Wärtsilä 9L34SG with 4050 kW (5430 bhp) shaft power, the 16-cylinder Wärtsilä 16V34SG engine of 7200 kW (9655 bhp), and the 20-cylinder Wärtsilä 20V34SG with 9000 kW (12,070 bhp) shaft power.

Compared with gas turbines often used for driving compressor sets in this power range, Wärtsilä 34SG engines offer substantially lower fuel gas consumption and greater turndown ratios.

The engines have a full-load efficiency of 46.3% (heat rate 5493 BTU/hph), a 30% speed turndown ratio (from 750 to 525 rpm) and a 70% torque turndown ratio. Engine efficiency and exhaust emissions remain virtually unchanged over the whole load range.

The Wärtsilä 34SG engine has low exhaust emissions. NO_x emissions remain below the German TA-luft and US EPA emission levels throughout the entire speed and torque range.

The Wärtsilä 34SG compressor-drive engine is based on the thoroughly proven diesel engine Wärtsilä 32. In all Wärtsilä has delivered more than 5000 engines of the Wärtsilä 32 and 34 types for a



A Wärtsilä 34SG gas engine driving a 6 cylinder reciprocating compressor in an underground gas storage in the USA.

multitude of power generation, mechanical drive and ship power applications. This corresponds to more than 20,000 MW of installed power, establishing Wärtsilä as the absolute market leader for this size of engine.

The new compressor-drive engine is derived from the second-generation Wärtsilä 34SG, which in 2001 succeeded the first-generation Wärtsilä 34SG engines, originally introduced in 1995. Since its introduction to the power generation market, the second-generation Wärtsilä 34SG has sold more than 300 engines accounting for 2500 MW of power.

The Wärtsilä 34SG engine has a fully electronic engine control system for all the principal engine functions: gas feed, charge air flow, fuel gas flow control, individual cylinders, and ignition control. Through complete control of these critical engine functions, engine performance can be optimized over the whole operating field.

As a true heavy-duty engine, the Wärtsilä 34SG is well suited to continuous high load applications, such as gas compressor drives on pipelines. The intervals between planned maintenance requirements are extensive, with for example, 24,000 running hours between cylinder head and piston overhauls.

The new compressor-drive engines are supported through Wärtsilä's extensive worldwide network of trained field support and spare parts resources. Wärtsilä will also provide long-term service and support agreements that are tuned to meet the specific needs of customers.



WHY ARE THEY BURNING MONEY?

Instead of burning the gas in oil wells, we use it to pump the oil from the well all the way to the terminal. This is the kind of practical thinking that will give you a better return on your investment, whether you need a ship power, service or power plant solution on land or at sea. Learn more of what 17,000 of us can do for you all across the globe at wartsila.com.

WARTSILA.COM


WÄRTSILÄ